ORDNANCE OFFICE,

WASHNGTON, *October* 14, 1847.

Captain A. MORDECAI,

*Washington Arsenal.*

SIR: The duty of arranging, preparing, and publishing drawings of a uniform system of Artillery, and of revising the Ordnance Manual and publishing a new edition, is assigned to you. * * * * * *

G. TALCOTT, *Lt. Col. of Ordnance.*

---

ORDNANCE BOARD.

WASHINGTON, *November* 15, 1849.

To Brig. Gen. TALCOTT,

*Col. of Ordnance.*

SIR: Under your instructions of the 27th ult., the Ordnance Board have carefully examined the Ordnance Manual, as revised by Major A. Mordecai for a new edition, in pursuance of your order dated October 14, 1847, and have made such alterations and additions as appeared to be required preparatory to the publication of the work.

R. L. BAKER, *Brevet Lieut. Col.*
J. W. RIPLEY, *Brevet Lieut. Col.*
J. SYMINGTON, *Major of Ordnance*
A. MORDECAI, *Brevet Major.*
B. HUGER, *Brevet Col.*

} ORD. BOARD.

---

ORDNANCE DEPARTMENT,

WASHINGTON, *November 17th*, 1849.

Hon. GEO. W. CRAWFORD,

*Secretary of War.*

It is respectfully recommended that the revised edition of the Ordnance Manual be printed for the use of the Army.

G. TALCOTT, *Bvt. Brig. Gen.,*
*Colonel of Ordnance.*

Approved, November 23, 1849:

G. W. CRAWFORD.

EXTRACTS *from the preface to the first edition of the Ordnance Manual.*

"This work being designed chiefly for the use of those charged with the fabrication and care of the *materiel*, leaves untouched nearly all that relates to the personal service of Artillery, either in the field or in garrison." * * *

"It is earnestly requested that all officers of the Army, and especially those of the Ordnance Department, will avail themselves of every opportunity to verify the details and add to the information here given, and that they will communicate to the Colonel of Ordnance any corrections or amendments which it may appear advisable to make in a future edition of the work."

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## LIST OF PLATES.

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Q.



R.



S.

W.

## ERRATA.

Page 37—List of *Irons*, 5th line: For *links*, read *rings*.

" 133—12th line from the bottom; Add: 4 *notch plates*, fastened to the arcs, each by 4 *screws*.

" 217—First column of table: For 4, read 1.

" 218—1st line: For weight, read height.

" 428—*Equation of the Trajectory:* In the 2nd term of the second member, for $x$, read $x^2$.

" 437—19th line: The words "area of the" should be transposed to the beginning of the 18th line.

# ORDNANCE MANUAL.

## CHAPTER FIRST.

### ORDNANCE.

The following are the kinds and calibres of ordnance used in the land service of the United States:

| KIND OF ORDNANCE. | | CALIBRE. | MATERIAL. | |
|---|---|---|---|---|
| GUNS | Field | 6-pounder | Bronze | Plate 1. |
| | | 12-pounder | Bronze | Plate 1. |
| | Siege and garrison | 12-pounder | ..... | Plate 1. |
| | | 18-pounder | ..... | Plate 1. |
| | | 24-pounder | Iron | Plate 1. |
| | Seacoast | 32-pounder | ..... | Plate 1. |
| | | 42-pounder | ..... | Plate 1. |
| HOWITZERS | Mountain | 12-pounder | ..... | Plate 1. |
| | Field | 12-pounder | Bronze | Plate 1. |
| | | 24-pounder | Bronze | Plate 1. |
| | | 32-pounder | ..... | Plate 1. |
| | Siege and garrison | 8-inch | ..... | Plate 2. |
| | | 24-pounder | ..... | Plate 10. |
| | Seacoast | 8-inch | ..... | Plate 2. |
| | | 10-inch | ..... | Plate 2. |
| COLUMBIADS | | 8-inch | Iron | Plate 9. |
| | | 10-inch | Iron | Plate 9. |
| MORTARS | Light | 8-inch | ..... | Plate 2. |
| | | 10-inch | ..... | Plate 2. |
| | Heavy | 10-inch | ..... | Plate 2. |
| | | 13-inch | ..... | Plate 2. |
| | Stone mortar | 16-inch | Bronze | Plate 2. |
| | Coehorn | 24-pounder | Bronze | Plate 2. |
| | Eprouvette | 24-pounder | Iron | Plate 2. |

A 12-inch columbiad, of cast iron, has also been made for trial.

The plates and the tables of dimensions and weights refer to the latest patterns.

For the description of ordnance of former patterns, see the first edition of this Manual.

## *Nomenclature.*

The forms of the several pieces of ordnance are shown in the Plates referred to in the last column of the preceding table.

Cannon made of bronze are commonly called *brass* cannon.

The *cascable* is the part of the gun in rear of the base ring; it is composed generally of the following parts: the *knob*, the *neck*, the *fillet*, and the *base of the breech*.

The *base of the breech* is a frustum of a cone, or a spherical segment, in rear of the breech.

The *base ring* is a projecting band of metal adjoining the base of the breech and connected with the body of the gun by a concave moulding.

The *breech* is the mass of solid metal behind the bottom of the bore, extending to the rear of the base ring.

The *reinforce* is the thickest part of the body of the gun, in front of the base ring; if there is more than one reinforce, that which is next to the base ring is called the *first reinforce;* the other, the *second reinforce*. In some howitzers, instead of a reinforce, there is a *recess* in the metal around the chamber, next to the base ring.

The *reinforce band* is at the junction of the first and second reinforces in the heavy howitzers and columbiads.

The *chase* is the conical part of the gun in front of the reinforce.

The *astragal* and *fillets*, in field guns, and the *chase ring* in other pieces, are the mouldings at the front end of the chase.

The *neck* is the smallest part of the piece, in front of the astragal or the chase ring.

The *swell of the muzzle* is the largest part of the gun in front of the neck. It is terminated by the muzzle mouldings, which, in field and siege guns, consist of the *lip* and the *fillet*. In the seacoast guns and heavy howitzers and columbiads, there is no fillet. In field and siege howitzers, and in mortars, a *muzzle band* takes the place of the swell of the muzzle.

The *face* of the piece is the terminating plane perpendicular to the axis of the bore.

The *trunnions* are cylinders, the axes of which are in a line perpendicular to the axis of the bore, and in the same plane with that axis.

The *rimbases* are short cylinders, uniting the trunnions with the body of the gun. The ends of the rimbases, or the *shoulders of the trunnions*, are planes perpendicular to the axis of the trunnions.

The *bore* of the piece includes all the part bored out, viz: the cylinder, the chamber, (if there is one,) and the conical or spherical surface connecting them.

The *chamber*, in howitzers, columbiads, and mortars, is the smaller part of the bore, which contains the charge of powder. In howitzers and columbiads the chamber is cylindrical; it is united with the large cylinder of the bore by a conical surface; the angles of intersection of this conical surface with the cylinders of the bore and chamber are rounded (in profile) by arcs of circles. In the 8-inch siege howitzer, the chamber is united with the cylinder of the bore by a spherical surface, in order that the shell may, when necessary, be inserted without a sabot.

A conical chamber which is joined to the cylinder of the bore by a portion of a spherical surface, (as in the 8-inch and 10-inch light mortars,) is called a *Gomer chamber*.

The *bottom of the bore* is a plane perpendicular to the axis, united with the sides (in profile) by an arc of a circle, the radius of which is one-fourth of the diameter of the bore at the bottom. In the columbiads, the heavy sea coast mortars, the stone mortar, and the eprouvette, the bottom of the bore is hemispherical.

The *muzzle*, or mouth of the bore, is chamfered to a depth of 0.15 inch to 0.5 inch, (varying with the size of the bore,) in order to prevent abrasion, and to facilitate loading.

The *true windage* is the difference between the true diameters of the bore and of the ball.

The axis of the *vent* is in a plane passing through the axis of the bore, perpendicular to the axis of the trunnions. In guns, and in howitzers having cylindrical chambers, the vent is placed at an angle of 80° with the axis of the bore, and it enters the bore at a distance from the bottom equal to one-fourth the diameter of the bore.

The diameter of the vent is *two-tenths* of an inch, in all pieces except the eprouvette in which it is *one-tenth*.

The vents of brass guns are bored in *vent pieces*, of wrought copper, which are screwed into the gun.

The *lock piece* is a block of metal at the outer opening of the vent, in some pieces of ordnance, to facilitate attaching a lock to the cannon.

The *natural line of sight* is a line drawn in a vertical plane through the axis of the piece, from the highest point of the base ring to the highest point in the swell of the muzzle, or to the top of the *sight*, if there is one.

The *natural angle of sight* is the angle which the natural line of sight makes with the axis of the piece.

## PRINCIPAL DIMENSIONS AND WEIGHTS OF GUNS.

| | IRON. | | | | | BRASS. | |
|---|---|---|---|---|---|---|---|
| | SEA COAST. | | SIEGE AND GARRISON. | | | FIELD. | |
| | 42 | 32 | 24 | 18 | 12 | 12 | 6 |
| | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| Diameter of the bore | 7. | 6.4 | 5.82 | 5.3 | 4.62 | 4.62 | 3.67 |
| True windage | 0.16 | 0.15 | 0.14 | 0.13 | 0.10 | 0.10 | 0.09 |
| Length of bore | 110. | 107.6 | 108. | 109. | 103.4 | 74. | 57.5 |
| Ditto in diameters | **15.71** | **16.78** | **18.56** | **20.56** | **22.38** | **16.** | **15.67** |
| Length from rear of base ring to face of muzzle | 117. | 114. | 114. | 114. | 108. | 78. | 60. |
| Whole length of the piece | 129. | 125.2 | 124. | 123.25 | 116. | 85. | 65.6 |
| Semi-diameter of the base ring | 12.2 | 11.2 | 10.7 | 9.875 | 8.7 | 6.5 | 5.15 |
| Semi-diameter of the swell of the muzzle | 8.4 | 7.7 | 7.793 | 6.935 | 5.932 | 5.17 | 4.125 |
| Distance between these two semi-diameters | 115. | 112. | 111. | 111.6 | 105.8 | 76.3 | 58.7 |
| Natural angle of sight | ..... | ..... | 1° 30′ | 1° 30′ | 1° 30′ | 1° | 1° |
| Distance from rear of base ring to rear of trunnions | 43.2 | 42.2 | 43. | 43.50 | 42. | 30.7 | 23.25 |
| Diameter of the base ring | 24.4 | 22.4 | 21.4 | 19.75 | 17.4 | 13. | 10.3 |
| Distance between the rimbases | 22. | 20.7 | 18. | 16.8 | 14.8 | 12. | 9.5 |
| Length of the trunnions | 6.5 | 6. | 5. | 4.75 | 4.5 | 3.5 | 2.8 |
| Diameter of the trunnions | 7. | 6.4 | 5.82 | 5.3 | 4.62 | 4.62 | 3.67 |
| Distance from axis of trunnions to face of muzzle | 70.3 | 68.6 | 68.09 | 67.85 | 63.69 | 44.99 | 34.91 |
| Weight ..... pounds | 8,465 | 7,200 | 5,790 | 4,913 | 3,590 | 1,757 | 884 |
| Preponderance ..... pounds | 440 | 466 | 255 | 200 | 200 | 60 | 33 |

## PRINCIPAL DIMENSIONS AND WEIGHTS OF COLUMBIADS AND HOWITZERS.

| | COLUMB'DS. | | HOWITZERS. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | IRON. | | IRON. | | | | BRASS. | | | |
| | | | Sea Coast. | | Siege and garrison. | | Field. | | | Mountain. |
| | 10-in. | 8-in. | 10-in. | 8-in. | 8-in. | 24-pr. | 32-pr. | 24-pr. | 12-pr. | 12-pr. |
| | Inches | Inches | Inches | Inches | Inches | Inches | Inches | Inches | Inches | Inches |
| Diameter of the bore | 10. | 8. | 10. | 8. | 8. | 5.82 | 6.4 | 5.82 | 4.62 | 4.62 |
| True windage | 0.12 | 0.12 | 0.12 | 0.13 | 0.13 | 0.14 | 0.15 | 0.14 | 0.10 | 0.10 |
| Length of bore, exclusive of chamber | 99.00 | 100. | 96. | 85.5 | 38.5 | 53.25 | 64. | 56.25 | 46.25 | 28.16 |
| Ditto .....in diameters | **9.9** | **12.5** | **9.6** | **10.68** | **4.81** | **9.15** | **10.** | **9.66** | **10.** | **6.1** |
| Diameter of the chamber | 8. | 6.4 | 7. | 6.4 | 4.62 | 4.62 | 4.62 | 4.62 | 3.67 | 3.34 |
| Length of the chamber | 12. | 11. | 9.5 | 7.5 | 8. | 4.75 | 7. | 4.75 | 4.25 | 2.75 |
| Length from rear of base ring to face of muzzle | 120. | 119. | 112. | 98. | 52. | 62. | 75. | 65. | 53. | 32.91 |
| Whole length of the piece | 126. | 124. | 124.25 | 109. | 61.5 | 69. | 82. | 71.2 | 58.6 | 37.21 |
| Semi-diameter of base ring | 16. | 13. | 13.25 | 11.10 | 9.125 | 6.9 | 6.9 | 6. | 5. | 3.8 |
| Semi-diameter of swell of muzzle | 10.75 | 8.5 | 10.125 | 8.25 | 8.225 | 5.85 | 5.6 | 4.875 | 4.1 | 3.45 |
| Distance between these semi-diameters | 117.5 | 117. | 109.5 | 96. | 51.5 | 61.8 | 74.75 | 64.8 | 52.85 | 32.91 |
| Natural angle of sight | 1° 21′ | 1° 23′ | ..... | ..... | 1° | 1° | 1° | 1° | 1° | 0° 37′ |
| Distance from rear of base ring to rear of trunnions | 41.5 | 41.5 | 41. | 37.4 | 24. | 24.69 | 30.7 | 27.5 | 23.25 | 15. |
| Diameter of base ring | 32. | 26. | 26.5 | 22.2 | 18.25 | 13.8 | 13.8 | 13.8 | 12. | 10. |
| Distance between the rimbases | 31. | 25. | 25. | 20.7 | 18. | 12.8 | 12. | 11.5 | 9.5 | 6.9 |
| Length of the trunnions | 9. | 6.5 | 7.5 | 6. | 5. | 3.25 | 3.5 | 3.25 | 2.8 | 2.25 |
| Diameter of the trunnions | 10. | 8. | 8. | 6.4 | 5.82 | 4.62 | 4.62 | 4.2 | 3.67 | 2.7 |
| Distance from axis of trunnions to face of muzzle | 73.5 | 73.5 | 67. | 57.4 | 25.09 | 35. | 41.99 | 35.4 | 27.91 | 16.56 |
| Weight .....pounds | 15,400 | 9,240 | 9,500 | 5,740 | 2,614 | 1,476 | 1,920 | 1,318 | 788 | 220 |
| Preponderance .....pounds | 470 | 350 | 450 | 380 | 460 | 70 | 125 | 112 | 51 | 30 |

## PRINCIPAL DIMENSIONS AND WEIGHTS OF MORTARS.

| | IRON. | | | | BRASS. | | IRON. |
|---|---|---|---|---|---|---|---|
| | HEAVY. | | LIGHT. | | Stone mortar. | Coehorn 24-pr. | Eprouvette. |
| | 13-in. | 10-in. | 10-in. | 8-in. | | | |
| | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| Diameter of the bore | 13. | 10. | 10. | 8. | 16. | 5.82 | 5.655 |
| True windage | 0.13 | 0.13 | 0.13 | 0.12 | ..... | 0.14 | 0.025 |
| Length of the bore, exclusive of the chamber | 26. | 25. | 15. | 12. | 19.8 | 8.82 | 11.5 |
| Ditto .....in diameters | **2.** | **2.5** | **1.5** | **1.5** | **1.24** | **1.51** | **2.** |
| Diameter of the chamber. Superior, (at the bottom of the shell in iron mortars,) | 9.5 | 7.15 | 7.6 | 6.08 | 5.3 | 3. | 1.5 |
| Diameter of the chamber. Inferior | 7.25 | 5.64 | 5. | 4. | 3. | 2. | 1.5 |
| Length of the chamber | 13. | 10. | 5. | 4. | 6.75 | 4.25 | 1.35 |
| Whole length of the mortar | 53. | 46. | 28. | 22.5 | 31.55 | 16.32 | |
| Distance from face of muzzle to front of trunnions | 41. | 37. | 20. | 16.5 | 20. | 13.57 | |
| Distance between the rimbases | 36. | 27.5 | 20.5 | 16.25 | 18. | 7.5 | |
| Length of the trunnions | 8.5 | 6.5 | 5. | 4. | 6. | 2.5 | |
| Diameter of the trunnions | 12. | 9. | 8. | 6. | 8. | 2.75 | |
| Weight.....pounds | 11,500 | 5,775 | 1,852 | 930 | 1,500 | 164 | 220 |

## OF THE MATERIALS FOR ORDNANCE.

### *Bronze.*

*Bronze* for cannon, (commonly called *brass*,) consists of 90 parts of copper, and 10 of tin, allowing a variation of one part of tin, more or less. It is more fusible than copper, much less so than tin, more sonorous, harder, and less susceptible of oxidation, and much less ductile, than either of its components. Its fracture is of a yellowish color, with little lustre, a coarse grain, irregular, and often exhibiting spots of tin, which are of a whitish color. These spots indicate defects in the metal; but they seldom contain more than 25 per cent. of tin. The specific gravity of bronze is about 8,700, being greater than the mean of the specific gravities of copper and tin.

*Pure copper* is of a red color, inclining to yellow; it has a fine metallic lustre. Its fracture exhibits a short, even, close grain, of a silky appearance; it is very ductile and very malleable. The greater the purity of copper, the more malleable it is, and the finer the grain. Specific gravity from 8,600 to 9,000.

*Pure tin* is of a white color, a little darker than silver; it is malleable, and susceptible of being rolled into sheets, but it is not very ductile; it is very soft, and, when bent backwards and forwards, it gives a peculiar crackling sound, the distinctness of which is in proportion to the purity of the tin. Specific gravity, 7,290 to 7,320.

*Analysis of bronze.* Nitric acid dissolves the copper and converts the tin into an insoluble peroxide. Put into a small glass matrass 10 parts (say 100 grains) of bronze, in small particles, and 80 parts of very pure nitric acid, at 22° Beaumé's hydrometer, (specific gravity, 1,180;) heat it gradually to ebullition, and continue that heat until red vapors cease to come over. Let it settle; pour off the liquor, and add to the oxide of tin 20 parts of nitric acid; let it boil ten minutes; decant the liquor again, and repeat the same operation; dilute the first portion decanted with 2 or 3 times its volume of water, and pass it through a filter; do the same with the second and third portions. Then throw the oxide of tin on a double filter, the two parts of which are equal; wash the precipitate on the filter until the water that comes off no longer gives a blue color when heated with ammonia, and does not change the color of litmus paper. Spread the filter on paper, and dry it perfectly in a stove or a sand bath. Weigh it, adding the exterior filter to the weights, in order to ascertain the quantity of peroxide of tin which remains on the upper filter; 127 parts of peroxide give 100 parts of pure tin.

If lead is present, it will be dissolved by the acid. To detect it:—after the solution is cool, add sulphate of soda, in order to precipitate the lead in the state of an insoluble sulphate, 145 parts of which contain 100 of lead.

## *Cast Iron.*

(*See also Chapter* 14.)

Iron for making cannon must be of the best quality of charcoal iron, made in a smelting furnace, with a cold blast, and should be selected particularly for its strength. It should be soft, yielding easily to the file or chisel; its fracture presenting an uniform appearance; color, dark grey; aspect, brilliant; chrystals of medium size.

When cast into cannon, it should approach that degree of hardness which resists the file and the chisel, but not too hard to be bored and turned without great difficulty. Its color a bright lively grey; chrystals small, with acute angles, and sharp to the touch; structure uniform, close, and compact. If the pig iron be too soft, coarse, and loose, its strength and density may be increased by remelting it once or twice, and by continuing it in fusion several hours, under a high heat.

But as the quality of cast iron cannot be accurately determined by an inspection of its fracture alone, samples taken from the pig iron, and from the sinking heads of cannon are submitted to practical tests. The mean specific gravity of pig iron is 7.00; and its tenacity is about 16,000 pounds to the square inch.

The following table shows some of the results obtained in the trials of samples from gun heads:

| DATE. | DESIGNATION OF GUNS. | | | | IRON. | |
|---|---|---|---|---|---|---|
| | Where made. | No. | Kind. | Weight. | Specific gravity. | Tenacity. |
| 1846 | | | | lbs. | | lbs. |
| April..... | Richmond, Va. | 28 | 32-pdr. S. C. guns. | 7,200 | 7.204 | 26,396 |
| July..... | do. | 25 | do. do. | 7,200 | 7.226 | 28,462 |
| June..... | Pittsburgh, Pa. | 33 | 8-inch columbiads. | 9,237 | 7.227 | 27,133 |
| September. | Pittsburgh, Pa. | 7 | 8-inch navy guns. | 6,280 | 7.299 | 32,445 |
| November. | West Point, N.Y. | 37 | Siege mortars, howitzers & guns. | ..... | 7.236 | 27,000 |
| 1847 | | | | | | |
| June..... | Boston, Mass. | 25 | 24-pdr. howitzers. | 1,477 | 7.222 | 29,006 |
| 1848 | | | | | | |
| April..... | Boston, Mass. | 20 | 24-pdr. guns. | 5,778 | 7.297 | 30,828 |
| June..... | West Point. | 20 | 32-pdr. navy guns. | 6,437 | 7.270 | 30,686 |
| 1849 | | | | | | |
| June..... | West Point. | 11 | 8-inch navy guns. | 11,943 | 7.248 | 31,430 |
| June..... | Boston, Mass. | 35 | 24-pdr. howitzers. | 1,500 | 7.305 | 36,651 |
| | Mean..... | 241 | ..... | ..... | 7.248 | 29,693 |

In making guns from iron of which the quality is not known, a sample gun is made and proved to extremity, with gunpowder. The gun adopted for this proof is a long 9-pounder gun, of the same pattern as the 8-pounder used for the same purpose in France and Belgium. It is fired with the following series of charges, viz:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st. | 20 | rounds, | 3 | pounds of powder, | 1 | ball. | Without wads. |
| 2d. | 20 | " | 4.5 | " | 2 | " | |
| 3d. | 10 | " | 4.5 | " | 3 | " | |
| 4th. | 5 | " | 9 | " | 6 | " | |
| 5th. | – | | 18 | " | 13 | " | |

In order that the iron shall be used for ordnance, the trial gun should sustain the first four series of rounds without breaking.

## INSPECTION OF ORDNANCE.

### *Instruments.*

1. *Star gauge.*—This is an instrument for measuring the diameter of the bore of a gun, at any part.

The head is of brass, with four steel sockets for the measuring points. Two of the sockets are soldered fast into the head; the other two are moveable. The moveable sockets and points are pushed out by means of two inclined cylinders, which are fastened to a stem, forming a conical slider. This slider tapers 0.35 in. in a length of 2.2 in.; so that by pushing the slider the 35th part of this length (about .06 in.) the distance between the moveable points is increased .01 in.

The slider is connected with a square steel rod, consisting of three parts, which are screwed together, according to the length of bore to be measured. This rod slides through a brass tube, which is also made in three pieces.

The tube is graduated, in inches and quarters, commencing at the measuring points, so as to indicate the distance of the latter from the muzzle of the gun.

The handle is of wood attached to a brass cylinder, or socket, through which the sliding rod passes. In the tube of the handle there is a slit, on the side of which a scale is marked, to indicate the movements of the measuring points. Each joint of the long tube has a mark, made on a small plate of silver, which shows the place of the zero on the scale, when the measuring points are adjusted to the true diameter of the bore. In this position the handle is fixed on the sliding rod by means of a screw clamp.

A *ring gauge*, for each calibre, is used for adjusting the instrument for use.

A *rest*, in the form of a T, is placed in the mouth of the gun, to keep the instrument in the axis of the bore. This rest has three slides, which can be

adjusted to the different sizes of bore; the upright branch is moveable, for convenience of packing.

The star guage, its points and rest, are packed in one box, and the ring gauges in another.

2. *The cylinder staff.*—This is a round staff, made of mahogany, or other hard wood. It is in two parts, which are joined together by brass sockets and screws; each part has also a brass socket and screw at the outer end, to receive the *cylinder gauge*, *guide plate*, *measuring point*, and *searcher*. The staff is graduated, in inches and tenths, on a strip of brass let into it, on one side. These graduations are arranged to read the distances from the extemity of the measuring point, when it is screwed on the staff.

The cylinder staff is supported, at the muzzle of the piece, by a *half tompion* of wood, having in the centre a groove of the size of the staff. The *rest* for the star guage may be used also for this purpose.

3. The *cylinder gauge* is a hollow cylinder of wrought or cast iron, turned to the exact minimum (or true) diameter of the bore. The length of the cylinder is equal to its diameter. It has cross heads, at right angles to each other; one with a smooth hole of the same diameter as the cylinder staff; the other tapped for the screw of the staff socket.

4. The *searcher* is used to ascertain whether there are any cavities in the bore. It consists of four flat springs about 13 inches long, with sharp points, turned outwards at the end, attached to a socket on which the cylinder-staff is screwed.

5. The *guide-plate* is a circular iron plate 0.2 inch thick, and of the minimum diameter of the bore; it has a hole in the centre, with a thread by which it is screwed to the cylinder-staff; it serves to direct the measuring point to the centre of the bottom of the bore.

6. The *measuring point* is screwed on the end of the cylinder staff, over the guide-plate, to measure the depth of the bore; it is of iron, cylindrical in shape, so far as it screws on the end of the staff, and tapering down to the diameter of 0.75 inch.

7. The *trunnion-gauge* is an iron ring of the diameter of the trunnionsr which must pass over them and fit closely. The exterior diameter of this gauge serves to verify that of the rimbases.

8. The *trunnion-square* is a double square of wood, the distance between whose branches is the same as that between the rimbases of the gun; in the centre is a pointed sliding plate, with a thumb-screw to fasten it; the lowe, edges of the branches, which are shod with iron, are in the same plane, parallel to the upper edge of the connecting piece, so that when the square is placed with its branches resting on the trunnions, the upper edge of the connecting

piece is parallel to their axis. Each branch has also an iron plate projecting perpendicularly from one side to rest on the top of the trunnions. It is used to ascertain the position of the trunnions in relation to the axis of the bore and to each other.

9. The *trunnion rule*, for measuring the distance from the rear of the base ring to the rear of the trunnions.

10. *Callipers*, to measure diameters.

11. A *standard scale*, for verifying other instruments.

12. A wooden *rule*, to measure exterior lengths.

13. The *vent-gauges* are two pointed pieces of steel wire, 0.005 in. greater and less than the true diameter of the vent.

14. The *vent-searcher* is a hooked steel wire, about half the diameter of the vent.

15. A *rammer-head*, shaped to the form of the bottom of the bore, and furnished with a staff, is used to ascertain the interior position of the vent.

16. A *mirror;* a *wax taper; bees-wax.*

17. *Rammer*, *sponge*, and *priming wire.*

18. *Figure* and *letter stamps*, to affix the required marks.

## *Inspection of Iron Ordnance.*

Cannon presented for inspection and proof, are placed on skids for the convenience of turning and moving them easily. They are first examined carefully on the exterior, to ascertain whether there are any flaws or cracks in the metal, whether they are finished as prescribed, and to judge, as well as practicable, of the quality of the metal. They must not be covered with paint, lacker, or any other composition. If it is ascertained that an attempt has been made to conceal any flaws or cavities by plugging, or filling them with cement, or any substance, the gun is rejected without further examination. After this preliminary examination, the inspector proceeds to verify the dimensions of the piece. The *interior of the bore* is first examined by reflecting the sun's rays into it from the mirror; or, if the sun is obscured, by a lighted wax taper or a lamp placed on the end of a rod, and inserted into the bore. The *searcher* is then introduced, and pushed slowly to the bottom of the bore and withdrawn, turning it at the same time; if one of the points hangs, the position of the hole is marked on the outside of the gun by noticing its distance from the muzzle, and its position in the bore; the size and figure of the cavity are found by taking an impression of it in *wax* placed on the end of a hook. The *cylinder-gauge*, screwed on the staff, is then pushed gently to the bottom of the cylindrical part of the bore and withdrawn; it must go to the bottom, or the bore is too small.

The *bore of the piece*. is then measured with the star gauge. The measurements should be made at intervals of $\frac{1}{4}$ inch in the part of the bore occupied by the shot; at intervals of 1 inch in the rest of the bore in rear of the trunnions, and of about 1 calibre from the trunnions to the muzzle.

The *position of the trunnions*, with regard to the axis of the bore and to each other, is next ascertained.

*To verify the position of the axis of the trunnions:* set the trunnion-square on the trunnions, and see that the lower edges of its branches touch them throughout their whole length; push the slide down till it touches the surface of the piece, and secure it in that position by the thumb-screw; turn the gun over, and apply the trunnion square to the opposite side, and if, when the point of the slide touches the surface of the piece, the lower edges of the branches rest on the trunnions, the axis of the trunnions is in the same plane with the axis of the bore; if they do not touch the trunnions, their axis is above the axis of the bore by half the space between; and if the edges touch the trunnions, and the point of the slide does not touch the surface of the piece, their axis is below the axis of the bore. If the *alignment of the trunnions* be accurate, the edges of the trunnion-square will fit on them when applied to different parts of their surface; their diameter and cylindrical form, and the diameter of the rimbases, are verified with the trunnion-gauge.

*To ascertain the length of the bore*, screw the *guide-plate* and *measuring-point* on the cylinder staff, and push them to the bottom of the bore; place a *half-tompion* in the muzzle, and rest the staff in its groove; apply a *straight-edge* to the face of the muzzle, and read the length of the bore on the staff. The *exterior lengths* are measured by the *rule*, or by a *profile*, the accuracy of which is first verified. The *exterior diameters* are measured with the *callipers* and *graduated rule*. The *position of the interior orifice of the vent* is found from the mark made on the *rammer-head* by the *vent-gauge* inserted in the vent, while the rammer-head is held against the bottom of the bore—two impressions are taken. The position of the exterior orifice of the vent is also verified. The *vent* is examined with *gauges*, and with the *vent-searcher*, to ascertain if there are any cavities in it. In *mortars*, the dimensions of the *conical chambers*, and the *form of the breech*, may be verified with *patterns* made of plate iron. After the *powder proof*, the bore is washed and wiped clean, and the bore and vent are again examined, and the bore remeasured. The results of each of the measurements and examinations are noted on the inspection report against the number of the gun.

VARIATIONS ALLOWED IN THE DIMENSIONS OF IRON ORDNANCE.

| | | FIELD. | GARRISON, &c. |
|---|---|---|---|
| | | Inches. | Inches. |
| IN THE BORE... | More than the prescribed diameter | 0.02 | 0.03 |
| | Less than the prescribed diameter | .00 | .00 |
| IN EXTERIOR DIAMETERS. | Where turned, more or less | .04 | .05 |
| | Where not turned, more | .10 | .20 |
| | Where not turned, less | .05 | .05 |
| IN THE LENGTH. | Of the bore, more or less | .10 | .20 |
| | From rear of base ring to face of muzzle, more or less | .10 | .25 |
| | Of the breech, including cascable, more or less | .15 | .20 |
| | Of the base ring, more or less | .05 | .05 |
| | Of the reinforce, more or less | .10 | .20 |
| | Of the chase, including the muzzle, more or less | .10 | .15 |
| | From rear of trunnions to rear of base ring, more or less, in different pieces | .10 | .20 |
| IN THE POSITION OF THE AXIS OF THE TRUNNIONS | above the axis of the bore | .00 | .00 |
| | below the axis of the bore | .20 | .20 |
| IN THE LENGTH OF THE TRUNNIONS, | more | .10 | .10 |
| | less | .05 | .05 |
| Diameter of trunnions, less | | .03 | .04 |
| In the distance between the rimbases, less | | .05 | .05 |
| In the same gun, no variation is allowed in the position or in the alignment of the trunnions. | | | |
| IN THE VENT..... | Diameter, more | .005 | .005 |
| | Diameter, less | .00 | .00 |
| | Position of exterior orifice, more or less | .05 | .05 |
| | Position of interior orifice, more or less | .20 | .20 |
| DEPTH OF CAVITIES. | In the bore or vent | .00 | .00 |
| | On the exterior surface | .20 | .25 |
| | On the trunnions, within one inch of the rimbases | .10 | .10 |
| | On the trunnions elsewhere | .20 | .25 |
| *In the eprouvette*, no variation is allowed. | | | |

The whole exterior surfaces of iron guns, columbiads, and howitzers are turned in the lathe, or dressed smooth in the parts which cannot be turned.

## *Inspection of Brass Ordnance.*

*Brass cannon* are measured, and their dimensions recorded, as prescribed for iron cannon. *The exterior form and dimensions* are verified by the application of a *profile* cut out of sheet iron, of the exact shape of a longitudinal section of the piece. All brass ordnance, except stone mortars, should be bored under size from .04 to .05 inch, and after proof reamed out to the exact calibre. When the powder proof is finished, the bore should be cleaned and examined; the vent should then be stopped with a greased wooden plug, the muzzle raised, and the gun filled with water, to which pressure shall be applied to force it into any cavities that exist; or the water shall be allowed to remain in the bore about 24 hours. *The bore* must then be sponged dry and clean, and viewed with the *mirror* or *candle*, to discover if any water oozes from cracks or cavities, and also if any enlargement has taken place. The quantity of water that runs out of a crack or honey-comb will indicate the extent of the defect, and if it exceeds a few drops, the gun should be rejected, although the measured depth of the cavity may not exceed the allowance. If the water oozes out between the vent piece and the metal of the gun, a new vent piece must be inserted, and the gun again proved with one charge, and the water proof repeated. After the bore has been reamed out to the proper size, its dimensions are again verified, and an examination of the bore and vent is made, to detect any defects which may have been caused or developed by the proof. *Whitish spots* show a separation of the tin from the copper, and, if extensive, should condemn the piece. A *great variation from the true weight*, which the dimensions do not account for, shows a defect in the alloy. Any attempt to conceal cavities by filling them with screws, or by any other methods, should cause the rejection of the piece.

Brass cannon should be rejected for the following cavities or honey-combs:

*Exterior.*—Any hole or cavity 0.25 inch deep in front of the trunnions, and 0.2 inch deep at or behind the trunnions.

*Interior.*—From the muzzle to the reinforce, any cavity 0.15 inch deep. Any cavity from the reinforce to the bottom of the bore.

The specific gravity of the metal of brass ordnance should be occasionally ascertained, by taking that of some of the heaviest, and some of the lightest pieces, at each inspection.

The exterior surfaces of all brass ordnance are turned, or dressed smooth.

VARIATIONS ALLOWED IN THE DIMENSIONS OF BRASS ORDNANCE.

| | | Inch. |
|---|---|---|
| Length of bore, more or less | | 0.1 |
| Diameter of bore | more | .02 |
| | less | .00 |
| Exterior position of vent, more or less | | .05 |
| Interior position of vent, more or less | | .20 |
| Diameter of vent | more | .005 |
| | less | .00 |
| Diameter of trunnions | more | .00 |
| | less | .025 |
| Length of trunnions | more | .10 |
| | less | .05 |
| Position of trunnions | *above* the axis of the gun | .00 |
| | *below* the axis of the gun | .20 |
| | out of alignment | .00 |
| Distance from rear of base ring to rear of trunnions | | .10 |
| Distance between rimbases, less | | .04 |
| Length from the base ring to the muzzle, more or less | | .10 |
| Position of mouldings, more or less | | .10 |
| Any exterior diameter from the base ring to the muzzle inclusive, and diameter of rimbases, more or less | | .04 |
| Diameter of cascable, neck, and knob, more or less | | .05 |

A proper discretion must be exercised in the inspection of ordnance; such slight imperfections as do not injure a piece for service may be disregarded, whilst the instructions should be strictly enforced with regard to defects which may impair its utility.

## PROOF OF ORDNANCE.

*Gunpowder* for proving ordnance should be of the best quality, ranging not less than 250 yards by the eprouvette; it should be proved immediately before being used, unless it shall have been proved within one year previously, and there be no reason to suspect that it has become deteriorated.

The *cartridge bags* are made of woollen stuff, or of paper, the full diameter of the bore or chamber. They are filled by weight, and if not filled at the place where the guns are proved, each bag should be enveloped in a paper cylinder and cap, marked with the weight of powder and its proof range.

The *shot* must be smooth, free from seams and other inequalities that might injure the bore of the piece, and they must be of the true diameter given in the tables.

The *wads* are made of junk, as described in CHAPTER X.

## PROOF OF IRON ORDNANCE.

*Guns* and *howitzers* are laid with the muzzle resting on a block of wood and the breech on the ground, or on a thick plank, giving the bore a small elevation.

*Mortars* are mounted on strong wooden frames or beds, at an elevation of 45°, supported by the trunnions.

In proving iron ordnance, after pricking the cartridge, prime with powder, or a tube, and place over the vent a piece of portfire, set in clay or putty, long enough to permit the man who fires it to reach a place of safety before the charge explodes.

### *Proof charges for Iron Guns.*

FIRST AND SECOND ROUNDS.—A charge of *powder* equal to *one-half* of the weight of the shot; *two shot* and *one wad.*

THIRD ROUND.—A charge of *powder* equal to *one-third* of the weight of the shot; *one shot* and *one wad.*

In proving new guns, a compound shot, or a cylinder with hemispherical ends, of the true diameter of the shot, and equal in weight to the two shot, shall be used instead of them.

The wad is placed over the cylinder or the upper ball; the whole being well rammed.

Should any of the guns proved at one time fail to sustain the above proof, the remainder shall be again fired *twice* with a charge of powder equal to *one-half* of the weight of the shot, *one shot and one wad;* and if, in either or both of these trials, *one-fourth* of the whole number of guns should fail, the whole shall be rejected.

*Other iron ordnance* are fired with the following charges:

### *Columbiads.*

*10-inch.*—1st round: 20 lbs. of powder, one 10-inch strapped shot, and one wad over the shot.

2nd round: 24 lbs. of powder, one 10-inch shell strapped.

*8-inch.*—1st round: 12 lbs. of powder, one 8-inch strapped shot and one wad.

2nd round: 15 lbs. of powder, one 8-inch shell strapped.

### *Howitzers.*

SEA COAST.
- 10-*inch.*—2 rounds, with 15 lbs of powder, one 10-inch strapped shot, and one wad over the shot.
- 8-*inch.*—2 rounds, with 12 lbs. of powder, one 8-inch strapped shot, and one wad over the shot.

SIEGE AND GARRISON.
- 8-*inch.*—2 rounds, with 4 lbs. of powder, one 8-inch shot, and one wad over the shot.
- 24-*pdr.*—2 rounds, with 3 lbs. of powder, one 24-pdr. strapped shot, and one wad over the shot.

### *Mortars.*

HEAVY....
- 13-*inch.*—2 rounds, with 20 lbs. of powder, and one 13-inch shot.
- 10-*inch.*—2 rounds, with 10 lbs. of powder, and one 10-inch shot.

LIGHT.....
- 10-*inch.*—2 rounds, with 5 lbs. of powder, and one 10-inch shot.
- 8-*inch.*—2 rounds, with 2½ lbs. of powder, and one 8-inch shot.

Should any columbiad, howitzer, or mortar fail to sustain the above proof, the remainder of those offered at the same time shall be again fired *twice* with the same charges; and if, in either or both of these trials, *one-fourth* of the whole number should fail, the whole shall be rejected.

The *water proof*, as described for brass cannon, must also be applied occasionally to iron cannon, at the discretion of the inspector.

The bore and vent and the exterior surface of every piece which is approved, should be well covered with sperm oil immediately after the inspection.

## PROOF OF BRASS ORDNANCE.

They are mounted on appropriate carriages or beds, and fired three times; *guns* and *howitzers* at an elevation of 5°, *mortars* at an elevation of 45°; with the following charges:

### *Field Guns.*

A charge of *powder* equal to *one-third* of the weight of the shot, *one shot* and *one wad.*

### *Howitzers.*

FIELD,
- 32-pdr.—3¼ lbs. of powder, one strapped shot and one wad.
- 24-pdr.—2½ lbs. of powder, one strapped shot and one wad.
- 12-pdr.—1½ lbs. of powder, one strapped shot and one wad.

MOUNTAIN, 12-pdr.—¾ lb. of powder, one strapped shot and one wad.

## *Mortars.*

STONE MORTAR.—2½ lbs. of powder, covered by a wooden tompion 2 inches thick; a basket filled with alternate layers of stones and earth, weighing 100 lbs.

COEHORN, 24-pdr.—¾ lb. of powder, and one 24-pdr. shot.

In proving brass cannon in service, or after they have been bored to the proper calibre, the shot should be wrapped in cloth or strong paper to save the bore as much as possible from injury.

### MARKS.

All cannon are required to be weighed and to be marked, as follows, viz: the *number of the gun*, and *the initials of the inspector's name*, on the face of the muzzle; the numbers in a separate series for each kind and calibre at each foundry; the initial letters of the *name of the founder* and of the foundry, on the end of the right trunnion; the *year of fabrication* on the end of the left trunnion; the *foundry number* on the end of the right rimbase, above the trunnion; the *weight of the piece in pounds* on the base of the breech; the letters U. S. on the upper surface of the piece, near the end of the reinforce.

The natural line of sight, when the axis of the trunnions is horizontal, should be marked on the base ring and on the swell of the muzzle, whilst the piece is in the trunnion lathe.

Cannon rejected on inspection are marked X C, on the face of the muzzle; if condemned for erroneous dimensions which cannot be remedied, add X D; if by powder proof, X P; if by water proof, X W.

### INJURIES CAUSED BY SERVICE.

*Brass cannon* are little subject to external injury, except from the bending of the trunnions sometimes after long service, or heavy charges.

Internal injuries are caused by the action of the elastic fluids developed in the combustion of the powder, or by the action of the shot in passing out of the bore. These effects generally increase with the calibre of the piece.

Of the first kind, which exhibit themselves in rear of the shot, are: *the enlargement of the bore* by the compression of the metal, which is seldom a serious defect; *corrosion of metal*, particularly at the angles, such as the inner orifice of the vent, or the mouth of a cylindrical chamber; *cracks*, from the yielding of the cohesion of the metal; *cavities*, cracks enlarged by the action of the gas, and by the melting of the metal; observable especially in the upper surface of the bore.

Injuries of the second kind, which appear in front of the charge, are: *The lodgment of the shot*, a compression of the metal on the lower side of the bore, at the seat of the shot, caused by the pressure of the fluid in escaping over the top of the shot. There is a corresponding *burr* in front of the lodgment and the motion thereby given to the shot causes it to strike alternately on the top and bottom of the bore, producing other *enlargements*, generally *three* in number; the first, on the upper side, a little in advance of the trunnions; the second, on the lower side, about the astragal; the third, in the upper part of the muzzle; it is chiefly from this cause that brass guns become unserviceable; the extent of the injury varies according to the length of the bore. *Scratches* caused by the fragments of a broken shot, or the roughness of an imperfect one: *enlargement* of the muzzle by the striking of the shot in leaving the bore; *exterior cracks*, or longitudinal splits, caused by too great a compression of the metal on the interior.

*The durability of brass cannon* may be much increased by careful use, and by the precautions of *increasing the length of the cartridge*, or that of the *sabot*, or using *a wad over the cartridge*, in order to change the place of the shot; by *wrapping the shot in woollen or other cloth*, or *in paper*, so as to diminish the windage and the bounding of the shot in the bore. In field *guns*, both brass and iron, the paper cap, which is taken off from the cartridge should always be put over the shot.

*Iron cannon* are subject to the above defects in a less degree than brass, except the corrosion of the metal, by which the vent especially is rendered unserviceable from enlargement. The principal cause of injury to iron cannon is the *rusting* of the metal, producing a roughness and enlargement of the bore, and an increase of any cavities or *honey combs* which may exist in the metal.

The service to which an iron cannon has been subjected may generally be determined by the appearance of the vent.

## *Spiking and unspiking cannon, and rendering them unserviceable.*

*To spike a piece, or to render it unserviceable:* Drive into the vent a jagged and hardened steel spike with a soft point, or a nail without a head; break it off flush with the outer surface and clinch the point inside by means of the rammer. Wedge a shot in the bottom of the bore by wrapping it with felt, or by means of iron wedges, using the rammer or a bar of iron to drive them in; a wooden wedge would be easily burnt by means of a charcoal fire lighted with the aid of a bellows. Cause shells to burst in the bore of brass guns, or fire broken shot from them with high charges. Fill a piece with sand over the

charge to burst it. Fire a piece against another, muzzle to muzzle, or the muzzle of one to the chase of the other. Light a fire under the chase of a brass gun, and strike on it with a sledge to bend it. Break off the trunnions of iron guns; or burst them by firing them with heavy charges and full of shot, at a high elevation.

When guns are to be spiked temporarily, and are likely to be retaken, a *spring spike* is used, having a shoulder to prevent its being too easily extracted.

To *unspike a piece:* If the spike is not screwed in or clinched, and the bore is not impeded, put in a charge of powder of $\frac{1}{3}$ the weight of the shot and ram junk wads over it with a handspike, laying on the bottom of the bore a strip of wood with a groove on the under side containing a strand of quick match by which fire is communicated to the charge; in a brass gun, take out some of the metal at the upper orifice of the vent, and pour sulphuric acid into the groove for some hours before firing. If this method, several times repeated, is not successful, unscrew the vent piece, if it be a brass gun, and if an iron one, drill out the spike, or drill a new vent.

*To drive out a shot wedged in the bore:* Unscrew the vent piece, if there be one, and drive in wedges so as to start the shot forward, then ram it back again in order to seize the wedge with a hook; or pour in powder and fire it, after replacing the vent piece. In the last resort, bore a hole in the bottom of the breech, drive out the shot, and stop the hole with a screw.

## *Preservation of Ordnance.*

Cannon should be placed together, according to kind and calibre, on skids of stone, iron, or wood, laid on hard ground, well rammed and covered with a layer of cinders, or of some other material, to prevent vegetation.

*Guns and long howitzers.*—The pieces should rest on the skids in front of the base ring and in rear of the astragal; the axis inclined at an angle of 4 or 5 degrees with the horizon, the muzzle lowest; the trunnions touching each other; or if space is wanting for that arrangement, the trunnion of one piece may rest on the adjoining piece, so that the axis of the trunnions is inclined about 45° with a horizontal line; the vent down, stopped with a greased wooden plug, or with putty or tallow. If circumstances require it, the pieces may be piled in two tiers, with skidding placed between them, exactly over those which rest on the ground; the muzzles of both tiers in the same direction and their axes preserving the same inclination.

*Short howitzers and mortars.*—On thick planks, standing on their muzzles, the trunnions touching, the vents stopped.

*Iron ordnance* should be covered on the exterior with a lacker impervious to water, (see CHAP. VII ;) the bore and the vent should be greased with a mixture of *oil* and *tallow*, or of *tallow* and *beeswax* melted together and boiled to expel the water. The lacker should be renewed as often as requisite, and the grease at least once every year.

The lacker and grease should be applied in hot weather.

The cannon should be frequently inspected, to see that moisture does not collect in the bore.

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## ORDNANCE OF FOREIGN COUNTRIES.

The materials for the following table have been collected, with few exceptions, from the manuals of artillery in England, France, Belgium, Prussia, and Austria, and from memoranda obtained in Russia and Sweden.

The dimensions and weights are given in our own measures.

The column of *exterior length* shows the length from the rear of the base ring to the face of the piece, and the *length of bore* includes the chamber, when not otherwise mentioned.

In *England*, *France*, *Belgium*, and *Sweden*, howitzers and mortars take their denominations, as with us, from the diameter of the bore, or from the calibre of a gun of corresponding bore; in *Austria* and *Prussia*, from the weight of a stone ball of the calibre of the bore ; in *Russia*, from the true weight of the shell.

# CHAPTER SECOND.

## SHOT AND SHELLS.

### NOMENCLATURE, DIMENSIONS, WEIGHTS.

*Diameters of gauges for Shot and Shells.*

| | 13 in. | 12 in. | 10-in. | 8-in. | 42 | 32 | 24 | 18 | 12 | 9 | 6 | 4 | 3 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| Large - - | 12.90 | 11.90 | 9.90 | 7.90 | 6.86 | 6.27 | 5.70 | 5.18 | 4.53 | 4.12 | 3.60 | 3.14 | 2.86 | 1.96 |
| Small, new - | 12.84 | 11.84 | 9.84 | 7.85 | 6.81 | 6.22 | 5.65 | 5 13 | 4.49 | 4.08 | 3.56 | 3 10 | 2.82 | 1.92 |
| Small, old - | 12.80 | – | 9.80 | 7.80 | 6.76 | 6.18 | 5 61 | 5.10 | 4.46 | 4.05 | 3.54 | – | 2 80 | |

For the manner of using these gauges, see *page* 31.

*Shot.*

| | 13-in. | 12 in. | 10-in. | 8 in. | 42 | 32 | 24 | 18 | 12 | 9 | 6 | 4 | 3 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter, in. | 12 87 | 11.87 | 9.87 | 7.88 | 6.84 | 6.25 | 5.68 | 5.17 | 4.52 | 4.10 | 3.58 | 3.12 | 2 84 | 1.95 |
| Weight, lbs. | 294 | 231 | 128 | 65 | 42.7 | 32 6 | 24 4 | 18.5 | 12.3 | 9.25 | 6.1 | 4.07 | 3 05 | 1 |

*Shells.*

| | For Columbiads & S. C. Howitzers. | | For Mortars. | | | For Guns and Howitzers. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10-in. | 8-in. | 13-in. | 10-in. | 8-in. | 42 | 32 | 24 | 18 | 12 |
| | In. | In. | In. | In. | In. | In. | In. | In. | In | In. |
| Diameter - - | 9.87 | 7.88 | 12.87 | 9.87 | 7.88 | 6.84 | 6.25 | 5.68 | 5.17 | 4.52 |
| Thickness of sides and bottom. { True - | 2. | 1.5 | 2.1 | 1.6 | 1.25 | 1.2 | 1. | 0.9 | 0.9 | 0.7 |
| Greatest | 2.1 | 1.58 | 2.25 | 1.7 | 1.33 | 1.25 | 1.05 | 0.95 | 0.94 | 0.74 |
| Least - | 1.9 | 1.42 | 1.95 | 1.5 | 1.17 | 1.15 | 0.95 | 0.85 | 0.86 | 0.66 |
| Thickness at fuze hole | 3. | 2.25 | 2.1 | 1.6 | 1.25 | 1.8 | 1.35 | 1.35 | 1.35 | 1.05 |
| Diameter of fuze hole. { Exterior | 1.45 | 1.338 | 1.8 | 1.75 | 1.3 | 1. | 0.9 | 0.9 | 0.9 | 0.9 |
| Interior | 1. | 1. | 1.483 | 1.51 | 1.113 | 0.73 | 0.698 | 0.698 | 0.698 | 0.743 |
| Distance between ears | 6. | 5. | 7. | 6. | 5. | – | – | – | – | – |
| Weight, - - lbs. | 101 | 50.5 | 197 | 87.5 | 44.5 | 31. | 22.5 | 17 | 13.4 | 8.4 |

The 8-inch mortar shell is used for the siege howitzer.

The *ears* of a shell are holes for the points of the shell hooks, 0.5 inch in diameter, bored opposite to each other, and perpendicular to the axis of the fuze hole; the metal is cut out above them at the distance indicated in the table, in a direction perpendicular to the axis of the holes, which must remain 0.25 inch deep, with a thickness of 0.25 inch of metal above them, at the thinnest part.

### *Carcasses,*

Are shells having three additional holes, of the same dimensions as the fuze hole, pierced at equal distances apart in the upper hemisphere of the shell, with their exterior openings tangent to the great circle which is perpendicular to the axis of the fuze hole.

| | 13-in. | 10-in. | 8-in. | 42 | 32 | 24 | 18 | 12 |
|---|---|---|---|---|---|---|---|---|
| Mean weight, lbs. | 194 | 86 | 43 | 30 | 21.60 | 16 | 12.5 | 8 |

### *Spherical case shot.*

| | 8-in. | 42 | 32 | 24 | 18 | 12 | 6 |
|---|---|---|---|---|---|---|---|
| | In. | In. | In. | In. | In. | In. | In. |
| Diameter | 7.88 | 6.84 | 6.25 | 5.68 | 5.17 | 4.52 | 3.58 |
| Thickness of metal at the sides. True | 0.7 | 0.65 | 0.60 | 0.55 | 0.5 | 0.45 | 0.36 |
| Greatest | 0.725 | 0.675 | 0.625 | 0.575 | 0.525 | 0.475 | 0.385 |
| Least | 0.675 | 0.625 | 0.575 | 0.525 | 0.475 | 0.425 | 0.335 |
| Thickness of metal at the fuze hole | 1.6 | 1.5 | 1.5 | 1.1 | 1.1 | 0.75 | 0.75 |
| Radius of reinforce at the fuze hole | 3.0 | 2.75 | 2.5 | 2.3 | 2.1 | 1.8 | 1.4 |
| Diameter of fuze hole. Exterior | 1.2 | 1.2 | 1.2 | 0.9 | 0.9 | 0.9 | 0.9 |
| Interior | 0.96 | 0.975 | 0.975 | 0.735 | 0.735 | 0.788 | 0.788 |
| Mean weight lbs. | 30. | 20.32 | 16. | 11.86 | 8.7 | 6.1 | 3.06 |

The thickness of metal at the fuze hole is supposed to be measured in the axis of the fuze hole between the spherical surfaces of the shell and of the reinforce.

The fuze holes of shells and spherical case shot taper 0.15 inch to 1 inch.

*Grape shot.*

| | 8-in. | 42 | 32 | 24 | 18 | 12 |
|---|---|---|---|---|---|---|
| | In. | In. | In. | In. | In. | In. |
| Diameter of large gauge..... | 3.60 | 3.17 | 2.90 | 2.64 | 2.40 | 2.06 |
| Diameter of small gauge..... | 3.54 | 3.13 | 2.86 | 2.60 | 2.36 | 2.02 |
| Mean weight.....lbs. | 6.1 | 4.2 | 3.15 | 2.4 | 1.8 | 1.14 |

*Canister shot.*

| | NATURE OF ORDNANCE. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 42-pdr. gun. | 32-pdr. gun. | 24-pdr. gun & 8 in. siege howitzer. | 18-pdr. gun. | 12-pdr. gun and 32 pdr. howitzer. | 24-pdr. howitzer. | 6-pdr gun | 12-pdr. howitzer. | |
| | | | | | | | | Field. | Mountain. |
| | In. | In. | In. | In. | In. | In. | In. | In. | |
| Diameter of large gauge, | 2.26 | 2.06 | 1.87 | 1.70 | 1.49 | 1.35 | 1.17 | 1.08 | Musket ball. |
| Diameter of small gauge, | 2.22 | 2.02 | 1.84 | 1.67 | 1.46 | 1.32 | 1.14 | 1.05 | |
| Mean weight, lbs. | 1.5 | 1.14 | 0.86 | 0.64 | 0.43 | 0.32 | 0.21 | 0.16 | |

*Grenades.*

Six-pounder spherical case shot may be used for *hand grenades*, and shells of any calibre for *rampart grenades*.

*Lead balls.*

DIAMETERS OF LEAD BALLS FROM 1 TO 32 TO THE POUND.

| No. of balls to 1 lb. | Diameter. | No. of balls to 1 lb. | Diameter. | No. of balls to 1 lb. | Diameter. | No. of balls to 1 lb. | Diameter. |
|---|---|---|---|---|---|---|---|
| | In. | | In. | | In. | | In. |
| 1 | 1.670 | 9 | 0.803 | 17 | 0.650 | 25 | 0.571 |
| 2 | 1.326 | 10 | .775 | 18 | .638 | 26 | .564 |
| 3 | 1.157 | 11 | .751 | 19 | .626 | 27 | .557 |
| 4 | 1.051 | 12 | .730 | 20 | .615 | 28 | .550 |
| 5 | 1.977 | 13 | .710 | 21 | .605 | 29 | .544 |
| 6 | .919 | 14 | .693 | 22 | .596 | 30 | .537 |
| 7 | .873 | 15 | .676 | 23 | .587 | 31 | .531 |
| 8 | .835 | 16 | .663 | 24 | .579 | 32 | .526 |

For the mode of fabrication of lead balls, see CHAPTER X.

DIAMETERS OF CAST IRON BALLS FROM ¼ POUND TO 50 POUNDS WEIGHT.

| Weight. | | Diam. | Weight. | Diam. | Weight. | Diam. | Weight. | Diam. |
|---|---|---|---|---|---|---|---|---|
| Lbs. | oz. | In. | Lbs. | In. | Lbs. | In. | Lbs. | In. |
| 0 | 4 | 1.231 | 9 | 4.065 | 23 | 5.531 | 37 | 6.512 |
| | 6 | 1.403 | 10 | 4.211 | 24 | 5.639 | 38 | 6.570 |
| | 8 | 1.551 | 11 | 4.346 | 25 | 5.714 | 39 | 6.627 |
| | 10 | 1.665 | 12 | 4.474 | 26 | 5.789 | 40 | 6.684 |
| | 12 | 1.701 | 13 | 4.595 | 27 | 5.862 | 41 | 6.738 |
| | 14 | 1.865 | 14 | 4.710 | 28 | 5.930 | 42 | 6.793 |
| 1 | | 1.954 | 15 | 4.819 | 29 | 6.004 | 43 | 6.846 |
| 2 | | 2.462 | 16 | 4.924 | 30 | 6.068 | 44 | 6.898 |
| 3 | | 2.819 | 17 | 5.025 | 31 | 6.140 | 45 | 6.951 |
| 4 | | 3.104 | 18 | 5.121 | 32 | 6.205 | 46 | 7.002 |
| 5 | | 3.341 | 19 | 5.215 | 33 | 6.268 | 47 | 7.052 |
| 6 | | 3.551 | 20 | 5.304 | 34 | 6.330 | 48 | 7.101 |
| 7 | | 3.738 | 21 | 5.392 | 35 | 6.392 | 49 | 7.145 |
| 8 | | 3.908 | 22 | 5.476 | 36 | 6.442 | 50 | 7.198 |

The specific gravity of shot and shells is about 7,000.

*To find the weight of a cast iron shot or shell:*

Multiply the cube of the diameter of the shot in inches, or the difference of the cubes of the exterior and interior diameters of the shell, by 0.134 for the weight in pounds.

*For lead balls*, the multiplier is 0.2142.

*To find the diameter of a cast iron shot of a given weight:*

Divide the weight in pounds by 0.134, and the cube root of the quotient will be the diameter in inches.

*To find the quantity of powder which a shell will contain:*

Multiply the cube of the interior diameter of the shell in inches by 0.01744, for the weight of powder in pounds.

## INSPECTION OF SHOT AND SHELLS.

Shot and shells should be made of grey or mottled iron, of good quality, (see CHAP. XIV. *Cast iron.*) They must be cast in sand, and not in iron moulds; the shot from the latter are generally not spherical in form, nor uniform in size; they are also full of cavities, and are cracked by being heated.

*Spherical case shot* must be made with peculiar care, of the best quality of iron, in order that they may not be liable to break in the gun.

## *Shot.*

INSPECTING INSTRUMENTS: One *large* and one *small gauge* and one *cylinder gauge* for each calibre: the cylinder gauge has the same diameter as the large gauge; it is made of cast iron, and is 5 calibres long. One *hammer*, weighing half a pound and having a flat face and a conical point. *Steel punches.*

*One searcher*, of steel wire No. 20, with a handle.

The shot should be inspected before they become rusty; after being well cleaned, each shot is placed on a table and examined by the eye to see that its surface is smooth, that the metal is sound and free from seams, flaws and blisters. If cavities or small holes appear on the surface, strike the point of the hammer or punch into them and ascertain their depth with the searcher; if the depth of the cavity exceed 0.2 inch, the shot is rejected; and also if it appear that an attempt has been made to conceal such defects by filling up the holes with nails, cement, &c.

The shot must pass in every direction through the large gauge and not at all through the small one; the founder should endeavor to bring the shot up as near as possible to the *large gauge* or to the *true diameter*.

N. B. The diameters of the small gauges have been recently increased, in order to produce greater uniformity in the dimensions of shot and shells, by reducing the limits of variation allowed in their fabrication. The new gauges are to be used only in the inspection of shot and shells to be hereafter made, and the projectiles now on hand are not to be rejected from service on account of passing through these gauges.

After having been thus examined, the shot are passed through the *cylinder gauge*, which is placed at an inclination of about 2 inches between the two ends and supported on blocks of wood in such a manner as to be easily turned from time to time, to prevent its being worn in furrows. Shot which *slide* or *stick* in the cylinder are rejected; the latter must be pushed out from the lower end with a wooden rammer.

Shot are proved by dropping them from a height of 20 feet on a block of iron, or rolling them down an inclined plane of that height, against another shot at the bottom of the plane.

The average weight of the shot is deduced from that of three parcels of 20 to 50 each, taken indiscriminately from the pile: some of those which appear to be the smallest should be also weighed, and they are rejected if they fall short of the weight expressed by their calibre more than one *thirty-second* part. They almost invariably exceed that weight.

### *Grape and Canister shot.*

The dimensions are verified by means of a large and a small gauge attached to the same handle. The surface of the shot should be smooth and free from seams.

### *Shells and hollow shot.*

INSPECTING INSTRUMENTS.—A *large* and *small guage* for each calibre, and a *cylinder gauge* for shells of 8 inches and under.

*Callipers* for measuring the thickness of the metal at the sides of the shell.

*Callipers*, to measure the thickness at the bottom of the shell.

*Gauges* for the dimensions of the fuze hole, and for the thickness of metal at the fuze hole.

*A pair of hand bellows; a wooden plug* to fit the fuze hole, and bored through to receive the nozzle of the bellows.

*A hammer; a searcher; a cold chisel; steel punches.*

The surface of the shell and its exterior dimensions are examined as in the case of shot. The shell is next struck with the hammer to judge by the sound whether it is free from cracks; the position and dimensions of the ears are verified; the thickness of metal is then measured at several points on the great circle perpendicular to the axis of the fuze hole, and at the bottom, and at the fuze hole. The diameter of the fuze hole, which should be accurately reamed, is then verified, and the soundness of the metal about the inside of the hole is ascertained by inserting the finger.

The shell is now placed on a trivet in a tub containing water deep enough to cover it nearly to the fuze hole; the bellows and plug are inserted into the fuze hole and the air forced into the shell; if there are any holes in the shell, the air will rise in bubbles through the water. This test also gives another indication of the soundness of the metal, as the parts containing cavities will dry more slowly than the other parts.

The mean weight of shells is ascertained in the same manner as that of shot.

Shot and shells rejected in the inspection are marked with a X, made with the cold chisel; on shot near the gate, and on shells, near the fuze hole.

### PRESERVATION AND PILING OF BALLS.

Balls should be carefully lackered as soon as possible after they are received. For the composition of lacker and the manner of applying it, see CHAP. VII.

When it becomes necessary to renew the lacker, the old lacker should be removed by rolling or scraping the balls, which should never be heated for that purpose.

Balls are piled according to kind and calibre, under cover if practicable, in a place where there is a free circulation of air, to facilitate which the piles should be made narrow if the locality permits; the width of the bottom tier may be from 12 to 14 balls, according to the calibre.

Prepare the ground for the base of the pile by raising it above the surrounding ground so as to throw off the water; level it, ram it well, and cover it with a layer of screened sand. Make the bottom of the pile with a tier of unserviceable balls buried about two-thirds of their diameter in the sand; this base may be made permanent: clean the base well and form the pile, putting the fuze holes of shells downwards, in the *intervals*, and not resting on the shells below. Each pile is marked with the number of serviceable balls it contains.

The base may be made of bricks, concrete, stone, or with borders and braces of iron.

Grape and canister shot should be oiled or lackered, put in piles, or in strong boxes, on the ground floor, or in dry cellars; each parcel marked with its kind, calibre, and number.

### *To find the number of balls in a pile.*

*Multiply the sum of the three parallel edges by one-third of the number of balls in a triangular face.*

In a square pile, one of the parallel edges contains but one ball; in a triangular pile, two of the edges have but one ball in each.

The number of balls in a triangular face is $\frac{n(n+1)}{2}$; $n$ being the number in the bottom row.

The sum of the three parallel edges in a triangular pile is $n + 2$; in a square pile, $2n + 1$; in an oblong pile, $3\mathcal{N} + 2n - 2$; $\mathcal{N}$ being the length of the top row, and $n$ the width of the bottom tier: or, $3m - n + 1$; $m$ being the length and $n$ the width of the bottom tier.

If a pile consist of two piles joined at a right angle, calculate the contents of one as a common oblong pile, and of the other as a pile of which the three parallel edges are equal.

In the following Table of the number of balls in a pile, the second line shows the number in a triangular pile, the base of which is the corresponding number in the first line.

The other numbers show the contents of square and oblong piles; the length and width of the base being in the upper line and in the left hand column respectively.

# CHAPTER THIRD.

## ARTILLERY CARRIAGES.

### NOMENCLATURE.

The nomenclature and the tables of dimensions and weights given in this chapter, apply to the latest patterns adopted. The parts are enumerated generally in the order in which they are put together.

The classification adopted for bolts, nuts, chains, nails, screws, &c., is shown in the tables following the nomenclature.

### FIELD GUN CARRIAGES.—*Plate* 3.

There are three gun carriages for field artillery, viz:

One for the 6-pounder gun and the 12-pounder howitzer.

One for the 24-pounder howitzer.

One for the 12-pounder gun and the 32-pounder howitzer.

The parts of these carriages are all similar, differing only in their dimensions.

#### *Wood.*

1 *stock*, in two pieces; 2 *dowels;* 2 *cheeks;* 1 *axle body.*

#### *Irons.*

2 *trail handles.*
2 *bolts* and 2 *nuts* for do.
1 *lock-chain bolt*, 1 *washer*, and 1 *nut.*
1 *eye-plate for lock-chain.*
1 *lock-chain*, No. 5, 3 *links*, 1 *toggle.*
1 *lunette*, for the trail.
1 *trail-plate;* 2 *rivets.*
12 *nails*, for lunette and trail plate.
1 *large pointing ring and plate.*
2 *bolts* and 2 *nuts*, for do.
1 *small pointing ring.*
2 *bolts* and 2 *nuts*, for do.
2 *wheel guard plates.*
10 *nails*, for do.
2 *prolonge hooks.*
8 *nails*, for do.
1 *stop*, for rammer head.
4 *nails*, for do.
1 *ear-plate*, for worm.
2 *nails*, for do.
1 *key*, for worm.
1 *key chain;* 1 *eye pin.*
1 *eye plate*, for sponge and rammer chains.
2 *screws*, for eye-plate.
2 *chains and hasps*, for sponges and rammers.
2 *turnbuckles*, (BRASS.)
2 *stud plates*, for turnbuckles.
2 *trunnion plates.*
20 *nails*, for do., in 6-pdr. and 24-pdr. howitzer carriage.
28 *nails*, in 12 pdr. carriage.
2 *chin bolts;* 2 *bevel washers* and 2 *nuts.*
2 *key bolts;* 2 *nuts.*
6 *cheek bolts;* 4 *washers;* 6 *nuts.*
2 *cap squares;* 2 *eye pins.*
2 *cap-square chains;* 2 *eye pins.*
2 *cap-square keys.*
2 *key chains;* 2 *eye pins.*
2 *D rings*, for handspikes.
4 *staples*, for D rings.
1 *linstock-socket.*
6 *nails*, for do.

## FIELD-GUN CARRIAGES—*Irons*—(Continued.)

6 *rondelles*, (CAST IRON.)
3 *assembling bolts*.
3 *washers* and 3 *nuts*, for do.
1 *washer hook*, for lock chain.
2 *washer hooks*, for handspikes.
1 *axletree*; the *arms*, the *stop*.
2 *under straps*.
1 *axle strap*.
1 *bevel washer*, for 6-pdr. axle strap.
3 *axle strap bolts*; 3 *nuts*.

2 *axle bands*.
6 *nails*, for do.
1 *box for elevating screw*, (BRASS.)
2 *bolts*, for do.; 2 *washers*; 2 *nuts*.
1 *elevating screw*.
2 *shoulder washers*, 2 *linch washers*, 2 *linch pins*. } for axletree.

2 WHEELS.

## LIMBER.—*Plate* 4.

The same limber is used for all field carriages.

### *Wood.*

1 *axle body*.
2 *hounds*.
1 *fork*.
1 *splinter bar*.

4 *foot board brackets*.
2 *foot boards*.
1 *pole*.
1 *pole prop*.

### *Iron.*

8 *screws*, for foot board brackets.
20 *nails*, for foot boards.
4 *rivets* and 4 *burrs*, for hounds.
4 *plates*, for stay pins; 8 *nails*.
1 *axletree*.
1 *pintle hook*.
3 *bolts*, for do.; 2 *washers*; 3 *nuts*.
1 *stay plate*, for limber chest.
2 *nails*, for do.
1 *pintle key*.
1 *key chain*; 1 *eye pin*.
1 *tar bucket hook*; 2 *nails*.
2 *bolts*, for hounds; 2 *washers*; 2 *nuts*.
2 *under straps*.
4 *bolts*, for under straps; 4 *nuts*.
2 *axle bands*; 6 *nails*.
2 *end bands*, for splinter bar.
4 *rivets*, for do.
2 *bolts*, for hounds and splinter bar.
4 *washers* and 2 *nuts*, for do.
1 *eye plate*, for pole prop socket.
2 *middle bands*, for splinter bar.
4 *trace hooks*.
1 *fork strap*.

2 *bolts*, for splinter bar and fork.
2 *nuts*, for do.
1 *pole prop socket*; 1 *rivet*.
1 *pole prop ferrule*; 1 *rivet*.
1 *pole prop chain*; 1 *toggle*.
1 *eye pin*, for pole prop chain.
1 *burr*, for eye pin.
2 *stay pins*, for ammunition chest.
2 *keys*, for stay pins.
2 *key chains*; 2 *eye pins*.
1 *rivet* and 1 *burr*, for end of pole.
1 *pole bolt*; 2 *washers*; 1 *nut*.
1 *pole strap* and 3 *rivets*.
2 *pole chains*; the *links*; the *ring*.
1 *muff*, for pole yoke.
1 *collar*, for muff; in two parts.
2 *branches*, for pole yoke; 2 *rings*.
2 *bolts*, for collar and branches.
1 *washer*, for muff; 1 *key*.
2 *shoulder washers*.
2 *linch washers*.
2 *linch pins*.

2 WHEELS, No. 1.
1 AMMUNITION CHEST.

### WHEELS.

There are two Nos. of wheels for field carriages. No. 1, for the 6-*pounder gun carriage*, the *caisson*, the *forge*, the *battery wagon*, and for the *limbers* of all field carriages. No. 2, for the 24-*pdr. howitzer* and the 12-*pdr. gun carriages*. These wheels are of the same form and height, and they fit on the same axle-tree arm; they differ only in the dimensions of their parts, and consequently in strength and weight.

*Wood.*

1 *nave*.
14 *spokes*.
7 *fellies*.
7 *dowels*.

*Iron.*

2 *brow bonds*; 2 *end bands*.
12 *nails*, for bands.
1 *tire*.
7 *tire bolts*; 7 *washers*; 7 *nuts*.
1 *nave box*, (CAST IRON.)

### AMMUNITION CHEST.—*Plate* 4.

The same ammunition chest is adapted to the limber and to the caisson.

For the interior arrangement of the chests, for different kinds of ammunition, see CHAPTER XI.

*Wood.*

2 *sides*.
2 *ends*.
1 *principal partition*.
1 *bottom*.
1 *frame for cover*; 2 *sides*; 2 *ends*.
1 *panel for cover*.
1 *cover lining*.

*Iron.*

34 *cut nails*, for sides, ends and bottom.
4 *screws*, for the bottom.
60 *copper nails*, for cover lining.
4 *corner plates*, for ends and sides.
2 do. for end and bottom.
1 do. for side and bottom.
96 *screws*, for corner plates.
1 *assembling bolt*; 1 *nut*.
1 *turnbuckle*, (BRASS.)
1 *washer plate*, for do.; 2 *screws*.
1 *back stay*; 6 *screws*.
2 *front stays*; 4 *rivets*; 8 *screws*.
2 *hinges*; 4 *rivets*; 20 *screws*.
2 *hinge plates*; 4 *screws*.
1 *hasp*; 1 *rivet*; 5 *screws*.
1 *hasp plate*; 2 *screws*.
2 *handles*; 8 *rivets*
14 *copper washers*, for rivets.
56 *copper tacks*, for washers.
1 *cover*, (SHEET COPPER.)
216 *copper tacks*, for cover.

### CAISSON.—*Plate* 4.

*Wood.*

1 *middle rail*.
2 *side rails*.
1 *cross bar*.
1 *bolster*, for front foot board.
1 *front foot board*.
1 *rear foot board*.
1 *axle body*.
1 *stock*.

## SIEGE CARRIAGES.

### GUN CARRIAGE.—*Plate 7.*

There are three gun carriages for siege artillery, viz:

One for the 12-pounder gun;

One for the 18-pounder gun;

One for the 24-pounder gun and the 8-inch howitzer.

These carriages are constructed in the same manner, differing only in their dimensions.

When the 8-inch howitzer is mounted on the 24-pounder carriage, a *quoin* is used, instead of the elevating screw; the howitzer being too short to rest on the screw.

#### *Wood.*

1 *stock*, in two pieces; 2 *dowels.*
2 *cheeks.*
1 *axle body.*
1 *breech bolster.*

#### *Iron.*

1 *assembling bolt;* 2 *washers;* 1 *nut.*
1 *manœuvring bolt;* 2 *collars.*
4 *washers* and 2 *nuts*, for do.
6 *rondelles*, (CAST IRON.)
2 *assembling bolts;* 4 *washers;* 2 *nuts.*
1 *lock chain bolt;* 2 *washers;* 1 *nut.*
1 *lock chain* and *toggle.*
1 *shoe;* 1 *key*, for shoe.
2 *trunnion plates.*
2 *chin bolts;* 2 *bevel washers;* 2 *nuts.*
2 *key bolts;* 2 *nuts.*
4 *cheek bolts;* 4 *washers;* 4 *nuts.*
2 *travelling trunnion bolts.*
2 *washers;* 2 *nuts*, for do.
2 *trunnion plate bolts;* 2 *nuts.*
2 *cap squares;* 2 *eye pins.*
2 *cap square chains;* 2 *eye pins.*
2 *cap square keys.*
2 *key chains;* 2 *eye pins.*
1 *axletree.*
2 *understraps.*
1 *axle strap.*
2 *bolts*, for axle strap; 2 *nuts.*
2 *axle bands;* 6 *nails.*
1 *lock chain hook;* 2 *washers;* 1 *nut.*
1 *hook*, for the shoe.
1 *cheek plate*, for do.; 3 *screws.*
1 *box*, for elevating screw, (BRASS.)
2 *bolts*, for do.; 2 *washers;* 2 *nuts.*
1 *elevating screw.*
1 *strap staple;* 1 leather strap and buckle.
2 *wheel guard plates;* 12 *nails.*
1 *lunette;* the *rondelle;* 3 *rivets.*
2 *lunette bolts;* 2 *washers;* 2 *nuts.*
1 *trail plate;* the *guard plate;* 6 rivets.
29 *nails*, for trail plate.
2 *bolster bolts;* 2 *washers;* 2 *nuts.*
2 *shoulder washers*, for axletree.
2 *linch washers.*
2 *linch pins.*

2 WHEELS.

## WHEEL.

The same wheel is used for all the siege gun carriages and their limbers.

### *Wood.*

1 *nave;* 14 *spokes;* 7 *fellies;* 7 *dowels.*

### *Iron.*

2 *brow bands;* 2 *end bands;* 12 *nails;* 1 *tire;* 7 *tire bolts;* 7 *washers;* 7 *nuts;* 1 *nave box,* (BRASS.)

## LIMBER.—*Plate 7.*

### *Wood.*

1 *fork;* 2 *hounds;* 1 *splinter bar;* 1 *pole;* 1 *leading bar.*

### *Iron.*

1 *rivet bolt,* for fork; 2 *washers;* 1 *nut.*
1 *axletree.*
1 *pintle plate;* 7 *nails.*
1 *sweep bar.*
2 *bolts,* for ears of sweep bar.
2 *washers;* 2 *nuts,* for do.
1 *axle strap.*
1 *lashing chain;* 4 *rings;* 1 *hook.*
6 *axle-strap bolts;* 2 *washers;* 6 *nuts.*
2 *understraps.*
4 *bolts,* for do.; 2 *washers;* 4 *nuts.*
1 *pintle;* 1 *nut.*
2 *end bands,* for splinter bar; 4 *rivets.*
2 *middle bands,* for do.
4 *trace hooks,* for splinter bar.
1 *bridle,* for front of fork.
2 *bolts,* for splinter bar and fork.
2 *nuts,* for do.
2 *bolts,* for splinter bar and hounds.
4 *washers* and 2 *nuts,* for do.

1 *bridle,* for middle of fork; 4 *nails.*
1 *rivet,* for the pole; 1 *burr.*
1 *eye plate,* for pole.
2 *pole chains.*
1 *ferrule,* for end of pole.
1 *pole clasp;* 1 *clasp bolt.*
2 *bolts,* for eye plate; 3 *washers;* 2 *nuts.*
2 *bolts,* for pole and fork.
4 *washers* and 2 *nuts,* for do.
1 *middle band,* for leading bar; 2 *rivets.*
1 *hook,* for do.
1 *double trace hook,* for middle band.
2 *end bands,* for leading bar; 4 *rivets.*
2 *trace hooks,* for end bands.
2 *axle shoulder washers.*
2 *linch washers.*
2 *linch pins.*

2 WHEELS.

PENDULUM HAUSSE; or tangent scale.

The *scale* is made of sheet brass No. 13. At the lower end is a brass bulb, filled with lead. The *slider* is of thin brass, and is retained in any desired position on the scale by means of a brass set screw with a milled head. The scale is passed through a slit in a piece of steel, with which it is connected by a brass screw, forming a pivot on which the scale can vibrate laterally; this slit is made long enough to allow the scale to take a vertical position in any ordinary cases of inequality of the ground on which the wheels of the carriage may stand. The ends of this piece of steel form two journals, by means of which the scale is supported on the seat attached to the gun, and is at liberty to vibrate in the direction of the axis of the piece.

The *seat* is of iron, and is fastened to the base of the breech by 3 *screws*, in such a manner that the centres of the two journal notches shall be at a distance from the axis equal to the radius of the base ring.

A *muzzle sight*, of iron, is screwed into the swell of the muzzle of guns, or into the middle of the muzzle ring of howitzers. The height of this sight is equal to the dispart of the piece, so that a line from the top of the muzzle sight to the pivot of the tangent scale is parallel to the axis of the piece; consequently, the vertical plane of sight passing through the centre line of the scale and the top of the muzzle sight, will be also parallel to the axis, in any position of the piece; the tangent scale will, therefore, always indicate correctly the angle which the plane of sight makes with the axis.

The seat for suspending the hausse on the gun is adapted to each piece, according to the varying inclination of the base of the breech to the axis. The hausse, the seat and the muzzle sight, are marked for the kind of gun to which they belong. The hausse, when not in use, is carried in a leather pouch suspended to a shoulder strap.

The graduations on the scale are the tangents of each quarter of a degree, to a radius equal to the distance between the muzzle sight and the centre of the journal notches, which are, in all cases, one inch in rear of the base ring.

*Tangent scales for Pendulum Hausses for field guns and howitzers.*

| | FOR GUNS. | | FOR HOWITZERS. | | | |
|---|---|---|---|---|---|---|
| | 6-pdr. | 12-pdr. | 12-pdr. | 24-pdr. | 32-pdr. | |
| | In. | In. | In. | In. | In. | |
| Radius of base ring | 5.15 | 6.5 | 5.0 | 6.0 | 6.9 | |
| Dispart ... | 1.025 | 1.33 | 0.9 | 1.125 | 1.3 | Height of muzzle sight. |
| Tang. 1° | 1.042 | 1.349 | 0.931 | 1.138 | 1.310 | |
| 2° | 2.084 | 2.698 | 1.862 | 2.275 | 2.621 | |
| 3° | 3.124 | 4.046 | 2.792 | 3.412 | 3.933 | |
| 4° | 4.164 | 5.392 | 3.722 | 4.548 | 5.248 | |
| 5° | 5.203 | 6.737 | 4.650 | 5.683 | 6.566 | |

GUNNER'S PERPENDICULAR. This is made of sheet brass; the lower part is cut in the form of a crescent, the points of which are made of steel; a small spirit level is fastened to one side of the plate, parallel to the line joining the points of the crescent, and a slider is fastened to the same side of the plate, perpendicular to the axis of the level. The instrument is useful in marking the points of sight on siege guns and mortars, when the platform is not perfectly level.

CANNON LOCK. Hidden's patent.

The *seat* is of cast brass; it is attached to the gun, on the left side of the vent, by means of two steel *steady pins* and *one screw pin*, if the gun has no lock piece; a small brass *roller* is set into the rear end of the seat for the lanyard to pass round.

The *hammer* is of brass, with a cone of hardened steel screwed into the head, and fastened by a rivet; the hole for the pin on which the hammer turns is oblong, so that the head of the hammer is drawn back by the same pull of the lanyard which causes it first to strike the primer on the vent.

The *lanyard* is a piece of sash cord .25 in. thick and 6 feet long; one end is secured to the shank of the hammer by a knot; the other end carries an iron *toggle*, which serves for a handle, and also for a wrench to turn the screw pin that fastens the lock to the gun.

For guns that have lock pieces, the seat of the lock is made with a flanch to fit the side of the lock piece, to which it is fastened by *two bolts*, with thumb nuts.

LOCK COVER. It is made of black bridle or harness leather. The cap which covers the lock is 7 in. long, 3. in. wide, and 3 in. high. *Two billets* and *two*

*buckle straps*, with black buckles, fasten it on the gun; the length of the straps being proportioned to the diameter of the piece.

VENT COVER, for field pieces without locks; (leather) 6 inches long, 4 inches wide, with a *copper pin* riveted to it, 0.175 inch diameter, and 2 inches long—2 *straps*, 1 inch wide, with *buckles*. The length of the strap varies with the size of the piece. In permanent batteries sheet lead may be used for vent covers.

FUZE SETTER; (brass) *the handle*, upper end slightly rounded—the *cup* 2.1 inches diameter; depth 0.3 inch. Whole length 5 to 6 inches.

FUZE MALLET; (dog wood or oak) in one piece; *head* 5.5 inches long, 4 inches diameter—*handle* 7.5 inches long, 1.25 inch diameter.

FUZE SAW; (tenon saw,) 10 inch blade.

FUZE RASP; 12 inch wood rasp.

FUZE AUGER, for boring out the composition to any required depth: *bit* 0.2 inch diameter sliding in a brass *socket* graduated to 10ths of an inch, and held by a thumb screw in the side—*handle*, of hard wood.

FUZE GIMLET; common gimlet 0.2: used for boring across the composition instead of sawing off the fuze.

SHELL-PLUG SCREW; (iron) *stem* 3 inches long, cut with a deep, sharp thread —*eye* 2 inches diameter.

FUZE-PLUG REAMER. A conical steel reamer, for reaming the holes for paper fuzes, in the wooden fuze plugs.

FUZE EXTRACTOR. The inner *screw* and its *stem* are made of steel, and riveted into the *handle*, which is of iron. The stem is contained in a *hollow screw* of steel, which is worked up and down by means of an iron *nut* with *two handles;* the screw being prevented from turning by a slot and a *feather* in the frame; the nut is kept in place by 4 *iron set screws*, the points of which enter into a groove in the nut. The *frame* is of cast brass.

In using this fuze extractor, the inner stem is screwed into the fuze or plug to be extracted, by means of the upper handle, and it is lifted out by turning the nut of the hollow screw.

GUNNER'S PINCERS. Made of iron, with steel jaws 1 inch wide; whole length 10.5 inches.

GUNNER'S CALLIPERS. Made of sheet brass, with steel points. The graduations show the diameters of guns and of shot, linear inches, degrees of the circle, &c.

GUNNER'S QUADRANT; (wood) a graduated *quadrant* of 6 inches radius attached to a rule 23.5 inches long. It has a *plumb line* and *bob*, which are carried, when not in use, in a hole in the end of the rule, covered by a brass plate.

MAUL, for driving pickets; *head* (elm or hickory) 6 inches diameter, 8 inches long—*handle* (ash) $1\frac{1}{2}$ inch diameter, 24 inches long, with an iron band on each end, 1 inch wide, $\frac{1}{4}$ inch thick.

POINTING WIRE, for mortars; (iron wire No. 7) 20 inches long.

QUOIN for siege mortars; (oak) length 19.5 inches; height 7.85 inches; *handle*, 6 inches long.

CHOCK for casemate carriage; small wedge with a handle on one side.

PLUMMET, for mortars—*line* and *bob*.

SCRAPER, for do.; (iron) *handle* 0.5 inch by 0.3 inch square, 27 inches long—one end formed like a *spoon;* the other, a *scraper*.

SPATULA, for mortars; (ash or hickory,) *handle* 16.5 inches long—*blade* 6 inches—*square end* 3 inches long.

SPLINTS; (white pine) 6 inches long, 0.25 inch thick at the large end, 1 inch wide.

WIPER, for the chambers of mortars; tow cloth, 1 yard square.

GUNNER'S SLEEVE, for mortars; (serge or flannel.)

BASKET, for mortar implements— of strong wicker work, 18 inches in diameter, 12 inches deep.

TARPAULINS are made of two sizes: large, 15 feet by 12 feet; small, 5 feet square. For the manner of painting them, see CHAPTER VII.

TOMPIONS, for 8-inch siege howitzers and mortars, and 10-inch mortar.

BROOM, for mortar batteries, (hickory or birch.)

SHELL HOOKS; (iron) 2 *branches* 0.5 inch diameter, in shape of an *S*, joined by a *rivet;* upper end of the branches connected by 2 *small rings*, 1.25 inch diameter, and 1 *large ring* 3.4 inches diameter: straight *points*, to insert into the ears of the shell 0.5 inch diameter, 0.75 inch long—whole length of branches 12.48 inches.

TOW HOOK; (iron,) *handle* 0.4 inch diameter, 13 inches long; *hook* 1 inch—the other end forms a *hammer* 0.6 inch diameter, 2 inches long.

Used for unpacking ammunition chests.

FUNNEL, for filling shells; (copper or tin,) diameter of *funnel* 3.3 inches—diameter of *pipe* 0.7 inch—length of pipe 2 inches.

POWDER MEASURES. They are made of sheet copper, from No. 16 to No. 20. The bottom is made with a flanch .1 inch deep, turned downwards, and it is brazed or soldered to the sides.

*Interior dimensions of cylindrical Powder Measures.*

| Contents. | Diameter and height. | Contents. | Diameter and height. |
|---|---|---|---|
| Lbs. oz. | In. | Lbs. oz. | In. |
| 0 1 | 1.337 | 2 0 | 4.240 |
| 0 2 | 1.685 | 2 8 | 4.571 |
| 0 4 | 2.122 | 3 0 | 4.857 |
| 0 8 | 2.673 | 4 0 | 5.346 |
| 1 0 | 3.368 | 4 8 | 5.560 |
| 1 4 | 3.628 | 6 0 | 6.120 |
| 1 8 | 3.855 | 8 0 | 6.736 |

PROLONGE; 3.5 inch hemp rope of 4 strands; on one end, a *toggle* and 3 *round links* in a *thimble*—on the other end, a *hook* and *thimble*—from the end of the hook to the centre of 1*st ring*, 31 inches; from centre of 1st to centre of 2*d ring*, 8 feet; from centre of 2d ring to end of toggle, 16 feet. Whole length of prolonge 26 feet 7 inches—the *toggle* of round iron 0.75 inch diameter, 7.5 inches long, with an eye in the centre—*toggle rings* of 0.5 inch round iron; the ring that enters the thimble is 3 inches, the other two 2.75 inches exterior diameter—*hook* 5.5 inches long; *eye* of 0.5 inch round iron, exterior diameter 2.5 inches; body of hook 0.75 inch diameter, tapering to a point—*thimbles* 1.1 inch interior diameter—*prolonge rings* of 0.6 inch round iron, 4.5 by 3.5 inches; the concave flattened part that is lashed to the rope is 2 inches long, lashed with marline.

SPONGE BUCKET, for field gun carriages. It is made of sheet iron, No. 13; the top and bottom are turned over the sides, and fastened each by *four rivets*. Diameter 7.8 inches; height 9 inches.

The *float* is of wood, fastened by *two rivets* to a cross bar; it is put in before the top is fastened on. The *handle* of the float is fastened to it with *two rivets*, and it is connected with the bail of the bucket by a *chain*. The *bail* is fastened to the bucket by *two ears*, each held by *three rivets*. A *toggle*, which is fastened to the bail by *two links* and a *swivel*, serves to attach the bucket to the eye of the axle strap on the gun carriage.

TAR BUCKET. The bucket is made of sheet iron, No. 13, like the sponge bucket. The *cover* is fastened to the top by a rivet on which it turns, and it is kept closed by shutting over a stud riveted into the top. The *ears* are fastened to the bucket each by *three rivets;* a *ring*, for suspending the bucket on its hook, is connected with the ears by *two chains*. Diameter of bucket 7.2 inches; height 8 inches.

WATER BUCKET, for the travelling forge. The *staves* and the *bottom* are of oak; there are sixteen staves, and the bottom is made of not more than two pieces. *Three hoops*, made of hoop iron, No. 16; each hoop is joined together with *two rivets*, No. 1, and fastened to the bucket with *two rivets*. *Two ears* let into the sides, and fastened each by *one rivet*. The *bail* has a *link* connected with it by a *swivel*. Diameter at top 11 inches; bottom 10.25 inches; height 11 inches.

WATER BUCKET, for garrison service. It is made in a similar manner with the preceding, except that the bail has no link and swivel attached to it. Diameter at top 10.25 inches; bottom, 13.5 inches; height 11 inches.

WATERING BUCKET, for field service, made of sole leather. The bottom is of two thicknesses, fastened to each other with 25 *copper rivets*, and to the sides with 61 *rivets;* the side seams fastened with 28 *rivets*, all 0.5 inch long. A rim of sheet copper, No. 24, is fastened on the upper edge with 14 *copper rivets;* 2 *ears* for the bail, fastened each with 4 *rivets*, 0.62 inch long. The *bail* is of round iron 0.5 inch thick. Interior diameter of the bucket at top 12 inches; at bottom, 10 inches; height 9 inches.

SHOVEL—*blade* sheet iron, pointed with steel—length 12 inches; width 10.5 inches—*handle* (ash) 1.5 inch thick at bottom, and 1.25 inch at top; length 45 inches—*ring*, 1.5 inch diameter, secured by a *strap* to the handle at 9 inches from the upper end.

PICKAXE; iron, pointed at both ends with steel—length of each blade 6.5 inches; width of edge of axe 3 inches—*handle* (hickory) about 1.5 inch by 1.25 inch, and 30 inches long.

FELLING AXE—*blade* with steel edge, length 7.25 inches; width of top 3.5 inches, of edge 4.75 inches; thickness at top 0.75 inch, at the eye 1.25 inch; size of the eye 2.25 inches by 0.75 inch—*handle* (hickory) 27 inches long.

HAND BILL, OR BILL HOOK; (iron with steel edges)—*blade*, whole length 8.25 inches; width in the middle 3 inches, near the shank 2.7 inches; thickness 0.25 inch—*hook* 1 inch long—*shank* 8 inches long—*handle* (hickory) 7.5 inches long.

DRAG ROPE; 4 inch rope 28 feet long, with a *thimble* worked in a loop at one end, and a *thimble and hook* at the other end—6 *handles*, wood, 12 inches long, 1.5 inch in diameter, fastened in the rope at the distance of 4 feet apart, and at the same distance from the ends of the rope.

MEN'S HARNESS; 4 inch rope 18 feet long, with *thimbles* and a *hook* like the drag rope—instead of handles, 10 *loops* made of strips of bag leather 5 feet long, 2.75 inches wide, are fastened to the rope in pairs, each pair being secured in place by two knots worked on the rope; the first pair of loops at 3 feet from he hook; the others, at a distance of $3\frac{1}{2}$ feet apart.

SCREW JACK; for field service. The *stand*, (cast iron;) the *hoisting screw;* the *nut;* 2 *handles;* the *cap plate*, fastened on the top of the stand by 4 *screws.* Height of the stand 19 inches; length of screw 15 inches; handles 7.25 inches each.

*Weights af Implements and Equipments.*

| KIND. | Weight. | KIND. | Weight. |
|---|---|---|---|
| | Lbs. | | Lbs. |
| Woollen sponges. 42-pdr.. | 0.7 | Fuze plug reamer | 0.3 |
| 32-pdr.. | 0.65 | Fuze extractor | 3.53 |
| 24-pdr.. | 0.5 | Gunner's pincers | 0.85 |
| 18-pdr.. | 0.4 | Gunner's callipers | 0.5 |
| 12-pdr.. | 0.35 | Gunner's quadrant, wood | 0.84 |
| 6-pdr.. | 0.25 | Gunner's perpendicular | 0.6 |
| Sponge covers.... 42-pdr.. | 0.28 | Maul | 10. |
| 6-pdr.. | 0.14 | Pointing wire | 0.08 |
| Trail handspike | 7.25 | Quoin, for siege mortars | 7. |
| Manœuvring handspike | 8.25 | Chock | 1.4 |
| Shod handspike and long manœuvring handspike | 12. | Plummet | 1. |
| Truck handspike | 18.5 | Scraper | 2.3 |
| Roller handspike | 7. | Spatula | 0.75 |
| Linstock | 0.9 | Splint | 0.03 |
| Port-fire stock | 0.65 | Gunner's sleeve | 0.25 |
| Pass box | 7. | Basket | 4. |
| Budge barrel | 15.5 | Tarpaulins ..... Small... | 9. |
| Gunner's havresack | 1.86 | Large .. | 54. |
| Port-fire case | 1.55 | Mortar tompions. 8-inch . | 5. |
| Tube pouch | 0.95 | 10-inch . | 7. |
| Priming horn | 0.86 | Broom (hickory) | 3.75 |
| Priming wire | 0.08 | Shell hooks | 2. |
| Gunner's gimlet | 0.08 | Tow hooks | 0.6 |
| Vent punch | 0.08 | Funnel | 0.32 |
| Thumbstall | 0.003 | Powder measures. 4 oz | 0.3 |
| Port-fire cutter | 0.77 | 8 oz | 0.5 |
| Tangent scale | 0.21 | 1 lb | 0.75 |
| Pendulum hausse and case | 0.65 | 3 lbs | 1.6 |
| Cannon lock | 2.75 | Prolonge | 18. |
| Lock cover | 0.9 | Sponge bucket | 10. |
| Vent cover | 0.45 | Tar bucket | 7. |
| Lanyard for friction primers. | 0.10 | Water bucket, wood | 10. |
| Fuze setter | 2.66 | Watering bucket, leather | 8. |
| Fuze mallet | 2.75 | Shovel | 4.75 |
| Fuze saw | 0.75 | Pickaxe | 6.5 |
| Fuze rasp | 0.75 | Felling axe | 6. |
| Fuze auger | 0.3 | Hand bill | 2. |
| Fuze gimlet | 0.1 | Drag rope | 16.5 |
| Shell plug screw | 0.31 | Men's harness | 23. |
| | | Screw Jack | 25. |

## *Preservation and arrangement in Store.*

*Implements* collected together according to kind and calibre, in a dry place, arranged on shelves or racks, in bundles or bunches, or in boxes, according to their nature, with marks and labels showing the kind and number of the articles.

*Sponges, rammers, ladles and worms* complete, placed on pins in a vertical frame, or suspended vertically or horizontally by racks or hooks, from the joists, supported so as not to bend.—When in separate parts, the *heads* piled on shelves or on the floor, and the *staves* tied up in bundles, according to kind and calibre.

The *woollen sponges* should be preserved from moths by means of camphor, pepper, &c., or by being sealed up in strong paper bags.

*Handspikes*, in square piles, heads and points alternating.

*Leather Equipments*—hung on pins or hooks, in dry and cool rooms.

All wood painted, except tool handles—Iron either painted or oiled—See CHAPTER VII.

*Sappers and miner's tools*, arranged in piles, the iron coated with varnish—See CHAPTER VII.

# CHAPTER FIFTH.

## ARTILLERY HARNESS.—Plate 13.

The construction of the field carriages requires a harness different, in some respects, from that of common wagons. The limber having no sweep bar, the pole is supported directly by the wheel horses, by means of a chain which connects the hames with the pole yoke of the limber; and, in order to diminish the weight at the end of the pole, the leading bars are dispensed with, the traces of the leaders being attached to those of the wheel horses.

The same harness is perfectly adapted also to the siege carriages; but, as these are arranged for draught in the ordinary manner, common wagon harness may be used with them, if necessary.

*Black leather* is used for the harness, when not otherwise specified; it should be of the best quality, and the strongest leather is selected for the parts which are exposed to the greatest strain, such as traces and breeching. The leather is sewed with strong waxed thread, in double stitch, with about eight stitches to the inch. The seam along an edge is 0.15 inch or 0.2 inch from the edge. The awls should be small for the thread. The ends of the thread should be well fastened before they are cut off.

Straps, or other pieces which have buckles or iron loops attached to them, are generally doubled on a length equal to twice their width, to receive the buckle or loop, which is fastened by two seams. The double end is shaved down.

Standing loops are placed close to the buckles. Their ends are shaved down, brought together, and fastened between the two parts of the strap, if it is doubled.

The tongue holes for buckles are made with a punch corresponding to the size of the tongue. Their distance apart is generally equal to the width of the strap, and the first hole is at double that distance from the end of the strap. This end is shaved down and reduced in width, to facilitate its entrance into the buckle.

The buckles, loops, rings, and hooks are of wrought iron japanned, (black.) The buckles are all made with rollers.

NOTE.—A *layer* is a piece of leather sewed upon another piece, to strengthen it.

A *chape* is a piece used to fasten a buckle or a loop to a strap, or other piece of leather.

A *billet* is a strap which enters a buckle.

A *safe* is a piece of leather placed under a buckle, &c., to prevent it from chafing.

## *Head Gear.*

The head gear is made of strong, black bridle leather, not less than 0.1 inch thick.

HALTER. *One crown piece*, having a billet at each end, for the buckles of the cheek straps.

*Two cheek straps.* Each of them is sewed to a square *iron loop*, and has at the upper end a *buckle*, with *one standing* and *one sliding loop*.

*One brow band*, having a loop at each end, through which the crown piece passes.

*One nose band*, sewed to the same loop as the cheek straps.

*Two chin straps.* They are doubled, and are sewed to the loops of the cheek straps, and also to another *square iron loop* in rear.

*One throat strap.* It is made double and sewed to the last mentioned iron loop; its upper end is formed into a loop to receive the throat lash.

*One throat lash*, with *one buckle*, *one standing* and *one sliding loop* on the left side. It passes through the loops in the brow band and the throat strap.

*One chain*, (common halter chain.) It consists of about 65 links, No. 1, connected by *two rings* and a *swivel*. It is fastened by a ring to the loop which connects the chin straps of the halter. The other end of the chain has a *toggle* and a *loose ring*, to hitch with. Whole length of chain, $4\frac{1}{2}$ feet.

BRIDLE. *One crown piece.* It is split at each end, so as to form, at one end, *two billets* for the buckles of the cheek straps, and at the other, one billet and one buckle strap, with a *buckle* and a *standing loop* for the *throat lash.*

*One brow band*, formed into a loop at each end for the crown piece to pass through.

*Two cheek straps.* Each of them is sewed at the lower end into an *iron loop*, and has at the upper end a *buckle*, with *one standing* and *one sliding loop*, to fasten it to the crown piece. *Two billets* for attaching the bit to the loops of the cheek straps. Each billet has a *buckle* with *one standing* and *one sliding loop*.

*Two reins.* Each rein is sewed to a *billet*, which has a *buckle*, a *standing* and a *sliding loop*, for attaching it to the bit. The short rein is on the near side, and has a *buckle*, a *standing* and a *sliding loop*, for the billet of the long rein.

THE BIT. It is made of iron, tinned. The *bars* are riveted into the *cheek pieces.* There should be different degrees of severity in the curve of the *port mouth.* The width of the bit, between the cheeks, also varies for three sizes, viz: $4\frac{3}{8}$ inch, 5 inch, and $5\frac{1}{4}$ inch; about three-fifths being of the medium size.

The *curb chain* consists of 19 links, diminishing in size from the middle towards each end. It is attached by an *S* to the right cheek piece, and by a *hook* to the left.

## *Driver's Saddle.*

WOOD. The frame of the tree is made of beech, and consists of the *pommel*, the *cantle*, and *two side bars*, which are notched into the pommel and cantle. The frame is covered with *canvas*, which is glued on and painted.

IRON. *Two pommel plates.* The upper one is fastened by *six rivets* passing through both plates; the lower one by two additional *rivets* in each end, one of which holds one end of the stirrup bar. *One cantle plate*, fastened on the under side of the cantle and the side bars by *ten rivets.*

*Two stirrup bars.* The front end fastened to the pommel by one of the rivets of the lower pommel plate; the rear end fastened to the side bar by *one rivet.* The *stay* is formed of a piece of iron bent round the stirrup bar, and fastened to the side bar by *one rivet.* There is a roller on each side of the stay, for the stirrup and girth billets to pass over.

*Two loops*, with rollers; one fastened to the pommel, the other to the cantle, by two of the rivets which hold the plates. The saddle tree is covered with hemp webbing and strong tow linen, stretched on and nailed to the tree.

LEATHER. The *seat* is covered with black upper leather, and stuffed with deer's hair. *Two skirts* are sewed, with welts, to the cover of the seat. *Two iron loops*, for holster straps, are fastened to the front of the saddle by leather loops which pass through slits in the skirts, and are nailed to the tree.

*Two inner skirts*, or flaps, nailed to the side bars, protect the pad from being chafed by the stirrup and girth leathers. The *pad* is made of russet sheep skin, lined with strong linen, and faced with black sheep skin; it is stuffed with deer's hair, and quilted.

*Two iron loops*, for cloak straps, are fastened by leather loops, which are nailed to the under side of the cantle.

*One billet*, for the collar strap, is sewed to the upper loop on the pommel.

*Two girth billets*, and *two billets* for the trace loops, are sewed on the stirrup bars, behind the middle stay.

*Two stirrup leathers* pass over the stirrup bars in front of the stay; the *buckle*, with *one standing* and *one sliding loop*, is sewed to the thin end of the strap, which is doubled and stitched, on a length of 8 inches, where it passes through the eye of the stirrup.

The *girth* is of thick black leather. It has a *buckle* and a *standing loop* fastened to each end by a layer.

The pommel and the cantle are plated with *sheet brass*, No. 20, fastened with brass tacks.

## *Valise Saddle.*

WOOD: The frame of the tree is made like that of the driver's saddle, except in its dimensions.

IRON: The *lower pommel plate* is fastened by *ten rivets*, six of which also hold the *upper plate*. These plates have holes in them for the shank of the bridle hook. The hole in the upper plate is square; that in the lower, round.

The *cantle plate* is fastened under the cantle with *eight rivets*.

The *hook* for the reins is fastened to the top of the pommel by a *nut*. The end of the shank should be riveted over the nut.

*Two loops*, for the collar strap and the crupper, are fastened to the pommel and cantle, as in the driver's saddle. *Four oval rings*, for the valise straps, are fastened by staples which are driven into the tree; two of them in the side bars and two in the cantle.

LEATHER: The *seat* and the *pad* are formed as in the driver's saddle, but the seat is not stuffed. The *skirts* are joined in a similar manner to the cover of the seat.

The *girth* is of leather, and is sewed to the off skirt of the saddle; it has a *buckle* and *two loops*, fastened to it by a layer. A *billet* for the girth is sewed to the near skirt.

*Two billets*, for the trace loops, pass through the skirts, and are nailed to the side bars.

*Two valise straps*, each with a *buckle*, a *standing* and a *sliding loop*.

A *billet* for the collar strap is sewed to the iron loop on the pommel.

The *crupper strap* is double. It is sewed to the iron loop on the cantle, and has another *loop*, with a roller, attached to the rear end, for the back strap of the crupper to pass through, so that the same crupper may fit both saddles.

## *Valise.*

The valise is made of black bridle leather, and lined with cotton ticken. The lining is pasted to the inside of the valise; it is sewed round the borders of the outer cover, forming a pocket which has an opening in the middle. The *inner flap* is held down by a *strap* passing through *six staples* of iron wire, No. 12, and fastened by a *buckle* and *loop;* a strip of leather is stitched over the inner ends of the staples.

The ends of the valise are double.

The *cover* is fastened down by *three billets* and *three buckle straps* and *loops*. The *handles* are of leather, rounded and sewed into the ends. *Two loops*, 1 inch wide, for the valise straps to pass through, are sewed to the bottom of the valise.

## *Whip.*

The *stock* is of hickory or of raw hide, about 30 inches long. It is covered with braided leather. A *loop* for the hand is fastened to the butt of the whip.

The leather should be well fastened together at the small end. A *lash* of thread is tied on, and not plaited in with the leather.

## *Leg Guard.*

The *body* is made of stout kip leather; *two layers* are stitched to the upper and lower parts. The *under strap*, to pass under the foot, is sewed to the bottom. *Four leg straps*, each with a *buckle* and a *loop*, are fastened to the body of the leg guard, under the plate. The billet ends of these straps pass through slits in the body.

The *plate* is of iron 0.1 inch thick, and is fastened to the body with *five rivets*.

## *Nose Bag.*

The *bottom* is made of stiff leather, 6 inches diameter and 4 inches deep, to which a bag of strong linen is sewed. Width of bag at the top, 15 inches; whole height, 15 inches. The head strap, 1 inch wide, has a buckle strap 6 inches long, and a billet 34 inches long, sewed to the bag.

## *Draught Harness.*

THE COLLAR. The *rim* is made of bridle leather, and stuffed with uncut rye straw. The *belly*, made of upper leather, in two pieces, is stuffed with straw cut into pieces not longer than $\frac{1}{4}$ inch. The collars are of 2 sizes, 17 and 20 inches; they are made open at the top, and the size is further varied by *two buckle straps* and *two billets* sewed to the open ends. A *pad*, made of black sheep skin, stuffed with deer's hair, protects the neck of the horse from being chafed by these straps.

THE HAMES are made of iron, and painted black. The *branches* have studs forged on them to receive the bolts of the *joint loops* for the trace tugs; these loops turn freely on the bolts. *Two links*, for supporting the breast strap, are welded into the eyes of the bolts.

*Two rings*, for the trussing straps, are welded into the rectangular eyes at the upper ends of the branches. The branches are joined together, at the lower ends, by a *clasp* which is made fast to the off branch. The *chain* and *toggle*, for connecting the pole yoke with the hames, are fastened to the hames clasp.

*Two leather safes* are sewed round the branches, under the joint loops, to protect the collar from being chafed by the trace tugs.

*Two trace tugs*, made of four layers of leather, 0.63 inch thick, are stitched into the joint loops and into *two loop rings* through which the traces pass.

*Two trussing straps*, each with *one buckle*, *one standing*, and *one sliding loop*, pass through the rings in the upper ends of the hames. They are used for trussing up the harness.

*One hames strap*, with a *buckle* and *two loops*, connects the two branches together at the top.

*One collar strap*, having *one buckle* and *one loop*, passes round the hames strap, and is buckled to the billet on the pommel of the saddle, to keep the collar in place.

THE TRACES, for the wheel and the leading harness, are alike, except in the length of the leather part.

*The leather trace* is made of three layers of leather, making a thickness of 0.63 inch. An *iron loop* is fastened to each end with *three rivets*, 0.25 inch thick.

*The trace chains* are made of iron 0.3 inch diameter. The front chain has *five links* and a *toggle*. The rear chain has *fourteen links*, *four rings*, (oval,) and a *toggle*.

*Two trace loops*. The loop is formed by doubling the leather. It has at the upper end a *buckle* and a *standing loop*, by means of which it is connected with the billet on the saddle. At the lower end of each trace loop is an *iron loop*, to which the belly band is sewed. The *belly band* is made in two parts, one being a billet, and the other having a *buckle* and a *standing loop*.

*One loin strap*, for supporting the traces. It is the same for the wheel and the leading harness, except in length. A *layer* is sewed under the middle of the wheel loin strap, forming a loop through which the back strap of the crupper passes. Each end of the loin strap is buckled into a *loop*, like those just described, through which the trace passes.

THE CRUPPER. The *dock* is made of a piece of leather, 3.5 inches wide and 14 inches long, which is doubled and rounded, without being stuffed. A *buckle* and a *standing loop* are sewed to each end. The *body* of the crupper is split, at the rear end, into two billets which connect it with the buckles of the dock. At the other end are a *buckle* and *four loops* for the billet of the back strap. A *layer*, 10 inches long, is sewed on the body, leaving an opening for the hip strap to pass through; a short *layer* is inserted under the first, in rear of this opening. The *back strap* is sewed in under the first layer in front of the opening for the hip strap. The back strap, passing through the loop in the middle of the loin strap, and through the iron crupper loop on the saddle, returns to the buckle on the body of the crupper. A *sliding loop* holds the two parts together, near the saddle.

## *Breeching.*

*The breech strap* is made of thick harness leather. A *layer*, also of stout leather, is stitched on the outside of the strap. A *buckle* and *three standing loops* are fastened, at each end, by both these pieces of leather, which are turned back three or four inches and stitched down. *Two iron loops* are fastened by chapes sewed to the breech strap.

*Four tugs*, for the hip straps, are fastened to the breech strap; two of them in the buckles, and two in the iron loops. These tugs are made double, and have

each a *buckle* and *three standing loops* attached to them. A *safe* is sewed to the inside of each tug, to prevent it from chafing the horse.

*The hip strap* is made in one piece, split at each end into two billets which buckle into the tugs of the breech strap.

*The breast strap* is made of three layers put together in such a manner as to make the strap 0.63 inch thick in the middle, and 0.5 inch at the ends, where it is buckled to the breech strap. The breast strap is supported by the iron loops on the hames, and by the trace loops attached to the saddle. An *iron loop*, with an eye for the pole chain hook, slides on the middle part of the breast strap; it is covered with leather, to prevent it from chafing the strap.

The *pole chain hook* is like the trace hook of the limber; it is welded into the eye of the sliding loop, and forms a direct connection between the pole and the breeching, independently of the collar and hames.

*Harness required for each horse.*

| PARTS. | WHEELERS. | | LEADERS. | | Weight. |
|---|---|---|---|---|---|
| | Near side. | Off side. | Near side. | Off side. | |
| | | | | | Lbs. |
| Halter | 1 | 1 | 1 | 1 | 3.5 |
| Bridle | 1 | 1 | 1 | 1 | 3. |
| Driver's saddle | 1 | ..... | 1 | ..... | 18. |
| Valise saddle and valise | ..... | 1 | ..... | 1 | 11.5 |
| Collar and hames | 1 | 1 | 1 | 1 | 16. |
| Pair of traces { Wheel | 1 | 1 | ..... | ..... | 9.5 |
| Pair of traces { Leading | ..... | ..... | 1 | 1 | 11.5 |
| Trace loops and belly band | 1 | 1 | 1 | 1 | 1. |
| Loin straps and trace loops. { Wheel | 1 | 1 | ..... | ..... | 1. |
| Loin straps and trace loops. { Leading | ..... | ..... | 1 | 1 | 1. |
| Crupper | 1 | 1 | 1 | 1 | 0.75 |
| Breeching, hip strap and breast strap | 1 | 1 | ..... | ..... | 8.5 |
| Leg guard | 1 | ..... | ..... | ..... | 2.25 |
| Whip | 1 | ..... | 1 | ..... | 0.5 |
| Nose bag | 1 | 1 | 1 | 1 | 1.15 |
| | Lbs. | Lbs. | Lbs. | Lbs. | |
| WEIGHT. { For each horse | 65.15 | 55.9 | 56.4 | 49.4 | |
| WEIGHT. { Set for 2 horses | 121.05 | | 105.8 | | |

PLATE 13 represents the harness of each horse complete. It shows the manner in which the parts are put together, and also the manner of hitching the horses to the carriage.

# CHAPTER SIXTH.

## MOUNTAIN ARTILLERY.

The carriage and most of the equipments for mountain service being of a peculiar kind, all the details relative to them are collected, for more convenient reference, in this chapter.

*The ordnance* for mountain service is the light 12-pdr. howitzer, described in CHAPTER I.

The gun carriage is adapted to transportation on a pack horse; but for occasional draught when the roads permit, it is furnished with a thill, which is used with the same saddle that carries the pack.

### GUN CARRIAGE.—*Plate* 14.

WOOD: 1 *stock*, in two pieces; 2 *dowels;* 1 *axletree.*

#### *Iron.*

3 *assembling bolts;* 4 *washers;* 3 *nuts.*
2 *washer hooks*, (drag hooks.)
2 *trunnion plates;* 6 *nails.*
2 *bolts*, for do.; 2 *nuts.*
2 *chin bolts;* 2 *nuts.*
2 *key bolts;* 2 *nuts.*
2 *cap squares;* 2 *eye pins.*
2 *cap square chains;* 2 *eye pins.*
2 *cap square keys.*
2 *key chains;* 2 *eye pins.*
2 *implement hooks.*
2 *staples*, for straps.
1 *lunette;* 2 *rivets;* 6 *nails.*
1 *trail plate;* 6 *nails.*
1 *knee*, for trail plate; 2 *rivets.*

1 *handspike staple.*
2 *friction plates*, for shaft; 4 *nails.*
1 *box*, for elevating screw.
2 *bolts*, for do.; 2 *washers;* 2 *nuts.*
1 *elevating screw.*
1 *axle skean.*
1 *axle bolt;* 2 *washers;* 1 *nut.*
2 *rivets*, for axle arms; 4 *burrs.*
2 *ferrules*, for axle arms; 2 *rivets.*
2 *axle bands;* 4 *nails.*
2 *understraps.*
2 *linch pins.*

2 WHEELS.

#### *Wheel.*

WOOD: 1 *nave;* 12 *spokes;* 6 *fellies;* 6 *dowels.*
IRON. 4 *nave bands;* 12 *nails.*
1 *tire;* 6 *tire bolts;* 6 *washers;* 6 *nuts.*
1 *nave box*, (BRASS.)

# CHAPTER EIGHTH.

## SMALL ARMS AND ACCOUTREMENTS.

### NOMENCLATURE.

*Percussion Musket.*—Plate 15.

BARREL. 1st reinforce (from the breech to the corner of the flats and ovals 1.89 in.;) 2d reinforce (to the lower band, 8.8 in.;) chase (to the top of the upper band, 28.66 in.;) muzzle, *bayonet stud*, breech, flats and ovals, cone seat, fence, vent, bore, thread for breech screw, thread for the cone.

BREECH SCREW. Plug, with its thread; tenon, shoulders, tang, tang screw hole, notch for side screw, chamfer.

TANG SCREW: shoulder.

CONE: screw thread, shoulder, square, cone, vent.

BAYONET. *Blade:* point, face flute, back flutes, edges of back and blade, corners, elbow, neck.—*Socket:* muzzle end, bridge end, bridge, mortice, shoulder for the clasp, stop pin.—*Clasp:* body, studs, bridge, groove, *stop*, *clasp-screw*.

LOCK. *Lock plate:* front and rear ends, middle, sides, bolsters, chamfer, convex; 3 holes, for the pivots of the main spring, and bridle, and for the arbor of the tumbler; 6 screw holes; 1 mortise for the sear spring stud.—*Hammer:* body, head, comb, countersink, slit, tumbler hole—*Tumbler:* body, friction shoulder, arbor, square, pivot, hook, half-cock notch, cock notch, screw hole—*Tumbler screw.*—*Bridle:* body, eye, pivot, three holes for the tumbler pivot, sear screw and bridle screw—*Bridle screw.*—*Sear:* body, eye, nose, tang, screw hole, friction shoulder—*Sear screw.*—*Sear spring:* blade (upper and lower branch and elbow,) eye, stud, notch, chamfer, screw hole—*Sear spring screw.*—*Main spring:* blade (upper and lower branch and elbow,) hook, pivot, eye, (rest and point,) chamfer, screw hole.—*Main spring screw.*

TWO SIDE SCREWS.

*In all the screws* the parts are: the stem, the head, the slit, the thread.

MOUNTINGS. *Upper band*: body, pipe for the rod, back, upper and lower straps, creases, *sight*, groove, tang, hole for the band spring pivot.—*Upper band spring:* stem, wire, shoulder, pivot.—*Middle band:* body, stud, creases, hole

for the swivel rivet.—*Middle band swivel:* wire, eye, holes in the eye, rivet.—*Middle band spring:* stem, wire, shoulder.—*Lower band:* body, tang, creases.—*Lower band spring:* same as middle band spring.—*Side plate:* body, eyes and holes for the side screws.—GUARD.—*Guard plate:* body, bolsters, trigger stud, 2 holes for the guard bow, 2 for wood screws, 1 for tang screw, 1 for trigger-screw.—*Guard bow:* body, pillars, stems with their screw threads, swivel stud and hole; 2 *nuts* for stems—*Swivel and rivet.*—*Trigger:* blade, tang or finger piece, hole for the screw.—*Trigger screw*—*Two wood screws* for guard plate.—*Butt plate:* body, toe, heel, corners, tang, screw holes.—*Two wood screws* for butt plate.

RAMROD.—Stem, head, screw.—*Ramrod spring:* stem, eye, spoon.—*Pin* for rod spring.—*Stop* for rod.

STOCK.—Butt, comb, handle, head, facings, 1st and 2nd reinforce, chase, shoulders for the lower and middle bands; *grooves* for the barrel and ramrod; *beds* for the tang and tenon, lock, side plate, guard plate, nuts of the guard bow and trigger stud, butt plate, rod spring and band springs; *mortices* for the trigger and rod stop; *holes* for the rod, the side screws, tang screw, guard screws, butt plate screws, band springs, and pin for the rod spring.

IMPLEMENTS.—*Screw-driver*, with cone wrench.—*Wiper*—*Ball-screw*—*Spring-vice.*

## Materials of which the parts are made.

*Steel:* Tumbler, sear, lock springs, band springs, ramrod spring, ramrod, blade of the bayonet, screw-driver, wiper, and ball screw.

*Brass:* Sight.

*Wood:* Stock (black walnut.)

*Iron:* Socket of the bayonet, and all the other parts not enumerated under the three preceding heads.

NOTE.—The brass for parts of small arms is composed of 80 copper, 17 zinc, and 3 tin.

## *Flint Musket.*—Pattern of 1840.

(See first edition of Ordnance Manual.)

This arm is like the new percussion musket, except in the parts relating to the mode of priming, viz:

BARREL. Omit *cone seat*, and *cone.*

LOCK. Omit *hammer.*

Add: *Pan* (brass)—*pan screw*—*battery* and *battery screw*—*battery spring* (steel)—*battery spring screw*—*cock*—*upper jaw*—*flint screw.*

## *Flint Musket.*—Pattern of 1822.

Of this kind are most of the muskets in store at the Arsenals, which are now being altered to percussion. The bayonet has no *clasp*.

BARREL: *bayonet stud.*
BREECH SCREW.
TANG SCREW.
BAYONET: blade, socket.

LOCK.
- *Lock plate; 2 side screws.*
- *Pan; pan screw.*
- *Battery; battery screw.*
- *Battery spring.*
- *Battery spring screw.*
- *Cock; upper jaw; flint screw.*
- *Tumbler; tumbler screw.*
- *Bridle; bridle screw.*
- *Sear; sear screw.*
- *Sear spring; sear spring screw.*
- *Main spring; main spring screws.*

TWO SIDE SCREWS.

MOUNTINGS.
- *Upper band; sight.*
- *Upper band spring.*
- *Middle band.*
- *Middle band swivel* and *rivet.*
- *Middle band spring.*
- *Lower band.*
- *Lower band spring.*
- *Side plate.*
- GUARD: *guard plate; guard bow.*
- *Swivel* and *rivet.*
- *Trigger; trigger pin.*
- *Guard plate screws,* (2.)
- *Butt plate; 2 butt plate screws.*

RAMROD.
STOCK.

IMPLEMENTS.—*Screw-driver—Wiper—Ball-screw—Spring-vice.*

### Materials.

*Steel:* Face of the battery, lock springs, ramrod, blade of the bayonet, screw-driver, wiper, and ball screw.

*Brass:* Pan and sight.

*Wood:* Stock.

*Iron:* Bayonet socket, back of the battery, and all the other parts not enumerated under the three preceding heads.

### *Alteration of Flint Muskets to Percussion.*

THE BARREL is altered: 1st, by closing the vent in the side, and boring a new vent on the upper part of the barrel; 2nd, by upsetting a *cone seat* in the metal of the barrel, and putting in a *percussion cone.* The screw thread of the cone for altered muskets is a little shorter than that for the new muskets, so that it may not project into the bore.

THE LOCK is altered: 1st, by removing the *cock*, the *battery, battery screw, battery spring, and battery spring screw;* 2nd, by cutting off the *pan*, near the face of the lock plate, filling up the hollow of the remaining part with brass, soldered in, and dressing off the upper surface even with the top of the lock plate; 3d, replacing the cock by a *percussion hammer*; 4th, filling up the holes of the battery screw and the battery spring screw with pieces of those screws, rounded on the outer end, and filling the pivot hole of the battery spring with wire.

## *Percussion Rifle.*

BARREL: *sight, guide, grooves, bands. Cone. Breech screw; tang screw.*
LOCK: *lock plate; hammer; tumbler; tumbler screw; bridle; bridle screw; sear; sear screw; sear spring; sear spring screw; main spring; main spring screw.*
TWO SIDE SCREWS.
MOUNTINGS: *upper band,* with *swivel stud.*
*Upper band swivel,* and *rivet.*
*Upper band spring.*
*Lower band; lower band spring.*
*Side plate.*
*Guard plate; guard bow and nuts.*
*Guard bow swivel and rivet.*
*Trigger; trigger screw.*
*Guard plate screw.*
*Butt plate;* 2 *butt plate screws.*
*Box plate;* the lid and the strap joined by a *hinge* and *rivet.*
*Three box plate screws.*
*Box plate spring; screw,* for do.
*Box plate catch;* 2 *rivets.*
RAMROD: *rod spring and pin; stop.*
STOCK: *patch box.*
IMPLEMENTS: *screw driver,* with cone wrench; *wiper; ball screw; spring vice; bullet mould.*

### Materials.

*Steel:* Cone, guide, tumbler, sear, lock springs, band springs, rod spring, box spring, ramrod, (except the head,) screw driver, wiper, ball screw. Some of the barrels are also now made of cast steel.

*Brass:* Sight, bands, guard plate, guard bow, side plate, butt plate, box plate and strap, head of ramrod.

*Wood:* Stock.

*Iron:* Parts not enumerated under the preceding heads.

## *Cavalry Musketoon*—Percussion.

BARREL: *swivel stud; cone; breech screw; tang screw; swivel.*
LOCK: same as for rifle.
TWO SIDE SCREWS.
MOUNTINGS: *upper band* and *sight.*
*Upper band spring.*
*Lower band; swivel bar stud.*
*Swivel bar; ring; screw; nut.*
*Side plate.*
*Guard plate; guard bow,* and *nuts.*
*Trigger; trigger screw.*
2 *guard plate screws.*
*Butt plate;* 2 *butt plate screws.*
RAMROD: *head; button.*
RAMROD SWIVEL: 2 *side bars; screw; axis.*
STOCK.
IMPLEMENTS, same as for the musket.

### Materials.

*Steel:* Cone, tumbler, sear, lock springs, band spring, ramrod, (except the head,) screw driver, wiper, and ball screw.

*Brass:* Bands, side plate, guard plate, guard bow, butt plate.

*Wood:* Stock.

*Iron:* Head of ramrod and all the other parts not enumerated under the three preceding heads.

## *Artillery Musketoon*—Percussion—Plate 15.

BARREL—*Bayonet stud; cone.*
*Breech screw; tang screw.*
LOCK—Same as for rifle.
TWO SIDE SCREWS.
MOUNTINGS: *Upper band and sight.*
*Upper band spring.*
*Lower band, and swivel stud.*
*Lower band spring.*
*Lower band swivel and rivet.*
*Side plate.*
*Guard plate; guard bow and nuts.*
*Trigger; trigger screw.*
2 *guard plate screws.*
*Swivel plate and stud; 2 screws.*
*Swivel and rivet.*
*Butt plate; 2 butt plate screws.*
*Ramrod spring, and pin.*
*Ramrod stop.*
STOCK.
IMPLEMENTS, the same as for the musket.

N. B.—The musket bayonet may be used with this arm.

### Materials.

*Steel:* Cone, tumbler, sear, lock springs, band springs, ramrod, screw driver, wiper, and ball screw.

*Brass:* Sight. *Wood:* Stock. *Iron:* The remaining parts.

## *Sapper's Musketoon*—Percussion.

This arm is the same as the artillery musketoon, with the addition of an *upper band stud* on the barrel, and a *catch stud* on the upper band, for the sword bayonet.

SWORD BAYONET: *Blade,* (steel;) *gripe and guard,* (brass) in one piece; slot for the catch stud; socket for the barrel; *clasp* and *clasp screw,* similar to those on the musket bayonet—*Scabbard,* (leather) with brass *band and tip.*

## *Pistol*—Percussion—Plate 15.

BARREL: *Sight; swivel stud. Cone.* BREECH SCREW: *Tang screw.*

LOCK: Same parts as for the musket and rifle. TWO SIDE SCREWS.

MOUNTINGS: *Band and side plate,* in one piece—*guard plate—guard plate screw—trigger—trigger screw—guard bow—guard bow nuts—butt plate—butt plate screw.*

RAMROD: Button—*head,* riveted on.

RAMROD SWIVEL: *Two side bars*—1 *screw*—1 *cross bar,* riveted into the side bars.

STOCK.

IMPLEMENTS: *Screw driver and cone wrench—wiper—ball screw—spring vice—bullet mould.*

### Materials.

*Steel:* Cone, tumbler, sear, lock springs, ramrod, (except the head,) screw driver, wiper, and ball screw.

*Brass:* Sight, band and side plate, guard plate, guard bow, butt plate.

*Wood:* Stock.

*Iron:* Head of ramrod and the remaining parts.

The tumbler of the pistol is now made with a *safety notch,* in place of the half cock notch.

## *Hall's Carbine*—Percussion—Plate 15.

This is a cavalry carbine, which loads at the breech by means of a moveable chamber called the *receiver*.

BARREL: *Ramrod stud, sight, guide.*

TWO SUPPORTERS: Each with 2 holes for supporter screws, 2 holes for side screws, 1 for swivel bar and 1 for chock screws—4 *supporter screws;* the heads are countersunk in the supporters, and they are dressed smooth and flush with the outer face of the supporters, which are permanently connected with the barrel by these screws, and by being soldered in place.

TWO CHOCKS: 2 *chock screws.*

RECEIVER AND LOCK: Bore, shoulder for the chocks, cone seat, vent, slot for the side screw, mortise for the lock, studs for the catch—*Cone—Hammer and tumbler*, in one piece; slit for the link—*tumbler screw—sear and trigger*, in one piece; slot for side screw—*sear screw—sear spring—sear spring screw—link—link screw—main spring—main spring screw—catch—catch screw—catch spring—catch spring screw.*

TWO SIDE SCREWS: One of them is the axis of the receiver; the other passes through the supporters and the butt piece.

BUTT PIECE—*Butt piece screw*, passing through the supporters and the butt piece.

APRON: Lining of the stock, at the junction of the barrel and receiver—*Stop*, riveted to the apron, for the receiver to rest on. The apron and stop have a screw hole tapped to receive the front guard plate screw.

MOUNTINGS: *Upper band—ramrod spring*, riveted to the upper band—*upper band spring—lower band*, with stud for swivel bar—*swivel bar;* the rear end is a side screw for the supporters—*swivel screw—swivel ring—guard plate;* 2 studs for the catch lever—*guard bow—guard bow nuts—catch lever and pin—three guard plate screws—butt plate—2 butt plate screws.*

RAMROD.

STOCK.

IMPLEMENTS: *Screw driver and cone wrench—wiper—spring vice—bullet mould.*

### Materials.

*Steel:* Chocks; hammer and tumbler; link; sear part of trigger; all the springs; ramrod.

*Brass:* Sight; bands; guard plate; guard bow; butt plate.

*Wood:* Stock.

*Iron:* The remaining parts.

For description of *Hall's Rifle*, (flint lock,) see first edition of Ordnance Manual.

## *Principal Dimensions and Weights of Small Arms.*

| DIMENSIONS. | FLINT MUSKET. | | PERCUSSION. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1822. | 1840. | Musket. | Rifle. | Cavalry Musketoon. | Artillery Musketoon. | Sapper's Musketoon. | Pistol. | Hall's Carbine. |
| | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| BARREL. Diameter of the bore | 0.69 | 0.69 | 0.69 | 0.54 | 0.69 | 0.69 | 0.69 | 0.54 | 0.52 |
| BARREL. Variation allowed, *more* | 0.015 | 0.015 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| BARREL. Diameter at the muzzle | 0.82 | 0.85 | 0.85 | 0.90 | 0.85 | 0.85 | 0.85 | 0.70 | 0.75 |
| BARREL. Diameter at breech, between the flats | 1.25 | 1.25 | 1.25 | 1.15 | 1.25 | 1.25 | 1.25 | 1. | 1. |
| BARREL. Length, without the breech screw | 42.0 | 42. | 42. | 33. | 26. | 26. | 26. | 8.5 | 21. |
| RECEIVER. Diameter of chamber | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 0.56 |
| RECEIVER. Depth of chamber | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2.10 |
| BAYONET, length of the blade | 16. | 18. | 18. | ..... | ..... | 18. | 22. | | |
| RAMROD, length | 41.96 | 41.70 | 41.70 | 33. | 25.70 | 25.70 | 25.70 | 8.7 | 19.50 |
| ARM COMPLETE. Length, without bayonet | 57.64 | 57.80 | 57.80 | 48.8 | 41. | 41. | 41. | 14.3 | 40. |
| ARM COMPLETE. Length, with bayonet fixed | 73.64 | 75.80 | 75.80 | ..... | ..... | 59. | 62.1 | | |
| WEIGHTS. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| BARREL, without breech screw | 4. | 4.19 | 4.25 | 5.17 | 2.94 | 2.94 | 2.95 | 1.03 | 3.55 |
| LOCK, with side screws | 1.23 | 1.22 | 0.85 | 0.55 | 0.58 | 0.58 | 0.58 | 0.43 | |
| BAYONET | 0.73 | 0.64 | 0.68 | ..... | ..... | 0.68 | 2.33 | | |
| ARM COMPLETE. Without bayonet | 9.34 | 9.78 | 9.14 | 9.68 | 7.22 | 7.02 | 7.02 | 2.73 | 8.14 |
| ARM COMPLETE. With bayonet | 10.10 | 10.42 | 9.82 | ..... | ..... | 7.70 | 9.35 | | |
| Flint lock altered to percussion—deduct | 0.24 | 0.24 | | | | | | | |

## INSPECTION OF SMALL ARMS.

All the materials used in the manufacture of arms must be of the best quality, and they should be tested by the inspectors, according to the methods indicated in CHAPTER XIV.

The wood for gun stocks should be seasoned at least 3 years and kept in a dry place 2 years before being worked; it must be free from knots and sap, and no wood which is *brash* or light, (cut from old trees,) or worm eaten, or in any degree decayed, or which is cut across the grain at the handle of the stock, or which is kiln dried, should be used or received.

The following rules for inspection apply more particularly to the percussion musket, when not otherwise stated, but the principles and most of the details of the inspection are the same for all fire arms, whether made at the national armories, or by contract at private establishments.

The attention of the inspecting officers should be directed, as much as possible, to the operations of the workmen in the course of the fabrication of arms.

Each component part is first inspected by itself and afterwards the arm in a finished state.

The materials and the forms and dimensions of all the parts must conform strictly to those of the established patterns; the workmanship and finish must be equal to those of the model arms, and the several parts must be browned, blued, case hardened, or polished as in the standard model.

The forms and dimensions of the parts are verified by means of the following gauges:

### *List of Verifying Gauges for the Percussion Musket.*

Each set of gauges is distinguished by the letter with which it is marked. The pieces of the same set are numbered as in the following list.—In some cases *each groove* of a gauge is numbered; for instance, those of the barrel, rod, and bayonet gauges: these numbers will not be found on the list.

| No. | FOR BARRELS. |
|---|---|
| 1 | 1 Stock gauge for the length of the barrel and rod. |
| 2 | 1 Groove gauge for the diameters of the barrel. |
| 3 | 1 Standard plug, } |
| 4 | 1 Limit plug, } for the calibre of the barrel. |
| 5 | 1 Taper plug, } |
| 6 | 1 Tap and die for the barrel and breech screw. |
| 7 | 1 Standard tap and die for the cone seat and cone. |
| 8 | 1 Tap gauge for the depth of thread in the cone seat. |
| 9 | 1 Groove gauge for the finished barrel and breech screw. |
| 10 } 11 } | 2 Gauges for the exterior of the cone seat. |
| 12 | 1 Receiving gauge for the barrel and breech screw. |

| No. | MUSKET—BARREL—*Continued.* |
|---|---|
| 13 | 1 Gauge for the vent. |
| 14 | 1 Receiving gauge for the muzzle. |
| 15 | 1 Groove and tap gauge for the cone. |
| | FOR LOCKS. |
| 16 | 1 Pattern for lock plates. |
| 17 | 1 Groove gauge for lock plates. |
| 18 | 1 Receiving and groove gauge for tumblers. |
| 19 | 1 Receiving and groove gauge for bridles. |
| 20 | 1 Receiving and groove gauge for sears. |
| 21 | 1 Size gauge for the hole in the sear. |
| 22 | 1 Groove gauge for hammers. |
| 23 | 1 Gauge for the set and length of the hammers. |
| 24 | 1 Receiving gauge for hammers. |
| 25 | 1 Gauge drift for tumbler holes. |
| 26 | 1 Groove gauge for main springs. |
| 27 | 1 Groove gauge for sear springs. |
| 28 | 1 Groove and tap gauge for the lock screws, and for all the screws except the wood screws. |
| 29 | 1 Gauge for depth of tumbler screw hole. |
| 30 | 1 Receiving gauge for finished locks. |
| | FOR MOUNTINGS AND OTHER PARTS. |
| 31 | 1 Pattern and receiving gauge for butt plates. |
| 32 | 1 Groove gauge for butt plates. |
| 33 | 1 Groove gauge for bands. |
| 34 | 1 Gauge mandril for lower bands. |
| 35 | 1 Gauge mandril for middle bands. |
| 36 | 1 Gauge mandril for upper bands. |
| 37 | 1 Groove and receiving gauge for guard plate bow and nuts. |
| 38 | 1 Tap gauge for tang screw hole, trigger stud, and guard bow nuts. |
| 39 | 1 Receiving gauge for guards. |
| 40 | 1 Receiving and groove gauge for triggers. |
| 41 | 1 Receiving and groove gauge for lower and middle band springs. |
| 42 | 1 Receiving and groove gauge for upper band springs. |
| 43 | 1 Receiving and groove gauge for side plates. |
| 44 | 1 Receiving and groove gauge for rod springs and wire pins. |
| 45 | 1 Groove and plug gauge for swivels. |
| 46 | 1 Groove gauge for breech plate and guard screws, (wood screws.) |
| 47 | 1 Receiving gauge for bayonets. |
| 48 | 1 Scabbard gauge for bayonets. |
| 49 | 1 Groove gauge for bayonets. |
| 50 | 1 Plug for bayonet sockets. |
| 51 | 1 Groove and plug for bayonets and socket clasps. |
| 52 | 1 Groove and pattern gauge for bayonet necks. |
| 53 | 1 Grooved and tapped gauge for rods. |
| 54 | 1 Groove gauge and pattern for rod stop. |
| 55 | 1 Apparatus for testing lock springs; consisting of a stock, scale beam, and brass pods weighing 10 pounds. |
| 56 | 1 Gauge for the angle of the stock, and positions of the bands on the finished musket. |

*For the repair of the Artillery Musketoon:*

The same parts as for the Cavalry Musketoon, with the following exceptions:

Omit: *Swivel bars, rings,* and *nuts.*
Add: Swivel plate and studs.....25
Swivel plate screws.....50
Swivels and rivets.....50
Lower band springs.....20

For the repair of arms in the hands of troops in garrison, take about one-half of the number of parts required for arms in the field.

*Spare parts* required for repairs, if not obtained from arms that are broken up, are supplied from the armories, on requisitions made in the manner pointed out by the regulations of the Ordnance Department.

## *Durability and strength of Musket Barrels.*

The United States musket barrel being much like the French musket barrel, the following remarks relative to the latter, (extracted from the *Aide Memoire,*) will apply to the former. It is to be observed that the charge of the French musket was formerly 162 grains Troy, priming included, (or 146 grains, exclusive of priming,) and is therefore considerably greater than our present service charge.

The regulation fixing the duration of small arms in the French service at 50 years, is founded on the durability of the barrel, which is the most important part of those arms. Experience has shown that a musket barrel will bear 25,000 discharges without becoming unserviceable, and even in time of war a musket is not fired more than 500 times a year. The wear caused by firing is therefore small, and the principal cause of the rejection of barrels is the diminution of 0.09 inch in the diameter at the breech. With good management and care, that diminution will take place very slowly, and it ought not generally to occur in the space of 50 years.

It has also been ascertained, by direct trials, that the strength of the barrel furnishes every requisite security against the accidents of service and the want of care on the part of the soldier; and that, even after being reduced in diameter 0.09 inch at the breech, it is still perfectly safe against the effect of the charge. In experiments made in 1806, barrels reduced 0.13 inch at the breech, bore a double and triple charge with one ball, or 2 cartridges placed one over the other.

Other trials were made in 1829, at the manufactory of Mutzig, on arms sent there for repairs, which had been a greater or less time in the hands of the troops. They furnished the following results:

1st. When a musket barrel is charged with a single cartridge, placed in any part of it, or with 2 or even with 3 cartridges, inserted regularly, without any

interval between them, there is no danger of bursting; with 4 cartridges inserted regularly over each other, or with 2 or even 3 cartridges placed over each other with slugged balls, (or balls *driven* in, as in a rifle,) there is danger only in case of some defect of fabrication, or some deterioration in the barrel—with more than 4 cartridges inserted regularly one over another, or with 2, 3, and 4 cartridges with intervals between them, it is not safe to fire.

2nd. No danger of bursting is occasioned by leaving a ball screw in the barrel. There may be danger from a plug of wood driven tight into the muzzle, when the barrel has been loaded with 2 cartridges; or from a cork rammed into the barrel to a certain distance from the charge, with another cartridge over it.

Snow, clay, and sand, which may be accidentally introduced into the barrel are not dangerous, if they lie close to the charge; but they are so, when there is a space between them and the charge; in this case sand is the most dangerous, then clay and snow.

Balls or pieces of iron inserted over the charge, were not attended with danger when placed close to the charge, even when their weight amounted to $1\frac{1}{4}$ lb.; but there is danger from a piece of iron 0.5 inch square, weighing $\frac{1}{4}$ lb., if placed 20 inches or more from the breech.

3d. A barrel with a defect which might have escaped the inspector at the armory, bore the explosion of 3 cartridges, regularly inserted. After mutilation, which may have caused a reduction of metal in some parts, it may still be used without danger.

Finally, the diminutions of exterior diameter which may be produced in ordinary service are never sufficient to be dangerous. In these trials, barrels originally 0.272 inch thick at the breech, did not burst when loaded with 2 cartridges, until the thickness was reduced to 0.169 inch, and with one cartridge to 0.091 inch.

## SWORDS AND SABRES.

### NOMENCLATURE.

### *Cavalry Sabre.*—Plate 15.

BLADE. Shoulder, back, edge, bevel, point, curvature, large groove, small groove ; *tang*, riveting.

HILT. *Surmounting* (brass,) notch for the guard, back, rivet cap, hole for the tang of the blade—*gripe*, wooden body, (birch or maple,) leather covering, (calf skin blackened,) wires, (brass,) notch for the guard, ridges, shoulder, hole for the tang of the blade—GUARD ; *front branch*, hook ; *back branch; middle branch; plate*, mortise for the tang, flange, bead, lip.

SCABBARD. (sheet steel)—*Body*, back, front, sides, holes for the rivets—*Mouth piece*, rim, springs, rivet holes ; 2 *rivets*—2 *Bands*, knob, eye for the ring—2 *Rings*—*Tip*, front branch, back branch.

The same sabre, with gilt mountings, for cavalry officers.

### *Sabre for Mounted Artillery.*—Plate 15.

BLADE. With but one groove.

HILT. *Guard*, one branch terminating in a scroll ; the plate has 2 countersinks, one for the gripe, the other for the scabbard.

SCABBARD. *Spring*, fastened to the back by 1 *rivet*—no mouth piece.

In other respects the nomenclature is the same as that of the cavalry sabre.

The same sabre, with ornamented gilt mountings, for mounted officers of artillery and infantry.

### *Foot Artillery Sword.*—Plate 15.

BLADE. Straight, two edged, narrower nearer the hilt than in the middle—*Body* (or blade proper,) shoulder, shoulder rounding, ridges, point, bevels, edges—*Tang*, its rounding and riveting, three holes for the gripe rivets.

HILT. (brass, in one piece)—Cross, knob and panel of the cross, mortise for the tang, gripe, fillet, necks, swell, knob with an *eagle* on each side, bolster and hole for the tang rivet, grooves and ridges, three holes and bolsters for the gripe rivets—3 *Rivets* (iron.)

SCABBARD. (harness leather, jacked, blackened, and varnished,)—*Body*, edges, inner and outer sides—*Mountings* (brass.)—*Ferrule*, stud, bead, cap—*Safes* (buff leather)—4 *Nails* for the ferrule and safes—*Tip*, bead, knob—4 *Nails* for the tip.

## *Infantry Sword.*—Plate 15.

BLADE. (Straight, cut and thrust)—Back, edge, groove, bevel, point.

HILT. *Surmounting* (brass,) notch for the hook of the guard, rivet cap, shoulder for the ferrule, hole for the tang ; 2 *ferrules*—*Gripe*, wooden body, hole for the tang—*Covering* (sheet brass,) grooves and ridges.

GUARD, in one piece ; *branch*, hook and its shoulder ; *plate*, flange, bead ; *knob*.

SCABBARD. (Leather)—*Ferrule and hook*, (brass,)—*Tip* (brass,) body, front branch, back branch.

This sword is for the non-commissioned officers of foot troops; a similar one, without the guard *plate* and with a blade 26 *inches long*, for musicians.

The sword for *officers not mounted* is also of the same pattern, with ornamented gilt mountings and a silver gripe; the inner half of the guard plate is made with a *hinge*.

### *Principal dimensions and weights of Swords and Sabres.*

| DIMENSIONS. | Cavalry sabre. | Artillery sabre. | Artillery sword. | Infantry sword. |
|---|---|---|---|---|
| | In. | In. | In. | In. |
| Whole length of the sword or sabre in its scabbard | 43.25 | 38.6 | 26. | 38.75 |
| Length of the blade proper | 36. | 32. | 19. | 32. |
| Length of the scabbard | 37.25 | 33. | 20. | 32.5 |
| Width of the blade in the middle | 1.1 | 1.06 | 1.8 | 0.72 |
| Versed sine of the curvature of the blade in the middle | 1.5 | 2.32 | | |
| Versed sine of the curvature of the blade in proof | 7.5 | 6.5 | ..... | 6.5 |
| WEIGHTS. | Lbs. oz. | Lbs. oz. | Lbs. oz. | Lbs. oz. |
| Weight of the sword or sabre, complete | 4 8 | 4 1½ | 3 3 | 2 5 |
| Weight of the finished blade | 1 5 | ..... | 1 9 | |
| Weight of the scabbard | 2 2 | ..... | 10 | |

### PROOF AND INSPECTION OF SWORDS AND SABRES.

1st. The dimensions and form of the *blade* are verified by comparing it with the model, and by applying the appropriate gauges and patterns, for the length, width and thickness at several points, and the curvature, if any.

2nd. The *blade* is then proved as follows :—1st. The point is confined by a staple, and the blade is bent on each of the flat sides over a cylindrical block, the curvature of which is that of a circle 35 inches diameter, the curvature of the part next the tang being reduced by inserting a wedge 0.7 inch thick at the

head and 14 inches long. 2nd. It is struck twice, on each of the flat sides, on a block of oak wood the curvature of which is the same as the above. 3d. It is struck twice on the edge and twice on the back across an oak block 1 foot in diameter. 4th. The point is placed on the floor and the blade bent until it describes an arc having the versed sine indicated in the above table. After these trials the blade is examined to see that it is free from flaws, cracks, or other imperfections, and that it is not *set*, that is to say, does not remain bent.

The blade of the *Artillery sword* is proved by striking each of the sides and edges twice on a flat block of hard oak wood.

The stamp of approval or condemnation is placed on the side of the blade, below the tang.

3d. The form, dimensions and workmanship of the *mountings* are examined and compared with the model. After the blade is mounted, the sword is again examined, and it is struck 4 times on a hard block of wood to test the strength of the mountings. The quality of the brass mountings may be tested by breaking a certain number, not more than 4 in each hundred, which should be taken from the pieces rejected for erroneous dimensions.

4th. The form, workmanship, and finish of the *scabbards* are examined and compared with the model, and their fitting to the blades tested. The sewing of leather scabbards and the fastening of the ferrules and tips will be particularly examined.

Steel scabbards are proved by letting fall on them, from a height of 18 inches, an iron weight of two pounds, 1 inch square at the base: 1st, on one side just above the upper band; 2nd, on the same side, 6 inches from the tip; 3d, on the opposite side, just above the lower band. In this proof the scabbard should not remain indented. The nature of the material (whether iron or steel) may be tested, if there is any doubt, by using nitric acid which will leave a black spot on the steel but not on the iron.

### PACKING SWORDS AND SABRES.

Packing boxes for swords and sabres are made on the same principles as those for muskets and other small arms, being furnished with packing boards or partitions made with grooves to receive the scabbards near the hilt and near the point; the swords are placed in their scabbards, with the hilts and points alternately towards each end of the box; except the Artillery swords, two of which are placed in the length of the box, their points resting on a packing board in the middle. Number packed in a box:

| | |
|---|---|
| 30 Cavalry sabres. | 50 Artillery swords. |
| 50 Artillery sabres. | 50 Infantry swords. |

### CLEANING SWORDS AND SABRES.

The iron and brass parts of swords and sabres are cleaned in the same manner as those of muskets. When the oil on the blade of a sword is dried up, it will leave a spot which may be removed by covering it with oil and rubbing it smartly, after a short time, with a linen rag. When a leather scabbard has become wet, draw the blade and dry the scabbard slowly without heating it; wipe the blade dry and pass an oiled rag over it and the scabbard, before returning the blade. Oil the blades of arms in store, and also the scabbards, especially on the seams.

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## ACCOUTREMENTS.

### *Infantry Accoutrements.*

CARTRIDGE BOX, (black bridle leather.) Length 7.2 inch; width 1.6 inch; depth in front, 5.8 inch—*inner cover*, (light upper leather,) 4 inches wide, with end pieces sewed to it, so as to cover the ends of the box—*flap*, 8.5 inches wide at bottom, 8 inches at top, with a button hole *strap* sewed near the bottom—*brass button*, riveted to the bottom of the box—*implement pocket* (light upper leather) sewed to the front of the box; 6 inches long, 3.5 inches deep, with a *flap*, *strap*, and *loop*—2 *loops*, on the back of the box, near the top, for the shoulder belt to pass through. 2 *roller buckles* (japanned, black,) for the belt; sewed to the bottom of the box. TWO TINS, each with *one lower division*, 3 inches by 3.3 inches, open in front, to contain a bundle of 10 cartridges, and 2 *upper divisions*, 2.7 inches deep, one of 2 inches by 1.35 inch for 6 cartridges; the other 1.35 inch square, for 4 cartridges. The edges of the tin are turned over and soldered down, to prevent them from cutting the cartridges. All the tin linings should be made to slide freely in the boxes.

CARTRIDGE BOX PLATE: (brass,) oval, 3.5 inches by 2.2 inches, with the letters U. S. stamped on it—2 *eyes*, of iron wire, for fastening the plate to the flap of the box.

CARTRIDGE BOX BELT: (buff leather,) width, 2.25 inches; length, 55.5 inches, clear of the 2 *billets* for buckles, which are each 4.25 inches long and 0.875 inch wide.

CARTRIGE BOX BELT PLATE: (brass,) circular, 2.5 inches diameter, stamped with an *Eagle;* 2 *eyes*, of iron wire.

CAP POUCH: (black bridle leather,) length and depth 3 inches; width 1.25 inch—*inner cover*, with end pieces—*flap*, made of the same piece as the back, with a button hole strap at the bottom—*brass button*, riveted under the bottom of the pouch—2 *loops*, sewed to the back, 2.25 inches long, to admit a waist belt,

of 2 inches—*lining*: a strip of sheepskin, with the wool on, 1.5 inch wide, glued with fish glue, and sewed to the back, at the mouth of the pouch.

CONE PICK: (steel wire, No. 18,) 1.5 inch long, with a ring handle 0.5 inch diameter; it is carried in a loop in the inner left hand corner of the cap pouch.

BAYONET SCABBARD: (black bridle leather.) Length, including the ferrule and tip, for the bayonets of the model of 1822, 18 inches; for bayonets of model of 1840, 19.5 inches. *Ferrule and tip*, brass. *Frog:* (buff leather,) sewed to a socket of black leather which is fastened to the top of the scabbard—the frog slides on the waist belt.

WAIST BELT: (buff leather) width 1.5 in.; length 38.5 in.; a *loop* at one end.

WAIST BELT PLATE, (brass) oval, 2.8 in. long by 1.6 in. wide, stamped with the letters U. S. 1 *stud* and 1 *hook* (brass.)

GUN SLING, (russet, bag leather) width 1.25 in.; length 46. in.; 1 *standing and* 1 *sliding loop—hook*, (brass) fastened to the sling with 2 *brass rivets*.

SWORD SHOULDER BELT, for non-commissioned officers—(buff leather)—width 2.3 in.; length of short branch 17 in.; long branch 40 in.—1 *standing loop*, on long branch—*Frog* for sword.

SHOULDER BELT PLATE—like the cartridge box belt plate, except in having 3 *hooks*, instead of eyes.

## *Rifle Accoutrements.*

CARTRIDGE BOX. The leather parts are like those of the infantry cartridge box; length 7.2 in., depth in front 5 inches, width 1.6 in. *Two loops* are placed upright on the back of the box, to receive a 2 in. waist belt. The *tin lining* has 2 lower divisions, each 3.3 in. long by 2.8 in. deep, and 5 upper divisions, 1.35 in. square by 2.1 in. deep.

CARTRIDGE BOX PLATE. Like the infantry waist belt plate, except in having instead of a stud and a hook, 2 *eyes*, to fasten it to the flap of the box.

CAP POUCH.
CONE PICK.
WAIST BELT. 2 in. wide.
WAIST BELT PLATE: like infantry cartridge box plate, with 2 *studs* and a *hook*.
GUN SLING.
SWORD SHOULDER BELT, for non-commissioned officers.

} In other respects the same as for the infantry.

POUCH, (light upper shoe leather,) 7 in. wide at bottom, 6.6 in. at top, 5.5 in. deep, made with *gussets* at the sides and bottom—*partition—flap*, 2.7 in. deep, with a *strap* and leather *button* on the front side—2 *loops*, (japanned iron,) 0.9 in. wide and 0.7 in. long, for the belt rings.

FLASK. *Body* (copper bronzed,) length 7 in., greatest width 4 in., thickness 2 in.; diameter at top 1.7 in.—*inner charging tube*, (brass) 0.57 in. diameter, 1 in. long—*outer charging tube* 0.65 in. diameter, 1.75 in. long—*valve and spring*—2 *rings* for belt, (copper.)—Flask holds 8 oz. of powder: maximum charger 100 grains, minimum 75 grains—Weight of flask complete, 13 oz.

FLASK-AND-POUCH BELT, (buff leather,) 1.5 in. wide—*belt*, 26 in. long—2 *straps* at each end, 13.5 in. long, 0.6 in. and 0.9 in. wide, to which the pouch and flask are attached by *brass hooks*, riveted to the straps.

## *Cavalry Accoutrements.*

CARTRIDGE BOX, for carbine or musketoon; like the rifle cartridge box.

PISTOL CARTRIDGE BOX. It is like the carbine cartridge box, except in its dimensions; length 6.2 in., width 1.3 in., height in front 3.5 in.—*inner cover*, 3.5 in. wide—*flap*, 6.6 in. wide at top, 6.8 in. at bottom, 6 in. deep—*Tins:* 2 lower divisions, 2 in. deep, 2.9 in. long, 1.2 wide; 5 upper divisions, 1.2 wide by 1.15 in. long and 1.5 in. deep.

CARTRIDGE BOX PLATE, for carbine or pistol cartridge box; the same as for the rifle.

CAP POUCH, } the same as for the infantry.
CONE PICK, }

SABRE BELT (buff leather)—*Waist belt*, 2 inches wide, 36 in. to 40 in. long—1 *square loop* and 2 *D rings* (brass,) for attaching the slings and shoulder strap—1 *shoulder strap*, 1.125 in. wide, 41 in. long, with 2 *hooks*, brass—2 *sabre* slings 1.125 in. wide; front sling 17 in. long, rear sling 34 in.—4 *studs* for do., brass—1 *sabre hook*, brass wire.

SABRE BELT PLATE—Like the rifle waist belt plate.

SWORD KNOT (buff leather)—*Strap* 1 in. wide, 36 in. long; one end of the strap is fastened to a *tassel* 3 in. long; the other end is passed through the tassel after going round the guard of the sabre, and is fastened by one of the tags of the tassel—1 *sliding loop*

CARBINE SLING, (buff leather.) Length 56 in., width 2.5 in.—1 *buckle* and 1 *tip*, brass—*swivel* and *D* with *roller*, bright iron, 2.62 in. wide—*link* and *hook*, iron—*guard-spring*, steel.

HOLSTERS. *Pipe* (sole leather, black); diameter of cylindrical part 2 in.; length of do. 7.5 in.; width of the mouth, 4.8 in.; depth, 2.2 in.; whole length, 14.5 in.—*pocket*, (light upper leather,) 3.2 in. long, 2.5 in. deep, lined with *tin* and covered with a *flap*—5 *cylindrical divisions*, diameter 0.6 in., each for one cartridge—1 *centre piece* forming the backs and connecting the two holsters, (bridle leather, black,) length 22 in., width 5.75 in.—2 *straps* 14 in. long, 0.75

wide, with 2 buckles, to attach the holsters to the saddle—2 *surcingle loops*, (light bridle leather, black,) 1.5 in. wide, 3.5 in. long, doubled.

*Two holster covers*, (black leather;) 10 in. long, 9.5 in. wide over the cartridge-pocket—*straps*, 4 in. long, 1 in. wide, to button on 2 *brass studs* on the holster pipes.

## *Artillery Accoutrements.*

### For Mounted Artillery.

SABRE BELT (buff leather) 1.7 in. wide, 36 to 40 in. long—2 *leather loops*, sewed on the outside of the belt for attaching 2 *brass loops* for the slings—2 *sabre slings*, like those on the cavalry sabre belt—4 *studs* for do.—1 *sabre hook*.

SABRE BELT PLATE, (brass,) circular, 1.4 in. diameter, lettered *U. S.;* it slides on the belt and is fastened by a *brass hook* and a *sliding loop*—the plate hooks in a *ring* 1.95 in. exterior diameter, attached to the left side of the belt.

SWORD KNOT. Like that for cavalry.

### For Foot Artillery.

SWORD BELT (buff leather) 1.7 in. wide, made in three pieces; *long branch*, 24 in.; *frog piece* 4.5 in.; *short branch*, 4 in.; they are united together by 2 *loops*, brass—*frog*, 3.5 in. deep, 2.5 in. wide at top and 2.3 in. at bottom, suspended to the loops by 2 *slings* 1.3 in. wide and 3.5 in. long.

BELT PLATE, the same as for the sabre belt of mounted artillery.

This belt is also used by the non-commissioned officers of infantry, when armed with the foot artillery sword.

## *Sapper's Accoutrements.*

SWORD BELT, (buff leather,) 2 inches wide, 36 to 40 inches long. *Frog*, sliding on the waist belt; width of the loop for the belt 3 inches; width at the bottom 4 inches.

BELT PLATE, like that for the artillery.

CARTRIDGE BOX AND PLATE,
CARTRIDGE BOX BELT AND PLATE,
CAP POUCH,
CONE PICK,
} the same as for the infantry.

*Spare parts required for repair of Side Arms and Accoutrements, for one year, in the field.*

*For* 1000 *non-commissioned officers or musicians' swords.*

100 tips for scabbards.
20 ferrules and hooks.
40 guard bows.
50 belt plates.

*For* 1000 *Infantry accoutrements.*

50 tips for bayonet scabbards.
25 cartridge box plates.
50 cartridge box belt plates.
100 waist belt plates
100 cone picks.

*For* 1000 *Cavalry carbine slings.*

150 swivels.
150 swivel springs.

## MATERIALS REQUIRED FOR MAKING ACCOUTREMENTS.

### *Leather.*

19 Infantry cartridge box belts
200 Infantry bayonet frogs
45 Infantry waist belts
34 Rifle waist belts
33 Rifle pouch-and-flask belts
15 Cavalry sabre belts
20 Foot artillery sword belts
20 Horse artillery sabre belts
20 Carbine slings
70 Sword knots
} Either of these can be cut out of one hide of *buff leather.*

40 Gun slings—out of one butt of *bag leather.*
8 Pairs of holsters—out of one side of *heavy sole leather.*
11 Infantry cartridge boxes—except pockets and inner covers—out of one side of *heavy bridle leather.*

27 Bayonet scabbards
40 Cap pouch fronts
10 Carbine cartridge boxes
12 Pistol cartridge boxes (except ends)
10 Holster centre pieces
60 Pairs of holster straps
70 Surcingle loops
} Out of one side of *light bridle leather.*

12 Rifle pouches.
50 Pockets for infantry cartridge boxes
50 Inner covers for do do.
40 do. for cap pouches
40 Tops for do.
} Out of one side of *light upper shoe leather.*

MATERIALS FOR ACCOUTREMENTS—*Continued.*

*Thread.*

| | | |
|---|---|---|
| 100 Infantry cartridge boxes | 1.25 lbs. | *Shoe thread*, green, No. 10, waxed with rosin wax. |
| 100 Carbine.....do. | 1.0 " | |
| 100 Pistol.....do. | 0.9 " | |
| 100 Holsters | 1.25 " | |
| 100 Rifle pouches | 0.75 " | |
| 100 Gun slings | 0.13 " | |
| 100 Infantry waist belts | 0.06 " | *Shoe thread*, No. 3, half bleached, waxed with beeswax. |
| 100 Artillery sword belts | 0.8 " | |
| 100 Sabre belts | 0.33 " | |
| 100 Rifle pouch belts | 0.13 " | |

*Metals.*

*For* 100 *sets of Cavalry sabre belt mountings.*

| | |
|---|---|
| 100 Sabre hooks | 2.5 lbs. brass wire, No. . |
| 100 Loops | 4 lbs. brass wire, No. 10. |
| 100 Large hooks | 4 lbs. sheet brass, No. 11. |
| 100 Small hooks | 1.5 lb. sheet brass, No. 14. |
| 200 Rings | 4 lbs. brass wire, No. 10. |
| 400 Rivets | 0.375 lb. brass wire, No. 15. |
| 400 Studs | cast brass. |
| 100 Belt plates | *See* below. |

*Tins for* 100 *carbine cartridge boxes.*

75 sheets of sing'e tin. 1 lb. tinner's solder, (2 tin to 1 lead.)

*Tins for* 100 *pistol cartridge boxes.*

48 sheets of single tin. 1 lb. solder.

*Tins for* 100 *pairs of holsters.*

4½ sheets of single tin. } These tins may be cut from the remnants of the
1 lb. solder. } sheets required for 100 infantry cartridge boxes.

*Tins for* 100 *Infantry cartridge boxes.*

125 sheets of single tin. 1 lb. tinner's solder.

*For* 100 *plates for Infantry cartridge boxes, cavalry sabre belts, and rifle waist belts.*

4 lbs. sheet brass, No. 26.
7 lbs. do. No. 14, for sabre belt plate hooks.
1 lb. do. No. 5, for do. studs.
0.625 lb. iron wire, No. 14.
4 lbs. soft solder, (1 tin to 2 lead.)

*For* 100 *ferrules for bayonet scabbards.*

3 lbs. sheet brass, No. 25.
4.7 lbs. brass wire, 0.45 in. thick.
0.14 lb. copper wire, No. 15.
0.2 lb. spelter.

*For* 100 *Infantry cartridge box belt plates.*

3.75 lbs. sheet brass, No. 26.
0.844 lb. iron wire, No. 14.
4 lbs. soft solder.

*For* 100 *plates for Infantry waist belts and for carbine and pistol cartridge boxes.*

3 lbs. sheet brass, No. 26.
3 lbs. do. No. 14, for waist belt plate hooks.
0.75 lb. iron wire, No. 14, for cartridge box plates.
3 lbs. soft solder.

*For* 100 *gun sling hooks and rivets.*

1.5 lb. sheet brass, No. 14.
0.16 lb. brass wire, No. 15.

*For* 100 *Artillery sword belts.*

200 loops.....8.5 lbs. brass wire, No. 10
100 small hooks.....1.5 lb. sheet brass, No. 14.
200 rivets.....0.14 lb. brass wire, No. 15.

*For* 100 *Artillery sabre and sword belt plates.*

25 lbs. pig brass.

*For* 100 *Rifle pouch and flask belts.*

4 lbs. sheet brass, No. 15.
0.66 lb. brass wire, No. 15.

## WEIGHT OF ACCOUTREMENTS.

100 Infantry cartridge boxes and plates.....176 lbs.
100 Cartridge box belts and plates.....63 "
100 Cap pouches and cone picks.....13 "
100 Bayonet scabbards and frogs.....27 "
100 Waist belts and plates for infantry.....32 "
100 Gun slings.....15 "
100 Non-commissioned officers' shoulder belts and plates....60 "
100 Rifle or carbine cartridge boxes and plates.....118 "
100 Rifle waist belts and plates.....56 "
100 Rifle pouches.....43 "
100 Rifle flasks.....81 "
100 Rifle flask and pouch belts.....27 "
100 Pistol cartridge boxes and plates.....81 "
100 Cavalry sabre belts and plates.....115 "
100 Carbine slings and swivels.....110 "
100 Pairs of holsters and covers.....250 "
100 Mounted artillery sabre belts and plates.....97 "
100 Foot artillery sword belts and plates.....73 "
100 Sappers' sword belts and plates.....63 "

# CHAPTER NINTH.

## GUNPOWDER.

### MATERIALS.

### *Saltpetre.*

*Saltpetre, nitre, nitrate of potassa,* is composed of 53.45 nitric acid and 46.55 potassa—its specific gravity is 2,090—it melts at 660°, and is decomposed at a red heat—100 parts of water, at the temperature of 32°, dissolve 13.32 parts of nitre; at 59°, 25.49; at 86°, 45.90; at 104°, 63.80; at 140°, 110.70; at 176°, 170.80; at 212°, 246.15. Saltpetre crystallizes generally in six-sided prisms, terminated by six-sided pyramids, or in needles deeply striated—its taste is cool, saline, and slightly bitter—when thrown on burning charcoal it melts and deflagrates violently.

Saltpetre occurs naturally in great quantities, on the surface of the earth in India and other warm countries, and in the limestone caves of Virginia, Georgia, Tennessee and Kentucky; in the last named State, it is also found in the form of what is termed *rock ore,* being sand stone containing a very large proportion of nitre. This salt is formed spontaneously by the decomposition of animal and vegetable substances in moist situations, and on this principle artificial nitre beds are made for its production. Saltpetre obtained from any of these sources may be separated from the greater part of the foreign salts and earthy matter by lixiviation with wood ashes and evaporation. The nitrous earth of India yields about one-fifth of its weight of nitre; that of the nitre caves, from one to ten pounds of nitre to the bushel, and the rock ore as much as 20 or 30 pounds to the bushel. The best artificial nitre beds afford annually about a quarter of a pound of nitre to a bushel of earth. Nearly all the saltpetre used in the United States, for the manufacture of gunpowder, is obtained from India, whence it is imported in a crystalized state, called *grough saltpetre,* containing generally from 6 to 12 per cent. of foreign salts, earths, and water.

TEST OF GROUGH SALTPETRE: To a pound of grough saltpetre add a pint of water, saturated with pure saltpetre; stir the mixture for ten minutes with a glass rod, and decant the liquor on a filter; wash the saltpetre a second time in

the same manner, with half a pint of the saturated solution, and pour the whole on the filter ; let it drain, and then dry it perfectly by placing it first on a bed of some absorbent matter, such as ashes or lime, and then by evaporation in a glass vessel over a gentle fire. The saturated solution having taken up only the foreign salts, what remains on the filter, (allowing 2 per cent. for earthy matter and the saltpetre left by the saturated water,) is the quantity of pure saltpetre contained in the pound of grough. As the changes of temperature during the operation may affect the quantity of pure saltpetre remaining on the filter, it is proper to perform a corresponding operation, at the same time and under the same circumstances, on a like quantity of pure saltpetre ; the gain or loss thus ascertained will show the correction to be made in the former result.

## Refining Saltpetre.

Saltpetre to be used in the manufacture of gunpowder requires to be freed from the impurities present in its crude state. This may be done by boiling it in pure water and filtering the liquor through canvass bags. The method of refining on a large scale, at the refinery of Paris, is as follows :

First washing.—This first operation is performed on 11,660 lbs. of grough saltpetre, containing about 6 per cent. of foreign salts and 6 per cent. of water and earthy matters. This is washed with 4,400 lbs. of water saturated with pure saltpetre, obtained in previous operations ; if that is not at hand, pure water may be used : stir it well, and at the end of 12 hours rake up the saltpetre towards one side of the vessel, and let the water run off at the opposite side, carrying with it the foreign salts ; this is afterwards treated as mother water. After this washing the saltpetre contains only 1 per cent. of foreign matter, and the quantity is reduced to 11,000 lbs.

Melting. In a boiler of the capacity of about 900 gallons, dissolve 10,000 lbs. of the saltpetre from the first washing in 300 gallons of water, at a moderate heat, putting in first three-fourths of the saltpetre with a proportional quantity of water, and adding the rest in three successive parts. Prepare a solution of 36 oz. of glue in 4½ gallons of water, and when ebullition is about to commence in the boiler, pour in three-fourths of the solution of glue diluted with twice its bulk of water, and skim carefully ; then add 22 gallons of water, in order to diminish the density of the liquid, and to allow the foreign salts and earthy matters to pass through it, and settle at the bottom, or to rise in scum ; this is called *a washing*. Throw into the boiler one-third of the remainder of the saltpetre and the rest of the glue diluted with four gallons of water ; skim for about one hour—make a second washing, and about two hours after, a third—continue

the skimming and evaporation, increasing the heat, until there remains in the boiler but one part of water to four of saltpetre—let the liquor stand for some hours, keeping up a sufficient heat to prevent crystallization, and then draw it off into the crystallizing vat.

Crystallization. The liquor is kept in constant agitation by means of rakes, to prevent the formation of large crystals. Draw off the mother water when its temperature is reduced to 104°, and let the saltpetre drain for some hours.

Watering. When taken from the crystallizer the saltpetre contains not more than 1-500th of foreign salts; it is put into boxes capable of containing about 4,800 lbs.; on each of these boxes pour, with watering pots, 220 gallons of water, one-third at a time—the two first waterings are allowed to remain on the saltpetre two hours before being drawn off through openings in the bottom of the box; the third merely passes through the saltpetre.

Drying. After these waterings the saltpetre contains but 1-18000th of hydrochlorates. It is left to drain several days, and then dried in drying vats at a low heat, being constantly stirred.

Packing. If designed for transportation, the saltpetre when thoroughly dried, being then perfectly white and in small grains, is passed through a sieve of fine wire gauze and packed in barrels. A 100 lbs. powder cask will hold about 132 lbs. of saltpetre.

Saltpetre is also well preserved in cakes, which are made by fuzing the refined saltpetre in iron pots, and casting it into moulds of convenient size; the cakes are 12 in. square and 6 in. thick, weighing about 70 lbs.; six are packed in a box 12.75 in. × 12.75 in. × 38 in.; gross weight 465 lbs. This method of treating saltpetre has the advantage of expelling from it the water of crystallization; but it requires a little more work to pulverize the saltpetre afterwards, in making powder.

*The mother water*, as it issues from the crystallizer, is received in basins where it cools and deposites saltpetre, which is added to that which has undergone the first washing in another operation; the rest is evaporated to obtain grough saltpetre.

*The water used for watering the refined saltpetre* is kept to make the first washing of the grough saltpetre, or else it is added to the mother water.

*The scum* which is obtained in melting is called *foul scum*. Put about 4,400 lbs. of it into a boiler with 265 gallons of water; heat it gradually until it begins to boil; skim and allow it to settle; then draw off the liquor which, in cooling, will deposite grough saltpetre. On the residuum, whilst still hot, pour about 250 gallons of water and add the *second scum*, so as to fill the boiler; after this

has been boiled, skimmed, and allowed to settle, draw off the clear liquor and add it to the mother water. Add the last scum and the dregs to the materials for lixiviation.

Thus, 11,660 lbs. of grough saltpetre furnish 8,000 lbs. of pure, dry saltpetre, besides, 200 lbs. remaining in the scum, 1,200 lbs. in the mother water, and 1,000 lbs. in the washings, which are obtained in the subsequent operations; in all, 10,400 lbs. of pure saltpetre.

TEST OF REFINED SALTPETRE. In order to be used in the manufacture of gunpowder, saltpetre should not contain more than 1-3000th of chlorides.—To test this, dissolve 200 grains of saltpetre in the least possible quantity (say 1000 grains) of tepid distilled water; pour on it 20 grains of a solution of nitrate of silver containing 10 grains of the nitrate to 1033 grains of water, that being the quantity required to decompose 200-3000ths of a grain of muriate of soda; filter the liquid and divide it into two portions—to one portion, add a few drops of the solution of nitrate of silver; if it remains clear, the saltpetre does not contain more than 1-3000th of muriate of soda—to the other portion, add a small quantity of solution of muriate of soda; if it becomes clouded, the saltpetre contains less than 1-3000th. By using the test liquor in very small quantities, the exact proportion of muriate of soda may be ascertained; at the refinery of Paris it does not exceed 1-18000th of the saltpetre, and this degree of purity is attained also at the refinery of Messrs. Dupont. Saltpetre for the best sporting powder is refined a second time, and contains not more than 1-60000th part of chlorides.

## *Charcoal.*

Charcoal obtained from light woods is the best for the manufacture of gunpowder, being more easy to pulverize. *Willow* and *poplar* are used for this purpose in the United States.

The wood must be sound, and should not be of more than 3 or 4 years growth, and about 1 inch in diameter; branches larger than that should be split up. It is cut in the spring, when the sap runs freely, and is immediately stripped of its bark. The smaller branches are used for fine sporting powder.

The operation of charring may be performed in pits, but the method now almost universally pursued in making charcoal for gunpowder is that of *distillation*. For this purpose the wood is placed in an iron vessel, generally of a cylindrical form, to which a cover is luted; an opening, with a pipe, is made to convey off the gaseous and liquid products, and the wood is thus exposed to the heat of a furnace.

The charcoal thus obtained should retain a certain degree of elasticity, and should have a *brown* color, the wood not being entirely decomposed; it retains

the fibrous appearance of the wood, and the fracture is irridescent. As it readily absorbs 1-20th of its weight of moisture, it should be made only in proportion as it is required for use. Wood contains generally about 52 per cent. of carbon, but distillation furnishes not more than 30 to 40 per cent. of charcoal.

The specific gravity of charcoal triturated under heavy rollers is about 1,380; but in sticks, as it comes from the charring cylinders, it rarely exceeds 300.

### *Sulphur.*

Pure sulphur is of a citron yellow color and shining fracture; it crackles when pressed in the hand. The specific gravity of native sulphur is 2,033; that of sulphur refined by sublimation 1,900; its specific gravity is diminished by trituration. Sulphur melts at 220°, but at 320° it takes the consistency of paste; it sublimes at 680°. It is insoluble in water, but soluble in oils and in alcohol.

Sulphur is generally found in great quantities in the neighborhood of volcanoes; it may also be obtained from metallic ores (pyrites) and other sources. Most of that used in the United States is obtained from the French refineries.

Crude sulphur, as extracted by the first sublimation from the ore, contains about 8 per cent. of earthy matter. It is purified by a second sublimation, from which it is collected in the form of powder, called *flowers of sulphur*, or it is melted and run into moulds, making *roll brimstone*. It may also be refined, but not so thoroughly, by being simply melted and skimmed.

Pure sulphur is entirely consumed in combustion, and its purity is thus easily tested by burning about 100 grains in a glass vessel; the residuum should not exceed a small fraction of a grain.

## MANUFACTURE OF GUNPOWDER.

### *Proportions of Ingredients.*

| | | Saltpetre. | Charcoal. | Sulphur. |
|---|---|---|---|---|
| | By the Atomic theory.... | 74.64 | 13.51 | 11.85 |
| In the United States: | | | | |
| | For the military service. | 76 | 14 | 10 |
| | | 75 | 15 | 10 |
| | For sporting..... | 78 | 12 | 10 |
| | | 77 | 13 | 10 |
| In England: | For the military service... | 75 | 15 | 10 |
| | For sporting..... | 78 | 14 | 8 |
| | | 75 | 17 | 8 |
| In France: | For the military service... | 75 | 12.5 | 12.5 |
| | For sporting..... | 78 | 12 | 10 |
| | For blasting..... | 62 | 18 | 20 |
| In Prussia: | For the military service... | 75 | 13.5 | 11.5 |

It appears from experiments that the simple incorporation of the materials makes a powder which gives nearly as high ranges with the cannon as grained powder; the incorporated dust from the rolling barrel may therefore be used in case of necessity. Gunpowder burns at the temperature of 575° to 600° Fahr.

### DENSITY OF GUNPOWDER.

The density of gunpowder may be approximately determined by taking the weight of a given quantity; this is called the *gravimetric density*, and the measure used for the purpose a *gravimeter*. The gravimetric density may be expressed by the weight of a cubic foot in ounces, and a convenient form for the gravimeter is a brass cylindrical measure, 4 inches in diameter and 5.093 inches in height, containing 64 cubic inches, or 1-27th of a cubic foot. The weight of the contents should be ascertained with the powder loose and shaken; the difference gives an indication of the relative irregularity and size of grain.

The gravimetric density of unglazed powder (French) made in pounding mills, is about 840. The following results were obtained from some of the best powder made in cylinder mills:

| SIZE OF GRAIN. | | Specific gravity. | No. of grains of powder in 10 grs. Troy. | Weight of 1 cubic foot. | | Cubic inches in 1 lb. loose |
|---|---|---|---|---|---|---|
| | | | | Loose. | Shaken. | |
| | | | | oz. | oz. | |
| U. S. | Cannon | 1,912 | 150 | 929 | 1,039 | 30. |
| | Musket | 4,983 | 1,100 | 896 | 1,012 | 30.8 |
| | Rifle | ..... | 6,000 | 900 | 1,060 | 30.7 |
| | Sporting | 2,012 | 73,000 | 1,047 | 1,197 | 26.5 |
| English—Cannon | | 1,970 | 174 | 874 | 993 | 31.6 |

The specific gravities stated in the above table were obtained by means of alcohol; the results are not perfectly accurate, as the method is liable to some objections. The following method of ascertaining the specific gravity of gunpowder is pursued in the French manufactories, but it is also not free from objections. The specific gravity of the sporting powder of the above table obtained by this method is 1,890, and that obtained approximately, by direct measurement and weight of pieces of dried mill cake, is about 1,920.

### *Determination of the Specific Gravity of Gunpowder.*

The instrument used for this purpose is a cylindrical glass vessel of uniform diameter, the edges of which are well ground, and to which is adapted a cover of polished glass accurately ground on the surface, so as to close the vessel her-

metrically. The diameter of the vessel is 3 in., and its weight 4.5 in. With a good balance take the exact weight of the vessel and cover.—Fill the vessel with distilled water and cover it so as entirely to exclude the air; this may be effected by pouring in the water until it runs over the sides of the vessel, and then sliding the cover on—wipe the vessel and the cover perfectly dry, without disturbing the cover so as to admit air in the vessel.—Ascertain the weight of the vessel thus filled, and deducting its weight when empty, set down the weight of distilled water which it contains, which weight we will designate by $W$. Now wipe the vessel and cover perfectly dry, and ascertain in the same manner the weight $W'$, which the vessel will contain of water saturated with nitre, such as is used in testing the purity of saltpetre—pour out three-fourths of the saturated solution, and having weighed 1500 grains of powder free from dust, pour it *slowly* into the saturated solution, so that the air between the grains of powder may escape—then fill the vessel with the solution, and cover it as before; wipe it dry and ascertain the weight. From the weight thus found, subtract that of the vessel and cover, and that of the powder; the remainder will be the weight of the saturated solution in the vessel; deduct this weight from that $W'$, of the saturated solution, before obtained, and the difference will be the weight $w'$, of the quantity of the solution which occupies the same space as the given quantity of powder. Then $W' : W :: w' : w$, the weight of distilled water which would have been displaced by the powder; and this weight is to that of the powder as the specific gravity of distilled water is to the specific gravity of the powder. Repeat the operation three times, and take the mean result.

Alcohol may be used in the same manner, instead of saltpetre water.

## PACKING POWDER.

Government powder is packed in barrels of 100 lbs. each. Powder barrels are made of well seasoned white oak, and hooped with hickory or cedar hoops which should be deprived of their bark; the cedar is not so liable as hickory or white oak to be attacked by worms, and it should therefore be used in preference, or the hoops may be prepared by immersion in a solution of corrosive sublimate. The hoops should cover two-thirds of the barrel. The diameter of the bung-hole is 1.25 in.—Instead of a bung on the side, a screw hole 1.5 inch in diameter is sometimes made in the head of the barrel; it is closed by a wood screw with an octagonal head which must not project beyond the ends of the staves; under the head of the screw is a washer of thin leather steeped in a solution of beeswax in spirits of turpentine. This screw plug renders it unnecessary to take out the head of the barrel, and the hoops may therefore be secured with copper nails; for transportation, a piece of cloth should be glued

over the head of the plug.—Some barrels have been made with six copper hoops, and others with 4 copper and 8 or 10 cedar hoops; the copper hoops are 1 in. wide, and $\frac{1}{8}$ of an inch thick, fastened with two rivets, and nailed each with 3 copper nails, 0.625 in. long —Average weight of a hoop $2\frac{1}{4}$ lbs.

In 1836, some barrels were made water proof by a lining of India rubber cloth, to ascertain its efficiency in preserving the powder in damp situations, or in the exposure of service in the field. This lining appears to have had an injurious effect on the powder, when exposed to heat and moisture, in consequence of the affinity of the caoutchouc for sulphur.

### *Dimensions of Powder Barrels.*

| | |
|---|---|
| Whole length | 20.5 inches |
| Length, interior, in the clear | 18 " |
| Interior diameter at the head | 14 " |
| Interior diameter at the bilge | 16 " |
| Thickness of the staves and heads | 0.5 " |
| Weight of the barrel with cedar hoops | 25 lbs. |

The barrels have generally 12 hoops, 14 to 16 staves, and 2 or 3 pieces in each head. The above dimensions are calculated so that, with 100 lbs. of powder, there shall be a vacant space in the barrel, allowing the powder to shake, in order to prevent its caking—the barrel would contain about 120 lbs. of powder, settled by shaking.

### INSPECTION AND PROOF OF POWDER.

Gunpowder should be of an even grain, angular and irregular in form; it should be so hard as not to be easily crushed by pressure with the finger; it should, when new, leave no trace of dust when poured on the back of the hand, and should leave no beads or foulness when flashed, in quantities of 10 grains, on a copper plate. The size of the grain for each kind of powder is tested in the following manner:

There are three sieves or gauges for each size of grain, made by piercing round holes in thin sheets of brass. The sizes of these holes are as follows:

| | CANNON. | | | MUSKET. | | | RIFLE. | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. 1. | No. 2. | No. 3. | No. 4. | No. 5. | No. 6. | No. 6. | No. 7. | No. 8. |
| | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| Maximum. | 0.100 | ..... | ..... | 0.06 | ..... | ..... | 0.035 | | |
| Medium... | ..... | 0.085 | ..... | ..... | 0.05 | ..... | ..... | 0.03 | |
| Minimum . | ..... | ..... | 0.070 | ..... | ..... | 0.035 | ..... | ..... | 0.025 |

*Cannon powder*, sifted through the gauges Nos. 1, 2, and 3, should leave not more than 6 per cent. on No. 1; not more than 20 per cent. should pass through No. 3; and of the remainder, not more than one-half should pass through No. 2. This would give about 150 grains of powder in a weight of 10 grs. troy.

*Musket powder* should all pass through No. 4; about one-half should pass through No. 5; and nearly one-fourth through No. 6. This would give about 2,000 or 2,500 grains of powder in 10 grs. troy.

*Rifle powder* should all pass through No. 6; not more than one-fifth through No. 8; and not more than two-fifths through No. 7. This would give about 12,000 or 15,000 grains of powder in 10 grs. troy.

Ordinarily, the uniformity and size of grain will be judged of by mere inspection.

The powder in each barrel is proved. For this purpose a sample of about $3\frac{1}{2}$ oz. is taken from each; this is conveniently done by means of an *extractor*, which is a copper tube about 1 inch interior diameter, and 18 inches long, pointed at the bottom, and having a valve at the lower end, or an opening about 9 inches from that end, by covering which with the hand the powder may be poured out of the mouth of the tube; the sample is put into a tin canister marked with a number, a corresponding one to which is inscribed with chalk on the barrel; from these samples, the charges for the eprouvette are weighed on the proving ground, as they are required.

The platform for the mortar eprouvette should be a block of oak timber firmly established on a foundation of masonry, with which it is connected by strong bolts; to this block the iron bed plate is fixed by the three bolts provided for that purpose, the plate being also let into the wood about 1.5 inch, to avoid bending the bolts. The ground where the balls are to fall should be free from stones and not too hard.

The eprouvettes are provided with 3 service balls and a standard ball, (marked No. 1,) by means of which, and of the standard powder accompanying each eprouvette, the mortar and the service balls should be verified from time to time.

The eprouvette, being washed clean and dried by firing a scaling charge, is placed on its bed, in a vertical position, in which it is supported by a wedge or prop; the vent is stopped with a copper wire having a shoulder to prevent it from projecting into the chamber, and the charge of powder is introduced through a long funnel which is supported on the bottom of the bore, at the mouth of the chamber; the ball is then carefully lowered down by means of a hook, and the mortar placed on its bed, care being taken not to jar it roughly; it is primed with a small strand of quick match, and fired without delay. Two

charges are fired in this way from each sample of powder, and if the ranges differ more than 20 yards, a third charge is fired, and the two nearest ranges are used in obtaining the mean range. The mortar is scraped and wiped after each discharge, and it is washed and dried, as at first, after about 8 shots.

The general mean range of new powder proved at any one time must be not less than 250 yards; but no powder ranging below 225 yards is received. The powder in magazines is considered unserviceable if it does not range over 180 yards.

With the eprouvettes, as adjusted in 1837, good cannon powder ranges from 280 to 300 yards, and small grain powder, from 300 to 320 yards.

Inspection report. The report of inspection should show the place and date of fabrication and of proof—the kind of powder and its general qualities; as, hard or soft, round or angular, whether free from dust or not, of uniform or irregular grain—its gravimetric density—the separate ranges and the mean range—the condition of the mortar and the ball—the state of the weather.

Marks. Each barrel is marked on one head with the place and year of manufacture, and with the kind of grain, *cannon*, *musket*, or *rifle;* on the other head, with the year in which it was proved and the proof range, leaving room for subsequent proofs, which are marked in the same manner.

## *Remarks.*

Although the above is the established mode of proof and inspection for Government powder, it cannot be disguised that a very imperfect test of the relative projectile force of gunpowder is thereby afforded. Slight variations in the density of powder, which would but little affect its strength, when fired in large quantities, produce great difference in the proof range; and variations in the size of the grain cause still greater irregularities in the range, the powder being in other respects the same. In general, gunpowder of *small grain* and *low specific gravity* gives the highest range in the eprouvette, whilst recent experiments with the ballistic pendulum have shown that the greatest initial velocity, in a shot from a heavy gun, is produced by powder of *great specific gravity* and of *coarse grain*.

Pendulum eprouvette. The best mode of testing the projectile force of gunpowder is undoubtedly that of ascertaining its effects when used in the same quantities in which it is to be employed in service. This method has been partially adopted by establishing, at Washington Arsenal, a cannon pendulum and a musket pendulum, which are used for proving samples of powder sent from the manufactories. The apparatus shows the initial velocity of a ball fired from a cannon or a musket.

## FLINTS.

The best flints are translucent, with a smooth surface, of a uniform tint of light yellow or brown color, and slightly conchoidal fracture. They are generally obtained from England or France.

The parts of a flint are: the *edge* or *bevel*, the *back*, the *sides*, the *face*, slightly convex, and the *bed* or lower face, slightly concave; in using the flint, the bevel is placed uppermost. There are three sizes for military service; *musket*, *rifle*, and *pistol*, flints. A good musket flint will last for more than 50 fires. Flints are issued to the troops in the proportion of 1 flint to 20 rounds.

| DIMENSIONS. | MUSKET. | | RIFLE. | | PISTOL. | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Min. | Max. | Min. | Max. |
| | In. | In. | In. | In. | In. | In. |
| Whole length | 1.20 | 1.50 | 0.97 | 1.20 | 0.93 | 1.10 |
| Width | 1.08 | 1.13 | 0.79 | 0.88 | 0.83 | 0.92 |
| Thickness at the back | 0.26 | 0.33 | 0.20 | 0.29 | 0.21 | 0.27 |
| Length of the bevel | 0.39 | 0.55 | 0.41 | 0.71 | 0.30 | 0.42 |

The rifle and the musketoon take the same flint. In the inspection of flints, first verify their dimensions with a gauge, giving the maximum and minimum dimensions; see that the bevel is free from spots and irregularities of surface, that the face and bed are nearly parallel, and have not too great a curvature.

### *Packing Flints.*

Flints are usually packed, for sale, in large casks, or in barrels about the size of powder barrels; the latter will hold about 7,500 musket, 13,700 rifle, and 14,700 pistol flints.

In service, they are packed in boxes of the following dimensions:

| KIND OF FLINTS. | Interior dimensions of the box. | | | | Flints in each box. | | Total weight of box packed. |
|---|---|---|---|---|---|---|---|
| | Length. | Width. | Depth. | Cubic contents. | Number. | Weight. | |
| | In. | In. | In. | In. | | Lbs. | Lbs. |
| Musket | 24 | 11.5 | 8.75 | 2,415 | 5,000 | 111 | 129 |
| Rifle | 24 | 11.5 | 4.75 | 1,311 | 5,000 | 66 | 82 |
| Pistol | 24 | 11.5 | 3.25 | 897 | 5,000 | 42 | 55 |

The weights vary according to the kind of flint, the black and inferior kind being the heaviest.

The boxes should be made of pine boards 1 inch thick, planed on both sides, and dovetailed at the corners. The length and width of all flint boxes are the same; the depth only is varied to give the required capacity to boxes for different descriptions of flints. If any parcel of one denomination shall be found larger or smaller than usual, the depth of the boxes should be increased or diminished so as to contain them conveniently. A rope handle (or becket) is to be inserted in each end of the box. In boxing a large parcel, it will not be necessary that the contents of each box should be actually counted, if the flints are nearly uniform in size; after counting out accurately four or five parcels, of 5,000 each, from any cask, let each be separately weighed, and take the mean weight of the counted parcels as the basis for determining the quantity for each box, when taken from the same cask. After the flints are placed in the boxes, all the interstices are to be filled with dry sand, in order to exclude the air from them as much as possible; and for the same purpose, the boxes should be well made, of seasoned wood, and with close joints. Each box should be plainly marked on the end with the number and description of flints contained in it, and with the year in which they were manufactured, if this be known; if not known, then with the year in which they were procured.

Flints should not be placed in the upper stories of a building, but in the basement or cellar where the air is damp and cool.

## CARTRIDGES FOR SMALL ARMS.

| KIND. | | BALLS. | | CHARGES OF POWDER. | | | | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| | | Diameter. | Number in 1 pound. | Weight. | Number in 1 pound. | Ratio to wgt. of ball. | Blank cartridges. | |
| | | In. | | Grains | | | Grains | |
| Percussion. | Musket | 0.65 | 17 | 110 | 64 | 1-4th | 75 | Musket powder. |
| | Musketoon | 0.65 | 17 | 75 | 93 | 1-5th | 75 | |
| | Hall's carbine | 0.525 | 32 | 75 | 93 | 1-3d | 60 | Rifle powder. |
| | Rifle | 0.525 | 32 | 75 | 93 | 1-3d | 60 | |
| | Pistol | 0.525 | 32 | 30 | 233 | 1-7th | 30 | |

*Buckshot* are 0.31 in. in diameter; weight, about 150 or 155 to 1 lb.

Cartridges are made either with *single ball*, 1 *ball and* 3 *buckshot*, or sometimes with 12 *buckshot*, and they are designated accordingly.

## *Making Balls.*

To CAST BALLS. 6 men required to each kettle; 2 to cast the balls, 1 to extract and roll, and 3 to trim them.

TOOLS AND UTENSILS. 1 *iron kettle*, fixed in a furnace as before described—2 *iron ladles*, 0.10 in. thick, 3.5 in. diameter, with a lip on the left side and a handle 18 in. long a little bent—1 *bench*, of 4 in. plank—6 *moulds*, (brass,) with double rows for 6 or 8 balls on each side, or for 8 balls and 15 buckshot; placed on the bench—1 *mallet*—1 *double ball-gauge;* the diameter of one ring is 0.002 in. greater than, that of the other 0.0015 less than, the true calibre of the ball—3 *nippers;* one arm is bent and fixed in the bench, the other is about 5 in. longer and has a wooden handle; the jaws are of steel, two inches wide, tempered and ground sharp; they may be so formed as to cut the gate according to the spherical surface of the ball. Under the jaws of the nippers is a hole in the bench, through which the balls fall into *boxes* placed to receive them—1 *rolling barrel*, 2 feet long and 1 foot diameter, made of hard thick staves, with but little bilge, and hooped with iron; it has a small scuttle in the bilge, with hinges and a hasp and staple; the barrel has a gudgeon in each head, and is turned by a crank in a frame to which a hopper may be attached. Instead of the rolling barrel, 2 strong *canvas bags* may be used; they should be 5 feet long and 16 in. in diameter, suspended horizontally by 4 cords attached to the joists of the building—1 *screen*, (sheet iron,) the holes of which are of the diameter of the largest calibre gauge; it is supported by gudgeons which turn in a frame, or in the tops of two stakes driven in the ground.

CASTING. Weigh the lead; fill the kettle and cover it; as the lead melts add more, until it comes within 3 inches of the edges of the kettle; then cover it with a layer of powdered charcoal 1 in. thick; push the heat until paper in contact with the lead is inflamed by it; this requires from 1 to 2 hours.

Immerse the ladle and fill it about $\frac{3}{4}$ full of lead covered with charcoal, which is kept back by a piece of wood, in running the lead; fill all the moulds on one side, then turn them and fill the other side; the first castings are thrown back into the kettle, being imperfect from the moulds being cold; the diameter of some of the balls is verified from time to time, with the gauges; the moulds must be carefully cleaned when it is perceived that the lead sticks to them, and if any moulds give imperfect balls, they must be filled with copper.

Extract the balls and trim them; in cutting, the ball should be gently pressed with the left fore-finger against the nippers, the gate being placed between the jaws.

To smooth the balls. Put 100 lbs. of them into the rolling barrel, and roll them for 3 minutes; or 50 lbs. into a bag and shake it five minutes; then run them through the screen, putting in 50 lbs. at a time; those which remain on the screen are re-cast.

With the above force 30,000 to 35,000 musket balls are made in 11 or 12 hours.

With proper care in observing the instructions, 100 lbs. of lead will give from 96 to 98 lbs. of balls.

Pressed balls. Lead balls are now generally made by compression, by means of machinery; either at the arsenals or at private establishments. These balls are more uniform in size, smoother and more solid than the cast balls. *Compressed buckshot* are also readily obtained from private shot works.

Packing. Balls are packed in boxes made of 1 in. boards, 9 in. square inside and 5 in. deep, containing 100 lbs. of balls or buckshot; they should be marked on one end with the weight and kind of balls, the place and date of fabrication; the top is fastened with six 2-inch screws, and the boxes must be hooped with iron for transportation.

## *Making Cartridges.*

| DIMENSIONS OF PAPER FOR CARTRIDGES. | | SHEETS. | | TRAPEZOIDS. | | | |
|---|---|---|---|---|---|---|---|
| | | Length. | Breadth. | Height. | Long side. | Short side. | Number in one sheet. |
| | | In | In. | In. | In. | In. | |
| Musket. | Single ball, or ball and buckshot | 16.5 | 13 | 4.33 | 5.25 | 3 | 12 |
| | Blank | 20 | 15 | 4 | 4.75 | 2.75 | 20 |
| | 12 buckshot | 16.5 | 13 | 5.5 | 5 | 3 | 9 |
| Rifle... | Ball | 16.5 | 13 | 4 | 4.25 | 2.25 | 16 |
| | Blank | 20 | 15 | 3 | 4.25 | 2.25 | 30 |
| Pistol.. | Ball | 16.5 | 13 | 2.75 | 4.25 | 2.25 | 24 |
| | Blank | 20 | 15 | 2.5 | 4.25 | 2.25 | 36 |

To cut the paper. 1 Cutter, 1 assistant.

*Implements.* 1 *Cutting board*, 30 in. square—1 *pattern*, of hard wood or iron, of the dimensions of each of the papers—1 *rule*, of hard wood, 33 in. long,

1.5 in. wide, and 0.5 in. thick, to cut by—2 *laboratory* (shoe) *knives*—2 *sand stones*, for sharpening knives on.

The paper is first cut into strips of a width equal to the length of a trapezoid, and then into trapezoids, by means of the patterns; cut about 12 sheets at a time. A cutting machine, like that used by bookbinders, facilitates the operation, when many hands are employed.

To MAKE THE CYLINDERS. 1 Master; 10 men to roll the cylinders; 1 to fill them, 4 to fold, 4 to bundle. Boys or girls from 12 to 18 years of age may be advantageously employed.

*Implements and utensils*, for each workman for making cylinders: 2 *boxes* for the empty cylinders, made of ½ in. boards; interior dimensions, 20 in. long, 8 in. wide, and 5 in. high, without a cover; they are placed upon the sides, facing the front of the cartridge table which is furnished with brackets to receive them, and also with a small enclosure or *locker* for balls, at the right hand of each workman—1 *spool of thread*, turning on a vertical iron spindle fixed in the table near the shot locker, 1 lb. of thread is required for 10,000 single ball musket cartridges, being 8½ inches to a cartridge— 1 *choking string*, made by twisting together 4 or 5 cartridge threads; fastened to the edge of the table, at the right hand of the workman—1 *pair of scissors*, to cut the thread—1 *former*, cylindrical, of hard wood, of the same diameter as the ball; one end convex, the other concave, to receive one-third of the ball; length 6 or 7 inches.

Take the paper in the left hand, the former in the right; lay the paper on the table, with the side perpendicular to the bases towards the workman, the broad end to the left; place the former with its convex end at the broad end of the paper; turn it so as to envelop it with the paper, then with the right hand laid flat upon the paper, roll all the paper upon the former; seize it with the left hand, and with the choking string in the right hand, take one turn around the cylinder at about half an inch from the end, to which distance the end of the former is withdrawn; hold the former firmly in the left hand, and draw gently upon the choking string, pressing at the same time, with the left fore-finger, upon the projecting end of the cylinder, thus folding it neatly down upon the end of the former. Having choked the cylinder, carry it to the right side, and with the twine in the right hand, take two turns and a half hitch firmly around the part that has been choked; withdraw the former and introduce the ball, following it to the end of the cylinder with the former reversed; raise the whole again, and with the same thread, (which is never cut until the cartridge is finished,) take two half hitches just upon the upper side of the ball, between it and the concave end of the former. The operation is expedited by rolling the ball placed in the

concave end of the former and choking the paper over it. Cut the thread and place the cartridge in the box which stands fronting the workman.

*For ball and buckshot cartridges.* Roll and choke the paper, put in 3 buckshot, follow them with the former, and take a half hitch of thread over them; then insert the ball as before.

*Buckshot cartridges* have 4 tiers of 3 buckshot each, inserted like the first, with a half hitch between them, and finishing with a double hitch.

*For rifles*, the ball is prepared by being enveloped in a square piece of fine *muslin*, or of soft thin *leather*, or of *bladder*, tied over it and leaving a projecting end about $\frac{1}{2}$ in. long, which, after being trimmed with scissors, is introduced into the paper cylinder which is choked over it and fastened by two turns and a double hitch.

1,000 patches require about 4 yards of muslin.

*Cylinders for blank cartridges* are made by folding down the paper over the concave end of the charger, touching the fold with a little paste, and pressing it on a ball imbedded in the table for that purpose.

To FILL THE CYLINDERS. 1 Man to fill, 4 to fold, 4 to bundle.

*Implements and utensils.* 1 Large *copper pan* for powder.

1 *Charger* for each kind of cartridge, made of thin copper, with a handle at the top. The chargers are conical:

| Dimensions of chargers. | 110 grs. | 75 grs. | 30 grs. |
|---|---|---|---|
| | In. | In. | In. |
| Diameter { top | 0.8 | 0.7 | 0.5 |
| Diameter { bottom | 0.6 | 0.5 | 0.4 |
| Height | 1.35 | 1.25 | 0.85 |

1 *Funnel*, copper, of the following interior dimensions:

| | In. |
|---|---|
| Diameter of funnel, { superior | 1.75 |
| Diameter of funnel, { inferior | 0.5 |
| Diameter of pipe | 0.5 |
| Height of funnel | 1. |
| Length of pipe | 1.25 |

The funnel has a ring handle 0.6 in. diameter.

A charger, for filling cartridges much more expeditiously, is made by attaching to a large brass funnel two charging cylinders which communicate with one

discharging pipe at the lower end. These cylinders are alternately filled and emptied by a reciprocating motion of the funnel pipe.

1 *Folding box* for each calibre, made with only two sides; width equal to 5 times the diameter of the ball, height equal to twice that diameter. Two strips of wood nailed on the table will answer the same purpose more conveniently.

Take the boxes full of cartridge cylinders to the table in the filling room; as they are filled, incline the cylinders over from the empty ones; when all in one box are full, fold the paper down over the powder by two rectangular folds, and place the cartridges before the men who are to bundle them.

BUNDLING. Put a wrapper in the folding box and place in it 2 tiers of 5 cartridges each, parallel to each other and to the short sides of the wrapper, the balls alternating; wrap the cartridges, whilst in the folding box, by folding the paper over them; tie them, first in the direction of the length, then of the breadth, with a bit of twine fastened in a single flat knot.

A package of 12 *percussion caps* is placed in each bundle of 10 cartridges, at the end of the bundle.

The case for the caps is made like a cylinder for a rifle cartridge; it is choked at one end and tied; when the caps are inserted it is folded like a cartridge.

*Dimensions of bundles of Percussion Cartridges.*

| KIND OF CARTRIDGE. | | Length, (height of cartridge.) | Breadth. | Thickness. |
|---|---|---|---|---|
| | | In. | In. | In. |
| Musket | Ball | 2.6 | 3.1 | 1.35 |
| | Buck and ball | 2.90 | 3.1 | 1.35 |
| | Buck shot | 3.1 | 3.1 | 1.35 |
| | Blank | 1.83 | 3.1 | 1.35 |
| Musketoon | Ball | 2.5 | 3.1 | 1.35 |
| | Buck and ball | 2.18 | 3.1 | 1.35 |
| | Buck shot | 2.43 | 3.1 | 1.35 |
| | Blank | 1.39 | 3.1 | 1.35 |
| Rifle | Ball | 3. | 2.6 | 1.15 |
| | Blank | 1.9 | 2.6 | 1.15 |
| Hall's Carbine | Ball | 2.1 | 2.6 | 1.15 |
| | Blank | 1.58 | 2.6 | 1.15 |
| Pistol | Ball | 2. | 2.6 | 1.15 |
| | Blank | 1.12 | 2.6 | 1.15 |

Wrapping paper is but slightly sized, with a view to its being immersed, before using it, in a varnish made of bees-wax, linseed oil and spirits turpentine, for the purpose of making the paper water proof.—See CHAPTER VII.

1000 lbs. of paper require :

Bees-wax.....133 lbs.,
Spirits of turpentine.....135 gallons,
Linseed oil.....10 gallons.

With the above mentioned force, 10,000 musket cartridges are made and bundled in 10 hours, being 1000 for each maker of cylinders.

## *Packing Cartridges.*

Ball cartridges are packed in boxes to contain 1000 each. Blank cartridges may be packed in powder barrels.

### *Interior dimensions of packing boxes for* 1000 *Percussion Cartridges.*

| KIND. | Depth. | Length. | Width. | WEIGHT. | |
|---|---|---|---|---|---|
| | | | | Empty. | Packed. |
| | In. | In. | In. | Lbs. | |
| Musket, buck and ball.... .. | 6.75 | 15.5 | 11.75 | 12. | 107 |
| Musketoon, ball..... | 6.75 | 15.5 | 9. | 11.5 | 100 |
| Rifle, ball..... | 5.75 | 13. | 11.75 | 11. | 60 |
| Hall's Carbine..... | 5.75 | 13. | 11. | 9. | 55 |
| Pistol, ball..... | 5.75 | 13. | 8. | 7. | 45 |

The boxes are made of 1 in. white pine boards, and are furnished with wooden brackets or handles nailed to the ends ; the lids fastened with four $1\frac{3}{4}$ in. screws. They are painted olive color. The kegs or boxes should be lined with strong water proof paper, and the bundles of cartridges must be closely packed, so as not to shake in transportation. Each keg or box should be marked, on both ends, with the number and kind of cartridges ; on the inside of the cover, with the place and date of fabrication.

## AMMUNITION FOR FIELD SERVICE.—*Plate* 17.

The charges of powder are contained in *cartridge bags.*

The projectile is attached to a block of wood called a *sabot.*

*For the guns and the* 12-*pounder howitzer*, the cartridge and the projectile are attached to the same sabot, making together *a round of fixed ammunition.*

For 32 *and* 24-*pounder howitzers*, the projectile is separate from the charge, and the cartridge is attached to a block of wood, called a *cartridge block.*

### *Charges of Powder.*

| KIND. | FOR GUNS. | | FOR HOWITZERS. | | |
|---|---|---|---|---|---|
| | 12-pdr. | 6-pdr. | 32-pdr. | 24-pdr. | 12-pdr. |
| | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| For shot | 2.5 | 1.25 | – | – | – |
| For spherical case or canister | 2. | 1. | 2.5 | 2. | 1. |
| For shells. Small charge | – | – | 2.5 | 2. | 1. |
| For shells. Large charge | – | – | 3.25 | 2.5 | |

### *Cartridge Bags.*

The best materials for cartridge bags are wildbore, merino, and bombazette. The stuff should be composed entirely of wool, free from any mixture of thread or cotton, and of sufficiently close texture to prevent the powder from sifting through; that which is not twilled is to be preferred. Flannel is used when the other materials cannot be conveniently obtained.

MAKING CARTRIDGE BAGS. A cartridge bag for field service is made of a rectangle which forms the cylinder, and a circular piece which forms the bottom.

| DIMENSIONS. | 12-pdr. gun; 32 & 24-pdr. howitzers. | 6-pdr. gun, and 12-pdr. howitzer. | REMARKS. |
|---|---|---|---|
| | In. | In. | |
| Length of rectangle (cylinder developed) | 14.2 | 11.4 | 1 in. allowed for seam. |
| Height | 10. | 7.25 | 0.5 in. do. |
| Diameter of bottom | 5.25 | 4.37 | 1 in. do. |

The length of the rectangle (development of the cylinder) should be taken in the direction of the length of the stuff, as it does not stretch in that direction.

One hundred 12-pounder cartridge bags require about 27 yards of stuff of single width, (22 inches.)

One hundred 6-pounder bags take about 15 yards.

IMPLEMENTS. *Tables—patterns*, of hard, well seasoned wood, or of sheet iron or tin for the rectangles and bottoms—*scissors*—*chalk*, or *colored crayons*.

A marker and his assistant spread a piece of stuff on a table, and with the patterns trace out the rectangles and bottoms; a cutter follows and cuts them out with scissors.

*Sewing.* The bags are sewed with woollen yarn, with 12 stitches to an inch; they are stitched within half an inch of each edge, and the two edges of the seam are turned down on the same side and basted, to prevent the powder from sifting through; the edges of the bottom are basted down upon the sides. Bags for fixed ammunition are sewed to within 3 in. of the mouth, for 12-pdrs.; to within 2.75 in., for 6-pdrs.; all others, up to the mouth.

Cartridge bags when filled should pass through the small shot gauge of their calibre; those used for patterns should be thus verified. The empty bags should be measured by laying the bag, flattened out, between two marks on a table, showing the width of the pattern bag; a variation of 0.1 in. greater or less is allowed. Reject those sewed with too large stitches.

Bags for immediate use, or for blank cartridges, may be formed by sewing together two rectangular pieces with semicircular ends; the stuff is marked, for cutting and sewing, with stamps of the following dimensions:

| CALIBRES.... | | | 12-pdr. | 6-pdr. |
|---|---|---|---|---|
| | | | In. | In. |
| Stamps, for cutting, | Width | | 7.6 | 6. |
| | Length, including semicircular ends. | | 10.5 | 8.5 |
| for sewing, | Width | | 6.6 | 5.2 |
| | Length, including semicircular ends. | | 10. | 8. |

These stamps are made of 1 in. boards of the dimensions of the cutting stamp, with a handle in the middle of one side; to the edges of the board is fastened a strip of tin or copper projecting about $\frac{1}{4}$ in. on the side opposite to the handle; another strip is inserted in like manner in a groove parallel to the edges of the board, at the distance indicated for the sewing stamp; the edges of these strips are made rough, to retain the chalk or paste used for marking.

PACKING. Cartridge bags are preserved from moths by being packed with pounded camphor and black pepper, or dipped in water with arsenic dissolved in it. Or, they may be sealed up, in bundles of 50, in cases made of cartridge paper, carefully closed with strips of thin paper pasted over the seams. Each bundle is marked with the number and kind of bags.

They may be preserved from moisture by being enveloped in water proof paper, as above recommended for cartridges for small arms.

## *Cartridge Blocks.*—Plate 17.

Cartridge blocks are cylinders of wood to which the cartridges of howitzers are attached, to give them a better finish, and to increase the length of the smaller charges, so that they may fill the chamber of the piece, and may be less apt to turn in the bore.

They are made of *poplar*, *linden*, or other soft wood.

| DIMENSIONS. | 32-PDR. HOWITZER. | | 24-PDR. HOWITZER. | |
|---|---|---|---|---|
| | Small charge. | Large charge. | Small charge. | Large charge. |
| | In. | In. | In. | In. |
| Diameter | 4.15 | 4.15 | 4.15 | 4.15 |
| Height | 2. | 0.75 | 1. | 0.5 |
| Distance from middle of groove to bottom of block | 0.4 | 0.375 | 0.4 | 0.25 |
| Width of groove | 0.3 | 0.3 | 0.3 | 0.3 |
| Depth of groove | 0.15 | 0.15 | 0.15 | 0.15 |

## *Sabots*—Plate 17.

Sabots are made of *poplar*, *linden*, or other light, close grained wood; the stuff should be clear of knots and splits, and it must be well seasoned.

Sabots for shot and spherical case, for guns, have *one groove* for attaching the cartridge—those for gun canisters, and for the 12-pdr. howitzer shells, spherical case and canisters, have *two grooves*. These grooves are .3 in. wide and .15 in. deep. The corners of the grooves and bottom are slightly rounded.

Sabots for the 32 and 24-pdr. howitzers have no grooves; they are furnished with *handles*, made of cord about .15 in. thick, passing through two holes in the sabots, .25 in. diameter, and fastened by knots countersunk on the inside.

The dimensions of finished sabots are verified with appropriate gauges.

| DIMENSIONS OF SABOTS. | 12-PDR. GUN. | | 6-PDR. GUN. | | 32-PDR. HOWTZR. | | 24-PDR. HOWTZR. | | 12-PDR. HOWTZR. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Shot and sph. case. | Canister. | Shot and sph. case. | Canister. | Shells and sph. case. | Canister. | Shells and sph. case | Canister. | Shells and sph. case. | Canister. |
| | In. | In. | In. | In | In. | In. | In. | In. | In. | In. |
| Whole height | 2. | 2.25 | 1.55 | 2.25 | 2.4 | 4.75 | 2.4 | 4.45 | 3.2 | 4.45 |
| Greatest diameter | 4.35 | 4.52 | 3.35 | 3.58 | 5.6 | 6.24 | 5.3 | 5.68 | 4.27 | 4.52 |
| Diameter of bottom of conical part | - | - | - | - | 4.5 | 4.5 | 4.6 | 4.6 | 3.6 | 3.6 |
| Height of conical part | - | - | | - | 2.4 | 4. | 2.4 | 3.75 | 2. | 2.75 |
| Diameter at bottom of sabot | 4.15 | 4.15 | 3.2 | 3.2 | 4.5 | 4.5 | 4.6 | 4.6 | 3.2 | 3.2 |
| Cavity for ball. Depth | 1.5 | - | 1. | - | 1.5 | - | 1.5 | - | 1.3 | |
| Cavity for ball. Radius of curvature | 2.26 | - | 1.8 | - | 3.12 | - | 2.84 | - | 2.26 | |
| Height of cylinder for tin | - | 0.5 | - | 0.5 | - | 0.75 | - | 0.7 | - | 0.5 |
| Diameter of do. | | 4.47 | - | 3.53 | - | 6.19 | - | 5.63 | - | 4.47 |
| Distance from middle of lower groove to bottom of sabot | 0.4 | 0.4 | 0.4 | 0.4 | - | - | - | - | 0.4 | 0.4 |
| Distance between centres of grooves | - | 0.8 | - | 0.8 | - | - | - | - | 0.5 | 0.5 |
| Distance between holes for handles | - | - | - | - | 1.5 | 2.3 | 1.5 | 2.3 | | |
| Length of cord for handle | - | - | - | - | 12. | 20. | 12. | 19. | | |

## *Straps.*

*Straps* are made of sheet tin; they are cut with shears and straightened with a wooden mallet, upon a block of lead.

*For shot*, there are two straps crossing at right angles, one passing through a slit in the middle of the other. *For shells*, there are four straps soldered to a *ring* of tin, or fastened to it by cutting 4 slits in the ring, into which the upper ends of the strap are hooked and turned down on the inside of the ring.

| DIMENSIONS. | FOR SHOT. | | FOR SHELLS AND SPH. CASE. | | | |
|---|---|---|---|---|---|---|
| | 12-pdr. | 6-pdr. | 32-pdr. | 24-pdr. | 12-pdr. | 6-pdr. |
| | In. | In. | In. | In. | In. | In. |
| STRAPS.. Width | 0.45 | 0.35 | 0.6 | 0.55 | 0.45 | 0.35 |
| STRAPS.. Length | 12.75 | 10. | 10.5 | 9.00 | 7.50 | 5.5 |
| RINGS... Exterior diam. | ..... | ..... | 2.3 | 2.3 | 2.3 | 2.3 |
| RINGS... Interior do. | ..... | ..... | 1.2 | 1.15 | 1.15 | 1.15 |

## *Strapping Shot and Shells.*

UTENSILS AND IMPLEMENTS. 1 *bench*—2 *pans*, containing *nails* 0.55 in. long, with strong flat heads 0.2 in. diameter—*boxes* and *barrels*, for straps and sabots—4 *hammers*, for strapping—1 *common hammer*—4 *punches*—*shot gauges*, of each calibre—1 *gauge* for each calibre, 0.04 in. greater than the largest shot

gauge, through which the shot should pass after it is strapped—*tow* or *rags*, for wiping balls—1 *wheelbarrow*—1 *tarpaulin*, if the shop has not a plank floor.

A helper knocks off the scales from the balls with a hammer, cleans and dries the interior of the shells, if requisite, wipes the balls, and gauges them both before and after they are strapped. The workman inserts the roughest part of the shot in the cavity of the sabot, and strikes a few blows on the bottom of the sabot to make the shot enter; he can tell by the sound if the shot touches the bottom of the cavity; if it does not touch, he tries another sabot. With the edge of the hammer he bends one end of the strap which is not slit into the groove of the sabot, punches and nails it; he fastens the other end in the same manner, cutting off the superfluous length; he then nails the other strap, and with his hammer sets them both in, close to the ball, at the top of the sabot.

The sabots for 32 and 24-pounder field howitzers having no groove, each strap is fastened by one nail on the side and 2 under the bottom of the sabot. Two men can strap, in 10 hours, 130 shot, or 75 shells, cutting the tin from the sheet.

If tin or sheet iron cannot be procured, straps may be made of *strong canvas*, 1 inch wide, sewed at the point of crossing. The part of the ball which is to be inserted in the sabot is dipped in glue; the straps are also glued to the ball; the ends are doubled into the groove and secured by two nails in each end. Another method is to wrap round the ball a band of canvass 1 inch wide, one half of which is glued to the ball, the other to the sabot; or, the shot may be kept in place by merely tying the cartridge bag over the top of it.

## *Fuze Plugs.*—Plate 17.

The fuzes for field shells and spherical case are inserted, at the moment of loading the gun, into wooden *fuze plugs*, previously driven into the shells.

These plugs are made of *beech*, perfectly seasoned and dried, so that they may not shrink after they are driven.

| DIMENSIONS. | | For 32-pdr. spherical case. | For other shells and spherical case. | REMARKS. |
|---|---|---|---|---|
| | | In. | In. | |
| Exterior diameter, | at top..... | 1.25 | 0.95 | Exterior taper .15 in. to 1 in. |
| | at bottom.. | 1.025 | 0.75 | |
| Interior diameter. | at top..... | 0.50 | 0.50 | Interior taper .05 in. to 1 in. |
| | at bottom.. | 0.425 | 0.4325 | |
| Height..... | | 1.5 | 1.35 | |

*Charging Shells.*

| CHARGES. | | 32-pdr. | 24-pdr. | 12-pdr. | REMARKS. |
|---|---|---|---|---|---|
| | | Lbs. oz. | Lbs. oz. | Lbs. oz. | |
| Powder required | to fill the shell..... | 1 5 | 1 | 0 8 | Rifle or musket powder is used in preference to cannon powder |
| | to burst the shell..... | 0 11 | 0 8 | 0 5 | |
| | to blow out the fuze plug | 0 2 | 0 2 | 0 1 | |
| | for service charge..... | 1 | 0 12 | 0 7 | |

MATERIALS. *Rifle or musket powder—Fuze plugs.*

IMPLEMENTS. 1 *Funnel—Powder measures*, to hold the required charges—1 *small mallet*—1 *Fuze plug reamer.*

The shells having been properly cleaned and dried, and attached to the sabots, pour in the charge of powder; drive in the fuze plug with the mallet, until the top of it is within .1 in. of the surface of the shell; be careful that the plug is not split in driving. Ream out the fuze hole in the plug, with a careful steady hand; if the hole is properly reamed, the fuze will project about .15, when pressed in with the thumb. Stop up the hole in the fuze plug, by inserting a wad of dry tow, which should be pressed in firmly with a round stick.

*Spherical Case Shot.*

| CHARGE. | 8-in. | 42 | 32 | 24 | 18 | 12 | 6 |
|---|---|---|---|---|---|---|---|
| Number of musket balls..... | 486 | 306 | 225 | 175 | 120 | 78 | 38 |
| Bursting charge of powder, oz. | 15 | 9 | 8 | 6 | 5 | 4.5 | 2.5 |
| Weight of shot loaded.....lbs. | 59.5 | 39 | 30.13 | 22.75 | 16.3 | 11. | 5.5 |

The shot having been cleaned and strapped to the sabot, put in the balls. In order to get in the whole number of balls, it is sometimes necessary, when the shell is nearly full, to push the upper balls aside, with the finger, or with a stick. Pour in the charge of powder, shaking it down among the balls. Insert the fuze plug, ream out the hole and stop it with tow, in the same manner as for common shells.

## *Canisters.*—Plate 17.

*A canister for field service* consists of a tin cylinder attached to a sabot and filled with cast iron shot. For the dimensions of *Canister Shot*, see CHAP. II.

*To form the cylinder*, the tin is lapped, from .3 to .5 in. and soldered. The cylinder is fastened to the sabot with 6 or 8 nails .5 in. to .75 in. long. A

plate of rolled iron is placed on the sabot, and the canister is closed with a sheet iron cover; the top of the cylinder is cut into strips .4 in. to .5 in. long, and turned down over the cover.

The tin is .02 in. to .025 in. thick. (Double tin.)

| DIMENSIONS OF CANISTERS. | FOR GUNS. | | FOR HOWITZERS. | | |
|---|---|---|---|---|---|
| | 12 | 6 | 32 | 24 | 12 |
| | In. | In. | In. | In. | In. |
| Length of tin for cylinder, (developed).. | 14.40 | 11.5 | 20. | 18.3 | 14.4 |
| Height of ditto..... | 6.65 | 5.4 | 7.1 | 6.3 | 5.2 |
| Interior diameter of cylinder..... | 4.45 | 3.53 | 6.19 | 5.63 | 4.45 |
| Diameter of plates for bottom and cover | 4.40 | 3.48 | 6.14 | 5.58 | 4.40 |
| Thickness of bottom plate..... | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Thickness of sheet iron cover..... | 0.07 | 0.07 | 0.10 | 0.10 | 0.07 |
| Height of finished canister, includ'g sabot | 8. | 6.75 | 10.5 | 9.55 | 8.75 |
| Number of tiers of shot..... | 4 | 4 | 4 | 4 | 4 |
| Number of shot in each of 3 lower tiers. | 7 | 7 | 12 | 12 | 12 |
| Number of shot in 4th tier..... | 6 | 6 | 12 | 12 | 12 |
| Whole number of shot..... | 27 | 27 | 48 | 48 | 48 |
| | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| Weight of finished canister..... | 14.8 | 7.32 | 28.5 | 21.25 | 10.8 |

A variation of 0.05 in. more or less, is allowed in the diameter of the iron bottom.

The exterior diameter of each canister must be verified with the maximum shot gauge of the calibre, and the interior, with a cylinder of a diameter 0.02 in. less than that given in the table, which should enter the canister, otherwise it is rejected.

Before filling the canister, dip the tin cylinder into a lacker of bees-wax dissolved in spirits of turpentine, to prevent it from rusting. Coat the balls and the plates with paint or coal tar.

FILLING CANISTERS. Place the canister upright on a bench; insert the iron bottom and place it flat on the sabot; put in a tier of balls, fill the interstices with dry sifted saw dust, pack it with a pointed stick so that the balls will hold by themselves, and throw out the loose saw dust; place another tier of balls and proceed in the same manner until the canister is filled; cover the upper tier with saw dust; put on the cover and on it place one of the iron bottoms furnished with a handle, and strike it with a small mallet in order to compress the saw dust; then remove this bottom and turn down the slit pieces of the canister over the cover, with a hammer. When the canister is finished, verify its diameter with the maximum shot gauge of the same calibre.

## *Cylinders and Caps.*

For the greater security of field ammunition, the cartridges are covered with paper cylinders and caps. The cap is drawn off at the moment of loading the piece, and in using solid shot it may be placed over the shot, to diminish the windage. A cylinder and a cap are formed together by folding the paper over a *former*, which allows a lap of about 0.75 inch for pasting. The requisite length for the cylinder is cut off from the smaller end; the rest forms the cap, which is *choked* at the end from which the cylinder is cut.

| DIMENSIONS. | | FOR GUNS. | | FOR HOWITZERS. | | |
|---|---|---|---|---|---|---|
| | | 12 | 6 | 32 | 24 | 12 |
| | | In. | In. | In. | In. | In. |
| Paper for a cylinder and a cap. | Length, developed | 14.4 | 11.6 | 14.4 | 14.4 | 11.6 |
| | Height | 12.5 | 11.5 | 12. | 10. | 8. |
| Height of cylinder | For large charge | 5. | 4. | 5.25 | 3.5 | |
| | For small charge | 4. | 3.5 | 5. | 3. | 3. |
| Formers for cylinders and caps. | Length (exclusive of handle) | 15. | 13. | Same as 12-pdr. gun | | Same as 6-pdr. gun |
| | Width at upper end | 6.71 | 5.25 | | | |
| | Width at lower end | 6.6 | 5.17 | | | |
| | Thickness | 0.15 | 0.15 | | | |
| Cylindrical formers for choking caps. | Length | 10. | 10. | | | |
| | Diameter | 4.3 | 3.3 | | | |

The choking former should be bored through the axis with a $\frac{1}{2}$ inch hole, to facilitate drawing off the cap; one end is rounded.

## *Fixing Ammunition.*

IMPLEMENTS AND UTENSILS: *Barrels* for powder—1 *funnel*—1 *set of powder measures*—1 *straight edge*, to strike the measures with—*barrels*—*tubs*, formed of barrels sawed in two, or *boxes* for the cartridge bags—2 *tarpaulins*—2 *benches*—12 *choking sticks*, 6 with holes in them and 6 slit—6 *knives*—6 *handbarrows*, with four legs and a box, and *tarpaulins* to cover them—*calibre gauges*, for the cartridge bags and for fixed ammunition; they may be made of wood—6 *stools*—1 *wheelbarrow*—1 *mallet*—1 *copper chisel*—1 *copper drift*, or a *wrench*, to open powder barrels.

For dimensions of powder measures, see *page* 235.

*Fixing shot, or spherical case, for field guns.* The bags should be filled in the small magazine or filling room, and carried, after being shaken and gauged,

to the finishing room. One of the gaugers takes a filled bag with one hand, squeezing the bag upon the powder; he strikes with the other hand on the top and bottom of the bag, twisting the mouth of the bag down upon the powder at the same time; he then tries it with the small gauge, through which it should pass with not more than 0.25 inch play; should it not do this, the bag is emptied and rejected. These bags, filled and gauged, are placed upright in a tub or box, and carried by the gaugers into the finishing room, where the men are placed in pairs, sitting astride on a bench, facing each other. One of them opens a bag and levels the powder, the other inserts the sabot of a strapped shot square upon the powder and draws up the end of the bag over the shot; the first man passes about 4 feet of twine through the pierced stick, and makes two turns and a double hitch with the end at the top of the sabot; he makes a knot in the end of the twine, inserts it into the slit in the other choking stick, and tightens the double hitch by rolling the twine on the sticks and bearing upon the sabot; he then takes out the end of the twine from the slit, ties it in a hard knot, which he tightens with the assistance of the choking stick, and cuts the twine off near the knot. The second man turns down the mouth of the bag over the sabot and the first makes a similar tie in the groove; he makes another tie below the sabot, the twine being lodged between it and the powder, to prevent the latter from sifting in between the bag and the sabot; he then runs the paper cylinder over the cartridge and sabot, leaving about 2 inches of the end of the cartridge uncovered, and he makes a tie, similar to the others, in the groove of the sabot. He now holds the shot in the left hand and examines it, striking the sabot with the right hand, if necessary, to bring it straight; if the shot is properly fixed, the sabot and the bag will be on the same axis; the seams should be between two straps, and the knots should be neither on the seams nor on the straps.

The assistants pass the cartridges through the large gauge, which is 0.04 inch larger than the large gauge for the shot. If the size is correct, they put on the paper cap, lay the cartridges on their sides in the box of the handbarrow, and carry them to the magazine. Those which will not pass through the gauge are handed back to the fixers, who cut the strings and put them up anew.

*Canisters for field guns* are fixed in the same manner as shot, except that the first tie is made in the upper groove of the sabot; the cylinder is tied in the lower groove. The caps must be cut somewhat shorter than those for shot cartridges.

*For the 12-pdr. field howitzer:* The shells, spherical case, and canisters, are fixed in the same manner as the gun canisters.

*For the mountain howitzer:* The sabots having but one groove, the first tie is omitted, and the cartridge is covered with a cap only.

*For the 32-pounder and 24-pounder howitzers:* The cartridge is not attached to the projectile. The cartridge block is inserted with the grooved end next to the powder, and a tie made in the groove; the mouth of the bag is then turned down, and another tie is made between the cartridge block and the powder; the superfluous part of the bag is cut off, and the cartridge is covered with its cylinder and cap, as in other cases.

When the shot is attached to the sabot by a single band of canvas, or when it is placed in the sabot without any strap, the cartridge bag is drawn over it and tied on top; for this purpose, the bag should have an additional length of from $2\frac{1}{2}$ to 3 inches.

When sabots cannot be obtained, place upon the powder a layer of tow about 0.2 in. thick, forming a bed for the shot; tie the bag over the shot and around the tow; the bag requires to be 1 inch longer than for strapped shot.

*Dimensions and weights of Fixed Ammunition.*

| DIMENSIONS. | | FOR GUNS. | | FOR HOWITZERS. | | |
|---|---|---|---|---|---|---|
| | | 12 | 6 | 32 | 24 | 12 |
| | | In. | In. | In. | In. | In. |
| Height of charge of powder; including cartridge blocks for 32 and 24-pdr howitzers | Large charge | 5. | 4. | 7.4 | 5.9 | 3.25 |
| | Small charge | 4. | 3.25 | 7.4 | 5.4 | |
| Height of strapped shot or shell | | 5.02 | 4.13 | 7.14 | 6.58 | 6.42 |
| Height of canister with sabot | | 8. | 6.75 | 10.5 | 9.55 | 8.75 |
| Height of a round of fixed ammunition, with cap. | Shot | 10.4 | 8.43 | | | |
| | Shell | ..... | ..... | ..... | ..... | 10. |
| | Spherical case | 9.5 | 7.8 | ..... | ..... | 10. |
| | Canister | 12.4 | 10.3 | ..... | ..... | 12.3 |
| WEIGHTS. | | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| Cartridge, including cartridge block | Large charge | 2.56 | 1.3 | 3.88 | 2.7 | |
| | Small charge | 2.06 | 1.05 | 3.1 | 2.34 | 1.05 |
| Shot, strapped | | 12.75 | 6.28 | | | |
| Shell, strapped and charged | | ..... | ..... | 24.6 | 18.8 | 9.35 |
| Spherical case, strapped and charged | | 11.43 | 5.75 | 31. | 23. | 11.3 |
| Canister with sabot | | 14.8 | 7.32 | 28.5 | 21.25 | 10.8 |
| Round of ammunition, complete | Shot | 15.4 | 7.6 | | | |
| | Shell, with small ch'ge | ..... | ..... | 27.7 | 21.15 | 10.5 |
| | Spherical case | 13.5 | 6.82 | 34.1 | 25.34 | 12.5 |
| | Canister | 16.91 | 8.4 | 31.6 | 23.6 | 11.85 |

## *Packing Field Ammunition.*

*Packing boxes* for field ammunition are made of well seasoned stuff, (generally white pine,) 1.25 in. thick, dovetailed at the corners. The top of the box is fastened with six 2 in. screws; the box has two handles of 1¾ in. rope, attached to brackets at the ends.

The boxes are painted olive color on the outside, and the kind of ammunition is marked on both ends, in large white letters. The place and date of fabrication are marked on the inside of the cover.

### *Dimensions and Weights of Packing Boxes.*

| KIND OF AMMUNITION. | No. of rounds. | INTERIOR DIMENSIONS. | | | WEIGHT. | |
|---|---|---|---|---|---|---|
| | | Length. | Width. | Depth. | Empty. | Packed. |
| *For Guns.* | | In. | In. | In. | Lbs. | Lbs. |
| 12-PDR. Shot | 8 | 17.5 | 10.5 | 9.5 | 23 | 148 |
| 12-PDR. Spherical case. | 8 | 17.5 | 9.5 | 9.5 | 22 | 132 |
| 12-PDR. Canister | 8 | 18.4 | 12.5 | 9.5 | 24 | 161 |
| 6-PDR. Shot | 14 | 24. | 8.75 | 7.75 | 25 | 133 |
| 6-PDR. Spherical case. | 14 | 24. | 8.25 | 7.75 | 24 | 118 |
| 6-PDR. Canister | 14 | 25.5 | 10.5 | 7.75 | 26 | 146 |
| *For Howitzers.* | | | | | | |
| 32-PDR. Shells | 4 | 12.75 | 12.75 | 12. | 23 | 136 |
| 32-PDR. Spherical case. | 4 | 12.75 | 12.75 | 12. | 23 | 162 |
| 32-PDR. Canister | 4 | 12.75 | 12.75 | 15.5 | 25 | 158 |
| 24-PDR. Shells | 6 | 17.25 | 11.5 | 11.5 | 25 | 155 |
| 24-PDR. Spherical case. | 6 | 17.25 | 11.5 | 11.5 | 25 | 180 |
| 24-PDR. Canister | 6 | 17.25 | 11.5 | 14.75 | 26 | 170 |
| 12-PDR. Shells | 12 | 27.5 | 9.25 | 10.5 | 30 | 160 |
| 12-PDR. Spherical case. | 12 | 27.5 | 9.25 | 10.5 | 30 | 183 |
| 12-PDR. Canister | 12 | 27.5 | 9.25 | 12.5 | 31 | 177 |

The above weights are those of white pine boxes.

*Contents of each packing box for Field Ammunition.*

| KIND OF AMMUNITION. | FOR GUNS. 12-pdr. | FOR GUNS. 6-pdr. |
|---|---|---|
| **SHOT.** | | |
| Shot fixed | 8 | 14 |
| Priming tubes | 5 | 5 |
| Portfires | 1 | 1 |
| Slow match, yds | 1.5 | 1.5 |
| **SPHERICAL CASE.** | | |
| Shot fixed | 8 | 14 |
| Priming tubes | 5 | 5 |
| Portfires | 1 | 1 |
| Slow match, yds | 1.5 | 1.5 |
| Fuzes: black, 2 sec. | 3 | 7 |
| Fuzes: red, 3 sec. | 8 | 14 |
| Fuzes: green, 4 sec. | 3 | 7 |
| Fuzes: yellow, 5 sec. | 3 | |
| **CANISTER.** | | |
| Canisters fixed | 8 | 14 |
| Priming tubes | 5 | 5 |
| Portfires | 1 | 1 |
| Slow match, yds | 1.5 | 1.5 |

| KIND OF AMMUNITION. | HOWITZERS. 32-pdr. | HOWITZERS. 24-pdr. | HOWITZERS. 12-pdr. |
|---|---|---|---|
| **SHELLS.** | | | |
| Shells fixed | .... | .... | 12 |
| Shells strapped | 4 | 6 | |
| Cartridges, small charge | 4 | 6 | |
| Cartridges, large charge | 1 | 1 | |
| Priming tubes | 3 | 3 | 5 |
| Portfires | 1 | 1 | 1 |
| Slow match, yds | 1.5 | 1.5 | 1.5 |
| Fuzes: black, 2 sec. | 2 | 2 | 6 |
| Fuzes: red, 3 sec. | 4 | 6 | 12 |
| Fuzes: green, 4 sec. | 2 | 2 | 6 |
| Fuzes: yellow, 5 sec. | 2 | 2 | |
| **SPHERICAL CASE.** | | | |
| Shot fixed | .... | .... | 12 |
| Shot strapped | 4 | 6 | |
| Cartridges, small charge | 4 | 6 | |
| Priming tubes | 3 | 3 | 5 |
| Portfires | 1 | 1 | 1 |
| Slow match, yds | 1.5 | 1.5 | 1.5 |
| Fuzes: black, 2 sec. | 2 | 2 | 6 |
| Fuzes: red, 3 sec. | 4 | 6 | 12 |
| Fuzes: green, 4 sec. | 2 | 2 | 6 |
| Fuzes: yellow, 5 sec. | 2 | 2 | |
| **CANISTER.** | | | |
| Canisters fixed | .... | .... | 12 |
| Canisters with sabots | 4 | 6 | |
| Cartridges, small charge | 4 | 6 | |
| Priming tubes | 3 | 3 | 5 |
| Portfires | 1 | 1 | 1 |
| Slow match, yds | 1.5 | 1.5 | 1.5 |

*Manner of packing Ammunition Boxes.*

For Guns. *Shot, spherical case and canisters, fixed:* Laid in two tiers across the box, the shot or canisters alternating with the cartridges at each side. The shot or canisters of the upper tier rest on those of the lower, and not on the cartridges.

FOR 32-PDR. AND 24-PDR. HOWITZERS. *Shells and spherical case shot:* Placed upright, the balls down, resting on strips of wood about .25 in. thick, placed lengthwise of the box and nailed to the bottom, so as to prevent the fuze plugs from bearing on the bottom of the box. The balls are held down by small strips of wood tacked with sprigs to the sides of the box, over the sabots. The cartridges are laid on top of the sabots.

*Canisters* are packed in the same manner, omitting the strips of wood in the bottom of the box.

FOR 12-PDR. FIELD AND MOUNTAIN HOWITZERS. *Shells and spherical case shot, fixed:* Placed upright, the balls down, resting on strips of wood, as for the other howitzers.

*Canisters* are packed in the same manner, resting on the bottom of the box.

In all the boxes, the small stores are placed in the vacant spaces on top of the ammunition.

The fuzes of each color are put up in a bundle, wrapped in water-proof paper of corresponding color, and marked with the time of burning. All the fuzes for a box are put in one parcel, wrapped with water-proof paper, and marked: FUZES.

A layer of tow is placed in the bottom of each box, and the whole contents are well packed in tow, filling the box so as to be pressed down by the cover. About 3 lbs. of tow are required for a box.

## AMMUNITION FOR SIEGE AND GARRISON SERVICE.

### *Cartridges.*

The ordinary service charge of powder for heavy guns is *one-fourth* the weight of the shot; but the charge varies according to circumstances, from *one-third* the weight of the shot, (for a breaching battery,) to *one-sixth* of that weight, for firing double shot or hot shot, and still less, for ricochet firing. The charges for mortars and howitzers vary according to the required range.

*Cartridge bags for siege and garrison service* are usually made of woollen stuff. These are cut in two pieces, in the form of a rectangle with semicircular ends, which are sewed together to form the bag, as described in making bags for field service. See *page* 250, for the manner of making and preserving them.

FOR 32-PDR. AND 24-PDR. HOWITZERS. *Shells and spherical case shot*: Placed upright, the balls down, resting on strips of wood about .25 in. thick, placed lengthwise of the box and nailed to the bottom, so as to prevent the fuze plugs from bearing on the bottom of the box. The balls are held down by small strips of wood tacked with sprigs to the sides of the box, over the sabots. The cartridges are laid on top of the sabots.

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## *Dimensions of Cartridge Bags.*

| | GUNS. | | | | | COLUMBIADS | | HOWITZERS. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 42-pdr. | 32-pdr. | 24-pdr. | 18-pdr. | 12-pdr. | 10 in. | 8-in. | Siege 8-in. | Sea coast. 10-in | Sea coast. 8-in. |
| Charge of powder - pounds | 10.5 | 8. | 8. | 6. | 4. | 20. | 12. | 4. | 12. | 8. |
| | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| Diameter of chamber - - - | 7. | 6.4 | 5.82 | 5.3 | 4.62 | 8. | 6.4 | 4.62 | 7. | 6.4 |
| Length of chamber - - - | - | - | - | - | - | 12. | 11. | 8 | 9.5 | 7.5 |
| Diameter of cartridge - - - | 6. | 5.5 | 5. | 4.6 | 4.2 | 7.5 | 6. | 4.2 | 6.5 | 6. |
| Length of 1 lb. of powder in a cartridge - - - - - - | 0.98 | 1.16 | 1.45 | 1.75 | 2. | 0.63 | 0.98 | 2. | 0.83 | 0.98 |
| Width of cutting stamp - - | 10.35 | 9.55 | 8.75 | 8.15 | 7.6 | 12.7 | 10.35 | 7.6 | 11.15 | 10.35 |
| Width of sewing stamp, and of the finished bag - - - | 9.35 | 8.55 | 7.75 | 7.15 | 6.6 | 11.7 | 9.35 | 6.6 | 10.15 | 9.35 |
| Whole length of bag, cut - - | 18. | 18. | 18. | 17. | 14. | 24. | 20. | 14. | 18. | 15. |
| Length of cartridge filled - - | 11. | 10.5 | 12. | 11. | 9. | 14. | 12.5 | 9. | 11. | 9. |
| Quantity 5-4 stuff for 100 bags, yds. | 30 | 27 | 25 | 23 | 14 | 36 | 30 | 14 | 31 | 20 |

PAPER BAGS. Cartridge bags for heavy ordnance may be made entirely of paper. The bottom is circular; one end of the paper forming the cylinder is cut into slips about 1 in. long which are pasted over the paper bottom, on a cylindrical former.

The dimensions of the formers and of the paper are easily obtained from the foregoing table. The formers must be bored through the axis, to facilitate drawing off the bag.

When a paper bag is filled, the open end is folded down about $\frac{3}{4}$ in. wide, and this fold is rolled on itself down to the powder, and the part which projects beyond the cylinder is turned in on the top of it.

These bags are apt to leave paper burning in the gun, for which reason those made of woollen stuff are preferable.

*For columbiads and sea-coast howitzers,* the cartridge should always occupy the whole length of the chamber; for this purpose, in firing with reduced charges, *a cartridge block* is placed in the bag, over the powder. The length of this block for any charge is easily deduced from the length occupied by 1 lb. of powder, as given in the above table.

*For mortars,* cartridge bags may be made in the same manner as for guns, their dimensions corresponding to those of the chamber of the mortar. But as the charge is generally poured loose into the chamber, the bag being used only for carrying it to the mortar, a gun cartridge bag of any convenient size may be used for mortar service.

*For firing hot shot*, cartridge bags are made double, by putting one bag within another; care must be taken that the bags are free from holes.

*For ricochet firing* or other occasions when very small charges are required, a cartridge bag for a piece of an inferior calibre may be used. Or else, after the charge is poured into the bag, place on it another bag filled with hay, pressing it with the hands to reduce the diameter; after having shaken this bag down and rolled and flattened the empty part of the two bags, tie them with woollen yarn, like a bundle of musket cartridges, placing the knot on top.

*For proving ordnance*, cartridge bags are made of woollen stuff for small calibres, and of paper for heavy ordnance. They should be of the full diameter of the bore or chamber.

## *Strapping Shells.*

*Sabots for shells* for heavy guns, howitzers and columbiads, are made of plank.

| DIMENSIONS OF SABOTS. | SIEGE AND GARRISON GUNS. | | | | | SEA COAST HOWITZERS. | | COLUMBIADS. | |
|---|---|---|---|---|---|---|---|---|---|
| | 42 | 32 | 24 | 18 | 12 | 10-in. | 8-in. | 10-in. | 8-in. |
| | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| Whole height | 2. | 1.5 | 1.5 | 1.5 | 1.5 | 2. | 2. | 2. | 2. |
| Greatest diameter | 6.58 | 6. | 5.43 | 4.92 | 4.35 | 7.75 | 6.79 | 8.41 | 6.79 |
| Diameter at bottom | | | | | | 6.75 | 6.15 | 7.75 | 6.15 |
| Cavity for the ball. Depth | 1. | 0.75 | 0.75 | 0.75 | 1. | 1. | 1. | 1. | 1. |
| Cavity for the ball. Radius of curv. | 3.42 | 3.12 | 2.84 | 2.58 | 2.26 | 4.93 | 3.93 | 4.93 | 3.93 |
| STRAPS. Width | 0.65 | 0.6 | 0.55 | 0.5 | 0.45 | 1. | 0.75 | 1. | 0.75 |
| STRAPS. Length | 21. | 19. | 17.5 | 16. | 14. | 29. | 23.5 | 29. | 23.5 |

One of the straps has a slit in the middle for the other strap to pass through. Two rings, or loops of tin, 0.38 inch diameter, are soldered securely to the slit strap of the howitzer and columbiad shells, for the purpose of attaching a handle made of cord 0.15 inch to 0.25 inch thick.

The shells are placed in the sabot, and the straps put on in such a manner that the fuze hole may fall in one of the angles, between two straps, and that the axis of the fuze hole may stand at an angle of about 45° with that of the sabot. The eyes of the shell should not be covered by the straps. The straps are fastened at each end with 2 *nails* in the side, and 2 in the bottom of the sabot.

In loading the piece, care must be taken to place the fuze hole in the upper part of the bore.

## *Canisters.*

*A canister for a siege and garrison gun*, is made by turning one end of the tin cylinder over the iron bottom, from 0.25 in. to 0.38 in. wide, according to the calibre; the other end is cut into strips 0.5 in. long, to turn down on the cover when the canister is filled. The cover for these canisters is of sheet iron .1 in. thick; it has a handle 3.75 in. long by 1.75 in. wide, made of iron wire No. 9, fastened to the cover by a strap of sheet iron, 2 in. long 1.75 in. wide, secured by two rivets 0.15 in. thick. The bottom plate is of cast iron, 0.5 in. thick.

For dimensions of *Canister Shot*, see CHAP. II.

*Canisters for 8-inch siege and sea-coast howitzers*, are attached to sabots, of the following dimensions:

| 8-INCH CANISTER SABOTS. | SIEGE. | SEA-COAST. | |
|---|---|---|---|
| | In. | In. | |
| Whole height | 4.68 | 5. | |
| Greatest diameter | 7.85 | 7.85 | |
| Diameter at the bottom | * | 6.4 | * Bottom hemispherical. |
| Diameter of cylinder for the tin | 7.8 | 7.8 | |
| Height of do | 0.75 | 0.75 | |

## *Dimensions and weights of Canisters.*

| DIMENSIONS. | FOR SIEGE AND GARRISON GUNS. | | | | | FOR 8-IN. HOWITZERS. | |
|---|---|---|---|---|---|---|---|
| | 42 | 32 | 24 | 18 | 12 | Siege. | S.coast |
| | In. | In. | In. | In. | In. | In. | In. |
| Length of tin for cylinder, developed | 21.5 | 20. | 18.3 | 16.7 | 14.4 | 25.1 | 25.1 |
| Height of ditto | 9.6 | 9. | 8.25 | 7.7 | 6.75 | 8.6 | 8.6 |
| Interior diameter of cylinder | 6.78 | 6.19 | 5.63 | 5.12 | 4.47 | 7.8 | 7.8 |
| Diameter of plates | 6.73 | 6.14 | 5.58 | 5.07 | 4.42 | 7.75 | 7.75 |
| Height of finished canister | 8.7 | 8.1 | 7.35 | 6.8 | 6. | 12.03 | 12.35 |
| Number of tiers of shot | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Number of shot in each of the 3 lower tiers | 7 | 7 | 7 | 7 | 7 | 12 | 12 |
| Number of shot in 4th tier | 6 | 6 | 6 | 6 | 6 | 12 | 12 |
| Whole number of shot | 27 | 27 | 27 | 27 | 27 | 48 | 48 |
| WEIGHT, finished canister, Lbs. | 48. | 37. | 29. | 23. | 15. | 53.5 | 54.5 |

## *Grape.*

For the dimensions of *Grape Shot*, see CHAPTER II.

A STAND OF GRAPE consists of 9 shot, put together by means of 2 *cast iron plates*, 2 *rings* and 1 *pin* and *nut*.—See *Plate* 17.

| DIMENSIONS. | 8-in. | 42 | 32 | 24 | 18 | 12 |
|---|---|---|---|---|---|---|
| | In. | In. | In. | In. | In. | In. |
| Diameter of plates | 7.85 | 6.83 | 6.24 | 5.68 | 5.17 | 4.52 |
| Thickness of plates | 0.6 | 0.6 | 0.5 | 0.5 | 0.4 | 0.4 |
| Interior diameter of rings | 6.55 | 5.73 | 5.16 | 4.75 | 4.26 | 3.8 |
| Diameter of round iron for rings and pin | 0.6 | 0.5 | 0.5 | 0.38 | 0.38 | 0.32 |
| Length of pin, including tapped part | 14.7 | 9.25 | 8.7 | 7.88 | 7.18 | 6.12 |
| Height of stand, between the outsides of the plates | 9.85 | 8.75 | 8.2 | 7.5 | 6.8 | 5.8 |
| WEIGHTS. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| Plates | 13.6 | 10.2 | 8. | 6.75 | 4.56 | 3.44 |
| Pin, nut, and rings | 4.75 | 2.8 | 2.5 | 1.81 | 1.12 | 0.69 |
| Stand, complete | 74.5 | 51.25 | 39.75 | 30.61 | 22.15 | 14.84 |

The square of the nut is 2 diameters of the pin; its thickness, 1 diameter. The head of the pin is countersunk flush with the bottom of the lower plate, which has a *slot* to prevent the pin from turning when the nut is screwed on. Each plate has on the inside 3 beds for the shot, of a depth equal to half the thickness of the plate; they are made in the form of a spherical segment, the curvature of which is the same as that of the shot; their centres are on equidistant radii, midway between the edge of the pin hole and that of the plate. In the upper plate are 2 holes 0.25 in. diameter, placed opposite to each other at 0.5 in. from the edge of the plate, to receive a rope handle.

*For the 8-inch sea-coast howitzer*, the stand of grape must be attached to a conical sabot. The sabot is 4.25 in. long, 7.85 in. diameter at the large end, and 6.4 in. at the small end. The sabot may be fastened to the lower plate with screws, or the pin may be made long enough to pass through it; or else the sabot may be inserted into the piece separately from the stand of grape.

*Filling Shells for Mortars.*

| CHARGES FOR MORTAR SHELLS. | | 13-in. | | 10-in. | | 8-in. | |
|---|---|---|---|---|---|---|---|
| | | Lbs. | oz. | Lbs. | oz. | Lbs. | oz. |
| Charge.. | of the shell filled with powder..... | 11 | | 5 | | 2 | 9 |
| | to burst the shell..... | 6 | | 2 | | 1 | |
| | to blow out the fuze..... | 0 | 6 | 0 | 5 | 0 | 4 |
| Ordinary service charge. | Cannon powder..... | 7 | | 3 | | 1 | 12 |
| | Incendiary match, or other composition.. | 0 | 8 | 0 | 6 | 0 | 6 |

1 Man to fill, 1 helper.

MATERIALS. *Cannon powder—incendiary match*—pieces of *fire stone* 3 in. long, or other incendiary composition—*loaded fuzes—tow.*

IMPLEMENTS AND UTENSILS. 1 *pair of shell hooks*—1 *handspike*—2 *hand hammers*—2 *scrapers*, (pieces of sword blade)—2 *tow hooks*—2 *pairs of pincers*—*rags*—1 *chisel* and 1 *mallet*, to clean the shells and break up any hard substance that may be found in the interior—2 *searchers*, for sounding cavities—*shell gauges*—1 *grate*, to dry the shells on—1 *fuze saw*—1 *gimlet*—a *ring of rope*, or a hollow block—1 *funnel—powder measures*—1 *tub*, or vessel for powder—2 *baskets*, for the composition and fuzes—1 *rasp*—1 *fuze setter*, and 1 *mallet.*

TO CHARGE A SHELL. Clean the shell inside and out; gauge it; see that it has no holes or fissures deep enough to cause its rejection; that the fuze hole is well reamed, and that there are no flaws around it on the inside; if the shell is wet, heat it slightly and let it cool slowly.

Cut the fuze to the proper length, according to the range, by resting it in a groove made in the block, the saw running in a cut made for it; or bore the fuze through with a gimlet, perpendicularly to the axis, at the proper length.

Place the shell on the block or ring of rope; pour in the powder and introduce the incendiary composition; try the fuze, which should enter $\frac{3}{4}$ of its length; cover the head of the fuze with tow, and drive it with the fuze setter and mallet, so that the head of the fuze shall project not more than 0.2 in. to 0.4 in.

Shells are generally filled and the fuzes driven in the battery magazines, as they are required.

*Charges for Shells for Columbiads and heavy Guns.*

| CHARGE OF POWDER. | COLUMBIADS. | | | | GUNS. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10-in. | | 8-in. | | 42 | | 32 | | 24 | | 18 | | 12 | |
| | Lbs. | oz. | Lbs. | oz. | Lbs. | oz. | Lbs. | oz. | Lbs. | oz. | Lbs. | oz. | Lbs. | oz. |
| To fill the shell - - | 3 | 4 | 1 | 12 | 1 | 8 | 1 | 5 | 1 | 0 | 0 | 11 | 0 | 8 |
| To burst the shell - - | 1 | 6 | 1 | 0 | 0 | 12 | 0 | 11 | 0 | 8 | 0 | 7 | 0 | 5 |
| To blow out the fuze plug - | 0 | 10 | 0 | 8 | 0 | 6 | 0 | 2 | 0 | 2 | 0 | 1¼ | 0 | 1 |
| For ordinary service - - | 3 | 0 | 1 | 8 | 1 | 4 | 1 | 0 | 0 | 12 | 0 | 10 | 0 | 7 |

The *fuzes* for these shells are made with paper cases, and are inserted at the time of loading the piece.

The *fuze plugs* are made of wood, or of brass, driven or screwed into the fuze hole; they are covered with a cap of peculiar construction which contains the priming of the fuze. The size of the plug is indicated by that of the fuze hole in the shell.

The bursting charge is poured into the shell through the hole in the fuze plug.

## *Wads.*

Wads for proving cannon are made of *junk.*

IMPLEMENTS. 1 *wad mould* with two holes for each calibre; made of cast iron cylinders set in oak, or of two strong pieces of oak strapped with iron and joined by a hinge—1 *drift* for ditto—1 *maul.*

| DIMENSIONS OF MOULDS. | 10 in. | 8 in. | 42 | 32 | 24 | 18 | 12 | 6 |
|---|---|---|---|---|---|---|---|---|
| | In. | In. | In. | In. | In. | In. | In. | In. |
| Diameter of moulds, { large hole - | 9.75 | 7.8 | 6.8 | 6.2 | 5.65 | 5.12 | 4.48 | 3.55 |
| Diameter of moulds, { small hole - | 9.4 | 7.5 | 6.5 | 5.9 | 5.3 | 4.8 | 4.1 | 3.2 |
| Thickness of upper block - - - | 10. | 8. | 7. | 6.4 | 5.8 | 5.3 | 4.6 | 3.7 |
| Thickness of lower block - - - | 5. | 4. | 4. | 4. | 4. | 4. | 4. | 4. |
| Width of blocks - - - - | 17. | 15. | 13. | 12. | 11.5 | 11. | 10. | 9. |
| Diameter of cylindrical drift - - | 8.5 | 7.3 | 6.2 | 5.6 | 5. | 4.5 | 3.8 | 2.9 |
| Height of do. do. - - | 24. | 24. | 24. | 24. | 24. | 24. | 24. | 24. |

MAKING WADS. The junk, after having been picked, is compressed by being beaten in the smaller mould until it assumes the requisite dimensions; it is then taken out, by raising the upper part of the mould, and closely wrapped with rope yarn passed over it in the direction of the axis of the cylinder and fastened by a few turns round the middle of the wad; after which it is placed in the large

mould and again beaten with the maul and drift; the diameter of the wad when finished is verified with a wooden gauge corresponding to the large gauge of the shot.

| DIMENSIONS AND WEIGHTS OF WADS. | 10-in. | 8-in. | 42 | 32 | 24 | 18 | 12 | 6 |
|---|---|---|---|---|---|---|---|---|
| | In. | In. | In. | In. | In. | In. | In. | In |
| Diameter and height of wad | 9.75 | 7.8 | 6.8 | 6.2 | 5.65 | 5.1 | 4.4 | 3.5 |
| | Lbs. oz. | Lbs. oz. | Lbs. oz. | Lbs. oz. | Lbs. oz. | Lbs. oz. | Lbs. oz. | Lbs. oz. |
| Weight of wad - - | 16 8 | 8 8 | 5 10 | 4 6 | 3 | 2 6 | 1 8 | 0 13 |
| Quantity of junk required for 100 wads - - | 1650 | 850 | 562 | 437 | 300 | 237 | 150 | 87 |

An addition of 3 per cent. to the quantity required may be allowed for waste, tar, &c.

*Wads for firing hot shot*, and for other like purposes, may be made of *hay* wrapped with rope yarn; they are fabricated in the same manner as junk wads.

*Ring wads* (or *grommets*, as they are called in the naval service,) have been found very serviceable in increasing the accuracy of fire, and they are to be preferred where the object of a wad is merely to retain the ball in its place. They consist of a ring of rope yarn, about 0.7 in. thick, with two pieces of strong twine tied across it, at right angles with each other. The size of the ring is the full diameter of the bore, in order that it may fit tight. These wads may be attached with twine to the straps, or to the balls; or, they may be inserted, like other wads, after the ball.

## MILITARY FIREWORKS.

### *Slow Match.*

PREPARATION. Slow match is made of hemp, flax, or cotton rope, about 0.6 in. diameter, made with 3 strands, slightly twisted. Cotton rope well twisted forms a good match without any preparation.

To prepare hemp or flax rope: boil it 10 minutes in water holding in solution 1-20th of its weight of sugar of lead, or let it remain in the *cold* solution until it is thoroughly saturated—run it through the hands, to take the water from it—twist it hard by attaching one end to the hook of a twisting winch, and putting a stick in a loop at a convenient distance for twisting—smooth it by rubbing it smartly with coarse mats, hair cloth, or cuttings of buff leather, commencing at the winch and rubbing always in the same direction, until the diameter of the rope is reduced 0.1 in. and until the tension and hardness are even—stretch it on poles or on a fence to dry, and put it up in neat coils of 25 yards each.

100 yards of rope require 2.5 lbs. of sugar of lead.

Match thus prepared burns 4 inches in an hour. Cotton match burns 4½ inches in an hour.

If sugar of lead cannot be procured, the rope may be simply leached. For this purpose, it is put into a leach-tub, and steeped in pure water for 12 hours—this water is then drawn off and replaced by ley prepared in a boiler with a quantity of ashes equal to half the weight of the rope, to which 5 per cent. of quick lime is added—this ley, with the ashes, is put, after being warmed, into the hopper of the tub, and when it has run through and remained some time in the tub, it is drawn off, heated again, and poured back on the ashes. This operation is several times repeated in the course of 24 hours, which is the time required for the rope to be well leached. After being taken out and twisted with sticks, it is steeped for 5 minutes in hot water, being stirred at the same time, and the operation is finished as before. Match prepared in this manner burns 5 inches in an hour.

By treating bad match or old rope with sugar of lead, very good match may be made.

Slow match weighs from 3 to 5 oz. to the yard.

Packing. Slow match is packed in tight casks or boxes. A cask 40 in. high, 24 in. diameter (weighing 60 lbs.) contains 150 lbs. of match.

Dimensions of a box to hold 200 lbs. hemp or 220 lbs. cotton match; 44 in. long, 28 in. wide, 18 in. deep—weight 87 lbs.—It is made of boards 1 in. thick, ends 1¼ in.—It has corner pieces of hard wood 2.25 in. square. The casks and boxes should be marked with the kind and quantity of match, place and date of fabrication.

## *Quick Match.*

Take cotton yarn, such as is used for candle wick, of such a size (generally 4 strands) that when doubled and twisted in the fingers, it may be 0.07 in. in diameter; wind it into a loose ball of convenient size, (say 1 lb., which will measure 1,000 yards,) and steep it in gummed brandy or whiskey, until the cotton is thoroughly soaked. In a wooden bowl or copper pan, put a layer about ¼ in. deep, of paste made of mealed powder and gummed spirits, of the consistency of flour paste; on this, spread a coil of the cotton by unrolling the ball and distributing it equally on the surface of the paste until there are 5 or 6 yarns over one another—put another layer of the paste, and proceed in this manner until the bowl is full, taking care not to entangle the strands; the last layer of paste should be a little deeper than the others. After the cotton has been 3 or 4 hours

in the bowl, wind it on a reel, making it pass through a funnel filled with the paste, and taking care that the several turns of yarn do not touch each other. Before it is dry, dredge it with mealed powder; let it dry slowly, then cut it off from the reel and put it in bundles. The gum should be first dissolved in the smallest possible quantity of hot water or vinegar, and afterwards mixed with spirits.

Match thus prepared should be hard and stiff, and the composition should hold firmly on; 1 yard burns, in the open air, 13 seconds.

1,000 yards of quick match require 1 lb. of cotton yarn, 8 lbs. of mealed powder, 1¼ gallons of spirits, and 2½ oz. of gum arabic. Weight when dried, 9 lbs.

By using *vinegar*, a match is made which burns less rapidly in the proportion of 4 to 5; and with pure water, in the ratio of 4 to 6. *Alcohol* makes a quicker match, but it cannot be gummed, and the composition does not stick.

A slow kind of match is made by adding sulphur to the mealed powder; with one-sixth of sulphur, 1 yard of match burns 22 seconds; with one-fifth, 33 seconds; with one-third, 53 seconds; with one-half, 162 seconds.

Quick match enclosed in tubes burns more rapidly than in the open air, and more so in proportion as the tubes are smaller. To communicate fire very rapidly, it is enclosed in paper tubes called *leaders*.

## *Priming Tubes.*

| | | In. |
|---|---|---|
| *Dimensions of tubes.*—Length | | 3.25 |
| Exterior diam. | at top | 0.17 |
| | at bottom | 0.14 |
| Interior diam. | at top | 0.12 |
| | at bottom | 0.09 |
| Exterior diam. of cup | at top | 0.75 |
| | at bottom | 0.70 |
| Depth of cup | exterior | 0.25 |
| | interior | 0.21 |

WEIGHT of 1000 tubes, empty—15 lbs.

*Metal for tubes*—50 lbs. Banca tin, 50 lbs. Lead, 1¼ lbs. Antimony } for 6,000 tubes.

*Making tubes.* The metal is melted in an iron pan, placed in the oven of a stove, and the moulds are kept heated, at the same time, so that their temperature may be high enough to scorch dry shavings. During the casting, the moulds should be smoked occasionally with rosin, or pine knots, to prevent the tubes from sticking. Six moulds should be used in casting, and they should

not be cooled by wetting them. When not in use, the moulds must be kept well oiled and free from rust.

The tubes are drawn from the moulds by means of a lever fixed into the work bench; when the spindle withdraws, leaving the tube in the mould, a small screw is inserted into the tube, which, by being gently tapped with a hammer, loosens the tube and withdraws it.

*Another method of making tubes*, now generally practised, is to cut the metal into small discs, each of which is formed into a tube by being pressed through a die.

Tubes are *cupped* by running them through a groove, over which a plane is passed, turning in the edges of the cup.

CHARGING. Tubes are filled with mealed powder made liquid by spirits of wine, which is injected into them with a *tube injector* holding one quart. A better method is to make the mealed powder into a soft paste, which is pressed into the tube with the thumb.

A strand of quick match 2 in. long is placed across the cup, which is then filled with the same paste; a small brass wire, (No. 22,) is run through the tube and withdrawn after the composition is dry.

A paper cap is placed over the cup and twisted tightly around the tube, under the cup.

*Composition to fill* 1,000 *tubes:*

$2\frac{1}{2}$ lbs. mealed powder.

2 quarts of whiskey, or spirits of wine.

WEIGHT of 1000 tubes, filled—18 lbs.

QUILL TUBES. Priming tubes may be made also of quills; for this purpose the barrel of the quill is cut off at both ends, the largest end is slit into 7 pieces 0.5 in. long, which are bent outwards at right angles; fine woollen yarn is then woven into these slits, like basket work, or a perforated disc of paper is pasted on them. The tube is filled and finished as before.

The small end of the quill may be closed with sealing wax, and the tube charged with rifle powder.

These tubes are preferable for service on ship-board, or in casemates or block-houses, as there is no danger from the fragments blown out of the vent, which there may be with metallic tubes.

*For mortar service*, priming tubes may be made by inserting a strand of quick match in a cylinder of thin paper, of the same diameter and length as the metal tube. The match should project about 2 inches beyond the upper end of the tube.

Tubes are tied up in bundles of 10, wrapped in paper.

## *Portfires.*

MAKING THE CASES. *Formers* for portfire cases are made of steel, turned smooth, 22 in. long, and 0.5 in. diameter, with a hole 0.2 in. diameter through one end, for the purpose of drawing it from the case. The length of the case is 18 inches; exterior diameter 0.65 in.; interior diameter 0.5 in. One sheet of paper, No. 4, makes two cases, and each case weighs 1 oz. The case is rolled hard with a hand rolling board, the sheet being pasted after one turn around the former.

DRIVING PORTFIRES. *Portfire moulds* are made of brass; they are 18 inches long, with a bore 0.65 in. diameter; the mould consists of two parts, 0.4 in. thick at top, and 0.6 in. at bottom, which are held together by a socket at bottom and by 4 strong bands.

Three *drifts* are used for driving portfires; they are made of steel, with brass tips, 0.5 in. long, upon the lower end. These drifts are 22 in., 15 in. and 10 in. long, and of a diameter 0.1 in. less than the interior diameter of the case. Four spiral grooves are cut upon the surface of the drifts, making one half of a revolution in 22 inches; the grooves are 0.15 in. wide, and 0.05 in. deep. The handles of the drifts are 6 inches long and 0.75 in. diameter, with the head enlarged to 1.25 in.

*Mallets* for driving portfires are turned of hard wood, and weigh one pound.

Put the case in the mould and drive on the rings—insert a small *funnel* in the top of the case—pass the long drift through the funnel to the bottom of the mould—fill the funnel with composition, and strike the drift about three blows every second, raising the drift about half an inch with the fingers of the left hand, between the blows. In this way the composition finds its way around the sides and through the grooves of the drift to the bottom, and is uniformly and compactly driven. The shorter drifts are used, as the case is filled. A man can drive 120 portfires in ten hours.

Portfires should not be primed with mealed powder. Before commencing the driving, a piece of paper should be pushed with the long drift to the bottom of the case, and after the portfire is driven, the top of the case should be turned in and beaten down; thus both ends of the composition are secured.

*Composition for* 100 *portfires:*

| | |
|---|---|
| Nitre | 13 lbs. |
| Sulphur | 4.5 lbs. |
| Mealed powder | 2.5 lbs. |

The portfires made with this composition burn ten minutes.

The composition must be intimately mixed, by grinding with a muller on the mealing table, rubbing it through the hands, and passing it through a sieve, regrinding the coarse parts that remain, and adding them.

Portfires may be driven in a cylinder of sheet copper or tin, supported in a hole in a block of hard wood; but as they cannot be driven so hard in this way, the proportion of mealed powder in the composition should be reduced to 1½ lb., in order that the portfire may not burn too fast.

| INTERIOR DIMENSIONS OF BOXES FOR PORTFIRES. | 100 | 200 |
|---|---|---|
| | In. | In. |
| Length | 18 | 18 |
| Width | 9.1 | 9.1 |
| Depth | 5.1 | 10.1 |
| Weight, packed.....lbs. | 38 | 70 |

The boxes are made of white pine boards 0.75 in. thick, the sides dovetailed together, and the top fastened with six 1¼ in. screws, the heads countersunk and covered with putty. They should be lined with water-proof paper, and painted with one coat of olive color—marked on one end with the number and kind of contents, and the year of fabrication.

*Fuzes for Mortar Shells.*—Plate 17.

| DIMENSIONS AND WEIGHTS. | 13-in. | 10-in. | 8-in. |
|---|---|---|---|
| | In. | In. | In. |
| Diameter of fuze at upper end | 1.85 | 1.7 | 1.25 |
| Diameter of fuze at lower end of first cone | 1.65 | 1.55 | 1.15 |
| Diameter of fuze lower end of fuze | 1.25 | 1. | 0.9 |
| Diameter of cup at the top | 1.25 | 1. | 0.75 |
| Diameter of cup at the bottom | 0.9 | 0.8 | 0.6 |
| Diameter of the bore | 0.4 | 0.3 | 0.3 |
| Length of first cone | 2.8 | 2.25 | 1.25 |
| Depth of the cup | 0.6 | 0.5 | 0.4 |
| Thickness of wood at the bottom of the fuze | 1.2 | 0.9 | 0.9 |
| Length of composition | 9. | 8. | 5. |
| Whole length of fuze | 10.8 | 9.4 | 6.3 |
| Length of 1st drift exclusive of the handles | 9. | 8. | 8. |
| Length of 2nd drift exclusive of the handles | 4.5 | 4. | 4. |
| Diameter of drifts | 0.36 | 0.27 | 0.27 |
| | Lbs. | Lbs. | Lbs. |
| Weight of composition for 100 fuzes | 8 | 4 | 2½ |
| Weight of 100 fuzes, complete | 54 | 33 | 16 |

Wooden fuzes for mortar service are made of beech, ash, or linden, seasoned and free from knots. They are bored in the lathe and the exterior is graduated into inches and tenths, (commencing at the bottom of the cup,) by means of a steel gauge applied to it in the lathe.

*Compositions for Mortar Fuzes.*

| No. | Nitre. | Sulphur. | Mealed powder. | Time of burning 1 inch. | REMARKS. |
|---|---|---|---|---|---|
| 1 | 2 | 1 | 3 | 3.8 sec. | For 10-inch and 8-inch mortars, light. |
| 2 | 2 | 1 | $2\frac{1}{4}$ | 5. sec. | For 13-inch and 10-inch mortars, heavy. |
| 3 | ..... | ..... | 1 | 2.2 sec. | For 8-inch howitzers. |

The composition must be well pulverized, thoroughly mixed with the hands and sifted. As the time of burning will vary a little according to the quality of the materials used, (especially of the mealed powder,) a few trials should be made to determine the exact composition in each case.

DRIVING. The articles necessary for driving fuzes are: *Blocks* with holes of the size of the fuze—*mallets—steel drifts*, shod with copper—*copper ladles*, to contain sufficient composition to make 1 diameter of the bore in height when driven—*copper pans—mealed powder—fuze composition.*

In driving fuzes, be careful to put in equal quantities of composition each time, by passing a drift over the ladle, to take off the composition along the edges; keep the strokes as regular as possible, giving always the same number and with the same force to each ladle full of composition. The pan with the composition must not be placed on the driving block, as the sulphur would collect together, and would separate from the rest of the composition.

13-in., 10-in., and 8-in. fuzes are driven with mallets that weigh 1 lb.; smaller fuzes, with mallets weighing $\frac{3}{4}$ lb. and $\frac{1}{2}$ lb.; 21 blows, in volleys of 3, are given to every ladleful of composition, in fuzes over 24-pdr., the drift being raised after each volley; 15 blows to each ladleful, in smaller fuzes.

One man, in 10 hours, can drive 50 13-in., 80 8-in., 120 to 150 smaller fuzes.

Fuzes must always be driven to the same height, for which purpose the last drift must be marked. They are primed with mealed powder, driven with the same force as is applied to a ladleful of composition. The space left in the bore

of the fuze, for the mealed powder, is about 0.2 in. The cup is filled with mealed powder moistened with spirits of wine or strong whiskey; when dry, it is covered with a small piece of paper, over which is pasted a cap of strong, water-proof paper, marked with the number of seconds the fuze burns to the inch. For preservation and transportation, the fuze is capped with water-proof paper, linen, or serge, tied on, and lackered. Fuzes are packed with tow, in boxes lined with water-proof paper.

Fuzes may be driven with *blind fire composition*, which will not discover the flight of a shell in the night:

| *Compositions:* | Mealed powder. | Sifted wood ashes. |
|---|---|---|
| 1 | 6 parts | 4 parts. |
| 2 | 16 parts | 9½ parts. |

One ladleful of the common fuze composition, or of mealed powder, must be driven in the top of these fuzes.

## *Fuzes for Field Service.*

The fuze for field shells and spherical case consists of a *paper case*, which is charged with fuze composition, and is inserted, at the time of loading the gun, into a *wooden plug* previously driven into the fuze hole, as described at *page* 254.

MAKING THE PAPER CASES. The case is made of a strip of smooth paper, rolled hard, on a mandril 0.35 inch diameter, and glued, after the first turn, with isinglass glue. The strip of paper is in the form of a rectangle joined to a trapezoid; it is rolled from the large end.

| | Inches. |
|---|---|
| Whole length of the paper | 18. |
| Length of the rectangular part | 9. |
| Width of the rectangular part | 1.5 |
| Width at small end | 0.4 |
| Diameter of finished case, before being cut — At top | 0.52 |
| Diameter of finished case, before being cut — At bottom | 0.44 |

*Log paper*, (so called,) or thin drawing paper is suitable for making these cases. The dimensions of the strip of paper must be regulated by trial with the kind of paper used.

After the case is dry, it is smoothed by rubbing it with a fine file, and with sand paper.

| FUZE COMPOSITIONS. | MEALED POWDER. | SULPHUR. | TIME OF BURNING 1 INCH. | COLOR OF FUZE. |
|---|---|---|---|---|
| 1..... | 1 | 0. | 2 seconds. | Black. |
| 2..... | 8 | 3. | 3 " | Red. |
| 3..... | 8 | 3.5 | 4 " | Green. |
| 4..... | 8 | 4.0 | 5 " | Yellow. |

The materials must be thoroughly incorporated by being carefully ground together with a muller. The composition should always be tried before driving many fuzes, as the time of burning is subject to variation, according to the quality of the materials and their manipulation.

One pound of composition is required to charge 100 fuzes.

CHARGING THE FUZE. The case is set in a brass die, made in two parts which are held together by a strong ring or socket inserted in a block of wood. The composition is driven in the usual manner with a half pound mallet, with 15 blows to each ladleful of composition; one ladleful makes a length of 0.25 inch in the fuze.

CUTTING. The fuze is next put into an iron gauge, the bore of which has the same taper as the fuze, and it is cut off at both ends, with a saw, or sharp knife, to the proper length. It is then stained the proper color, according to the composition used.

Interior diameter of cutting gauge { at top..... 0.5 inch. / at bottom..... 0.45 "
Length..... 1. "

## *Fuzes for heavy Guns, Columbiads and Howitzers.*

These fuzes are made in a similar manner to those for field service. Their dimensions are as follows:

*Paper for the case.* {
Whole length..... 19. inches
Length of rectangle. 6. "
Width of rectangle. 2.25 "
Width of small end. 0.4 "

*Fuze..* {
Diameter at top..... 0.53 "
" at bottom..... 0.4 "
Length..... 2. "
Diameter of composition..... 0.3 "

*Fuze Compositions.*

| NO. | NITRE. | SULPHUR. | MEALED POWDER. | TIME OF BURNING 1 INCH. | REMARKS. |
|---|---|---|---|---|---|
| 1 | 26 | 9 | 14 | 10 secs. | Materials procured from Dupont's powder mills. |
| 2 | 26 | 9 | 12 | 14 " | |
| 3 | 26 | 9 | 10 | 20 " | |

The time of burning of these slow compositions is subject to considerable variations, according to the quality of the materials and the manipulation in mixing them. In making these fuzes, therefore, especial care should be taken to try the composition used, and to vary the proportions so as to produce the required result. The above table is given as an approximate guide.

## PERCUSSION CAPS FOR SMALL ARMS.

MAKING THE CAPS. The cap for small arms is made of copper; it is very slightly conical, with a rim or flanch at the open end; it has four slits, extending about half the height of the cap.

The sheet copper for making the caps is No. 24, weighing about 13.5 oz. to the square foot. It is obtained in sheets 48 in. × 14 in., weighing 4 lbs.; the copper should be pure, well annealed, and rolled as evenly as possible.

The copper is cleaned by being immersed in a pickle made of 1 part (by measure) of sulphuric acid and 40 parts of water; it is then scoured by hand, with fine sand or saw dust, and washed clean in running water; after which it is slightly oiled by being rubbed with a rag dipped in clear neatsfoot oil.

The caps are formed by a machine which cuts a star or *blank* from the sheet and transfers it to a die in which the cap is shaped by means of a punch. For use in Boughton's machine, the copper is first cut into strips, from which the blanks are cut and the caps formed; Wright's machine cuts the blanks from the whole sheet and forms the cap. The first machine makes 2,196 caps, the second, 2,314 caps, from a sheet of the size above mentioned. Each machine can make about 5,000 caps an hour.

1,000,000 of caps, empty, weigh 1,162 lbs.

Before being charged, the caps are cleaned by being rolled in dry saw dust; but if only a small quantity of good oil is used, this operation is unnecessary.

PERCUSSION POWDER. The powder with which the caps are charged consists of *fulminate of mercury*, mixed with half its weight of saltpetre.

*To prepare the fulminate of mercury.* In a glass retort or bottle, holding about half a gallon, dissolve 10 oz. of pure mercury in 5.5 lbs. of nitric acid of the specific gravity of 1.40. The solution may be made at the ordinary temperature of the air in summer; in winter it is facilitated by placing the retort in a water bath heated to about 120°. The vapors which come over, being very deleterious, must not be inhaled.

When the solution is complete, pour the liquor into a glass vessel with a wide mouth, or a glazed stone jar, of the capacity of 8 or 10 gallons, into which 5.75 lbs. of alcohol, of the specific gravity of 0.85, have been previously poured—care must be taken to *pour the nitrate of mercury on the alcohol;* the reverse mode of mixing would be attended with danger. This operation must be performed at a safe distance from the fire, as the fumes of ether which escape are highly inflammable, and great heat is evolved during the effervescence which ensues from the mixture. When red fumes begin to appear, they must be reduced by adding a small quantity of alcohol. The proportion of alcohol used in the whole operation varies according to the quality of the acid and alcohol, and perhaps the state of the weather; the proper quantity is best determined by trial with the materials made use of.

When the effervescence has ceased, a precipitate of fulminate of mercury will be found at the bottom of the vessel; this must be repeatedly washed in soft water, until the water no longer reddens litmus paper. The fulminate is in the form of very small crystals, of a light grey color and brilliant surface. If the operation is well performed, no metallic mercury will be reproduced. The weight of the fulminate when dried is about 13 per cent. greater than that of the mercury used.

If the proper proportions are not used, (or if the materials are not of good quality,) the product will be, instead of fulminate, an impalpable, yellow powder, which is incombustible. When this is observed, the result may generally be corrected by varying the proportion of alcohol in the mixture.

The fulminate of mercury is kept under water, in jars or wide mouthed bottles, holding about 2 lbs. each, which should be preserved from frost.

*To prepare the percussion powder:* The water is drained from the fulminate, and the latter is partially dried, until it contains only 20 per cent. of moisture. In this state it is mixed with 60 per cent. of its weight of refined, pulverized saltpetre; the paste is worked with a spatula and a wooden muller, on a wooden table, until the ingredients are intimately mixed While still in a moist state, the mixture is passed through a common hair sieve; it is then dried, with great care, in the sun, or in a room warmed by flues. When quite dry, it is again

passed through a hair sieve, by rubbing it with the hand, or with a leather pad, so as to reduce it to a fine grained powder, but not to dust, when it is ready for use.

The dried powder is put into varnished wooden or paper boxes, holding about half a pound each, which should be kept in a small magazine, standing apart from other buildings.

CHARGING THE CAPS. The charge of each cap is *half a grain* of percussion powder, which is put into the cap and compressed by machinery contrived for the purpose. In one of these machines, (made at Washington Arsenal,) the caps are placed by hand and the powder is supplied from a small hopper.

In Wright's machine, the charging is combined with the apparatus for making the caps. The caps are taken up as they are formed, and they are charged and pressed without handling; this machine, being supplied with the copper in sheets and the percussion powder, delivers the caps ready for being varnished, at the rate of 5,000 an hour.

VARNISHING THE CAPS. In order to fix the charge in the cap and to protect it from the effects of moisture, a drop of varnish is put into each cap.

*To prepare the varnish.* Dissolve 1 lb. of the best gum shellac in 1 quart of rectified alcohol, containing 95 per cent. of pure spirit. The solution is made at the ordinary temperature of the air in summer; it requires about 20 days, during which it must be frequently stirred. The operation is found to be much hastened and facilitated by putting the materials into a small rolling barrel made of tin, which is kept in motion by the power which moves the machines.

1 quart of alcohol and 1 lb. of shellac make 1.46 quart of varnish; a small quantity of alcohol is occasionally added for thinning the varnish when it is used.

*To apply the varnish:* The caps are put into holes in a board 15 in. by 12 in. and .25 in. thick; 500 in each board. This is quickly done by taking a parcel of caps on the board and shaking it sideways, the caps settling themselves in the holes. When the boards are filled, the defective caps and those which have lost their charge, are easily detected by the eye. The varnish is contained in a glass tube, furnished with a sliding valve of iron wire, which allows a drop of varnish to escape, when the tube is pressed in the bottom of the cap. In this manner a boy or a girl can varnish 5,000 or 6,000 an hour; or the varnish may be applied by means of a simple machine; about twenty boards are used; the caps remain in them 30 or 40 minutes, when the varnish is sufficiently set for them to be turned out into a tray, for drying. These trays may be 18 in. long, 12 in. wide, and 2 in. deep, to contain 5,000 caps each. The caps should be exposed for 24 hours in a room heated to about 100°; they are then put into bags

and may be kept 2 or 3 days more in a temperature of about 120°, before they are packed in boxes.

Fifteen quarts of varnish are required for 1,000,000 of caps, and about 3 quarts of alcohol for thinning the varnish and cleaning the tubes.

Weight of 1,000,000 caps charged and varnished, 1,233 lbs.

PACKING. The caps are put into bags of strong linen, 10,000 in a bag. These bags are made like cartridge bags for field service; 6 in. diameter and 13.5 in. deep. They are marked with the place and date of fabrication.

Weight of bag, with 10,000 caps, 12.5 lbs.

Ten of these bags are packed in one box.

*The packing boxes* are made of white pine, 1 in. thick; the sides and ends dovetailed together. The top is fastened with six 2-inch wood screws. They have brackets for rope handles, on the ends.

Interior dimensions of box: length 30 in.; width 12 in.; depth 9.5 in. Weight 30 lbs.

The bags are packed tight in tow. The boxes are lined with thick paper; they are painted olive color, and marked on the ends with the number and kind of contents and the date of fabrication. The place and date of fabrication are marked also on the inside of the cover.

Weight of box packed with 100,000 caps, 155 lbs.

### *Materials required for* 1,000,000 *Caps.*

| | |
|---|---|
| *For the caps:* | 1,800 lbs. sheet copper, of which about one-third is returned in scraps. |
| *For the powder:* | 43 lbs. mercury. |
| | 382 lbs. nitric acid. |
| | 400 lbs. alcohol. |
| | 24 lbs. saltpetre. |
| *For the varnish:* | 10.25 lbs. gum shellac. |
| | 13 quarts alcohol. |
| *For bags:* | 32 yards of brown linen, ¾ yard wide. |
| *For boxes:* | 200 feet of white pine boards. |

### *Friction Primers for Cannon.*

*A friction primer*, for cannon, consists of a tube charged with gunpowder, to the top of which is fastened a cup containing friction powder, which is exploded by means of a slider pulled out with a lanyard.

*The tube* is made of sheet brass No. 22; it is formed by drawing a strip of

brass .65 in. wide and 3 or 4 feet long, through a hole 0.195 in. diameter, and cutting it into lengths of 1.6 in. One end of the tube is slit into four parts 0.075 in. deep, for the purpose of fastening it to the cup.

*The cup* is made of sheet brass No. 30, cut with a punch into pieces 1.8 in. by 0.65 in., with a hole of the size of the tube.

The slit end of the tube is passed through the hole in the cup, and the ends are turned over and hammered down close, to secure it in place.

*The slider* is made of sheet brass No. 22, cut into strips 2.3 in. by 0.2 in. and doubled lengthwise over a mandril 0.2 in. diameter, which forms the eye for the hook of the lanyard.

The bottom of the cup and one side of the slider are made rough.

CHARGING. A charge of *four grains* of friction powder, in a moist state, is spread in the cup, and the slider is placed on it, with the rough side next the powder; the sides and ends of the cup are then doubled over the slider and pressed down firmly on it.

The tube is filled like common priming tubes, with a paste of mealed powder moistened with whiskey; a wire is passed in it, to leave an opening in the tube.

VARNISHING. The primers are coated all over with a lacker of asphaltum dissolved in spirits of turpentine, or with shellac varnish. When dry, they are put up in bundles of 10, and wrapped in water-proof paper.

FRICTION POWDER. The powder is composed of equal parts of *chlorate of potash and sulphuret of antimony*, moistened with alcohol and mixed together in a wet state.

LANYARD. The lanyard, for pulling off the primers, is a piece of strong cod line (about .2 in. thick) 12 feet long; to one end is attached a small *iron hook*, with an eye for the line, and to the other end, a *wooden toggle* .75 in. diameter, and 4 inches long.

When the primers are kept dry, not more than one in a hundred will miss fire. If injured by moisture, they become serviceable again when dried.

### *Materials for making* 1,000 *Friction Primers.*

| | |
|---|---|
| Sheet brass No. 22 | 11.5 lbs. |
| Do. No. 30 | 4.5 " |
| Chlorate of potash | 0.375 " |
| Sulphuret of antimony | 0.375 " |
| Mealed powder | 1.25 " |
| Whiskey | 1 quart. |

Weight of 1,000 primers finished, 13.25 lbs.

### *Percussion Primers for Cannon.*

COMPOSITION: $\frac{1}{4}$ of fulminating mercury and $\frac{3}{4}$ of the following composition:

| | oz. |
|---|---|
| Chlorate of potash | 6 |
| Sulphur | $1\frac{3}{4}$ |
| Gunpowder | 1 |
| Antimony | $\frac{1}{2}$ |

*To prepare this composition:* Grind the chlorate of potash on a marble slab, with a little water; add the antimony and rub them well together, with water enough to make a stiff paste; then add the sulphur and the gunpowder successively, and mix the whole thoroughly. The composition must be kept in glass or tin; when dry it explodes by percussion.

*To make the primers:* Add the fulminating mercury to the above composition in a moist state, and mix them together, on glass or marble, with a wooden or ivory spatula; mould this paste into lozenges, 0.4 inch diameter and 0.04 inch thick; put the lozenges between two circular pieces of musket cartridge paper 0.8 inch diameter, which are united by isinglass glue and pressed firmly together; dry them and cut the paper with a circular cutter 0.6 inch in diameter.

Coat the primers with mastic varnish, or a solution of sealing wax in spirits of wine, or with other water proof varnish; keep them in glass bottles.

The cup of a quill tube may also be used to contain the fulminating composition, the barrel of the tube being charged with rifle powder.

Or the wafer may be made to form the bottom of a paper cap, which fits on the hammer of the lock.

## FIREWORKS FOR SIGNALS, LIGHTS, AND INCENDIARY PURPOSES.

All dry compositions must be well mixed, first by the hands, and then by being passed several times through a fine hair sieve, in order that the ingredients may be thoroughly incorporated. In mixing compositions which require the use of fire, the greatest precautions are necessary, particularly for those in which gunpowder enters. The dry parts of the composition may, generally, be mixed together first, and put by degrees into the kettle when the other ingredients are fluid, being well stirred all the time. When the dry ingredients are very inflammable, the kettle must not only be taken off from the fire, but the bottom of it must be dipped in water, to prevent the possibility of accidents.

## *Signal Rockets.*

IMPLEMENTS. *Formers*, for rolling the cases on—*rolling bench*—*callipers*, for measuring the diameter of the case—3 *hollow drifts*, bored to admit the spindle of the mould—1 *solid drift*—*former* for the cone—*former* for the pot—*mould and spindle*—*charging ladle*—*mallets*—*knives*—*scissors*—*gimlets*, for piercing the clay heads—*press* and *crank*, for rolling the cases—*choking machine*.

The dimensions of moulds, implements, and rockets are proportioned to the diameter of the orifice of the mould, or the exterior diameter of the rocket. The usual sizes are 1.5 in. and 2 in.

| | | |
|---|---|---|
| Height of the base of the mould | 1 | diameter of the orifice. |
| Height of the mould | $6\frac{1}{2}$ | " |
| Exterior diameter of the mould | $1\frac{1}{3}$ | " |
| Height of the spindle | $3\frac{1}{2}$ | " |
| Nipple | $\frac{1}{2}$ | " |
| Length of the screw of the spindle which passes through the foot of the mould | 1 | " |
| Thickness of the spindle: At the top | $\frac{1}{6}$ | " |
| Thickness of the spindle: At the bottom | $\frac{1}{3}$ | " |
| Thickness of the nipple: At the top | $\frac{1}{3}$ | " |
| Thickness of the nipple: At the bottom | $\frac{2}{3}$ | " |

Thickness of the base equal to its height.

*Moulds* for rockets are cast in one piece and bored to the proper calibre.

*Spindles*, with their nipples, are made of cast steel; the base and screw, of iron.

*Drifts* and *formers* are made of brass, or of hard seasoned wood. The wooden drifts are tipped with copper $\frac{1}{8}$ of an inch thick, which is let into the wood without exceeding the size of the drift—the first drift is pierced so as to receive the whole length of the spindle; the second to receive $\frac{2}{3}$; the third, $\frac{1}{3}$; the fourth solid. Each drift has a handle 4 or 5 inches long, and somewhat larger than the body of the drift; the top strengthened by a band of copper. The diameter of the *former* for cases is $\frac{2}{3}$ that of the orifice of the mould—one end is pierced to receive the tap of a piece of the same diameter as the former, and $1\frac{2}{3}$ diam. long—the diameter of the tap or small part of this piece, which enters into the former, for choking the case, is $\frac{1}{3}$ of the interior diameter of the mould. The diameter of the *ladle* for charging a rocket is equal to the interior diameter of the rocket and the length $1\frac{1}{2}$ diam.—it holds as much composition as, when driven, will measure in height one-half of the interior diameter of the case.

*Mallets* for driving 1.5 in. and 2 in. rockets weigh about two and three pounds respectively.

| | | | |
|---|---|---|---|
| Interior diameter of rocket case | | $\frac{2}{3}$ | exterior diameter. |
| Height of former | | 10 | " |
| Length | 1st drift without the handle | $5\frac{2}{3}$ | " |
| | 2nd drift do. | 4 | " |
| | 3d drift do. | $2\frac{1}{3}$ | " |
| | 4th drift do. | $1\frac{2}{3}$ | " |
| | former for pot | $2\frac{1}{3}$ | " |
| | former for cone | $1\frac{2}{3}$ | " |
| Diameter | former | $\frac{2}{3}$ | " |
| | drift | $\frac{2}{3}$ | " |
| | pot | 1 | " |
| | base of cone | $1\frac{2}{3}$ | " |

The former for cones has a handle 3 inches long in the centre of the base.

*Making rocket cases.* A sheet of paper No. 4 makes 2 strips for a 2-in. or an 1.5 in. rocket, by cutting it parallel to the short or the long side respectively. The former is first enveloped with a sheet of strong smooth paper which is pasted after the first turn, and rolled tight in the press; the other strips of paper are then rolled on the former in the same manner, until the case has attained the requisite size.

*To choke the case.* Wrap a piece of strong paper over it, at the joint in the former, to prevent the cord from chafing it; take a turn around it with the choking cord, and press on the treadle, turning the case at the same time, and drawing out the small part of the former as the paper contracts; wrap the choke firmly with strong twine. Let the case dry slowly, and when perfectly dry, trim it to the proper length, so that the distances from the middle of the choke to the bottom and top of the case shall be equal to the distance from the bottom of the spindle to the bottom and top of the mould respectively.

| COMPOSITIONS. | Nitre. | Sulphur. | Charcoal. | Steel filings. |
|---|---|---|---|---|
| 1 | 16 | 4 | 6 | 4 |
| 2 | 10 | 2 | 3 | |
| 3 | 8 | 2 | 3 | |

DRIVING ROCKETS. The composition must be well mixed by passing it through fine sieves and by rubbing it in the hands; the charcoal, being the lightest ingredient, must be added after the nitre and sulphur have been mixed; steel filings or antimony should be added after the charcoal. Whilst driving the rocket, the composition must be frequently stirred to prevent the settling of these heavy materials to the bottom. The clay which is driven in the top is pierced with a gimlet to the composition; through this hole the fire communicates to the bursting charge in the pot which contains the ornaments.

*To put the case in the mould.* Place it with the choked end down, over the spindle, and settle it with a mallet until it rests on the base of the spindle; then set the mould over it and key it to the base.

*To drive the rocket.* The hollow drifts are first used, taking the shorter drifts as the case fills, until the composition reaches the top of the spindle; then drive 1 diam. in height with the solid drift, cover this with a patch of stiff paper cut to fit the case, and over this patch drive a wad $\frac{1}{3}$ diam. high, of clay, or of plaster of Paris slightly moistened with water.

Rockets are sometimes driven solid throughout, and afterwards bored with a tap of the form of the spindle.

A rocket is primed with a piece of quick-match about 2 feet long, which is coiled in the bottom of the case, and covered with a cap of strong paper pasted down or tied in the choke.

The force to be employed in driving rockets depends on their size: A rocket 1.5 in. diam. receives 25 smart blows, and a 2 in., 30 blows of the mallet, on each ladleful of composition.

| WEIGHT. | 2-in. | 1.5-in. |
|---|---|---|
| | Oz. | Oz. |
| Case ready for charging | $9\frac{1}{2}$ | 4 |
| Case charged | 16 | 8 |
| Rocket finished | 20 | 10 |

POTS FOR ROCKETS, are made of rocket paper; two or three turns of paper are rolled upon a former of the same diameter as the rocket, being well pasted, except the interior or first turn upon the former. The pot is two diameters long, and is secured in its place on the rocket by paste and an exterior covering of fine paper. The interior depth of the pot, when attached to the rocket, is one diameter and a half.

CONES, are made of rocket paper, which is cut into circular pieces equal in diameter to twice the length of the cone intended to be made; each piece, being cut in half, makes two cones. They are rolled upon the former, pasted, and dried for use. In applying the cone to the rocket, its base is cut to the same diameter as the exterior of the rocket on which it rests; it is then filled with tow, to enable it the better to resist the action of the air, without much increasing its weight; it is confined in its position by another cone made of fine paper, about an inch longer than the interior cone; this outside cone must have its base

cut in slips, which being well pasted, unite with the sides of the rocket or pot and firmly secure the interior cone; a narrow slip of fine paper is then pasted over the bottom of the exterior cone, as a finish to the head of the rocket.

Sticks for rockets, are made of dry pine or other light wood; the length is 49½ diameters, or 9 times the length of the case; the large end which is attached to the rocket is ⅓ the exterior diameter square, diminishing to one half of that thickness at the lower end; in the large end, a groove is made of a length ⅔ that of the rocket case, in which the rocket is tied; the end of the stick is beveled off, to present less resistance to the air; just below this bevel, and also opposite to the choke of the rocket, notches are cut out to receive the twine with which the rocket is fastened to the stick. The poise of rockets should be verified by balancing them on a knife edge. Those of an exterior diameter under 1¼ in. should be balanced at 3 diameters from the neck; those of a diameter between that and 2 in., at 2½ diameters; and those of greater dimensions, at 2 diameters. All these dimensions and precautions should be strictly observed, for if the stick be too light, the rocket will not rise vertically, and if the stick be too long and heavy, it will rise slowly and not arrive at its proper height.

### *Decorations for Rockets.*

The pots of rockets are charged with various decorations, as *stars*, *serpents*, *gold rain*, *rain of fire*, *marrons*, *crackers*, &c., and with about half a charging ladleful of powder.

Stars are the most beautiful decorations of rockets. They are made by driving the composition, moistened with alcohol and a small quantity of gum arabic solution, in portfire moulds without any paper case, and with a moderate number of blows; they are cut into lengths of about ¾ of an inch and dredged with mealed powder. A more expeditious and better mode of making them is, to mould them in a brass cylinder of the diameter desired for the stars, and push them out with a rammer, cutting them into proper lengths as they are formed. Stars, after being dredged with mealed powder, must be dried in the shade. The gum arabic used in star composition is intended to give such consistency to the stars that the explosion of the head of the rocket may not break them in pieces and thereby destroy the effect.

| Compositions. | Nitre. | Sulphur. | Mealed powder. | Antimony. |
|---|---|---|---|---|
| 1 | 16 | 8 | 3 | |
| 2 | 16 | 7 | 4 | |
| 3 | 16 | 8 | 4 | 1.5 |

SERPENTS are driven in small cases made of rocket paper or playing cards, rolled over a former 0.4 inch in diameter and covered with two thicknesses of strong fine paper, the last turn of which is pasted. When dry, these cases are choked at one end, without being entirely closed, and are then charged about $\frac{2}{3}$ of their length with composition, by means of a small mallet, a drift and a block of wood with a hole bored in it, to receive nearly the whole length of the case. The case is choked over the composition, and the remainder of it is nearly filled with mealed powder, upon which a small paper wad is placed; a clay head is then driven on it and the end of the case turned down, to secure it; the other end is opened with a punch and primed with priming paste, or a small strand of quick match. Serpents are placed perpendicularly in the pot, with the primed end downwards.

| COMPOSITIONS. | Nitre. | Sulphur. | Mealed powder. | Charcoal. | Steel filings. |
|---|---|---|---|---|---|
| 1 | 3 | 2 | 16 | $\frac{1}{2}$ | |
| 2 | 15 | 4 | – | $2\frac{1}{2}$ | |
| 3 | 16 | 2 | 4 | 6 | |
| 4 | 16 | 4 | 4 | 2 | 6 |

GOLD RAIN, is made in the same manner as stars, observing to cut or mould the composition into pieces of equal size. The effect of this decoration is beautiful and it is less troublesome than serpents.

| COMPOSITIONS. | Nitre. | Sulphur. | Mealed powder. | Charcoal. | Pulverized soot. | German black. | Dissolved gum. |
|---|---|---|---|---|---|---|---|
| 1 | $\frac{1}{2}$ | $1\frac{1}{2}$ | 8 | – | $\frac{1}{2}$ | $\frac{1}{2}$ | $\frac{1}{2}$ |
| 2 | 16 | 10 | 6 | 4 | – | 2 | |
| 3 | 16 | 8 | 8 | 2 | – | 2 | |

RAIN OF FIRE, is made with small cases 0.3 in. diameter and 2 in. long; two thicknesses of paper are sufficient for them. The end of the case is closed and it is charged and primed like that for a serpent, omitting the powder for a cracker.

*Composition.* Mealed powder 16—Charcoal 6. Another kind which shows in sparks is made of camphor 16 parts, nitre 8, mealed powder 8, tow 8. The composition is formed into a very liquid paste with gummed brandy; tow chop-

ped fine is put into the paste, and rolled into small balls about the size of buck-shot; when they have imbibed sufficient composition, they are rolled in mealed powder and dried.

MARRONS, are cubes filled with grained powder, and enveloped with two or three layers of strong twine or marline; to give them more consistency they are dipped in kit; they are primed by punching a small hole in one corner and inserting quick match. They are made of strong pasteboard, cut into the form of a parallelogram whose sides are in the proportion of 3 to 5, divided by 4 cuts from each side extending $\frac{1}{3}$ of the width and at equal distances apart, which prepare the paper for folding into the form of a cube of the size of one of the small squares thus marked out.

PACKING ROCKETS. The sticks are tied up in bundles; the rocket case is wrapped with tow so as to be larger than the pot, the tow being confined with a piece of twine long enough to tie on the stick. The rockets are placed in a box on a bed of tow laid under the choke, and they are pressed closely together; tow is then carefully stuffed in between the heads of the rockets; each tier is also covered with tow.

## *War Rockets.*

The cases of war rockets are made of sheet iron, lined with paper, or wood veneer. The head is of cast iron, and may be either a solid shot, or a shell with a fuze communicating with the rocket composition. The case is usually charged solid, by means of a ram, or a press, and the core is then bored out.

The dimensions of war rockets are indicated by the exterior diameters of the cases.

These rockets have been made of two kinds, viz:

1. *The Congreve rocket*, which has a directing stick fastened to the tail piece, in the axis of the rocket.

2. *Hale's rocket*, which requires no stick, its direction being maintained by a peculiar arrangement of holes in the tail piece, through which the flame issues.

War rockets are usually fired from tubes or troughs, mounted on portable stands, or on light carriages.

For some memoranda of the ranges of Hale's rockets, *see* CHAPTER XIII.

## *Fire stone.*

| | | |
|---|---|---|
| COMPOSITION.—Rosin | 3 | parts. |
| Sulphur | 4 | " |
| Nitre | 10 | " |
| Regulus of antimony | 1 | " |

Pulverize these materials separately; mix them with the hands, and sift them three times. In a furnace of the second kind, (p. 230,) or in an iron kettle in the open air, melt together 1 part of *mutton tallow* and 1 of *turpentine;* add the above composition, a small quantity at a time, stirring the mixture constantly with large wooden spatulas. Let one portion of the composition be melted before the next is added, and work with great precaution, to prevent it from taking fire.

The composition is cast into cakes, or into cylindrical moulds. These moulds are made of paper and are of two sizes: No. 1, for 13-in. and 10-in. shells; No. 2, for 8-inch, 42-pdr and 32-pdr. In the axis of the cylinder a small paper tube is placed, to contain the priming. The cases of the moulds are about .05 in. thick; they are made by rolling rocket paper on a former, and fastening it with glue. The priming tubes are made with 4 turns of musket cartridge paper.

The moulds are supported by a frame of wood, in the bottom part of which are fastened a number of spindles to support the priming tubes. To the upper part of this frame a tin pan is fixed, having cylindrical spouts attached to the under side, to support the upper ends of the moulds; the frame may contain 20 moulds in two rows.

When the composition has become solid, take the cylinders out of the frame, and trim them; charge the priming tubes with the composition No. 1 for mortar fuzes, driven with 21 blows of the mallet, and dip the ends of the cylinder in mealed powder.

| DIMENSIONS OF CYLINDERS, ETC. | No. 1. | No. 2. |
|---|---|---|
| | In. | In. |
| Diameter of former for making the case | 1.3 | 0.9 |
| Length of ditto | 12. | 12. |
| Exterior diameter of the case | 1.4 | 1. |
| Length of the case | 3. | 3. |
| Diameter of the former for priming tubes | 0.25 | 0.25 |
| Length of ditto | 6. | 6. |
| Diameter of the spindle of the mould | 0.2 | 0.2 |
| Length of ditto above the base | 4.25 | 4.25 |
| | Lbs. | Lbs. |
| Quantity of composition for 100 cylinders | 18. | 10.$_2$ |

### *Valenciennes Composition.*

Nitre.....50 parts.
Sulphur.....28 "
Antimony.....18 "
Rosin..... 6 "

The composition is cast in cylindrical copper moulds 6 inches long, of a diameter to suit the shell in which it is to be used. It is used as an incendiary composition, in charging shells, and is inserted along with the bursting charge, in pieces as large as the shell will admit without interfering with the fuze.

### *Carcasses.*

| CALIBRE - - | 13-in. | 10-in. | 8-in. | 42-pdr. | 32-pdr. | 24-pdr. | 18-pdr. |
|---|---|---|---|---|---|---|---|
| | Lbs. | Lbs. oz. | Lbs. oz. | Lbs. oz. | Lb. oz. | Lb. oz. | Lb. oz. |
| Weight of composition - - - | 19 | 7 8 | 4 4 | 2 8 | 1 14 | 1 10 | 1 1 |

COMPOSITION. A solution of equal parts of white turpentine and spirits of turpentine, incorporated with as much portfire composition as will give the whole a compressible consistency; the portfire composition must be previously mixed with a small quantity of finely chopped tow. When properly incorporated, this composition is compactly pressed into the carcass with a drift, so as to fill it entirely. Sticks of wood of about $\frac{1}{2}$ inch diameter are then inserted into each hole of the carcass, in such a manner as to meet in the centre of the composition, in order that, when they are withdrawn, as many holes shall remain in the composition, in the same direction; in every hole thus formed, insert three strands of quick-match, of a length sufficient to allow of their being folded over the edge of the hole two or three inches; some dry portfire composition must then be pressed into the interstices, to keep the quick-match fast in its place. Carcasses may be filled with the above composition, omitting the *tow*, or with *fire stone*, and the holes may be bored with a gunner's gimlet before the composition becomes hard. The quick match must be coiled into the holes and secured, until the carcass is wanted, by fastening a small cotton patch over the holes with kit.

*Common shells* may be loaded and used as carcasses in the following manner: The bursting charge is placed in the bottom of the shell in a flannel bag, over which carcass composition is driven until the shell is nearly filled; then insert 4 or 5 strands of quick-match which must be secured by driving more composition upon it. These shells, after burning as a carcass, explode.

## *Fire Balls.*

*Fire balls* are projectiles of an oval shape formed of sacks of canvas, filled with combustible composition. They are used to light up the enemy's works and are loaded with shells, to prevent them from being approached.

The sacks are made of strong and close canvas, (sail cloth,) which may be cut straight and gathered at the ends; or more neatly, cut in three gores or curved pieces, to form a ball. They are made of two or three thicknesses of stuff, according to its strength, and the pieces are sewed together with strong thread. One end is left open, or the bag may be attached to an iron hoop, forming a mouth for charging it; this mouth must be large enough to admit the shell with which the fire ball is loaded. After being sewed, the sack is turned, to bring the seams inside.

| COMPOSITION. | 13-in. | 10-in. | 8-in. |
|---|---|---|---|
| | Lbs. | Lbs. | Lbs. |
| Rosin | 8. | 5.5 | 2.75 |
| Pitch | 4. | 2.75 | 1.25 |
| Mutton tallow | 1.5 | 1. | 0.5 |
| Spirits of turpentine | 1. | 0.66 | 0.33 |
| Linseed oil | 1. | 0.66 | 0.33 |
| Gunpowder | 12. | 8. | 4. |
| Dry composition | 10. | 6.66 | 3.33 |
| Chopped tow | 1. | 0.66 | 0.33 |
| Dry composition, additional | 2. | 1.33 | 0.66 |
| | In. | In. | In. |
| Height of composition. Before inserting the tarred link and above the shell | 1. | 1. | 0.5 |
| Height of composition. Whole height | 12. | 10. | 8. |
| Tarred link. Exterior diameter | 6.5 | 6. | 4.75 |
| Tarred link. Thickness | 2. | 1.75 | 1.5 |

*The dry composition* consists of:

| | |
|---|---|
| Beeswax | 0.66 |
| Nitre | 16. |
| Flowers of sulphur | 6. |
| Inflammable saw dust | 1.08 |
| Regulus of antimony | 2.66 |
| Gunpowder | 1. |

Melt the beeswax over the fire and add the nitre to it; when the mixture is about to melt, take it off from the fire and stir in the sulphur; then add the saw

dust, the antimony, and lastly, the powder, and mix them with the hands—Work with great caution against their taking fire.

*To prepare the inflammable saw dust:* Boil the saw dust in a solution of half its weight of nitre dissolved in an equal quantity of water—crude nitre or damaged gunpowder may be used for this purpose. Evaporate to dryness, stirring frequently; then spread out the saw dust, to become perfectly dry before being used.

*To prepare the shell:* A 32-pdr. shell is put into a 13-inch fire ball; a 24-pdr., into a 10-inch; a 12-pdr., into an 8-inch. The shell being charged with powder, put in a slow fuze. Dip the tarred link into the melted rosin, pitch, and tallow, and fasten it with twine to the shell, around the fuze hole.

*To charge the sack:* Put in the soft composition to the height indicated in the table, and level it with a spatula; put in the shell, with the tarred link, the fuze downwards; fasten the shell down with twine passed through the sides of the sack, or with a piece of canvas sewed to the sides. Fill the sack with composition to the proper height above the shell; put the additional quantity of dry composition in a heap in the centre of the sack, and finish filling it with the soft composition. Close the mouth by sewing, or tying the pieces together.

*The iron bottom:* The ball is furnished with an iron bottom, to prevent it from being broken by the force of the charge in the mortar. These bottoms are made of plate iron 3-16 in. thick.

| DIMENSIONS. | 13-in. | 10-in. | 8-in. |
|---|---|---|---|
| | In. | In. | In. |
| Inside diameter at top | 10.5 | 8.25 | 6.5 |
| Depth of concavity | 2.75 | 2.25 | 2.2 |

The iron is cut in a circular form, heated and partly shaped with a set hammer, in a concave wooden former; it is again heated and finished in an iron former. It is then put into a lathe, where the outer edge is trimmed and chamfered to the thickness of $\frac{1}{8}$ in.

The iron bottom is attached to the ball with the following cement:

| | Lbs. | Oz. |
|---|---|---|
| Beeswax | 0 | 3 |
| Pitch | 2 | |
| Rosin | 1 | |
| Turpentine | 1 | |
| Brick dust | 0 | 9 |

The materials for the cement are melted successively over a slow fire, and the brick dust is stirred in last.

The iron bottom is filled about one-third full with the cement, and the loaded end of the fire ball is inserted in it and left to cool.

The ball is next covered and strengthened with a net work made of spun yarn or cord, from 0.25 to 0.5 inch thick, according to the size of the ball. This net work is commenced at the bottom of the sack, and terminates at the top in a strong loop, which forms a handle for carrying the ball. The ball, when finished, should pass through the large shell gauge. Fire balls are dipped in a composition of equal parts of pitch and rosin, made warm.

*To prime the balls:* Make 4 holes, about 3 in. below the top, by driving in greased wooden pins, 1 in. diam. and 2 in. deep. When the ball is to be primed take out these pins and fill the holes with fuzes, or with fuze composition, driven as in a fuze, and with two strands of quick match, held fast by the composition; leave room in the priming hole for coiling the quick match, and cover it with a piece of canvas fastened with 4 nails.

The balls are not primed until they are to be fired.

## *Light Balls.*

*Light balls* are made in the same manner as fire balls, except that there is no shell in them, as they are used for lighting up our own works.

## *Tarred Links.* (Tourteaux.)

Are used for lighting up a rampart, or for incendiary purposes. They consist of coils of soft rope placed on top of each other and loosely tied together; the exterior diameter is 6 inches, the interior 3 inches. They may be made of pieces of slow match about 15 feet long; immerse them for 10 minutes in a composition of 20 pitch and 1 tallow, and shape them under water; when dry, plunge them in a composition of equal parts of pitch and rosin, and roll them in tow or sawdust. In making them, the hands of the workmen should be covered with linseed oil.

A *link* takes from 1 lb. to 1¼ lb. of composition and ½ lb. of tow. Two of them are put into a rampart grate, separated by shavings. They burn one hour in calm weather, half an hour in a high wind, and are not extinguished by rain. The grates are placed about 250 feet apart.

## *Pitched Fascines.*

Fagots of vine twigs, or other very combustible wood, about 20 in. long and 4 in. in diameter, tied in three places with iron wire, may be treated in the same

manner as *Links*, and used for the same purpose; their inflammability is increased by dipping the ends in melted fire stone.

### *Torches.*

In a solution of equal parts of water and nitre, boil old rope or slow match well beaten and untwisted; let it dry perfectly, and cut it in pieces about 4 feet long; tie three or four of these pieces around a piece of pine wood about 2 in. diameter and 4 feet long; cover the whole with a mixture of equal parts of sulphur and mealed powder, moistened with brandy; fill the intervals between the cords with a paste of 3 parts of sulphur and 1 of quick lime. When it is dry, cover the whole torch with the following composition:

| | |
|---|---|
| Pitch | 3 parts. |
| Venice turpentine | 3 " |
| Turpentine | ½ " |

### *Kit.*

*Composition:* 9 rosin, 6 pitch, 6 beeswax, 1 tallow. To be melted together and poured into water; then worked with the hands until it becomes soft and pliable.

### *Incendiary Match.*

Boil slow match in a saturated solution of nitre; let it dry; cut it into pieces, and plunge them into melted fire stone.

A yard of match requires about 1 lb. of fire stone.

### *Blue Lights.*

*Composition for* 100 *Lights:*

| | Lbs. | oz. |
|---|---|---|
| Saltpetre | 9 | 10 |
| Sulphur | 2 | 6½ |
| Red orpiment | 0 | 11 |

The ingredients are pulverized, rubbed between the hands, and passed several times through a fine hair sieve; the brilliancy of the light depends on the purity and thorough incorporation of the materials.

The composition is pressed into a hemispherical cup about 2.5 in. diameter, made of well seasoned wood, (beech, linden, &c.,) with a stem or handle about the size of a 13 in. fuze. It is primed with a strand of quick match, and covered with paper which is pasted over the bottom of the cup.

## STORAGE AND PRESERVATION OF AMMUNITION AND FIREWORKS.

*Leaden balls* are generally kept in cellars, on account of their weight; the boxes should be kept as dry as possible, and so piled as to admit the circulation of air about them.

*Flints* should be kept in cool, damp, and dark situations, generally in cellars; air, light, and heat seem to injure them; the occasional circulation of air is necessary for the preservation of the boxes or barrels containing them.

*Cartridges for small arms* are kept in magazines; the barrels or boxes being piled 3 or 4 tiers high at most. If barrels or boxes are not at hand, lay the bundles flat on a tarpaulin and pile them 10 high.

*Fixed ammunition for cannon.* If not in boxes, it should be placed in piles formed of two parallel rows of cartridges, with the sabots together; in 4 tiers for 12-pdr., and 5 for 6 pdr.; chock the lower tier with strips of wood fastened with small nails; put a layer of tow 2 in. thick between the shot; let the piles rest on planks, if there is no floor, and cover them with tarpaulins; have the place swept, and the cartridge bags brushed off. Leave a passage of 18 in. between the double rows, and keep them 2 feet from the walls.

Fixed ammunition should not be put into powder magazines, if it can be avoided; it should be kept in a dry place, above the ground floor if practicable; the store rooms should be always aired in fine weather; the piles should be taken down and made up again every six months at most, the bags examined and repaired, and the damaged cartridges broken up. A ticket on each pile should show the number and kind of cartridges, the additions to the pile, and the issues.

*Canisters.* Piled up like fixed ammunition, in 4 tiers for 24's and 18's; and 5, for 12's and 6's. Empty canisters in 10 or 12 tiers; the bottoms and covers separately.

*Cartridge bags filled.* Like fixed ammunition; or packed in boxes or barrels.

*Paper cartridge bags.* In bundles, packed in boxes or on shelves, in a dry place, with the precautions before indicated against worms and moths.

*Loaded shells* should never be put into magazines, except from absolute necessity; powder is not well preserved in them. They should be piled on the ground floor of a secure building—on planks, if the floor is not boarded; in 6 tiers at most; the fuzes of the lower tier in the vacant spaces between the shells; those of the other tiers turned downwards, like the fuze holes of empty shells; the pile should be covered with a tarpaulin.

*Slow-match.* In a dry place, such as a garret.

*Quick-match.* If not in boxes, it may be hung up in bundles, on ropes or pins, and covered with paper.

*Priming tubes, Portfires, Fuzes, Signal Rockets.* In safe and dry situations, packed in boxes.

*Fire balls.* In a cool place, separated from each other by shavings or straw, if they are piled up.

*Tarred Links.* Strung on a rope and hung up; for transportation they are packed in barrels, with straw between the tiers.

*Fascines and Torches.* Packed like the preceding.

*Fire stone and Incendiary Compositions* should not be kept in large quantities.

*Percussion primers,* in cool, dry places, apart from gunpowder and ammunition. Some cannon primers have exploded under circumstances which led to the opinion that their combustion was spontaneous. They should be carefully protected from rats, &c., by being enclosed in glass or tin.

## BREAKING UP UNSERVICEABLE STORES.

CARTRIDGES FOR SMALL ARMS. 1 *Box*—1 *rectangular screen,* of brass wire, which fits in the box—1 *board,* with 4 *copper hooks,* placed across the middle of the screen—*boxes* for balls—*barrels* for powder—1 *paper press*—1 *sieve*—*stools.*

Put the bundles of cartridges on the screen, and open them there near the wire gauze; put the pieces of twine on the hooks, the papers on the board; the balls remain on the screen, and must be well washed. The serviceable papers are put under the press, the others thrown into water or burnt. The powder is dried and sifted, to separate the dust and the caked powder, which are laid by to be reworked, or to be melted for the saltpetre.

FIXED AMMUNITION FOR CANNON. 1 *Tarpaulin*—1 *box*—2 *barrels*—1 *knife*—2 *brushes*—1 *punch*—1 *hammer*—1 *scraper* (piece of *sword blade*)—*tow*—a *tub* half full of water, to clean the balls—*stools.*

One man holds the cartridge over the box, whilst another cuts the twine, takes off the strapped shot, brushes it, and stands it on the tarpaulin, on its sabot; the first man pours the good power into a barrel, the caked powder into another, turns the bag wrong side out, and cleans it. The strapped shot are taken to the door of the laboratory, where the shot which still require cleaning are separated from their sabots and immersed in the tub of water; after standing some time they are washed and cleaned. The others remain strapped. The serviceable, reparable, and unserviceable cartridge bags are separated from each other; the last are immersed in water. The breaking up of fixed ammunition requires many precautions and should never be done in the magazine.

CANISTERS. Turn up the slit ends of the canisters, take off the covers and empty the canisters, separating the shot and bottoms.

QUILTED GRAPE. Cut the quilting, open the bag and take out the shot; then separate the bag from the stool.

PORTFIRES. Split the paper, take out the composition and pulverize it by rolling for 2 hours. It may be made to burn more or less quickly by adding mealed powder or sulphur.

## *Unloading Shells.*

This is necessary in order to save room in the store-houses, and to prevent accidents and the deterioration of the powder. It should be performed with great care, and at a distance from the magazines.

1 Artificer—1 helper.

IMPLEMENTS. 1 *Fuze extractor—a coil of rope*, or a *block*, to place the shell on—1 *brace*, with *bits* of the size of the bore of the fuzes—1 *copper chisel*—1 *wooden drift*—1 *mallet*—1 *copper hook*, and *rags*, to get out the powder and clean the interior of the shell—1 *knife*—a *tub* and a *basket* for the powder and fuzes—a *tarpaulin*—a *bucket of water*.

*For large shells*, in addition to the above: a *pair of shell hooks* and a *handspike*—2 *trestles* and a *frame*, to rest the shells on after extracting the fuze, for the purpose of emptying the shells over the tub.

Cut off the cap of the fuze; draw the fuze, and as soon as it is loose, hold the shell over the tub and empty it.

If the fuze breaks, or is bruised so that the extractor cannot hold it, pour water into the cup, and with the brace and bit bore out about 0.25 in. of composition; pour in more water, and proceed in the same manner until the composition is removed to the depth of 3 inches; then use the extractor again, or drive the fuze in with the wooden drift. If this cannot be done, bore out all the composition and wet the powder in the shell, by pouring water through the fuze; then drive in the fuze, and split it with the chisel, to get out the pieces.

## *Liniment for Burns.*

Sweet oil, 8 parts; hartshorn, 1 part.

Or, equal parts of linseed oil and lime water.

# CHAPTER ELEVENTH.

## EQUIPMENT OF BATTERIES FOR FIELD, SIEGE, AND GARRISON SERVICE.

## EQUIPMENT OF FIELD BATTERIES.

### INTERIOR ARRANGEMENT OF AMMUNITION CHESTS FOR FIELD GUNS AND HOWITZERS.—Plate 18.

The principal divisions of a chest are designated as the *right half* and the *left half*, to a person facing the front of the chest.

The smaller divisions in each half, perpendicular to the sides, are designated as *first*, *second*, *third*, &c., from the principal partition, each way; the divisions parallel to the sides are designated as the *front*, *middle*, and *rear divisions*.

#### *Ammunition Chest for the 6-pounder Gun.*

*Eight partitions*, (POPLAR,) four in each half, perpendicular to the sides of the chest. The partitions are supported by *two strips* of wood at each end, forming a groove in which the partition slides; each strip is fastened to the side of the chest with *four copper nails*.

In the first division of the right half are *two bolsters*, for spherical case shot; one fastened to the principal partition by 3 *screws;* the other fastened to the first moveable partition by 3 *screws*.

*One tray*, for holding equipments, rests on the partitions in the left half of the chest. The tray has *two sides*, *two ends*, and *one bottom*, (POPLAR OR WHITE PINE.) The sides and ends are dovetailed together and fastened by 12 *nails;* the bottom is fastened to the ends and sides by 14 *brass screws*. Three finger holes are bored in the inside of the ends, to lift the tray by; and a hole is bored through the middle of the bottom, to let the air escape when the tray is lifted out.

### *Ammunition Chest for the* 12-*pounder Gun.*

*Six partitions*, three in each half, perpendicular to the sides of the chest, supported as in the 6-pounder chest.

*Four bolsters*, for spherical case shot; one of them fastened to the principal partition with 3 *screws;* two fastened to the first partition in the right half with 3 *screws*, and one to the left side of the second partition, right half, with 3 *screws*.

The second and third partitions in the right half are made higher than the others, to suit the height of the canisters fixed.

*One tray*, for equipments, in the left half; made like that for the 6-pdr. chest.

### *Ammunition Chest for the* 12-*pounder Howitzer.*

*Six partitions*, three in each half, supported like those of the 6-pounder chest.

*Twenty-one bolsters*, for the lower tier of shells and spherical case shot. They are cupped out to receive the balls, and have holes bored through the bottom, for the fuzes to lie in. They are placed in the bottom of the chest, three in each division, except the first division in the right half; they are fastened to the bottom, each by 4 *sprigs*.

*Twenty-eight props*, for the upper tier of shells and spherical case. Four of the props are placed in each division, except the first one in the right half. Two of them are fastened to each end of the chest, two to the left side of the principal partition, and two to the right side of the first partition in the right half, each by 6 *copper nails*.

The rest of the props are fastened in pairs to the moveable partitions, each by 6 *copper nails*.

*Six props* for canisters, (OAK,) in the first division of the right half; three fastened to the principal partition, three to the moveable partition, each with 3 *screws*.

### *Ammunition Chest for the* 24-*pounder Howitzer.*

*Eight linings*, two in each of the front and rear divisions, fastened to the ends of the chest and to the principal partition, each by 6 *copper nails*.

*Four long partitions*, two in each half, parallel to the sides of the chest; they are supported by the end linings and by *two upright strips*, fastened to the ends and principal partition, each by 4 *copper nails*.

*Two short partitions* for canisters, in the rear division of the right half; each of them is supported by 4 *strips*, fastened to the back of the chest and to the long partition, each by 3 *copper nails*.

*Seven short partitions*, for shells and spherical case shot: two in each of the front divisions; two in the rear division of the left half, and one in the middle division of the right half. These partitions slide into grooves made each by *two upright strips*, which are fastened to the sides and to the long partitions, each by 4 *copper nails;* each partition is formed of two pieces which slip into the grooves, one over the other.

*Thirty-three bolsters* for shells and spherical case. Seven of them are fastened, at the bottom of the chest, to the end linings of the two front divisions and the left rear division, and to the principal partition in the right middle division, each by 2 *screws*. Twenty-four of the bolsters are fastened in pairs on each side of the short partitions of the two front divisions and the left rear divisions; twelve to the lower half and twelve to the upper half of the partitions; each pair fastened by 3 *screws* which pass through the bolsters and the partition. Two bolsters are fastened to the left side of the middle partition in the right half, one to the lower and one to the upper part of the partition, each by 2 *screws*.

## *Ammunition Chest for the 32-pounder Howitzer.*

*Six long partitions*, three in each half; one parallel to the ends, and two parallel to the sides of the chest; each partition is supported by 4 *strips* fastened to the sides and ends of the chest, or to the other partitions, each by 5 *copper nails*.

*Four short partitions*, one in the front and rear division of each half, made in two pieces and fastened in the same manner as those of the 24-pounder howitzer chest.

*Twenty-one bolsters* for shells and spherical case. Seven of them are fastened, at the bottom of the chest, to the ends and cross partitions, each by 2 *screws*. Twelve bolsters are fastened in pairs, as in the 24-pounder howitzer chest, to the short partitions in the left half, and in the rear division of the right half. Two bolsters are fastened, in like manner, on the right side of the short partition in the right front division.

*Screws and Nails for interior of Ammunition Chests.*

| | DESIGNATION. | No. | Size. | Length. | Kind. |
|---|---|---|---|---|---|
| 6-PDR. GUN. | *Screws*, For 2 bolsters for spher. case.. | 6 | No. 14 | 1.25 | Iron. |
| | *Screws*, " tray..... | 14 | No. 12 | 1. | Brass. |
| | *Nails*, for groove strips ..... | 128 | 3d | 1.13 | Copper. |
| 12-PDR. GUN. | *Screws*, For 2 single bolsters..... | 6 | No. 14 | 1.25 | Iron. |
| | *Screws*, " 2 double do..... | 3 | No. 14 | 2. | Do. |
| | *Screws*, " tray..... | 14 | No. 12 | 1. | Brass. |
| | *Nails*, for groove strips..... | 96 | 3d | 1.13 | Copper |
| 12-PDR. HOW'R. | *Screws*, For 3 bolsters for canisters .... | 9 | No. 14 | 1.25 | Iron. |
| | *Screws*, " 3 do..... | 9 | No. 14 | 1.5 | Do. |
| | *Nails*.., " bottom bolsters..... | 84 | Sprigs. | 1.5 | Do. |
| | *Nails*.., " upper bolsters and strips... | 264 | 3d | 1.13 | Copper. |
| 24-PDR. HOW'R. | *Screws*, For 9 single bolsters..... | 18 | No. 14 | 1.5 | Iron. |
| | *Screws*, " 12 pairs double do ..... | 36 | No. 14 | 2. | Do. |
| | *Nails*, for linings and strips..... | 216 | 3d | 1.13 | Copper. |
| 32-PDR. HOW'R. | *Screws*, For 9 single bolsters..... | 18 | No. 14 | 1.5 | Iron. |
| | *Screws*, " 6 pairs double do..... | 18 | No. 14 | 2. | Do. |
| | *Nails*, for strips..... | 200 | 3d | 1.13 | Copper. |

*Bill of Boards for interior of Ammunition Chests.*

| | DESIGNATION. | No. of pieces. | DIMENSIONS, (rough.) Length. | Width. | Thickness. | Quantity. | KIND. |
|---|---|---|---|---|---|---|---|
| | | | In. | In. | In. | Feet. | |
| 6-PDR. GUN. | Partitions..... | 1 | 168 | 11. | 0.625 | 8.02 | Poplar. |
| | Tray. bottom..... | 1 | 22 | 20. | 0.75 | 2.29 | Poplar, |
| | Tray. sides..... | 1 | 22 | 10. | 0.75 | 1.15 | or white |
| | Tray. ends..... | 1 | 20 | 11. | 1. | 1.53 | pine. |
| 12-PDR. GUN. | Partitions..... | 1 | 84 | 12. | 0.75 | 5.25 | Poplar. |
| | Partitions..... | 1 | 42 | 14. | 0.75 | 3.06 | Do. |
| | Tray. bottom..... | 1 | 22 | 20. | 0.75 | 2.29 | Poplar, |
| | Tray. sides..... | 1 | 22 | 7.5 | 0.75 | 0.86 | or white |
| | Tray. ends..... | 1 | 20 | 9. | 1. | 1.25 | pine. |
| 12-PDR. HOW'R. | Partitions..... | 1 | 120 | 15.5 | 0.75 | 9.69 | Poplar. |
| | Bolsters for lower tier..... | 1 | 54 | 10. | 2. | 7.50 | Do. |
| | Props for upper tier..... | 1 | 90 | 12. | 1. | 7.5 | Do. |
| | Bolsters for canisters..... | 1 | 8 | 10. | 1.5 | 1.87 | Oak. |
| 24-PDR. HOW'R. | Partitions..... | 1 | 96 | 15.5 | 0.75 | 7.75 | Poplar. |
| | Partitions..... | 1 | 13 | 10.5 | 1. | 0.94 | Do. |
| | Partitions..... | 1 | 96 | 8.25 | 1. | 5.5 | Do. |
| | Linings..... | 1 | 54 | 15.5 | 1. | 5.81 | Do. |
| 32-PDR. HOW'R. | Partitions..... | 1 | 108 | 16. | 1. | 12. | Poplar. |
| | Partitions..... | 1 | 60 | 8.5 | 1. | 3.54 | Do. |

*Ammunition carried in each Chest.*

| KIND. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| FOR 6-POUNDER GUN. | | Lbs. | |
| Shot, fixed | 35 | 266. | In the left half, and in 4th and 5th divisions of right half. |
| Spherical case, fixed | 5 | 34.1 | In 1st division, right half. |
| Canisters, fixed | 10 | 84. | In 2nd and 3d divisions, right half. |
| Spare cartridges, 1¼ lb | 2 | 2.6 | On the spherical case. |
| Fuzes... 2 sec.—*Black* | 2 | 0.1 | In the fuze pouch, or in bundles in the tray. |
| Fuzes... 3 sec.—*Red* | 5 | | |
| Fuzes... 4 sec.—*Green* | 3 | | |
| Percussion primers | 60 | 0.08 | In the tube pouch, or in bundles in the tray. |
| Friction primers | 40 | 0.52 | |
| Priming tubes | 20 | 0.30 | |
| Slow match, yards | 6 | 1.15 | On the ammunition in right half. |
| Port fires | 4 | 1.15 | |
| | | 390.00 | |
| FOR 12-POUNDER GUN. | | | |
| Shot, fixed | 20 | 308. | In left half, and in 4th division of right half. |
| Spherical case, fixed | 8 | 108. | In 1st and 2nd divisions, right half. |
| Canisters, fixed | 4 | 67.64 | In 3d division, right half. |
| Spare cartridges, 2½ lbs | 2 | 5.12 | On the spherical case. |
| Fuzes... 2 sec.—*Black* | 2 | 0.16 | In fuze pouch, or in bundles in the tray. |
| Fuzes... 3 sec.—*Red* | 8 | | |
| Fuzes... 4 sec.—*Green* | 3 | | |
| Fuzes... 5 sec.—*Yellow* | 3 | | |
| Percussion primers | 40 | 0.05 | In tube pouch, or in bundles in the tray. |
| Friction primers | 25 | 0.33 | |
| Priming tubes | 20 | 0.30 | |
| Slow match, yards | 6 | 1.15 | On the ammunition in right half. |
| Port fires | 4 | 1.15 | |
| | | 491.90 | |
| FOR 12-PDR. HOWITZER. | | | |
| Shells, fixed | 15 | 157.5 | In 2nd, 3d, & 4th divisions, right half. |
| Spherical case, fixed | 20 | 250. | In left half. |
| Canisters, fixed | 4 | 47.4 | In 1st division, right half. |
| Fuzes... 2 sec.—*Black* | 17 | 0.7 | In the fuze pouch, or in bundles, on the canisters, &c. |
| Fuzes... 3 sec.—*Red* | 35 | | |
| Fuzes... 4 sec.—*Green* | 18 | | |
| Percussion primers | 50 | 0.06 | In tube pouch, or in bundles, on the canisters, &c. |
| Friction primers | 30 | 0.40 | |
| Priming tubes | 20 | 0.30 | |
| Slow match, yards | 6 | 1.15 | On the canisters. |
| Port fires | 4 | 1.15 | |
| | | 458.66 | |

*Ammunition carried in each Chest*—Continued.

| KIND. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| FOR 24-PDR. HOWITZER. | | Lbs. | |
| Shells, strapped | 12 | 225.60 | In left half. |
| Spherical case, strapped | 8 | 184.00 | In front and middle divisions of right half. |
| Canisters | 3 | 63.75 | In rear divisions of right half. |
| Cartridges. Small charge. | 23 | 53.82 | 12 in middle division, left half; 9 in middle division, right half; 2 on canisters. |
| Cartridges. Large charge. | 2 | 5.40 | On canisters. |
| Fuzes 2 sec.—*Black.* | 6 | 0.40 | |
| Fuzes 3 sec.—*Red.* | 20 | | |
| Fuzes 4 sec.—*Green* | 7 | | |
| Fuzes 5 sec.—*Yellow* | 7 | | |
| Percussion primers | 30 | 0.04 | As for 12-pounder howitzer. |
| Friction primers | 20 | 0.26 | |
| Priming tubes | 10 | 0.15 | |
| Slow match, yards | 6 | 1.15 | |
| Port fires | 4 | 1.15 | |
| | | 535.72 | |
| FOR 32-PDR. HOWITZER. | | | |
| Shells, strapped | 8 | 196.80 | Front and rear divisions of left half. |
| Spherical case, strapped | 6 | 186.00 | Rear divisions, and right front division of right half. |
| Canister | 1 | 28.50 | Left front division, right half. |
| Cartridges. Small charge. | 15 | 46.50 | 1st division in each half. |
| Cartridges. Large charge. | 1 | 3.88 | |
| Fuzes 2 sec.—*Black.* | 4 | 0.28 | In fuze pouch, or in the middle divisions. |
| Fuzes 3 sec.—*Red.* | 14 | | |
| Fuzes 4 sec.—*Green* | 5 | | |
| Fuzes 5 sec.—*Yellow* | 5 | | |
| Percussion primers | 20 | 0.03 | In tube pouch, or in the middle divisions. |
| Friction primers | 15 | 0.20 | |
| Priming tubes | 10 | 0.15 | |
| Slow match, yards | 6 | 1.15 | In middle divisions. |
| Port fires | 4 | 1.15 | |
| | | 464.64 | |

*Implements and Equipments for Field Carriages.*

| KIND. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| FOR A GUN OR HOWITZER CARRIAGE. | | Lbs. | |
| Sponges and rammers | 2 | ..... | 12-pdr., 11.6 lbs.; 6 pdr., 9 lbs. |
| Sponge covers | 2 | 0.28 | |
| Worm and staff | ½ | 3.6 | |
| Hand spikes | 2 | 14.5 | On the gun carriage. |
| Sponge bucket | 1 | 10. | |
| Prolonge | 1 | 18. | |
| Linstock | 1 | 0.9 | |
| Lock | 1 | 2.75 | On the gun. |
| Lock cover | 1 | 0.9 | |
| Tar bucket | 1 | 7. | On the limber. |
| Water bucket, (leather) | 1 | 8. | |
| Gunner's havresacks | 2 | 3.72 | |
| Tube pouch | 1 | 0.95 | |
| Fuze pouch | 1 | 0.95 | In the implement trays, or in other vacant spaces in the ammunition chest. |
| Vent punch | 1 | 0.08 | |
| Gunner's pincers | 1 | 0.85 | |
| Tow hook | 1 | 0.60 | |
| Tangent scale | 1 | 0.21 | |
| Thumb stalls | 2 | 0.01 | |
| Priming wire | 1 | 0.08 | In the tube pouch. |
| Lanyard for friction primers | 1 | 0.10 | |
| Gunner's gimlet | 1 | 0.08 | In the fuze pouch. |
| Fuze plug reamer | 1 | 0.3 | |
| Tarpaulin, large | 1 | 54. | Strapped on the ammunition chest. |
| FOR A CAISSON. | | | |
| Felling axe | 1 | 6. | |
| Shovel, long handle | 1 | 4.75 | |
| Pick axe | 1 | 6.5 | In the places provided for them on the caisson body. |
| Spare handspike | 1 | 7.25 | |
| Spare pole | 1 | 25.30 | |
| Spare wheel | 1 | 180. | |
| Tow hooks | 2 | 1.2 | One in the limber chest, and one in a caisson chest. |
| Tar bucket | 1 | 7. | On the limber. |
| Watering bucket, (leather) | 1 | 8. | |
| Tarpaulin, large | 1 | 54. | Strapped on the limber chest. |

Two pairs of straps for the tarpaulins are fastened with screws to the edges of the lid of the limber chest, at 10 inches from the ends. The straps are 1.25 inch wide; the front straps, 24 inches long; the rear, 10 inches long, with buckles; each fastened with two 1 inch screws.

*Weights of Gun carriages and Caissons, equipped for Field Service.*

| DESIGNATION. | FOR GUNS. | | FOR HOWITZERS. | | |
|---|---|---|---|---|---|
| | 6-pdr. | 12-pdr. | 12-pdr. | 24-pdr. | 32-pdr. |
| GUN CARRIAGE. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| Gun | 884 | 1,757 | 788 | 1,318 | 1,890 |
| Gun carriage, without wheels | 540 | 783 | 540 | 736 | 783 |
| Two wheels | 360 | 392 | 360 | 392 | 392 |
| Limber body, without wheels | 335 | 335 | 335 | 335 | 335 |
| Two wheels | 360 | 360 | 360 | 360 | 360 |
| Ammunition chest, with interior divisions | 185 | 182 | 206 | 198 | 192 |
| Ammunition, packed | 395 | 497 | 465 | 541 | 470 |
| Large tarpaulin | 54 | 54 | 54 | 54 | 54 |
| Other implements and equipments | 83 | 86 | 83 | 86 | 86 |
| Total weight | 3,196 | 4,446 | 3,191 | 4,020 | 4,562 |
| Number of rounds of ammunition on each limber | 50 | 32 | 39 | 23 | 15 |
| CAISSON. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| Body, without wheels | 432 | 432 | 432 | 432 | 432 |
| Two wheels | 360 | 360 | 360 | 360 | 360 |
| Two ammunition chests | 370 | 364 | 412 | 396 | 384 |
| Ammunition, packed in do. | 790 | 994 | 930 | 1,082 | 940 |
| Limber body, without wheels | 335 | 335 | 335 | 335 | 335 |
| Two wheels | 360 | 360 | 360 | 360 | 360 |
| Ammunition chest | 185 | 182 | 206 | 198 | 192 |
| Ammunition, packed in do. | 395 | 497 | 465 | 541 | 470 |
| Large tarpaulin | 54 | 54 | 54 | 54 | 54 |
| Other implements and spare parts | 246 | 246 | 246 | 246 | 246 |
| Total weight | 3,527 | 3,824 | 3,800 | 4,004 | 3,773 |
| Number of rounds of ammunition on each caisson and its limber | 150 | 96 | 117 | 69 | 45 |

## EQUIPMENT OF TRAVELLING FORGES AND BATTERY WAGONS.

One forge and one battery wagon accompany each field battery. They are furnished with the tools and materials required for shoeing horses and for ordinary repairs and preservation of carriages and harness.

Other forges and battery wagons, equipped for the general service of the army, accompany the field park which contains the general supplies of ordnance stores.

*The forge for the field battery* is designated by the letter A.
*The forge for the field park* " " " B.
*The battery wagon for the field battery* " " C.
*The battery wagon for the field park* " " D.

## EQUIPMENT OF A FORGE FOR A FIELD BATTERY.

### *Interior arrangement of the Limber Chest.*

The chest is marked: FORGE A.

There are *five boxes* for tools and stores; *one shoeing box*, and *one can* for oil.

The boxes are marked: A, Nos. 1, 2, 3, 4, 5.

They are made of white pine, .75 in. thick, with loose covers of the same thickness; the covers have three ¾ in. holes bored in each end, to lift them by.

Two handles of double leather are nailed on the inside of the ends of the boxes, so as not to interfere with the covers.

The sides and ends of all the boxes for the forges and battery wagons are dovetailed together, and fastened with 8*d. nails;* the covers are made with clamps on the ends.

### *Exterior dimensions of the Boxes for* FORGE A.

| DESIGNATION. | Length. | Width. | Depth. | Weight. | REMARKS. |
|---|---|---|---|---|---|
| | In. | In. | In. | Lbs. | |
| A, Nos. 1 & 3 | 17.8 | 13.25 | 7.5 | 8.25 | |
| A, No. 2.... | 17.8 | 13.25 | 7.5 | 9.75 | A partition at 4.5 in. from one end. |
| A, No. 4.... | 23.5 | 8. | 6.5 | 8. | A partition for oil can, at 5.25 in. from one end. |
| A, No. 5.... | 39.8 | 9.8 | 6.5 | 14.5 | |
| Shoeing box. | 16.5 | 8. | 6.5 | 4.7 | |

The *oil can* is made of tin, to hold one quart; it is five inches square and four inches high, with a neck for a cork, one inch diameter and .5 in. high, near one corner. Weight 0.9 lb. It is marked: A, SPERM OIL.

Boxes Nos, 1, 2, and 3, are placed in the bottom of the chest; No. 1 against the left hand; No. 2 in the middle.

No. 4 is placed on top of Nos. 1 and 2, against the left end and the back of the chest; the division for the oil can on the left hand.

No. 5 is placed on top of Nos. 1, 2, and 3, against the front of the chest.

The shoeing box is placed on No. 3, against the right end and the back of the chest.

The tools and stores in all the boxes, and in the forges and battery wagons, are securely packed with tow.

*Contents of the Limber Chest of Forge* A.

| SMITH'S TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Horse shoes, Nos. 2 and 3.....lbs. | 100 | 100.00 | Box A, 1. |
| Horse shoes, Nos. 2 and 3.....lbs. | 100 | 100.00 | Box A, 3. |
| Horse shoe nails, Nos. 2 and 3.....lbs. | 50 | 50.00 | Box A, 2; large div'n. |
| Washers and nuts, No. 2..... | 30 | 5.25 | In Box A, 2. 91.11 lbs. |
| Washers and nuts, No. 3..... | 10 | 3.20 | |
| Washers and nuts, No. 4..... | 4 | 2.15 | |
| Nails, No. 1, C.....lb. | 1 | 1.00 | |
| Nails, No. 2, C.....lb. | 1 | 1.00 | |
| Tire bolts..... | 20 | 5.00 | |
| Keys for ammunition chests..... | 5 | 1.80 | |
| Linch washers..... | 8 | 7.30 | |
| Linch pins..... | 12 | 8.37 | |
| Chains, Nos. 1 and 2.....ft. | 2 | 1.54 | |
| Cold shut *S* links, No. 3..... | 50 | 2.50 | |
| Cold shut *S* links, No. 5..... | 12 | 2.00 | |
| Hand cold chisels..... | 2 | 2.00 | In Box A, 4. 28.52 lbs. |
| Hardie..... | 1 | 0.75 | |
| Files, assorted, with handles..... | 12 | 10.00 | |
| Buttress..... | 1 | 1.50 | |
| Hand punches, round and square..... | 2 | 2.00 | |
| Screw wrench..... | 1 | 2.42 | |
| Hand screw driver..... | 1 | 0.32 | |
| Hand vice..... | 1 | 1.00 | |
| Pair smith's callipers..... | 1 | 0.40 | |
| Taps..... Nos. 1, 2, 3, and 4..... | 4 | 1.50 | |
| Pairs dies.. Nos. 1, 2, 3, and 4..... | 4 | 1.83 | |
| Wood screws, 1 in., No. 14.....groce. | 1 | 2.10 | |
| Quart can of sperm oil..... | 1 | 2.70 | |
| Carried forward..... | .... | 319.63 | |

*Contents of the Limber Chest*—Continued.

| SMITH'S TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| Brought forward | .... | 319.63 | |
| Fire shovel | 1 | 3.05 | In Box A, 5. 80.05 lbs. |
| Poker | 1 | 1.90 | |
| Split broom | 1 | 1.25 | |
| Hand hammer | 1 | 3.50 | |
| Riveting hammer | 1 | 1.05 | |
| Nailing hammer | 1 | 1.80 | |
| Sledge hammer | 1 | 10.50 | |
| Chisels for hot iron | 2 | 3.00 | |
| Chisels for cold iron | 2 | 3.00 | |
| Smith's tongs | 3 | 15.00 | |
| Fore punch | 1 | 1.00 | |
| Creaser | 1 | 1.00 | |
| Fuller | 1 | 2.40 | |
| Nail claw | 1 | 5.00 | |
| Round punch | 1 | 2.10 | |
| Tap wrench | 1 | 3.75 | |
| Die stock | 1 | 6.25 | |
| Nave bands, developed | 4 | 11.75 | |
| Tire bands, developed | 2 | 2.75 | |
| Shoeing hammer | 1 | 0.82 | In shoeing box. 12.75 lbs. |
| Pair pincers | 1 | 2.00 | |
| Rasps, (12 inches) | 2 | 2.15 | |
| Shoeing knife | 1 | 0.33 | |
| Toe knife | 1 | 0.30 | |
| Pritchel | 1 | 0.85 | |
| Nail punch | 1 | 0.80 | |
| Clinching iron | 1 | 1.00 | |
| Oil stone | 1 | 1.50 | |
| Leather aprons | 2 | 3.00 | |
| Iron square | 1 | 2.00 | Fastened on inside of the chest cover with two copper clamps. |
| Padlock | 1 | 0.50 | On the chest. |
| Tar bucket | 1 | 7.00 | On its hook. |
| Boxes | 6 | 53.45 | |
| Tow for packing | .... | 5.00 | |
| Total | .... | 480.38 | |

## *Contents of the Forge Body*, A.

Box A, 6, of the same dimensions as A, 1, is carried in the iron room.

To put this box in, or take it out, loosen the thumb nuts and raise the rear of the bellows an inch.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Water bucket, wood | 1 | 10.00 | On its hook. |
| Anvil | 1 | 100.00 | On the fire place. |
| Vice | 1 | 29.00 | Fixed on the stock of the carriage. |
| Watering bucket, leather | 1 | 8.00 | On the vice. |
| Bituminous coal ..lbs. | 250 | 250.00 | In the coal box. |
| Coal shovel | 1 | 4.75 | In the coal box. |
| Padlock | 1 | 0.50 | On coal box. |
| Horse shoes, Nos. 2 and 3 ..lbs. | 100 | 100.00 | Box A, 6, in iron room. |
| Square iron, $\frac{1}{2}$ in. and $\frac{5}{8}$ in. ..lbs. | 100 | 100.00 | In the iron room. The bars not more than 3 feet long; the square iron in 2 bundles. |
| Flat iron, $1\frac{1}{4}$ in. $\times \frac{5}{8}$ in., 1 in. $\times \frac{1}{2}$ in. and $1\frac{1}{2}$ in. $\times \frac{1}{4}$ in. ..lbs. | 50 | 50.00 | |
| Round iron, $\frac{3}{4}$ in. ..lbs. | 50 | 50.00 | |
| Cast steel, $\frac{1}{2}$ in. square ..lbs. | 5 | 5.00 | |
| English blister steel ..lbs. | 5 | 5.00 | |
| Box | 1 | 8.25 | |
| Tow | .... | 2.00 | |
| Total, exclusive of vice | .... | 693 50 | |

NOTE.—100 lbs. of horse shoes, assorted, contain 90 shoes.
1 lb. horse shoe nails, No. 3, contains 140 nails.
1 lb. horse shoe nails, No. 2, contains 112 nails.

### EQUIPMENT OF A BATTERY WAGON FOR A FIELD BATTERY.

## *Interior arrangement of Limber Chest.*

The chest is marked: BATTERY WAGON, C.

The tools and stores are carried in *four boxes*, marked C, Nos. 1, 2, 3, and 4, respectively, and in *one oil can*.

The *boxes* are made of white pine .75 in. thick, with leather handles inside, and loose covers, like those of the limber chest of Forge A.

The covers of Nos. 1 and 2 are .75 in. thick; those of Nos. 3 and 4 are .5 in. thick.

*Exterior dimensions of the Boxes.*

| DESIGNATION. | Length. | Width. | Depth. | Weight. |
|---|---|---|---|---|
| | In. | In. | In. | Lbs. |
| C, No. 1 | 17.8 | 13.25 | 7.5 | 8.25 |
| C, No. 2 | 26.5 | 17.8 | 7.5 | 17.5 |
| C, No. 3 | 39.8 | 9.8 | 6.25 | 12.5 |
| C, No. 4 | 39.8 | 8. | 6.25 | 11. |

No. 3 has a partition, at 5.25 from one end, for the oil can.

No. 4 has two partitions perpendicular to the sides, making three divisions 15.8 in., 10 in., and 11 in. long, respectively.

The *oil can* is like that for the limber chest of Forge A, and is marked: C, SPERM OIL.

Boxes Nos. 1 and 2 occupy the bottom of the chest; No. 1 against the left end.

Nos. 3 and 4 are placed on top of Nos. 1 and 2; No. 3 against the rear of the chest.

*Contents of Limber Chest for Battery Wagon, C.*

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| CARRIAGE MAKER'S TOOLS. | | Lbs. | |
| Hand saws | 2 | 4.00 | Fastened to the inside of chest cover. |
| Tenon saw, (14 in.) | 1 | 1.50 | |
| Jack plane | 1 | 4.15 | In Box C, 1. 17.20 lbs. |
| Smoothing plane | 1 | 1.80 | |
| Brace, with 24 bits | 1 | 4.35 | |
| Spoke shave | 1 | 0.30 | |
| Gauge | 1 | 0.30 | |
| Plane irons | 2 | 1.05 | |
| Saw set | 1 | 0.25 | |
| Rule, (2 feet) | 1 | 0.14 | |
| Gimlets | 12 | 0.95 | |
| Compasses | pair. 1 | 0.18 | |
| Chalk line | 1 | 0.10 | |
| Brad awls | 2 | 0.17 | |
| Scriber | 1 | 0.15 | |
| Saw files, ($4\frac{1}{2}$ in.) | 12 | 0.87 | |
| Wood files, (10 in.) | 2 | 1.12 | |
| Wood rasp, (10 in.) | 1 | 0.40 | |
| Trying square, (8 in.) | 1 | 0.60 | |
| Hand screw driver | 1 | 0.32 | |
| Carried forward | .... | 22.70 | |

*Limber Chest for Battery Wagon*, C—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward | .... | 22.70 | |
| CARRIAGE MAKER'S TOOLS—Cont'd. | | | |
| Oil stone | 1 | 1.50 | In Box C, 2. 32.23 lbs. |
| Broad axe | 1 | 6.00 | |
| Hand axe | 1 | 5.00 | |
| Claw hatchet | 1 | 2.00 | |
| Claw hammer | 1 | 1.50 | |
| Pincers, (small) pair. | 1 | 1.06 | |
| Table vice | 1 | 3.80 | |
| Framing chisels, (1 in. and 2 in.) | 2 | 3.00 | |
| Firmer chisels, ($\frac{3}{4}$ in. and $1\frac{1}{2}$ in.) | 2 | 1.00 | |
| Framing gouges, (1 in. and $1\frac{1}{2}$ in) | 2 | 2.60 | |
| Augers and handles, ($\frac{1}{2}$ in. $\frac{5}{8}$ in. & $\frac{3}{4}$ in.) | 3 | 2.35 | |
| Screw wrench | 1 | 2.42 | |
| Felling axe } with handles | 1 | 6.00 | In Box C, 3. 23.25 lbs. |
| Adze } with handles | 1 | 3.30 | |
| Frame saw | 1 | 4.50 | |
| Quart can of sperm oil | 1 | 2.70 | |
| SADDLER'S TOOLS AND STORES. | | | |
| Mallet | 1 | 1.75 | |
| Clam | 1 | 5.00 | |
| Hammer | 1 | 0.65 | Box C, 4. |
| Shoe knife | 1 | 0.09 | |
| Half round knife | 1 | 0.28 | |
| Shears pair. | 1 | 0.47 | |
| Sand stone | 1 | 1.54 | |
| Rule, (2 feet) | 1 | 0.14 | |
| Needles | 100 | 0.08 | |
| Awls and handles | 12 | 0.75 | |
| Punches | 2 | 0.22 | |
| Pincers pair. | 1 | 0.75 | |
| Plyers pair. | 1 | 0.22 | |
| Claw tool | 1 | 0.12 | |
| Creaser | 1 | 0.15 | |
| Thimbles | 4 | 0.06 | |
| Strap awl | 1 | 0.01 | |
| Bees' wax lbs. | 2 | 2.00 | |
| Black wax lbs. | 3 | 3.00 | |
| Bristles oz. | 8 | 0.50 | |
| Shoe thread lbs. | 5 | 5.00 | |
| Patent thread lbs. | 2 | 2.00 | |
| Carried forward | .... | 96.21 | |

*Limber Chest for Battery Wagon*, C—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward | .... | 96.21 | |
| SADDLER'S TOOLS AND STORES—Cont'd. | | | |
| Buckles, (assorted, .75 in. to 1.5 in).doz. | 3 | 1.00 | In Box C, 4. 20.66 lbs. |
| Tacks.....M. | 3 | 0.75 | |
| Gunner's callipers | 1 | 0.50 | |
| Shoe knives | 2 | 0.18 | |
| Scissors.....pairs. | 2 | 0.20 | |
| Padlock | 1 | 0.50 | |
| Tar bucket | 1 | 7.00 | On its hook. |
| Boxes | 4 | 49.25 | |
| Tow for packing | .... | 7.00 | |
| Total | .... | 162.59 | |

*Interior arrangement of Wagon Body*, C.

A TILL, 9 in. wide and 9.5 in. deep, is placed at the back or right side of the wagon body.

AN AXE RACK extends along the whole length of the body, on the left side, 11 inches from the bottom; it is 2 in. deep and 1.5 in. wide, and is fastened to the side by the middle rivets of the side studs, and by 5 wood screws. The rack has notches, to hold three axes, a hatchet, and three hand bills.

*Four boxes*, for stores, marked: C, Nos. 5, 6, 7, and 8.

*One box*, marked: C, CANDLES.

*Exterior dimensions of Boxes for Wagon Body*, C.

| DESIGNATION. | Length. | Width. | Depth. | Weight. | REMARKS. |
|---|---|---|---|---|---|
| | In. | In. | In. | Lbs. | |
| C, Nos. 5 & 6 | 23. | 18.5 | 11.25 | 17.5 | No covers.. Of hard wood, 0.75 |
| C, No. 7.... | 23.5 | 20.25 | 14. | 28. | Loose cover } in. thick. |
| C, No. 8.... | 13. | 13. | 5. | 6. | Div. into } White pine, 0.625 in. thick, |
| Candle box.. | 11. | 6.5 | 5.5 | 2.85 | four parts } with covers, hinges, & locks. |

*Seven tin cans;* two marked: C, NEATS' FOOT OIL; one marked: C, LINSEED OIL; one: C, TURPENTINE; two: C, OLIVE PAINT; one: C, BLACK PAINT.

*Dimensions of Cans for Wagon Body, C.*

| KIND. | Capacity. | Diam. | Height. | Weight. | REMARKS. |
|---|---|---|---|---|---|
| | | In. | In. | Lbs. | |
| For neats' foot oil.. | 2 gals. | 8. | 11.5 | 2.2 | Rounded tops and necks for corks. |
| " linseed oil and turpentine.... | 1 gal. | 6. | 10. | 1.37 | |
| " olive paint..... | 25 lbs. | 9.75 | 10.25 | 3. | Flat tops; opening covered with a piece of tin, soldered on. |
| " black paint.... | 5 lbs. | 7. | 8.5 | 1.5 | |

*Two kegs*, for grease; exterior dimensions:

Diameter at the bilge..... 10.5 inches.
Diameter at the heads..... 9.75 "
Height..... 12.5 "
Weight..... 5 lbs.

*Contents of the Wagon Body, C.*

Box C, No. 5, is placed on the bottom of the wagon, next to the pile of harness which occupies the rear part of the body. Box No. 6 is on top of No. 5; No. 7 on the bottom of the wagon, in front of No. 5; No. 8 on top of No. 7. The candle box in No. 6.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Linseed oil.....gal. | 1 | 9.17 | In 1 tin can |
| Spirits turpentine....gal. | 1 | 8.77 | " 1 do. |
| Olive paint.....lbs. | 50 | 56. | " 2 do. |
| Black paint.....lbs. | 5 | 6.5 | " 1 do. |
| | | | In Box C, 5. 80.44 lbs. |
| Paint brushes..... | 12 | 3.00 | |
| Sperm or wax candles, lbs | 5 | 7.85 | In candle box. |
| Rammer heads..... | 4 | 2.90 | |
| Sponge heads..... | 4 | 3.20 | |
| Sponges..... | 12 | 3.00 | |
| Priming wires..... | 3 | 0.24 | |
| Gunner's gimlets..... | 3 | 0.24 | In Box C, 6. 28.73 lbs. |
| Lanyards for friction tubes..... | 4 | 0.40 | |
| Cannon spikes..... | 6 | 0.30 | |
| Dark lanterns..... | 3 | 3. | |
| Common lanterns..... | 4 | 4.60 | |
| Carried forward.... | .... | 109.17 | |

*Contents of the Wagon Body*, C—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward .... | .... | 109.17 | |
| Neats' foot oil .....gals. | 4 | 32.80 | In 2 tin cans. } In Box C, 7. 92.80 lbs. |
| Grease.....lbs. | 50 | 60. | " 2 kegs.... } |
| Nails,(4d,6d,8d,10d) lbs. | 20 | 20. | Box C, 8. |
| Felling axes..... | 2 | 12. | } In the axe rack. |
| Claw hatchet..... ... | 1 | 2. | |
| Hand bills..... | 2 | 4. | |
| Caisson stock..... | 1 | 35. | Under the till, against the side and rear of the wagon. |
| Rammers and sponges.. | 3 | 13.5 | On the caisson stock, against rear end. |
| Spokes..... | 40 | 72. | On the bottom; piled lengthwise against the front end. |
| Fellies..... | 24 | 160. | On the spokes, crosswise. |
| Grindstone, 14 in. $\times$ 4 in. | 1 | 50. | } On the fellies, against the left side of the wagon. |
| Arbor and crank for do.. | 1 | 6.5 | |
| Screw jacks ..... | 3 | 75. | On the fellies, against the front and the till. |
| Wheel traces ..... | 10 | 47.5 | In a pile occupying 30 inches at the rear end of the wagon, between the left side and the caisson stock, and up to the top of the till; the collars piled on each other, from the bottom. |
| Leading traces..... | 10 | 57.5 | |
| Collars..... | 6 | 27.5 | |
| Girths..... | 16 | 11. | |
| Whips..... | 16 | 8. | |
| Bridles..... | 6 | 18. | |
| Halters..... | 6 | 21. | |
| Halter chains..... | 12 | 15.5 | |
| Hame straps..... | 25 | 4.5 | |
| Spare nose bags..... | 12 | 13.5 | } On the harness. |
| Sash cord .....pieces. | 6 | 10. | |
| Slow match.....yds. | 50 | 6. | On box No. 7, to the left of No. 8. |
| Elevating screw..... | 1 | 15.75 | } On the pile of harness. |
| Pole yoke..... | 1 | 12.25 | |
| Harness leather....side. | 1 | 25. | } Under the till, in front of the pile of harness, and against the caisson stock. |
| Bridle leather.....do. | 2 | 22. | |
| Prolonge..... | 1 | 18. | On box No. 7, in front of No. 8. |
| Scythes..... | 4 | 9. | In the till, against the front end. |
| Carried forward.... | .... | 993.97 | |

*Contents of the Wagon Body*, C—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| Brought forward ... | .... | 993.97 | |
| Scythe stones..... | 4 | 6. | In the curve of the scythes. |
| Spades..... | 6 | 30. | In the till; the bits against the rear end. |
| Pick axes and handles... | 2 | 13. | Between the spade handles. |
| Corn sacks..... | 24 | 20. | On the scythes. |
| Tarpaulins, 5 feet square. | 2 | 18. | On the corn sacks, against front end. |
| Reaping hooks..... | 4 | 3.85 | Fastened to the ridge pole with a wooden clamp and a leather strap. |
| Scythe sneaths..... | 4 | 12. | Fastened to the ridge pole with two leather straps and buckles. |
| Spare stock for battery wagon..... | 1 | 90. | In the spare stock stirrup. |
| Padlock..... | 1 | 0.5 | |
| Watering bucket..... | 1 | 8. | Tied to the forage rack. |
| Forage..... | .... | ..... | In the forage rack. |
| Boxes ..... | 4 | 69. | |
| Tow..... | .... | 24.5 | |
| Total..... | .... | 1288.82 | Exclusive of forage. |

EQUIPMENT OF A FORGE FOR THE FIELD PARK.

*Interior arrangement of the Limber Chest.*

The chest is marked: FORGE B.

*Four boxes* for tools and stores; *one shoeing box*; *one tin can* for oil.

The boxes are marked B, Nos. 1, 2, 3, and 4, respectively. They are made like those for the Forge A.

*Exterior dimensions of boxes for Limber Chest of Forge* B.

| DESIGNATION. | Length. | Width. | Depth. | Weight. | REMARKS. |
|---|---|---|---|---|---|
| | In. | In. | In. | Lbs. | |
| B, No. 1..... | 17.8 | 13.25 | 7.5 | 8.25 | |
| B, No. 2..... | 26.5 | 17.8 | 7.5 | 17.5 | |
| B, No. 3..... | 23.5 | 8. | 6.5 | 8. | Partition for oil can, 5.25 |
| B, No. 4..... | 39.8 | 9.8 | 6.5 | 14.5 | in. from one end. |
| Shoeing box, B. | 16.5 | 8. | 6.5 | 4.7 | |

The oil can is like that for Forge A; it is marked: B, SPERM OIL.

Boxes Nos. 1 and 2 occupy the bottom of the limber chest; No. 1 against the left end.

No. 3 is placed on top of Nos. 1 and 2, against the left end and the back of the chest.

No. 4 on top of Nos. 1 and 2, against the front of the chest.

The shoeing box, on No. 2, against the right end and the back of the chest.

*Contents of Limber Chest of Forge* B.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Nuts and washers, No. 5 | 4 | 5.00 | |
| Nuts and washers, No. 4 | 6 | 3.22 | |
| Nuts and washers, No. 3 | 10 | 3.20 | |
| Nuts and washers, No. 2 | 45 | 7.88 | |
| Nails, Nos. 1 and 2, C.....lbs. | 2 | 2.00 | |
| Tire bolts | 20 | 5.00 | |
| Rivets, for ammunition chests...lb. | 1 | 1.00 | |
| Washers for bolt heads, Nos. 3 & 4.. | 20 | 2.50 | |
| Keys for ammunition chests | 5 | 1.80 | In Box B, 1. |
| Pole prop socket and ferrule | 1 | 1.30 | 83.40 lbs. |
| Linch washers | 8 | 7.00 | |
| Shoulder washers | 4 | 7.00 | |
| Linch pins | 12 | 8.00 | |
| Chain, No. 2.....feet. | 2 | 0.75 | |
| Pintle hook | 1 | 20.00 | |
| Cap square | 1 | 5.00 | |
| Tire bands, (clips,) developed | 2 | 2.75 | |
| Heading tools, for bolts | 2 | 12.00 | |
| Heading tool, for nails | 1 | 4.00 | |
| Tire punches, with handles | 2 | 3.00 | |
| Round punch, with handles | 1 | 2.10 | |
| Square punch, with handles | 1 | 2.10 | |
| Square hand punch | 1 | 1.00 | |
| Round hand punch | 1 | 1.00 | |
| Centre punch | 1 | 0.50 | |
| Key punch | 1 | 1.00 | |
| Set hammer, flat | 1 | 2.85 | |
| Set hammer, half round | 1 | 3.00 | In Box B, 2. |
| Chisels, for hot iron, with handles. | 3 | 4.50 | 73.30 lbs. |
| Chisels, for cold iron, with handles. | 2 | 3.00 | |
| Hand cold chisels | 2 | 2.00 | |
| Smith's tongs | 3 | 15.00 | |
| Nail claw | 1 | 5.00 | |
| Tire circle | 1 | 1.35 | |
| Bevel vice | 1 | 1.75 | |
| Hardie | 1 | 0.75 | |
| Fuller | 1 | 2.40 | |
| Hand axe | 1 | 5.00 | |
| Screws, 1 inch, No. 14.....groce. | 1 | 2.10 | |
| Small hand vice | 1 | 1.00 | |
| Hand screw driver | 1 | 0.32 | |
| Taps and Dies $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, and 1 in. pairs. | 6 | 2.85 | Box B, 3. |
| | 6 | 2.75 | |
| Gimlets, assorted | 12 | 0.95 | |
| Small punches | 3 | 0.75 | |
| Carried forward | .... | 167.42 | |

*Contents of Limber Chest of Forge* B.—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward | .... | 167.42 | |
| Spring compasses, pair. | 1 | 0.15 | In Box B, 3. 26.97 lbs. |
| Files, assorted, with handles | 12 | 10.00 | |
| Iron wire gauge | 1 | 0.25 | |
| Scribing awl | 1 | 0.15 | |
| Callipers, pair. | 1 | 0.40 | |
| Bevel | 1 | 0.35 | |
| Trying square | 1 | 0.60 | |
| Scriber | 1 | 0.15 | |
| Buttress | 1 | 1.50 | |
| Quart can of sperm oil | 1 | 2.70 | |
| Nave bands, developed | 4 | 11.75 | In Box B, 4. 59.37 lbs. |
| Hand hammer | 1 | 3.50 | |
| Riveting hammer | 1 | 1.05 | |
| Nailing hammer | 1 | 1.80 | |
| Sledge | 1 | 10.50 | |
| Fore punch | 1 | 1.00 | |
| Creaser | 1 | 1.00 | |
| Screw wrench | 1 | 2.42 | |
| Smith's shovel | 1 | 3.05 | |
| Smith's poker | 1 | 1.90 | |
| Split broom | 1 | 1.25 | |
| Tap wrench, with 4 holes | 1 | 3.75 | |
| Die stock | 1 | 6.25 | |
| Tracing point | 1 | 0.15 | |
| Augers, $\frac{3}{4}$ in. and 1 in., (with handles) | 2 | 2.50 | |
| Framing chisel | 1 | 1.50 | |
| Felling axe | 1 | 6.00 | |
| Shoeing hammer | 1 | 0.82 | In shoeing box. 12.75 lbs. |
| Shoeing pincers | 1 | 2.00 | |
| Shoeing rasps | 2 | 2.15 | |
| Pritchel | 1 | 0.85 | |
| Nail punch | 1 | 0.80 | |
| Toe knife | 1 | 0.30 | |
| Clinching iron | 1 | 1.00 | |
| Shoeing knife | 1 | 0.33 | |
| Leather aprons | 2 | 3.00 | |
| Oil stone | 1 | 1.50 | |
| Iron square | 1 | 2.00 | Fastened inside chest cover. |
| Padlock | 1 | 0.5 | |
| Tar bucket | 1 | 7.00 | On its hook. |
| Boxes | 5 | 52.95 | |
| Tow | .... | 14.00 | |
| Total | .... | 332.24 | |

### *Contents of Forge Body*, B.

Boxes B, Nos. 5 and 6, of the same size as A, No. 1, are carried in the iron room. To put these boxes in place, loosen the thumb nuts and raise the rear of the bellows one inch.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Water bucket | 1 | 10. | On its hook. |
| Watering bucket, (leather) | 1 | 8. | On the vice. |
| Anvil | 1 | 100. | On the fire place. |
| Vice | 1 | ..... | On the stock of the forge. |
| Square iron, ($\frac{1}{2}$ to 1 in.) ....lbs. | 100 | 100. | In the iron room. Bars not more than 3 feet long. Square iron in two bundles. |
| Flat iron, ($1\frac{1}{4}\times\frac{5}{8}$, $1\times\frac{1}{2}$, $1\frac{1}{4}\times\frac{2}{10}$, $1\frac{1}{2}\times\frac{1}{4}$ in.).....lbs. | 50 | 50. | |
| Round iron, ($\frac{3}{8}$ in.).....lbs. | 50 | 50. | |
| Cast steel.....lbs. | 10 | 10. | |
| English blistered steel.....lbs. | 5 | 5. | |
| Horseshoes, Nos. 2 & 3....lbs. | 200 | 200. | Boxes B, 5, and B, 6; half in each. |
| Horse shoe nails, Nos. 2 and 3.....lbs. | 20 | 20. | |
| Bituminous coal.....lbs. | 250 | 250. | In the coal box. |
| Coal shovel | 1 | 4.75 | |
| Padlock | 1 | 0.50 | On coal box. |
| Boxes | 2 | 16.5 | |
| Tow | .... | 3. | |
| Total | .... | 827.75 | Exclusive of vice. |

EQUIPMENT OF A BATTERY WAGON FOR THE FIELD PARK.

### *Interior arrangement of Limber Chest.*

The chest is marked: BATTERY WAGON, D.

*Two cleats*, of oak, are fastened to the ends of the chest, each with *four screws*, 1.5 in. No. 14. The cleats are .75 inch thick, and 1.75 inch wide; their upper edges are 7.5 inches from the bottom of the chest.

*Two boxes*, marked D, Nos. 1 and 2, occupy the upper part of the chest, resting on the cleats; No. 1 against the back of the chest. They are made of white pine, .75 in. thick, with leather handles and loose covers, .5 in. thick.

Each of the boxes is 39.8 in. long outside, and 6.25 in. deep.

No. 1 is 8 inches wide; it has two partitions 5.25 inches from one end, and 7.5 from the other, in the clear. Weight 11 lbs.

No. 2 is 9.8 inches wide, with two partitions, 14 inches from one end, and 11.8 inches from the other end. Weight 13 lbs.

*One oil can*, like that for the limber chest of Forge A, marked: D, SPERM OIL.

*Five wooden clamps*, for saws, are fastened to the interior of the chest cover, with *twelve screws*.

*Two brass clamps*, for webs or blades of frame saw, fastened to the interior of the cover, each with *six nails*.

## *Contents of Limber Chest, for Battery Wagon*, D.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| CARRIAGE MAKER'S TOOLS. | | Lbs. | |
| Bench planes | 4 | 16.00 | Packed with tow in the bottom of the chest. 106.24 lbs. |
| Wood clamps | 2 | 12. | |
| Oil stones | 2 | 3. | |
| Broad axe | 1 | 6. | |
| Hand axe | 1 | 5.35 | |
| Felling axe | 1 | 6. | |
| Hand hammer | 1 | 1.50 | |
| Claw hatchet | 1 | 2. | |
| Adze | 1 | 3.30 | |
| Table vice | 1 | 3.80 | |
| Holdfast | 1 | 10.5 | |
| Framing chisels | 4 | 6. | |
| Firmer chisels | 4 | 2. | |
| Gouges | 4 | 5. | |
| Frame saw | 1 | 4.50 | |
| Screw wrenches | 2 | 4.84 | |
| Augers and handles | 6 | 4.70 | |
| Claw hammers | 2 | 3.00 | |
| Saddler's mallet | 1 | 1.75 | |
| Saddler's clam | 1 | 5. | |
| Brace and 24 bits | 1 | 4.35 | Box D, 1. |
| Pincers, small.....pair. | 1 | 1. | |
| Callipers.....pair. | 1 | 0.40 | |
| Spoke shaves | 2 | 0.60 | |
| Gauges | 2 | 0.60 | |
| Plane irons | 6 | 3.15 | |
| Saw set | 1 | 0.25 | |
| Trying square | 1 | 0.60 | |
| Bevel | 1 | 0.35 | |
| Rule, (2 feet) | 1 | 0.14 | |
| Gimlets | 12 | 0.95 | |
| Compasses.....pair. | 1 | 0.18 | |
| Chalk line | 1 | 0.10 | |
| Brad awls | 2 | 0.17 | |
| Carried forward.... | .... | 119.08 | |

*Contents of Limber Chest for Battery Wagon*, D—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward | .... | 119.08 | |
| Scriber | 1 | 0.15 | In Box D, 1. 27.52 lbs. |
| Taper files, (4½ inches) | 12 | 0.87 | |
| Wood files | 6 | 3.36 | |
| Wood rasps | 2 | 0.80 | |
| Compass saw | 1 | 0.30 | |
| Harness buckles....groce. | 1 | 4. | |
| Tacks.....M. | 10 | 2.50 | |
| Quart can sperm oil | 1 | 2.70 | |
| Hand saws | 2 | 4. | Fastened to interior of chest cover, with wooden clamps. |
| Tenon saws | 2 | 3. | |
| Webs or blades for frame saw | 2 | 0.75 | Do. with brass clamps. |
| SADDLER'S TOOLS AND STORES. | | | |
| Hammer | 1 | 0.65 | In Box D, 2. 30.24 lbs. |
| Shoe knives | 6 | 0.54 | |
| Half round knife | 1 | 0.28 | |
| Shears.....pair. | 1 | 0.47 | |
| Sand stones | 3 | 4.62 | |
| Rule, (2 feet) | 1 | 0.14 | |
| Needles, assorted | 600 | 0.50 | |
| Collar needles | 5 | 0.05 | |
| Awls | 36 | 2.25 | |
| Awl handles | 6 | 0.60 | |
| Punches, (assorted) | 6 | 0.66 | |
| Pincers.....pairs. | 3 | 2.25 | |
| Plyers.....pairs. | 6 | 1.32 | |
| Claw tools | 3 | 0.36 | |
| Creasers | 3 | 0.45 | |
| Strap awls | 3 | 0.03 | |
| Gauge knife | 1 | 0.80 | |
| Compasses.....pair. | 1 | 0.18 | |
| Thimbles | 6 | 0.09 | |
| Bristles.....lb. | 1 | 1. | |
| Beeswax.....lbs. | 3 | 3. | |
| Black wax.....lbs. | 5 | 5. | |
| Patent thread.....lbs. | 5 | 5. | |
| Padlock | 1 | 0.50 | On its hook. |
| Tar bucket | 1 | 7. | |
| Boxes | 2 | 24. | |
| Tow | .... | 5.25 | |
| Total | .... | 208.50 | |

## *Interior arrangement of Wagon Body*, D.

*A till*, on the right side of the wagon,
*An axe rack*, on the left side of the wagon body, } as in Battery Wagon C.

*Eight boxes*, for tools and stores, marked: D, Nos. 3, 4, 5, 6, 7, 8, 9, 10, respectively.

*One shoeing box*, marked D.

## *Exterior dimensions of Boxes for Battery Wagon*, D.

| DESIGNATION. | Length. | Width. | Depth. | Weight. | REMARKS. |
|---|---|---|---|---|---|
| | In. | In. | In. | Lbs. | |
| D, Nos. 3 & 5. | 23.5 | 20.25 | 14. | 28. | Hard wood .75 inch thick, with hinged covers, and hooks. |
| D, No. 4..... | 27.5 | 23.5 | 14. | 34. | |
| D, No. 6..... | 19.5 | 19.5 | 10.5 | 21. | |
| D, No. 7..... | 31.5 | 19.5 | 8. | 26. | |
| D, No. 8..... | 12.5 | 8.5 | 7.5 | 4. | White pine .625 inch thick; with hinges and hooks. No. 9 div. into 4 parts. |
| D, No. 9..... | 13. | 13. | 5. | 6. | |
| D, No. 10..... | 14.5 | 6. | 5.5 | 3.5 | |
| Shoeing box... | 16.5 | 8. | 6.5 | 4.7 | |

*Eight tin cans:* Two of the capacity of *two gallons*, for NEATS' FOOT OIL and LINSEED OIL; three of *one gallon*, for the same oils, and for TURPENTINE; two, for *twenty-five pounds* each of OLIVE PAINT; and one, for *five pounds* of BLACK PAINT. They are made like those of the same capacity for Battery Wagon C.

*Two kegs*, for grease; like those in Battery Wagon C.

The *clamps* and other fixtures on the interior of the wagon cover, are mentioned in the list of contents.

*Contents of Wagon Body*, D.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Gun carriage stock, (ironed). | 1 | 165.00 | On the bottom of the wagon, against the right side, resting on two blocks to clear the rammer stop; the lunette to the rear. |
| Caisson stocks, (not ironed). | 2 | 70.00 | Against the left side and rear of the wagon; one on the other, the lunette ends in front. |
| Splinter bars | 2 | 30.00 | On the bottom, lying on each other against the caisson stocks and the rear of the wagon. |
| Tire bolts, nuts, and washers | 28 | 11.75 | On the bottom, against the front and right side. |
| Axletrees | 2 | 234.00 | On the bottom, against the gun carriage stock and the front end. |
| Half tires | 4 | 140.00 | Between the axletrees and the splinter bars. |
| Bar iron .....lbs. | 200 | 200.00 | In 5 bundles, not more than 3 feet long; on the half tires, against the front of the wagon. |
| Steel .....lbs. | 50 | 50.00 | |
| Pole yokes | 3 | 37.00 | On the bar iron towards the front. |
| Wheel traces | 10 | 47.5 | Piled on the bottom of the wagon, against the gun carriage stock and the till, and on the caisson stocks and splinter bars; occupying about 31 in. in length of the rear part of the wagon. |
| Leading traces | 10 | 57.5 | |
| Trace chains, staples, & rivets | 20 | 26.00 | |
| Collars | 6 | 27.50 | |
| Girths | 16 | 11.00 | |
| Whips | 16 | 8.00 | |
| Hames straps | 25 | 4.50 | |
| Bridles | 6 | 18.00 | |
| Halters | 6 | 21.00 | |
| Halter chains | 12 | 15.50 | |
| Harness leather .....sides. | 3 | 75.00 | Trimmed and rolled up tight; on the axletrees and tires, in front of the pile of harness. |
| Bridle leather. .....sides. | 2 | 22.00 | |
| Rope, 2¾ in.....lbs. | 30 | 30.00 | Between the front ends of the caisson stocks and the bar iron. |
| Nose bags | 12 | 13.50 | On the pile of harness. |
| Slow match.....yds. | 5 | 0.60 | |
| Screw jacks | 3 | 75.00 | On the slow match. |
| Elevating screws | 2 | 31.50 | |
| Drag ropes | 2 | 33.00 | Coiled on the screw jacks. |
| Grindstone and arbor | 1 | 56.50 | On the drag ropes. |
| Felling axes | 3 | 18.00 | In the axe rack. |
| Hand bills | 3 | 6.00 | |
| Carried forward | .... | 1535.35 | |

*Contents of Wagon Body*, D.—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward | .... | 1535.35 | |
| Neats' foot oil.....gals. | 3 | 25.00 | In 2 cans } In box D, 3; placed on the |
| Grease.....lbs. | 50 | 60.00 | " 2 kegs } caisson stocks & the rolls |
| Spirits turpentine .....gal. | 1 | 8.77 | " 1 can } of leather, against the front of the pile of harness. |
| LABORATORY TOOLS. | | | |
| Copper adze, with handle.... | 1 | 3.00 | |
| Wooden bowls..... | 4 | 6.00 | |
| Bench brushes..... | 2 | 0.90 | |
| Callipers.....pair. | 1 | 0.40 | |
| Dredging box..... | 1 | 1.00 | |
| Rocket mould.. } For 1.5 in. | 1 | 25.00 | |
| Set of formers.. } rockets. | 1 | 1.60 | |
| Set of drifts.... } | 1 | 1.75 | |
| Formers for cylinders and caps, each calibre.....set. | 1 | 7.50 | |
| Copper funnels..... | 4 | 4.00 | |
| Shot and shell gauges....set. | 1 | 15.00 | |
| Gimlets..... | 3 | 0.25 | |
| Copper hammer ..... | 1 | 1.80 | |
| Paste kettle..... | 1 | 9.00 | |
| Lead ladle..... | 1 | 2.00 | |
| Stencils, for letters and figures.....set. | 1 | 18.00 | In box D, 4; placed on the cais- |
| Box for do..... | 1 | 5.00 | son stocks and rolls of leather, |
| Mallets..... | 4 | 4.00 | next to No. 3. |
| Powder measures, 4 oz., 8 oz., 1 lb., and 2 lbs..... | 4 | 2.00 | |
| Brass mortar and pestle, small | 1 | 6.00 | |
| Moulds for musket and rifle balls, and buck shot...set. | 1 | 23.00 | |
| Wooden mullers..... | 2 | 4.00 | |
| Needles..... | 50 | 0.04 | |
| Paste brushes..... | 3 | 1.25 | |
| Copper pans, 10 or 12 in..... | 3 | 5.00 | |
| Rule, (2 feet,) not folded .... | 1 | 0.15 | |
| Sand stones ..... | 2 | 3.00 | |
| Spring balance, 30 lbs..... | 1 | 5.00 | |
| Scissors..... | 12 | 1.50 | |
| Copper scoop, large..... | 1 | 2.00 | |
| Do. small..... | 3 | 1.50 | |
| Hair sieve..... | 1 | 0.80 | |
| Hand screw drivers, large... | 2 | 2.00 | |
| Carried forward..... | .... | 1792.56 | |

*Contents of Wagon Body,* D—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward.... | .... | 1792.56 | |
| Spatula..... | 1 | 0.30 | In Box D, 4. 176.88 lbs. |
| Thimbles..... | 6 | 0.09 | |
| Gunner's callipers..... | 1 | 0.50 | |
| Priming wires..... | 6 | 0.50 | |
| Gunner's gimlets..... | 6 | 0.50 | |
| Gunner's pincers..... | 3 | 2.55 | |
| Tinner's furnace..... | 1 | 9.00 | |
| Linseed oil.....gals. | 3 | 26.5 | In 2 cans, In box D, 5; placed on the pole yokes and rope, between No. 4 and the front of the wagon. |
| Olive paint.....lbs. | 50 | 56. | In 2 cans |
| Black paint.....lbs. | 5 | 6.5 | In 1 can |
| Tarpaulins, 5 feet square.... | 2 | 18. | On the gun carriage stock. |
| Do.....do..... | 2 | 18. | Between the till and boxes Nos. 3, 4, and 5. |
| Marline.....lbs. | 10 | 10. | On box No. 3. |
| Sheep skins..... | 6 | 12. | On boxes Nos. 4 and 5. |
| ARMORER'S TOOLS. | | | |
| Wire awls..... | 3 | 0.25 | Box D, 6; placed on top of No. 5, against the front of the wagon. |
| Band set..... | 1 | 0.50 | |
| Drill brace..... | 1 | 2.60 | |
| Hand brace..... | 1 | 2.50 | |
| Centre bits..... | 6 | 0.40 | |
| Hand brushes..... | 2 | 0.60 | |
| Bench brush..... | 1 | 0.50 | |
| Callipers.....pair. | 1 | 0.30 | |
| Centre punch..... | 1 | 0.50 | |
| Cold chisels..... | 6 | 6.75 | |
| Stocker's chisels..... | 6 | 2.00 | |
| Stocker's gouges..... | 6 | 1.60 | |
| Compasses.....pair. | 1 | 0.18 | |
| Spring clamps..... | 2 | 3.00 | |
| Wood clamps..... | 2 | 3.00 | |
| Drill stock..... | 1 | 0.45 | |
| Drills, assorted..... | 6 | 0.25 | |
| Die stock..... | 1 | 0.75 | |
| Dies.....set. | 1 | 0.25 | |
| Files, assorted..... | 72 | 21.50 | |
| File handles..... | 12 | 1.5 | |
| Glue pot..... | 1 | 2.15 | |
| Carried forward.... | .... | 2004.53 | |

*Contents of Wagon Body,* D—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward..... | ..... | 2004.53 | |
| ARMORER'S TOOLS—(Cont'd.) | | | |
| Spring hooks..... | 3 | 0.63 | In Box D, 6. 100.92 lbs. |
| Bench hammers..... | 3 | 5.25 | |
| Drawing knife..... | 1 | 1.25 | |
| Nippers.....pairs. | 3 | 0.90 | |
| Plyers.....pairs. | 3 | 0.90 | |
| Reamers, assorted..... | 12 | 1.40 | |
| Spring compasses.....pair. | 1 | 0.21 | |
| Riffler..... | 1 | 0.25 | |
| Bench stake..... | 1 | 6.50 | |
| Hack saw frame..... | 1 | 1. | |
| Hack saw blades..... | 6 | 1. | |
| Armorer's punches..... | 4 | 0.38 | |
| Screw drivers, brace..... | 6 | 0.75 | |
| Rule, 2 feet..... | 1 | 0.15 | |
| Armorer's tongs..... | 2 | 2.50 | |
| Screw taps.....set. | 1 | 0.50 | |
| Breeching vice..... | 1 | 7. | |
| Hand vices..... | 3 | 3. | |
| Bevel vice..... | 1 | 1.75 | |
| Breeching wrench..... | 1 | 1.80 | |
| Tap wrench..... | 1 | 1.20 | |
| Straight edge..... | 1 | 0.57 | |
| Bayonet mandril..... | 1 | 2.50 | |
| Soldering irons..... | 2 | 3.50 | |
| Screw wrench..... | 1 | 2.42 | |
| Oil cans, small..... | 2 | 0.22 | |
| Tinner's shears.....pair. | 1 | 1.60 | |
| Brass scale, 1 foot..... | 1 | 0.20 | |
| Flint screw wrench..... | 1 | 0.06 | |
| Haversacks..... | 12 | 22.32 | In Box D, 7; placed on top of No. 4, and against No. 6. 37.46 lbs. |
| Tube pouches..... | 8 | 7.60 | |
| Thumb stalls..... | 8 | 0.04 | |
| Linen canvas .....yards. | 15 | 7.50 | |
| Sperm or wax candles...lbs. | 10 | 10. | In box D, 8, on top of No. 3. |
| Nails, 4d. to 10d.....lbs. | 20 | 20. | Box D, 9, on No. 3 and on the till. |
| Shoeing tools.....set. | 1 | 12.75 | In shoeing box, on No. 3. |
| Spades..... | 6 | 30. | In the till, on each other; the bits against the back of the wagon. |
| Carried forward.... | .... | 2164.13 | |

*Contents of Wagon Body*, D—Continued.

| TOOLS AND STORES. | NO. | WEIGHT. | PLACE. |
|---|---|---|---|
| | | Lbs. | |
| Brought forward.... | .... | 2164.13 | |
| Pick axes, without handles.. | 3 | 14.50 | In the till, between the spade handles. |
| Handles for do..... | 3 | 5. | |
| Sash cord.....pieces. | 24 | 40. | |
| Drill bow..... | 1 | 0.45 | In the till, lying on the bottom. |
| Barrel wiper and scraper.... | 1 | 2.5 | |
| Quick match.....lbs. | 2 | 2. | Box D, 10; in the left side of the till, in front of the spade handles. |
| Shoe thread.....lbs. | 10 | 10. | In the till, in front of box No. 10. |
| Dark lanterns..... | 3 | 3. | In the left side of the till, between the shoe thread & the front end. |
| Common lanterns ..... | 4 | 4.60 | |
| Rammer heads..... | 6 | 4.40 | In the till, between the lanterns and the side of the wagon. |
| Sponges..... | 12 | 3. | |
| Paint brushes..... | 12 | 3. | On box No. 10, and by the side of it. |
| Rammer staves..... | 6 | 13.5 | In the wagon cover; three on each side of the ridge pole, secured with two wooden buttons, which are fastened to the ridge pole, each with one screw. |
| Reaping hooks..... | 6 | 5.75 | Fastened to the ridge pole with a wooden clamp and a leather strap passing through a staple in the ridge pole. |
| Cross cut saw..... without | 1 | 9. | In the wagon cover, laid on each other, and fastened by 2 wooden clamps; the teeth of the cross cut saw against the right cover rail; the handle end of the pit saw against the rear board of the cover. |
| Pit saw..... handles | 1 | 15. | |
| Handles for do..... | 4 | 3. | On the spade handles. |
| Spare stock for battery wagon | 1 | 90. | On its hook. |
| Padlock..... | 1 | 0.5 | |
| Watering bucket..... | 1 | 8. | |
| Boxes..... | 8 | 155.20 | |
| Tow..... | .... | 26.50 | |
| Total..... | .... | 2583.03 | |

*Weights of Forges and Battery Wagons equipped for field service.*

| DESIGNATION. | For the Battery. | For the Park. |
|---|---|---|
| FORGE. | Lbs. | Lbs. |
| Body complete, without wheels | 997 | 997 |
| Two wheels | 360 | 360 |
| Anvil and water buckets | 118 | 118 |
| Stores in iron room | 320 | 455 |
| Stores in coal box | 255 | 255 |
| Limber body, without wheels | 335 | 335 |
| Two wheels | 360 | 360 |
| Limber chest, empty | 158 | 158 |
| Stores and tools on the limber | 480 | 332 |
| Total weight | 3,383 | 3,370 |
| BATTERY WAGON. | Lbs. | Lbs. |
| Body complete, without wheels | 910 | 910 |
| Two wheels | 360 | 360 |
| Stores in wagon body | 1,289 | 2,583 |
| Limber body, without wheels | 335 | 335 |
| Two wheels | 360 | 360 |
| Limber chest, empty | 158 | 158 |
| Stores and tools on the limber | 162 | 209 |
| Total weight, (exclusive of forage) | 3,574 | 4,915 |

## FIELD TRAIN.

### *Ordnance.*

The proportion of artillery to other troops varies generally between the limits of 1 and 3 pieces to 1,000 men, according to the force of the army, the character of the troops of which it is composed, the force and character of the enemy, the nature of the country which is to be the theatre of war, and the character and objects of the war.

Similar considerations must regulate the selection of the kinds of ordnance and the proportions of the different kinds in the train.

The following principles may be observed in ordinary cases:

2 pieces to 1,000 men { $\frac{2}{3}$ guns, of which { $\frac{1}{4}$ are 12-pdrs. / $\frac{3}{4}$ " 6-pdrs. ; $\frac{1}{3}$ howitzers, of which { $\frac{1}{4}$ " 24-pdrs. or 32-pdrs. / $\frac{3}{4}$ " 12-pdrs.

Distributed as follows:

*For the infantry:* 1 piece to 1,000 men—6-pdr. guns and 12-pdr. howitzers, in batteries of foot artillery.

*For the cavalry:* 2 pieces to 1,000 men—6-pdr. guns and 12-pdr. howitzers, in batteries of horse artillery.

*For the special and general parks of reserve:*

1 piece to 1,000 men { $\frac{1}{2}$ in 12-pdr. batteries / $\frac{1}{3}$ " 6-pdr. do. } of foot artillery. ; $\frac{1}{6}$ " 6-pdr. batteries of horse artillery.

### *Ammunition for Cannon.*

200 rounds to each piece, both of the reserves and of the active batteries.

The ammunition which cannot be carried in the caissons attached to the pieces will be kept in boxes with the reserves.

Additional supplies of ordnance and ordnance stores are placed in convenient depôts, according to circumstances.

### *Ammunition for Small Arms.*

100 rounds to each man; of which, for the musket, 40 rounds are in the cartridge box, 60 in the parks of reserve. In the same proportion for other small arms.

5 flints to 100 rounds, for arms with flint locks.

Percussion caps in the proportion of 12 caps to 10 cartridges.

*Composition of a Battery on the War Establishment.*

| KIND OF BATTERY..... | | | 12-PDR. | 6-PDR. |
|---|---|---|---|---|
| GUNS..... | 12-pounders, mounted..... | | 4 | |
| | 6-pounders, | do..... | ..... | 4 |
| HOWITZERS... | 24-pounder, | do..... | 2 | |
| | 12-pounder, | do..... | ..... | 2 |
| Total number of pieces..... | | | 6 | 6 |
| CAISSONS..... | for guns..... | | 8 | 4 |
| | for howitzers..... | | 4 | 2 |
| | | | 12 | 6 |
| TRAVELLING FORGE..... | | | 1 | 1 |
| BATTERY WAGON..... | | | 1 | 1 |
| Whole number of carriages with a Battery..... | | | 20 | 14 |
| AMMUNITION. For 4 guns.... | Shot..... | | 560 | 560 |
| | Spherical case..... | | 224 | 80 |
| | Canisters..... | | 112 | 160 |
| | | | 896 | 800 |
| For 2 howitzers | Shells..... | | 168 | 120 |
| | Spherical case..... | | 112 | 160 |
| | Canisters..... | | 42 | 32 |
| | | | 322 | 312 |
| Total number of rounds with a Battery..... | | | 1,218 | 1,112 |
| DRAUGHT HORSES. | 6 to each carriage..... | | 120 | 84 |
| | Spare horses—one-twelfth..... | | 10 | 7 |
| Total..... | | | 130 | 91 |

NOTE.—For two 32-pdr. howitzer carriages and 4 caissons, the number of rounds of ammunition is

| | |
|---|---|
| Shells..... | 112 |
| Spherical case... | 84 |
| Canisters..... | 14 |
| Total..... | 210 |

HARNESS, corresponding with the number of horses to the carriages.

### *Battery of Mountain Howitzers.*

| | | |
|---|---|---|
| Howitzers | 6 | |
| Gun carriages | 7 | |
| Ammunition chests | 36 | (48 rounds for each howitzer.) |
| Forge and tools, in 2 chests | 1 | |
| Set of carriage makers' tools, in 2 chests | 1 | |
| Pack saddles and harness | 33 | |
| Horses or mules | 33 | |

Such additional supplies of the above kinds as may be thought necessary will be carried with the park of reserve, together with the necessary ammunition for infantry, in packs.

A mountain howitzer ammunition chest will carry about 700 musket ball cartridges.

### *Rocket Battery.*

No regular organization of a rocket battery has been arranged.

The nature and number of rockets, and of carriages or conductors, will be determined by the character of the service for which they may be required.

### *The Field Park.*

The spare carriages, reserved supplies of ammunition, tools and materials for extensive repairs, and for making up ammunition, for the service of an army in the field, form the *Field Park*, to which should be attached also the batteries of reserve.

The quantities of these supplies must depend in a great measure on the particular circumstances of the campaign.

*The ammunition* required for artillery and small arms, (according to the proportions above stated,) in addition to what can be carried by the batteries and the troops, will be carried with the park, in caissons, or in store wagons.

The following carriages and stores, in due proportion, according to circumstances, will also form parts of the field park, viz:

*Spare gun carriages*, 1 to each field battery.

*Travelling Forges*, B
*Battery Wagons*, D } One or more of each.

*Spare spokes*, 50 to each battery,
*Spare fellies*, 20 to each battery,
*Spare harness*.....
*Horse shoes and nails*, } In boxes } In store wagons.

| | |
|---|---|
| Gunpowder. | Cannon primers, percussion and friction. |
| Saltpetre. | Fuzes and fuze plugs for field service. |
| Sulphur. | Stuff for cartridge bags. |
| Charcoal. | Woollen yarn. |
| Laboratory paper. | Cotton yarn. |
| Percussion caps for small arms. | Glue. |

## SIEGE TRAIN.

The number and kind of cannon for a siege train must be determined by the circumstances of each case, but the following general principles may be observed in assigning the proportion of different kinds and calibres, and the relative quantity of other supplies, for a Train of 100 pieces of ordnance.

### *Cannon.*

| | | | | |
|---|---|---|---|---|
| Guns.. | 24-pdr. | about one-half of the whole number | | 50 |
| | 18-pdr. or 12-pdr. | " one tenth | " | 10 |
| Howitzers, 8-in. siege | | " one-fourth | " | 25 |
| Mortars.. | 10-in. siege | " one-eighth | " | 12 |
| | 8-in. siege | " | | 3 |
| Stone mortars | | in addition to the 100 pieces | | 6 |
| Coehorn mortars | | | | 6 |
| Wall pieces | | | | 40 |

### *Gun Carriages.*

| | |
|---|---|
| For 24-pdr. guns and 8-in. howitzers, one-fifth spare | 90 |
| For 18-pdr. and 12-pdr. guns.....one-fifth spare | 12 |
| For 10-in. mortars and stone mortars, one-sixth spare | 21 |
| For 8-in. mortars | 4 |

### *Other Carriages.*

| | |
|---|---|
| *Mortar wagons.* 1 for each 10-in. mortar and bed, for each stone mortar and bed, and for three 8-in. mortars and beds | 38 |
| *Wagons*, for transporting implements, intrenching and miner's tools, laboratory tools and utensils, and other stores—each loaded with about 2,700 lbs., say | 140 |
| *Carts*, (carrying balls, &c., on the march) | 50 |
| *Park Battery wagons*, fully equipped | 28 |
| *Park Forges*, do. | 8 |
| *Sling carts*, large | 5 |
| *Do.* hand | 4 |

### *Draught Horses.*

| | |
|---|---|
| For each Gun and howitzer, with its carriage | 8 |
| " Spare gun carriage | 6 |
| " Mortar wagon | 8 |
| " Battery wagon | 6 |
| " Forge | 6 |

| | |
|---|---|
| For each cart | 2 |
| " Sling cart, large | 2 |
| Spare horses | 1-10th |
| Total, about | 1,900 horses. |

*Projectiles and Ammunition.*

| | | |
|---|---|---|
| For Guns.... | Round shot. 800 to each 24-pdr. | 40,000 |
| | Round shot. 1,000 to each 18 and 12-pdr. | 10,000 |
| | Grape and canisters strapped, 20 rounds to each piece | 1,200 |
| | Spherical case strapped, 20 rounds to each piece | 1,200 |
| For Howitzers.. | Shells, 800 to each 8-inch howitzer | 20,000 |
| | Canisters strapped, 5 to each | 125 |
| | Spherical case strapped, 20 to each | 500 |
| For Mortars.... | 600 shells to each 10-inch | 7,200 |
| | 800 " " 8-inch | 2,400 |
| | 200 " " Coehorn | 1,200 |
| *Gunpowder*, in barrels | lbs. | 500,000 |

Computing for each 24-pounder round shot, one-third the weight of shot.

" " 18 & 12-pdr. " one-fourth " "

" " grape, canister, and spherical case, one-sixth the weight of shot.

| | | | | |
|---|---|---|---|---|
| " | " | round of howitzer ammunition.. | 5 lbs. | including charge of shell. |
| " | " | " 10-inch mortar | 7 " | |
| " | " | " 8-inch " | 3 " | |
| " | " | " Coehorn | ½ " | |
| " | " | " Stone mortar | 1 " | |

*Cartridge bags*, 1 for each round.

*Cartridge paper*, bundles 200

*Wads*—hay wads, made in the field.

*Slow match*.....lbs. 4,500

*Port-fires*..... 2,000

*Priming tubes*, for mortars..... 15,000

*Fuzes*, ¼ more than the number of shells..... 40,000

*Wooden bottoms and baskets* for stone mortars, 200 to each..... 1,200

*Percussion primers*, for pieces furnished with locks, ¼ to spare.

*Friction tubes*, for guns and howitzers, 1 to each round.

*Cartridges for wall pieces*, 500 rounds to each.

*Cartridges, powder, percussion caps, flints and lead*, for small arms, according to the force of the army.

Most of the ammunition is transported by hired wagons.

## *Implements and Equipments.*

FOR EACH GUN.

2 Sponges—1 spare.
2 Rammers—1 do.
1 Worm to 4 pieces.
1 Ladle do.
8 Handspikes—2 spare.
1 Linstock.
1 Pass box to 4 pieces.
1 Tube pouch.
1 Havresack.
2 Thumbstalls.
2 Priming wires—1 spare.
1 Gunner's gimlet.
1 Tangent scale.
1 Vent cover, or lock cover.
1 Water bucket.
1 Broom.
1 Percussion lock and 2 lanyards.
2 Lanyards for friction tubes.

FOR EACH HOWITZER AND MORTAR.

| IMPLEMENTS. | HOWITZER. | MORTAR. |
|---|---|---|
| Sponges and rammers | 2—1 spare | 2—1 spare |
| Handspikes, (2 shod, for mortar) | 6—2 spare | 6—2 spare |
| Linstocks | 1 | 2—1 spare |
| Havresacks | 1 | 1 |
| Tube pouches | 1 | 1 |
| Priming wires | 2—1 spare | 2—1 spare |
| Gunner's gimlets | 1 | 1 |
| Quadrants | 1 | 1 |
| Fuze setters | 2—1 spare | *2—1 spare |
| Fuze mallets | 2—1 spare | *2—1 spare |
| Baskets | 1 | 1 |
| Chocks for wheels | 2 | |
| Loading tongs | 1 | |
| Tompions | 1 | 1 |
| Water bucket | 1 | 1 |
| Broom | 1 | 1 |
| Percussion locks and lanyards | 1 | |
| Lanyards for friction primers | 2 | |
| Plummets | | 1 |
| Pointing wires | | *2 |
| Quoins | | 2 |
| Shell hooks | | *2—1 spare |
| Scrapers | | 1 |
| Spatulas | | *1 |
| Gunner's sleeves (pair) | | 1 |
| Wipers of tow linen | | 1 |

Scales and weights, or a spring balance, funnel, set of powder measures of 3 sizes, and fuze extractor, to each battery magazine.

Implements marked * are not required for the stone mortar.

The number of implements must be proportioned to the whole number of gun carriages, including the spare carriages.

*One tar bucket* to each travelling carriage.

### *Platforms.*

For guns and howitzers..... 1-10th spare.
For mortars..... 1-8th do.

### *Embrasure Shutters.*

For half the number of guns and howitzers.

### *Spare Parts of Carriages.*

Proportion to the number of parts in the carriages:

Pintles for siege carriages..... 1-30th.
Nuts and washers, assorted..... 1-10th.
Linch pins..... 1-5th.
Axletrees..... 1-20th.
Wheels..... 1-15th.
Axle washers { Shoulder..... 1-20th. / Linch..... 1-10th.
Cap squares..... 1-15th.
Poles, one-half ironed..... 1-4th.
Elevating screws..... 1-8th.
Leading bars, one-half ironed..... 1-8th.

Spare parts of field carriages, as for field batteries.

### *Timber and other Materials for Repairs.*

Proportion to the number of parts that enter into the construction of the carriages:

Axle bodies for siege carriages 1-50th—Breech bolsters 1-20th—Cheeks 1-30th—Fellies 1-50th—Spokes 1-30th—Fork saddles 1-30th—Poles 1-20th—Hounds 1-20th—Splinter bars 1-20th—Leading bars 1-10th—Square timber of various scantling—Plank—Wooden parts of mortar wagons; of each 1-20th.

Bar iron assorted, 80 lbs. to a piece, 8,000 lbs.—Steel, 5 lbs. to a piece, 500 lbs.—Sheet iron, 50 sheets—Iron wire, 400 lbs.—Tin, 225 sheets—Nails, assorted, 300 lbs.—Screws, assorted, 5 groce.

### *Machines and Ropes.*

7 Gins, with tackle, complete—10 Lever Jacks—14 Screw Jacks—5 Lifting Jacks—20 Wheelbarrows, 1-5th for shells—7 Handbarrows—Balances, for weighing—10 Spare gin falls—75 Double prolonges—75 Single prolonges—

Drag ropes, 200—2¾ inch rope, 500 fathoms—Men's harness, 50—Small ropes, 200 lbs.—Twine, of various sizes, 50 lbs.

### *Tools.*

Sets of carriage makers' and blacksmiths' tools—Pioneers' tools, for the artillery alone, 40 to a piece, say 4,000; of which 1,600 spades, 270 shovels, 2,000 mattocks, 130 picks—Spare tool handles, one-half.

Axes, 5 to a piece, 500—Bill hooks, 2 to a piece, 200—Saws, various kinds, 100—10-foot rods, 2-foot rules, mason's levels, 50 of each—Mauls, 200—Scythes, 8—Miners' tools—Baskets.

### *Laboratory Tools and Materials.*

2 Sets of Laboratory tools; see CHAPTER X, *page* 231.

| | | | |
|---|---|---|---|
| Nitre, pulverized | 1,500 lbs. | Twine | 50 lbs. |
| Sulphur, pulverized | 100 " | Tarred rope yarn | 200 " |
| Charcoal, pulverized | 100 " | Copper wire | 10 " |
| Sulphur, roll | 100 " | Brass wire | 10 " |
| Pitch | 150 " | Cotton yarn | 25 " |
| Rosin | 150 " | Glue | 10 " |
| Beeswax | 50 " | Wrapping paper | 10 reams. |
| Camphor | 20 " | Tar | 2 barrels. |
| Spirits turpentine | 10 gals. | Mealed powder | 300 lbs. |
| Sperm oil | 30 " | Quick match | 150 " |
| Linseed oil | 2 " | Torches | 100 |
| Tow—Tarred links—Fire stone, &c. | | Coal tar | 1 barrel. |

### *Implements for firing Hot Shot.*

4 Sets—See CHAPTER XIII.

### *Instruments and Books.*

2 Theodolites, or other instruments for measuring angles—2 Levels and staves—2 Compasses—4 Surveying chains—Diagonal scales—Cases of mathematical instruments—Spy glasses—Thermometer—Barometer.

*Books.* Ordnance Manual—Artillery for the land service—Tables of firing—Logarithmic tables—Drawing paper.

### *Miscellaneous Supplies.*

Smiths' coal, 20 tons—Grease, 2,000 lbs., in 50 lb. kegs—Sand bags, 500 to each piece of ordnance—Chevaux de frise—Scaling ladders—Rampart grates, 50—Tarpaulins, various sizes, 100—2 Grindstones—Lanterns, 100—Sperm candles, 150 lbs.—Lamp lighter's torches—Canvas—Friction matches, in small tin cases.

## ARMAMENT OF FORTIFICATIONS.

The kind and number of pieces of ordnance required for the armament of each of the fortifications are prescribed by the War Department, according to the character and extent of each work.

The carriages, ammunition, implements, equipments, and other supplies, for a fort placed on the war establishment, may be proportioned to the number of pieces on the following general principles, the application of which must, however, be regulated by the importance of the position, and by the peculiar circumstances of each case.

| CARRIAGES. | For a front of attack. | For other land fronts and for sea-coast batteries. | |
|---|---|---|---|
| GUN CARRIAGES. Casemate | 1-6th | 1-20th | More than the number of pieces. |
| Barbette | 1-3d | 1-10th | |
| Siege | 1-3d | 1-10th | |
| Field | 1-3d | | |
| Mortar beds | 1-4th | 1-10th | |
| Trench carts, for advanced works | 1 to 20 pieces | | |
| Sling carts | 1 to 25 pieces | 1 to 25 pieces. | |
| Tumbrils or hand carts | 1 to 20 pieces | 1 to 20 pieces. | |
| Caissons | 1 to each field piece. | | |
| Forges, travelling, (besides permanent forges) | 1 to 30 pieces of all kinds. | | |
| AMMUNITION. | | | |
| For each 10-in. columbiad | 400 rounds. | | |
| For each gun and sea-coast howitzer and 8-in. columbiad | 800 " | 250 rounds. | 1-20th Grape and canister |
| For each 24-pdr. howitzer | 100 " | 100 " | 1-2nd Grape and canister |
| For each siege howitzer | 600 " | 200 " | 1-20th Grape and canister |
| For each 10-in. mortar | 400 " | | |
| For each mortar | | 200 " | |
| For 8-in. mortar, stone mortar, and Coehorn | 600 " | | |

Stone, 100 lbs. to each charge of a stone mortar.

Rampart grenades, 300 to a front of attack.

For each piece of artillery of a field battery for sorties, 200 rounds.

Drag ropes, 200—2¾ inch rope, 500 fathoms—Men's harness, 50—Small ropes, 200 lbs.—Twine, of various sizes, 50 lbs.

### *Tools.*

Sets of carriage makers' and blacksmiths' tools—Pioneers' tools, for the artillery alone, 40 to a piece, say 4,000; of which 1,600 spades, 270 shovels, 2,000 mattocks, 130 picks—Spare tool handles, one-half.

Axes, 5 to a piece, 500—Bill hooks, 2 to a piece, 200—Saws, various kinds, 100—10-foot rods, 2-foot rules, mason's levels, 50 of each—Mauls, 200—Scythes, 8—Miners' tools—Baskets.

### *Laboratory Tools and Materials.*

2 Sets of Laboratory tools; see CHAPTER X, *page* 231.

| | | | |
|---|---|---|---|
| Nitre, pulverized | 1,500 lbs. | Twine | 50 lbs. |
| Sulphur, pulverized | 100 " | Tarred rope yarn | 200 " |
| Charcoal, pulverized | 100 " | Copper wire | 10 " |
| Sulphur, roll | 100 " | Brass wire | 10 " |
| Pitch | 150 " | Cotton yarn | 25 " |
| Rosin | 150 " | Glue | 10 " |
| Beeswax | 50 " | Wrapping paper | 10 reams. |
| Camphor | 20 " | Tar | 2 barrels. |
| Spirits turpentine | 10 gals. | Mealed powder | 300 lbs. |
| Sperm oil | 30 " | Quick match | 150 " |
| Linseed oil | 2 " | Torches | 100 |
| Tow—Tarred links—Fire stone, &c. | | Coal tar | 1 barrel. |

### *Implements for firing Hot Shot.*

4 Sets—See CHAPTER XIII.

### *Instruments and Books.*

2 Theodolites, or other instruments for measuring angles—2 Levels and staves—2 Compasses—4 Surveying chains—Diagonal scales—Cases of mathematical instruments—Spy glasses—Thermometer—Barometer.

*Books.* Ordnance Manual—Artillery for the land service—Tables of firing—Logarithmic tables—Drawing paper.

### *Miscellaneous Supplies.*

Smiths' coal, 20 tons—Grease, 2,000 lbs., in 50 lb. kegs—Sand bags, 500 to each piece of ordnance—Chevaux de frise—Scaling ladders—Rampart grates, 50—Tarpaulins, various sizes, 100—2 Grindstones—Lanterns, 100—Sperm candles, 150 lbs.—Lamp lighter's torches—Canvas—Friction matches, in small tin cases.

## ARMAMENT OF FORTIFICATIONS.

The kind and number of pieces of ordnance required for the armament of each of the fortifications are prescribed by the War Department, according to the character and extent of each work.

The carriages, ammunition, implements, equipments, and other supplies, for a fort placed on the war establishment, may be proportioned to the number of pieces on the following general principles, the application of which must, however, be regulated by the importance of the position, and by the peculiar circumstances of each case.

| CARRIAGES. | For a front of attack. | For other land fronts and for sea-coast batteries. | |
|---|---|---|---|
| GUN CARRIAGES. Casemate | 1-6th | 1-20th | More than the number of pieces. |
| Barbette | 1-3d | 1-10th | |
| Siege | 1-3d | 1-10th | |
| Field | 1-3d | | |
| Mortar beds | 1-4th | 1-10th | |
| Trench carts, for advanced works | 1 to 20 pieces | | |
| Sling carts | 1 to 25 pieces | 1 to 25 pieces. | |
| Tumbrils or hand carts | 1 to 20 pieces | 1 to 20 pieces. | |
| Caissons | 1 to each field piece. | | |
| Forges, travelling, (besides permanent forges) | 1 to 30 pieces of all kinds. | | |
| AMMUNITION. | | | |
| For each 10-in. columbiad | 400 rounds. | | |
| For each gun and sea-coast howitzer and 8-in. columbiad | 800 " | 250 rounds. | 1-20th Grape and 1-2nd canister |
| For each 24-pdr. howitzer | 100 " | 100 " | 1-20th Grape and 1-2nd canister |
| For each siege howitzer | 600 " | 200 " | 1-20th Grape and 1-2nd canister |
| For each 10-in. mortar | 400 " | | |
| For each mortar | | 200 " | |
| For 8-in. mortar, stone mortar, and Coehorn | 600 " | | |

Stone, 100 lbs. to each charge of a stone mortar.

Rampart grenades, 300 to a front of attack.

For each piece of artillery of a field battery for sorties, 200 rounds.

*Gunpowder.* The quantity of cannon powder may be calculated on the following principles:

| | | | | |
|---|---|---|---|---|
| For each charge of a gun— | $\frac{1}{4}$ | of the weight of the shot. | | |
| Do. | do. | 10-in. columbiad, | 21 | lbs. |
| Do. | do. | 8 do. | 12 | " |
| Do. | do. | 24-pdr. howitzer, | 2 | " |
| Do. | do. | 8-in. siege howitzer, | 4 | " |
| Do. | do. | 10-in. sea-coast do. | 12 | " |
| Do. | do. | 8-in. do. do. | 8 | " |
| Do. | do. | 10-in. mortar, light, | 7 | " |
| Do. | do. | 10-in. do. heavy, | 15 | " |
| Do. | do. | 8-in. do. | 3 | " |
| Do. | do. | 13 in. do. | 30 | " |
| Do. | do. | Stone mortar | 1 | " |
| Do. | do. | Coehorn | $\frac{1}{2}$ | " |

(the first 10 rows: including the charge of the shell.)

To spare; for mining, fireworks, and waste, $\frac{1}{10}$ of the whole, including a proportion of mealed powder and its components, pulverized.

*Fuzes*, $\frac{1}{4}$ more than the number of shells.

*Tubes*, $\frac{1}{2}$ the number of rounds.

*Slow match*, 40 lbs. to a piece.

*Cannon cartridge paper*, 1 sheet to a round.

*Sabots.*

*Wooden bottoms* for stone mortars.

*Portfires*, 1 to 50 rounds.

*Percussion primers*, $\frac{1}{4}$ more than the number of rounds, for pieces furnished with locks.

*Friction primers*, $\frac{1}{2}$ the number of rounds.

## *Small Arms.*

| | | |
|---|---|---|
| Muskets | $\frac{1}{3}$ | more than the number of troops of the several kinds, supposed to be fully armed and equipped. |
| Musketoons | $\frac{1}{3}$ | |
| Pistols | $\frac{1}{8}$ | |
| Artillery and Infantry swords | $\frac{1}{25}$ | |
| Cavalry sabots | $\frac{1}{2}$ | |

Wall pieces—50 to a front of attack, or a front exposed to escalade.

*Ammunition:* Musket cartridges, for each man.....400

Musketoon, pistol, and rifle cartridges.....100

Cartridges for each wall piece .....400

Spare powder for small arms, $\frac{1}{25}$ of the whole quantity required for the cartridges—Cartridge paper in proportion.

Flints, 1 to 10 rounds, for arms with flint locks.

Percussion caps, in addition to those packed with the cartridges, $\frac{1}{4}$ the number of rounds.

## *Implements and Equipments.*

| FOR EACH GUN. | FOR EACH HOWITZER. |
|---|---|
| 1 Tompion<br>2 Rammers—1 spare.<br>2 Sponges— 1 do.<br>1 Worm, } to 6 pieces.<br>1 Ladle, }<br>1 Linstock.<br>1 Pass box.<br>1 Budge barrel.<br>1 Tube pouch.<br>2 Thumbstalls—1 spare.<br>2 Priming wires—1 do.<br>1 Gunner's gimlet.<br>1 Hausse, or tangent scale.<br>1 Vent cover, or lock cover.<br>1 Percussion lock and 2 lanyards.<br>2 Lanyards for friction tubes.<br>1 Water bucket.<br>2 chocks. | The same as for a gun, omitting *pass box*, and adding:<br>1 Haversack.<br>1 Fuze setter.<br>1 Fuze mallet.<br>1 Fuze extractor, to 6 pieces.<br>1 Quadrant.<br>1 Fuze saw.<br>1 Fuze gimlet.<br>Cylinhead wrench 2 bm 32 chamber sponge. |

FOR EACH MORTAR:

| | |
|---|---|
| 1 Sponge and rammer. | 1 Pair shell hooks. |
| 6 Handspikes—4 shod. | 1 Scraper. |
| 1 Linstock. | 1 Spatula. |
| 1 Haversack. | 1 Pair gunner's sleeves. |
| 1 Tube pouch. | 1 Wiper. |
| 2 Priming wires. | 1 Fuze setter. |
| 1 Gunner's gimlet. | 1 Mallet. |
| 1 Quadrant. | 1 Fuze saw. |
| 1 Plummet. | 1 Fuze extractor, to 6 mortars. |
| 2 Pointing wires. | 1 Basket. |
| 2 Quoins. | 1 Broom. |
| 1 Tompion. | 1 Tarpaulin. |

The implements for *shells* are not required for the stone mortar.

FOR EACH CASEMATE CARRIAGE: (including the spare carriages.)—2 Truck handspikes—2 Chocks—1 Broom. – 1 roller handspike – 4 manoeuvring handspikes.

FOR EACH BARBETTE CARRIAGE: 4 Manœuvring handspikes—1 Tarpaulin, or other cover—1 Platform and 1 maul; if the platform is not permanent. – 2 chocks. – 1 broom

FOR EACH SIEGE CARRIAGE: 4 Handspikes—1 Maul—1 Platform.

## *Spare Parts for repair of Carriages.*

Proportion of the number of spare parts to that of similar parts which belong to the carriages:

Forks for traversing wheels of barbette carriages..... 1-20th.
Pintles for siege carriage limbers..... 1-30th.
Pintles for casemate carriages..... 1-20th.
Linch pins..... 1-5th..
Axletrees { for siege carriages..... 1-20th. / for barbette carriages..... 1-40th. / for casemate carriages..... 1-40th.
Rollers for casemate carriages..... 1-40th.
Bolster plates, for pintles not permanently fixed..... 1-40th.
Wheels { for siege carriages..... 1-15th. / for barbette upper carriages, (including rollers,)..... 1-20th. / for casemate do. ..... 1-40th. / for barbette chassis..... 1-40th. / for casemate chassis..... 1-40th.
Axle washers, { shoulder..... 1-20th. / linch..... 1-10th.
Poles, for siege carriage limbers, one-half ironed..... 1-4th..
Elevating screws..... 1-8th..
Tongues (iron) for casemate carriages..... 1-10th.
Nuts, assorted..... 1-10th.

## *Timber and other Materials for Repairs.*

Cheeks, stocks, naves, spokes, felloes, for siege carriages; of each 1-20th—Cheeks of mortar beds, 1-12th. Handspikes, 4 to a piece—Tool handles, $\frac{1}{8}$—Sets of timber for barbette carriages, 1-20th. Ditto, casemate, 1-40th—Iron assorted, 50 lbs. to each piece—Nails and screws assorted, 100 to each piece—Steel, 1 lb. to each piece—Sheet iron, 6 square feet to each piece—Tin, 5 sheets to each piece—Spare parts for small arms, see CHAP. VIII.

## *Machines, Ropes, &c.*

Gins, casemate and rampart, as may be required, according to the extent of the fort—Screw Jacks—Capstans—Lever Jacks—Wheelbarrows, 1 to each piece—Handbarrow, for shells, 1 to each mortar—Sling handbarrow, or frame handbarrow with legs, 1 to 6 guns and howitzers—Platform balance, or scales

and weights—Gin falls, 1-5th spare—Double prolonges, 2 to each gin—Drag ropes—2¼ in. rope—Small rope, 5 lbs. to a piece—Handspikes, 7 feet long—Skids—Blocks—Rollers.

### *Tools.*

Sets of carriage makers', smiths' and armorers' tools—Intrenching and miners' tools—Saws—Levels—Paviours' rammers—10-foot rods—2-foot rules—the number of each kind to be regulated by the particular circumstances of each case.

### *Tools and Materials for Fireworks.*—See CHAPTER X.

Laboratory tools and materials, according to the extent and resources of the fort. See the proportion of those for a siege train.

For each night of a siege, or for each night on which the guns will probably be served, have 6 tarred links to each piece mounted on the ramparts of a front of attack, or of a sea-coast battery, and 5 fire balls for a front of attack—6 carcasses for each large mortar on a front of attack.

Signal rockets—Torches—Fire stone, &c.—according to circumstances.

### *Instruments, Books, and Stationery.*

According to the character and extent of the fort—See *Siege Train.*

### *Miscellaneous Supplies.*

Timber, plank, and boards—Wood for sabots, fascines, gabions, &c.—Pickets—Coal, 5 tons to a forge—Grease—Grindstones—Rampart grates, 2 to each piece on the ramparts—Sand bags, for the batteries of the front of attack—Lantern, 1 to each piece—Candles—Oil—Fire engine and buckets.

*Field pieces*, forming a part of the armament of a fortification, should be provided with their caissons, ammunition, &c., as for service in the field.

# CHAPTER TWELFTH.

## MECHANICAL MANŒUVRES.

A board of officers has been recently charged with revising and arranging the manœuvres of heavy ordnance; some general directions with regard to the mechanical manœuvres are retained here for present use.

### FIELD ARTILLERY.

The manœuvres may be performed by the men attached to the piece, and require no other implements than those belonging to the piece.

Begin, in all cases, by unlimbering and taking off the implements attached to the carriage.

#### *To change a Wheel.*

Tighten the cap squares; raise the elevating screw to its whole height; raise the carriage by means of two handspikes, one in the bore of the piece, and the other crossed under the first; support the carriage whilst the wheel is changed. For the 12-pdr. carriage, dig a hole 6 in. deep under the wheel that is to remain, in order to prevent it from sliding.

#### *To dismount a Piece.*

Take off the cap-squares; run up the elevating screw to its whole height; raise the trail; stand the piece upon its muzzle on the ground, and withdraw the carriage.

#### *To mount a Piece.*

Put a handspike under the piece a little in rear of the rimbases, and another under the cascable; place 2 men at the first handspike, 4 at the second, and 2 at the handles, or, (if the piece has no handles,) 4 at each handspike, and raise the piece upon its muzzle; bring up the carriage, raise the trail, and put the piece in its place; put on the cap squares, and lower the trail, relieving the weight of the piece by raising the muzzle.

In this manœuvre and the preceding, it may be necessary, with the 12-pdr. and larger calibres, to make a hole in the ground for the muzzle.

*When a piece is upset*, separate it from its carriage and remount it as above.

### *To transport a Piece by means of the Limber.*

Detach the prolonge ; place the limber over the piece so that the pintle hook shall be over the handles, (or over the rear of the trunnions,) with the breech toward the pole ; raise the pole, and elevate the muzzle of the piece; lash the piece to the pintle hook, with the prolonge, by passing the ring of the prolonge twice through the handles, (or round the piece in rear of the trunnions,) and over the pintle hook ; with the loose end of the prolonge, lash the cascable to the fork of the limber.

Or, the gun may be placed on blocks at the proper height, and then lashed to the limber as before.

## SIEGE ARTILLERY.

### *Implements.*

6 *Handspikes;* 7 feet long.

1 *Lever;* 15 feet long, 5.5 in. square; the ends beveled.

1 *Lever jack;* or blocks for fulcrum.

3 *Short rollers,* for guns; 12 inches long; 6 in. diameter for 12 and 18-pdrs.; 7 inches for 24-pdr. These rollers are hollowed out in the middle, to the depth of 0.25 in.

2 *Long rollers;* 42 inches long, 6 inches diameter.

1 *Small half roller;* 42 in. long, 3 in. diameter, 3 in. high.

1 *Large half roller;* 42 in. long, 6 in. diameter, 6 in. high.

2 *Skids;* 6 feet long, 8 inches square.

1 *Plank;* 67 in. long, 12 in. wide, 2.25 in. thick. The ends beveled on opposite sides.

4 *Blocks;* 20 in. long, 8 in. square.

4 *Half blocks;* 20 in. long, 8 in. wide, 4 in. thick.

2 *Quarter blocks;* pieces of plank, 20 in. long, 6 in. wide, 2 in. thick; for manœuvre of mortar beds.

1 *Purchase block,* for a fulcrum; 12.5 in. long, 7 in. wide, 5 in. thick, furnished with a handle 32 in. long, like a maul; a groove 1.75 in. wide and 1 in. deep is cut in one side and one end.

5 *Gun chocks;* wedges, 3.5 in. long, 2.75 in. wide, 2.5 in. high.

6 *Wheel chocks,* 7 in. long ; the cross section is triangular, base 6 in., height 3.25 in; the upper angle rounded.

6 *Roller chocks;* made like the wheel chocks; length 7 in., base 4 in., height 1.5 in.

2 *Long skids;* 15 feet long, 8 in. square; for rolling guns on.

1 *Hammer.*

1 *Wrench.*

### *Ropes.*

1 *Double prolonge;* girth 3.25 in., length 78 feet; a loop 18 in. long at one end.

1 *Single prolonge;* girth 3 in., length 48 feet.

1 *Trace rope;* girth 2.25 in., length 30 feet.

1 *Lashing line;* girth 1.75 in., length 10 feet.

The prolonges used in the mechanical manœuvres with heavy pieces should be designated by their lengths, in order to distinguish them from those used for field service.

For the weight and strength of ropes, see CHAPTER XIV.

KNOTS; *Plate* 19.

A non-commissioned officer and 11 men are required for the manœuvres.

In order to avoid accidents, the functions of each man should be designated beforehand.

### *Preliminary Manœuvres.*

IMPLEMENTS: 6 handspikes—1 lever jack—1 gun roller—1 small half roller—1 large half roller—4 blocks—2 half blocks—1 purchase block—2 gun chocks—4 roller chocks—6 wheel chocks.

1. *The gun being on the ground, to place blocks under the chase and reinforce.* Embar with four handspikes, two on each side, and raise first the chase and then the breech, to place the blocks.

To take them out, embar as before and remove the block from the breech first.

2. *The gun resting on two blocks, to place the half roller under the reinforce.* Place two blocks parallel to the piece, and by two purchases with the *lever*, under the knob of the cascable, raise the breech and lay the large half roller across these blocks. The half roller is taken out by heaving as above, and the breech is supported by a block.

3. *The gun being mounted on its carriage and in the trunnion holes, either limbered or unlimbered, to place a roller under the reinforce, or to remove it:* Bear down on the muzzle; place or remove the roller.

4. *The gun being in the travelling position, and limbered up, to place a roller under the reinforce, or to remove it.* Heave under the base ring, with two handspikes supported on the purchase block, laid on the stock of the carriage; raise the breech, and place the roller, or remove it.

*To place this roller nearer the centre of gravity of the piece;* take a second purchase with the handspikes, supported on the small half roller laid on the purchase block. This roller is removed by raising the breech as above.

5. *The piece being in the trunnion holes, to unlimber.* Unhook the lashing chain; raise the trail by means of a handspike placed across under it, assisting the movement by bearing on a handspike inserted in the bore. When the pintle is disengaged, remove the limber and lower the trail to the ground.

6. *To limber up.* Raise the trail as before; back the limber, insert the pintle in the pintle hole, and hook the lashing chain.

7. *The piece being in the travelling position, to unlimber.* Bear down on the pole which will raise the stock sufficiently high to place 4 blocks and a half block under the middle of the stock; raise the pole to disengage the pintle and remove the limber.

*To lower the trail on the ground.* Take a purchase with the lever under the trail, shift the blocks under the manœuvring bolts, remove successively at each purchase a half block, or a block, as the lever will allow, and lay a chock in place of the lowest block, which can be removed with a lift of the lever, or with handspikes.

*In the mortar wagon,* first raise the pole, and lay a half roller on the end of the *fork* against the pintle; on lowering the pole, the stock is raised sufficiently to place the blocks as above.

8. *To limber up.* The trail is raised on four blocks and a half block by successive purchases with the lever, as in lowering it; placing a block or half block at each heave, as the lift will allow.

## *To change a piece from the Trunnion Holes to the Travelling Position.*

*Required:* 11 men—6 handspikes—1 gun roller—1 small half roller—1 purchase block—2 gun chocks—4 roller chocks—6 wheel chocks—1 trace rope.

The carriage must be limbered up, or the trail raised upon 3 blocks and a half block.

Chock the wheels; depress the muzzle; remove the elevating screw, and place a roller under the reinforce.

Lift the muzzle, pushing the piece back, hauling at the same time on the trace rope attached to the knob of the cascable, until the trunnions come over their position. Remove the roller, and lower the breech on the bolster.

### *To change a piece from its Travelling Position to the Trunnion Holes.*

The carriage being limbered up, or the trail resting on 4 blocks and 1 half block.

Place a roller under the reinforce as near as possible to the rimbases.

Raise the chase, and let the gun run forwards to its position, checking it with the trace rope attached to the knob of the cascable. As soon as the trunnions pass over the chin bolts, depress the muzzle, and the trunnions drop into their holes

Remove the roller, and put in the elevating screw.

### *To Change a Wheel.*

11 Men—1 lever jack—2 wheel chocks.

Chock the wheel which is to remain; raise the carriage by means of the lever jack applied in front of the axletree, and support it until the wheel is changed.

### *To Mount a Piece on its Carriage.*

11 Men—6 handspikes—1 lever and blocks (or a lever jack,)—1 gun roller—1 small half roller—1 large half roller—2 skids—4 blocks—4 half blocks—1 purchase block—2 gun chocks—4 roller chocks—6 wheel chocks—1 trace rope.

The gun resting on two blocks, bring up the carriage unlimbered, in line with it, the trail 2 yards from the muzzle: Place the large half roller in rear of the rimbases, resting it on the two skids; raise the chase by a handspike placed across under the neck, and run the carriage back until the swell of the muzzle rests on the bolster.—With the lever jack, raise the breech and place two blocks on the skids, one under each end of the large half roller. Lift the chase, and run back the carriage until the bolster touches the half roller; take a purchase under the breech, and continue to raise it until two half blocks are placed under each end of the half roller. Lift the muzzle, by inserting a handspike in it, and run back the carriage until the rear ends of the cheeks touch the half roller, and the trunnions are over their travelling position. Raise the trail with the lever, and remove the 4 blocks and a half block to the trail under the position of the manœuvring bolts. Lift the chase and insert a gun roller by the front as far as the half roller; depress the muzzle, to make the piece bear on the roller. Change the piece to the trunnion holes.

### *To Dismount a Piece.*

The same implements required as for mounting it. Lift the trail by a handspike across under it, and support it on 3 blocks and a half block, under the manœuvring bolts.

Change the piece over the travelling trunnion bolts, and when the roller is removed, place the large half roller on the stock against the rear of the cheeks. Take a purchase under the trail, with the lever jack, and remove the blocks to the skids, placing 2 blocks and 2 half blocks on each skid under the ends of the half roller; as the trail comes to the ground, the ends bear on these blocks. Raise the muzzle, and run out the carriage until the muzzle, resting on the stock, is within 6 in. of the rear end of the cheeks. Raise the breech, and lower the half roller by a block on each side. Lift the muzzle and run out the carriage, until the swell of the muzzle rests on the bolster. Raise the breech and remove 1 block and 1 half block: lift the muzzle, remove the carriage, and let the muzzle rest on a block; take out the half roller and leave the piece on 2 blocks.

NOTE.—The manœuvre of mounting a gun may also be performed expeditiously, without the use of the lever jack, by raising the muzzle and the breech, in succession, and placing two sets of blocks under the piece, near the trunnions, until it is raised so as to rest on two skids, with four blocks and a large half roller in each set. In this position, by bearing down the muzzle and removing the rear set of blocks, the carriage, limbered up, may be run under the breech; a roller is then placed on the stock, and the gun is hauled back, with a rope attached to the knob of the cascable, until the trunnions are over the trunnion holes. Remove the front set of blocks and the roller, and lower the piece into its place.

This method requires 10 additional blocks, 20 inches long, 8 inches square.

The gun may be dismounted in like manner, by an inverse manœuvre.

### *To change a Carriage.*

11 men—6 handspikes—3 gun rollers—1 small half roller—a plank with beveled ends—2 gun chocks—6 roller chocks—6 wheel chocks.

The carriage with the gun being unlimbered, bring up the new carriage limbered up, in line with the first; the head of its cheeks two yards from the trail of the other carriage. Place a gun roller under the reinforce of the gun, and lift up the muzzle, to raise the trunnions from the trunnion holes, into which insert the lower end of two handspikes, and let the trunnions rest on them. Run up the new carriage, over the stock of the first, until the wheels touch, taking care that they are in the same line. Slide the plank forwards between the cheeks, until it bears upon the heads of both stocks, and wedge one of the gun rollers on the stock of the first carriage, so that it will support the plank if the weight of the gun causes it to spring; place a roller on the plank near the rimbases, and make the trace rope fast to the knob of the cascable. Lift and push at the muzzle; haul

on the rope, placing a second roller under and near the base ring, and let it clear the plank and rest on the stock, touching the plank, when the trunnions are over the chin bolts.

Take two or three turns with the rope around the manœuvring bolts, and hold taut on the rope. Raise the muzzle; take out the front roller by the head of the cheeks, and run the first carriage forward, lifting the muzzle and letting it rest on the stock as the carriage is moved off gradually. The trunnions will bear on the rear edges of the trunnion holes. When the first carriage is out of the way, remove the plank by the front, and insert a handspike in the muzzle; raise and work it, slacking off the rope at the same time sufficiently to let the trunnions drop into their places. Put in the elevating screw; remove the roller and rope, and put on the cap squares.

### *To place upon a Mortar Wagon a Mortar on its bed.*

11 Men—6 handspikes—2 long rollers—1 block—2 half blocks—4 roller chocks—6 wheel chocks—2 quarter blocks—1 single prolonge.

The mortar being on its bed, the mortar wagon unlimbered is placed in the prolongation of the axis of the bed, the trail two yards from the rear of the bed. Place the quarter blocks under the heads of the cheeks; lift the rear of the bed by handspikes at the rear notches, and place a handspike under it, or support it by the half blocks under the cheeks. Use the block, with chocks on it, as a fulcrum; take a purchase under the rear part of the transom and lift it, placing a roller under the middle of the bed, its ends resting on the two half blocks. Run the wagon back, the stock under the middle of the bed; place the second roller on the stock above the nuts of the pintle plate bolts. Double the prolonge, and hook the middle of it on the hooks of the windlass; take a turn with each end round the windlass and carry the ends to the rear manœuvring bolts; take a turn round each and make the ends fast. Heave at the windlass; when the roller on the half blocks is free, replace it under the ends of the cheeks, as the mortar rises on the wagon, and draw it up until the rear ends of the cheeks touch the rear cross bar plate. The roller will be in front of the centre of gravity, and the ends of the cheeks will touch the bottom boards. Limber up. Take the rope from the roller; carry the bight to the front, draw the mortar forward to its proper position. By a purchase under the transom, with two handspikes, remove the roller and lower the bed on a handspike. Take a second purchase, with half blocks for supports, under the rear notches of the cheeks; remove the handspike, and let the mortar down on the wagon.

### *The Mortar on the Mortar Wagon, to lower it to the ground.*

The same implements. Place the roller under the bed, by raising it in the same manner as for removing the roller. Fix the rope to the windlass and take as many turns round it as are required for drawing the mortar up. Attach the ends to the rear manœuvring bolts; work the windlass and draw the mortar back, till the rear ends of the cheeks touch the rear cross bar. Unlimber. Lower away by unwinding the windlass, placing a second roller under the head of the cheeks, as the first passes the centre of gravity; and when the latter is free, place it under the head of the cheeks, when they come near the two half blocks laid on each side of the trail. When the ropes no longer bear, take them off of the bolts. Place the quarter blocks under the head of the cheeks, and run the bed forward with handspikes, as into battery. Remove the wagon; and by raising the rear of the bed, as at first, take out the roller and let the bed rest on the ground.

### *To mount a Siege Mortar on its Bed.*

4 Handspikes; 1 single prolonge; 1 hammer; 1 wrench.

Raise the mortar on its muzzle; bring up the bed, the front transom within 6 in. of the mortar, the vent of which should be on the side opposite to the bed. Take a double turn with the middle of the rope round the mortar, close to the muzzle ring, the tie in front; bring the ends up over the trunnions, and carry them to the rear. Place two handspikes under the trunnions, the lower ends resting on the platform, or on the ground. Heave and haul the mortar against the bolster; place 1 handspike under each trunnion, the ends resting on the bolster, and two other handspikes between the heads of the cheeks and the mortar. Heave and haul, to raise the mortar on the bolster. As soon as it is sufficiently raised, shift one of the handspikes from under the piece to the bore; heave again, and the mortar will fall into its place.

Remove the rope and put on the cap squares.

To put on or to remove the cap squares, it is necessary *to bring the mortar into a vertical position*. To do this, place 2 handspikes in the muzzle, and support them by a wheel chock or a piece of plank; fasten the middle of the rope to the ends of the handspikes, and haul on the rope, assisted by two handspikes, with which the mortar is chocked, when it becomes upright.

### *To dismount a Mortar from its Bed.*

Bring the mortar vertical as above described, and remove the cap squares; take the handspikes out of the bore; pass the middle of the rope around the mortar,

just under the muzzle ring, and carry the ends to the rear; give a smart haul on the rope, assisted by two handspikes, and the mortar will fall over the transom and light on its muzzle.

A mortar standing on its face may be moved (cut) by means of two handspikes lashed to the trunnions.

*The mortar wagon* also serves for transporting a gun, which is drawn up on rollers, breech first, in a similar manner to the mortar and bed.

The piece can be shifted very quickly from this wagon to its carriage, both being limbered. The carriage and wagon are placed on the same line; the head of the cheeks next to the windlass, the wheels touching. Place 2 large rollers under the piece, and a gun roller on the head of the stock; make the middle of the trace rope fast to the knob of the cascable, and run the piece back until the trunnions are over the trunnion holes. Remove the wagon, and lower the trunnions into their holes. In a similar manner, the gun is changed from its carriage to the wagon.

*The lifting jack*, (a powerful geared screw jack,) is very useful with siege batteries. It may be used in place of the lever jack with fewer men, but requires more time. For any single operation, it is extremely convenient; as, with it, any part of a gun or carriage can be raised.

## *To Transport a Piece with a Sling Cart.*

1st. *With the common sling cart.* 10 Men—1 piece of 5-in. rope—1 double prolonge, or 2 single ones—4 chocks for wheels—6 handspikes.

The piece being raised from the ground on blocks, bring up the sling cart over the piece, the breech towards the pole; raise the pole vertically, by hand and by means of a prolonge attached to the end of it, and keep it in that position by passing a handspike on each side of it between the spokes of the wheels. Sling the piece with the rope passed under it before and behind the trunnions, and over the bolster; take out the handspikes from between the spokes and lower the pole by means of the prolonge and by hand; lash the breech to it, and bring up the limber.

2nd. *With the screw sling cart.* 4 Men, with lashing ropes. The sling cart being in place, sling the gun with a rope or with chains passing under it and fastened to the hooks of the screw head, or with chains furnished with rings to embrace the trunnions. Raise the piece by turning the handles of the screw nut, and when it is sufficiently high, lash the load to the bolster and pole, so as to relieve the pressure on the screw. The manœuvre is easy but slow, and the machinery must be kept in good order. The piece may be slung more quickly by blocking it up as high as the axletree will permit.

move the block; key the pintle hook, and lower the elevating screw. All the men working at the wheels of the carriage and limber, and at the pole, lower the piece gently from the platform. Horses may then be attached to the limber, if necessary.

*To raise on its Chassis a Barbette Carriage with its Piece mounted.*

The same number of men and the same implements as in the preceding manœuvre. The chassis having been lowered, as in the first part of the preceding manœuvre, bring the carriage up to the rear of the platform and place opposite to each wheel a plank resting on two blocks, making a gentle slope to roll the carriage up on the traversing platform—place skids as before on each side of the chassis—move the carriage forward until the rollers nearly rest upon the rails—run up the elevating screw—lighten up the trail, to disengage the pintle hook—remove the limber, and lower the lunette plate on a block placed upon the tongue—raise the trail again, to remove the block—lower the trail transom upon the tongue—run the carriage up to battery—replace the traverse wheels in the same manner as directed for taking them out, in the preceding manœuvre.

In situations where it may be required, the carriage can be used without its chassis; in this manner it may be applied to the embrasures of field works, by placing it in battery on a common platform for a siege piece, and resting the trail on a skid attached to the front hurter by a pintle. The rear of this skid may rest on a block so as to give it the same inclination as the tongue of the chassis.

*To place a Casemate Carriage in Battery and mount its Gun.*

14 to 16 Men required. The gun is brought to the casemate with the sling cart, and carried through the galleries on a truck.

The carriage for the embrasure farthest from the door of entrance is to be placed first, and its gun mounted before the next carriage is placed. The tongue of the chassis is inserted into the tongue hole, and the pintle in its hole, through the end of the tongue.

The top carriage is lifted by hand and placed on the chassis, which is traversed on one side, and the gun is laid near the middle of the casemate on blocks, the muzzle towards the embrasure. The casemate gin (legs 14 feet long) is placed over the carriage and gun; the legs and the roller over the gun, the pry-pole over the chassis. The gin is equipped and the gun slung in the usual manner. When the gun is raised sufficiently high, the chassis is traversed under it, and the upper carriage so placed that the trunnion holes come exactly under the trunnions of the gun, which is then lowered carefully to its place. Unsling the gun and remove the gin.

## MANŒUVRES OF THE FIELD AND SIEGE GIN.

10 Men, including a non-commissioned officer as director—5 handspikes—1 gin fall—2 lines—a number of pulley blocks, single or double, according to the manner in which the gin is to be equipped.

The gin fall is 4-in. rope, 90 feet long.

### *To put the Gin together.*

Lay the legs on the ground, the outer sides up, the bevels towards each other; place the windlass; connect the heads of the cheeks by the assembling bolt; and insert successively the 1st, 2nd, and 3d cross bars, and key them.

### *To carry the Gin.*

Put six men at the legs, viz., 2 abreast of the windlass, 2 abreast of the second cross bar, and 2 near the head; 2 men, with a handspike, carry the fall coiled up, with the blocks hooked to it; one man carries the prypole, another the remaining handspikes and the lines.

### *To set up the Gin.*

6 Men, placed in the same manner as for carrying the gin, set it up; 2 men place their feet against the bottom of the legs, or their handspikes against the lower cross bar; one sets up the prypole, two paces in front of the head of the gin, facing it. The director assists by putting the end of a handspike into the slit for the tongue of the prypole. When the prypole is in place, the foot of it should be equally distant from the two legs, 12 feet from the lower cross bar; the pullies should be over the middle of the weight to be raised.

### *To equip the Gin.*

The gin equipped with one pulley, can raise a 12-pounder garrison gun; with 2, an 18-pounder; with 3, a 24-pounder; with 5 or 6, a 32 or 42-pounder. It is generally proper to use more pulleys than are absolutely necessary, in order to avoid straining the fall.

1st. *To equip the gin with* 1 *pulley.* Pass one end of the fall over the windlass, and take three turns from left to right, the loose end being outside. Put a handspike in one of the mortises of the windlass, or let down the pall, if there is one; overhaul the fall, letting it wrap round the windlass; pass the end through the right hand pulley of the head, and secure it to the sling round the gun by a capstan knot.

2nd. *With* 2 *pulleys.* Hang a single block on the second cross bar, the point of the hook outwards; proceed as in the first case; pass the end of the fall through the block on the cross bar, and tie it round the head of the gin, the loose end of the rope hanging on the left side and pinched against the leg. Hook the

block to the sling round the gun, the point of the hook towards the left side of the gin.

3d. *With* 3 *pulleys.* Proceed as for two; pass the end of the fall through the left hand pulley at the head of the gin, from the outside; tie it to the sling on the side towards the prypole, and hook the block to it on the other side, the point inwards.

4th. *With* 4 *pulleys.* Hang a second block (or a double block) on the second cross bar. Proceed as in the last case; pass the end of the fall into the second block, and fasten it to the head of the gin as in the second case; hook both blocks to the sling, the points of the hooks inwards.

If a double block is used, place the pin perpendicular to the cross bar, the head towards the prypole; pass the fall the first time through the sheave next the prypole, the second time through that next the legs; hook the block to the sling, the point towards the left side of the gin.

5th. *With* 5 *pulleys.* Hang two single blocks, or a double block, on the second cross bar; fasten a third block to the head of the gin, on the left side, by a collar or coil of rope; the point of the hook being outwards, and the head of the pin towards the gin. Proceed as in the last case; pass the end of the fall into the third block, and fasten the end to the sling round the piece, to which the blocks are also to be hooked.

6th. *With* 6 *pulleys.* Fix a single block to the head of the gin, another on the second cross bar near the right leg, and a double block on the same cross bar near the left leg. Proceed as in the last case; pass the fall through the single block on the cross bar, and secure it to the head of the gin, the loose end of the rope hanging on the left side, and the third block hooked into the knot. Hook the double block and the other single block to the sling.

The man who directs the manœuvres, or the most intelligent man, should be charged with passing the fall through the pullies at the head of the gin, and with tying the knots, fixing slings, &c. If he is too much exposed by mounting on the third cross bar, the gin must be laid down, the head resting on the gun, and equipped in that position.

To lay the gin down, the men are placed in the same positions as for setting it up. If the gin has a clevis at the top, the fall may be reeved in the blocks, and the upper block then hooked to the clevis.

## *To Sling a Piece.*

A piece without handles may be slung by means of a rope, the two ends of which are tied together and which is passed under the piece, one-half before and the other behind the trunnions.

If this is not convenient, as when the gun lies on the ground, or is to be placed on its carriage, a sling may be made by splicing together the ends of a 5-inch hawser a little more than twice the length of the piece (about 26 feet) or by passing a strong rope several times, according to the weight, over the piece lengthwise, under the cascable and under the handspike or a block of wood inserted in the muzzle. The two sides of this sling may be brought together by another just behind the trunnions.

### *To Work the Gin.*

4 Men put their handspikes alternately, 2 by 2, in the mortises of the windlass; 2 others assist in heaving; 3 overhaul the slack of the rope; the non-commissioned officer or director steadies the piece or the load, by means of a guy or of a handspike in the bore.

*To make fast.* If the gin has no ratchet wheel and pall, put a handspike across the legs, and let the heaving handspikes in the mortises rest against it; cross the slack round the turns on the windlass, drawing it tight round the last turn, and pass it under the lower cross bar from the inside, tying it in a loop in which the point of a handspike is inserted; during this operation, one man bears with both hands on the turns round the windlass, to prevent the rope from slipping. The men and 4 handspikes are then no longer required.

*To shift the rope on the windlass.* When the turns on the windlass, commencing at the left, reach the other end, make fast with the handspikes resting as before. Tie a lashing line to the fall with an artificer's knot, 1 foot above the second cross bar; wrap both ends of the line several times round the fall and pass it round the leg, under the cross bar, lashing the fall and the cross bar together. Let the windlass turn so as to bring the weight to bear on the lashing line; then slip the rope to the left end of the windlass.

The gin may be worked, if necessary, by less than 10 men. The men at the slack may be saved by equipping the gin without taking the 3 turns on the windlass; pass the fall over the windlass, and bring it round underneath, placing the slack across the windlass, so that the fall may coil over it. By steadying the piece with a rope attached to the prypole and to one leg, and by equipping the gin with a greater number of blocks, 3 men may work it, 2 holding the handspikes, and the 3d assisting them alternately.

### *To use the Gin as a Derrick.*

12 Men, 2 being for the guys. Additional implements: 1 double prolonge, or 2 single ones—4 strong pickets, 4 or 5 feet long—2 mauls—and sometimes a second fall and a drag rope.

If the derrick is to be established on a parapet, or on earth which is not firm, lay a strong plank across two others, with holes in the first for the points of the feet; ram the earth about them and secure them with pickets.

Lay the gin down, the outer side underneath, and the feet of the legs resting on a skid.

The director steps 5 paces from the head of the gin, in a direction perpendicular to the cross bars, and then 4 paces to the right and left, where he marks the places for the two first pickets; the two others are placed 30 feet beyond the first, in the direction which the guys will take.

Drive the pickets inclining off from the gin; if necessary, strengthen them by putting a plank or a fascine behind each, and ramming the earth firmly about it.

Equip the gin as it lies; fasten the guys to the head of it with an artificer's knot, if they are formed of one rope; with German knots, if of two. The gin being raised almost vertically, 2 men take a turn of the guys around the first pickets, and the director makes them fast to the second pickets with an artificer's knot. Let down the fall and tackles, and prepare to work the windlass. On a parapet, the feet of the derrick should be 2 feet from the exterior crest; as the guys, by stretching, are apt to give the derrick too great an inclination, place it at first 4 feet from the crest, and after taking a few turns, let the load down again, and move the derrick to its proper place.

If the fall should not be long enough, join another to it by a flat knot, tied at 4 or 5 yards from the end of the second rope, passing a piece of round wood, of the size of a tool handle, through the knot, to prevent its tightening too much. The first fall passes only through the right hand pulley of the head of the derrick and over the windlass; when the knot comes up near the pulley, cease heaving and make fast; coil a drag rope round the head of the gin and tie it to the second fall by 5 or 6 loops, below the knot. Let go the windlass and bring the weight to bear on the drag rope. Undo the knot, and pass the end of the second fall through the pulley; take 3 turns with it round the windlass, and join the first fall to it, to lengthen the slack.

## GARRISON AND CASEMATE GINS.

The fall for these gins is 5-inch rope, 120 feet long. They are equipped with a pair of blocks adapted to receive such a number of ropes as may be necessary, according to the weight to be raised; the upper block being hung on the clevis at the head of the gin. They are worked like the field and siege gin.

# CHAPTER THIRTEENTH.

## ARTILLERY PRACTICE.

The plan of this work does not include the details relative to the service of artillery, either in the field or in garrison; but in the absence of more full and accurate tables of firing, it is thought useful to give here the mean results of such trials of the ranges of our ordnance as have been made, from time to time, by the Ordnance Department, together with some other practical information derived from authentic sources.

### *Ranges of Field Guns and Howitzers.*

The range of a shot or shell in this table is the first graze of the ball on horizontal ground, the piece being mounted on its appropriate field carriage.

The range of a spherical case shot is the distance at which the shot bursts near the ground, in the time given; thus showing the elevation and the length of fuze required for certain distances.

For the range of the Mountain Howitzer—see CHAP. VI.

| KIND OF ORDNANCE. | Powder. | Ball. | Elevation. | Range. | REMARKS. |
|---|---|---|---|---|---|
| | Lbs. | | ° ′ | Yards. | |
| 6-PDR. FIELD GUN. | 1.25 | Shot | 0 | 318 | |
| | | " | 1 | 674 | |
| | | " | 2 | 867 | |
| | | " | 3 | 1138 | |
| | | " | 4 | 1256 | |
| | | " | 5 | 1523 | |
| | 1. | Sph. case shot. | 2 | 650 | Time of flight 2 secs. |
| | | | 2 30 | 840 | " 3 " |
| | | " | 3 | 1050 | " 4 " |

*Ranges of Field Guns and Howitzers.*

| KIND OF ORDNANCE. | Powder. | Ball. | Elevation. | Range. | REMARKS. |
|---|---|---|---|---|---|
| | Lbs. | | ° ′ | Yards. | |
| 12-PDR. FIELD GUN. | 2.5 | Shot | 0 | 347 | |
| | | " | 1 | 662 | |
| | | " | 1 30 | 785 | |
| | | " | 2 | 909 | |
| | | " | 3 | 1269 | |
| | | " | 4 | 1455 | |
| | | " | 5 | 1663 | |
| | 1.5 | Sph.case. | 1 | 670 | Time 2 seconds. |
| | | " | 1 45 | 950 | " 3 " |
| | | " | 2 30 | 1250 | " 4 " |
| 12-PDR. FIELD HOWITZER | 1. | Shell | 0 | 195 | |
| | | " | 1 | 539 | |
| | | " | 2 | 640 | |
| | | " | 3 | 847 | |
| | | " | 4 | 975 | |
| | | " | 5 | 1072 | |
| | 0.75 | Sph. case | 2 15 | 485 | Time 2 seconds. |
| | | " | 3 15 | 715 | " 3 " |
| | | " | 3 45 | 1050 | " 4 " |
| 24-PDR. FIELD HOWITZER | 2. | Shell | 0 | 295 | |
| | | " | 1 | 516 | |
| | | " | 2 | 793 | |
| | | " | 3 | 976 | |
| | | " | 4 | 1272 | |
| | | " | 5 | 1322 | |
| | 1.75 | Sph. case | 2 | 600 | Time 2 seconds. |
| | | " | 3 | 800 | " 3 " |
| | | " | 5 30 | 1050 | " 4 " |
| | 2. | " | 3 30 | 880 | " 3 " |
| 32-PDR. FIELD HOWITZER | 2.5 | Shell | 0 | 290 | |
| | | " | 1 | 531 | |
| | | " | 2 | 779 | |
| | | " | 3 | 1029 | |
| | | " | 4 | 1203 | |
| | | " | 5 | 1504 | |
| | 2.5 | Sph. case | 3 | 800 | Time 2.75 seconds. |

## *Ranges of Heavy Ordnance.*

The *range* of a gun or howitzer in this table is the first graze of the ball on the horizontal plane on which the carriage stands.

| KIND OF ORDNANCE. | Powder. | Ball. | Elevation | Range. | REMARKS. |
|---|---|---|---|---|---|
| | Lbs. | | ° ′ | Yards. | |
| 18-PDR. SIEGE AND CARRISON GUN. On barbette carriage. | 4.5 | Shot | 1 | 641 | |
| | | " | 2 | 950 | |
| | | " | 3 | 1256 | |
| | | " | 4 | 1450 | |
| | | " | 5 | 1592 | |
| 24-PDR. SIEGE AND GARRISON GUN. On siege carriage. | 6. | Shot | 0 | 412 | |
| | | " | 1 | 842 | |
| | | " | 1 30 | 953 | |
| | | " | 2 | 1147 | |
| | | " | 3 | 1417 | |
| | | " | 4 | 1666 | |
| | | " | 5 | 1901 | |
| | 8. | " | 1 | 883 | |
| | | " | 2 | 1170 | |
| | | " | 3 | 1454 | |
| | | " | 4 | 1639 | |
| | | " | 5 | 1834 | |
| 32-PDR. SEA-COAST GUN. On barbette carriage. | 6. | Shot | 1 45 | 900 | |
| | 8. | " | 1 | 713 | |
| | | " | 1 30 | 800 | |
| | | " | 1 35 | 900 | |
| | | " | 2 | 1100 | |
| | | " | 3 | 1433 | |
| | | " | 4 | 1684 | |
| | | " | 5 | 1922 | |
| | 10.67 | " | 1 | 780 | |
| | | " | 2 | 1155 | |
| | | " | 3 | 1517 | |
| 42-PDR. SEA-COAST GUN. On barbette carriage. | 10.5 | Shot | 1 | 775 | |
| | | " | 2 | 1010 | |
| | | " | 3 | 1300 | |
| | | " | 4 | 1600 | |
| | | " | 5 | 1955 | |
| | 14. | " | 1 | 770 | |
| | | " | 2 | 1128 | |
| | | " | 3 | 1380 | |
| | | " | 4 | 1687 | |
| | | " | 5 | 1915 | |

*Ranges of Heavy Ordnance.*

| KIND OF ORDNANCE. | Powder. | Ball. | Elevation. | Range. | REMARKS. |
|---|---|---|---|---|---|
| | Lbs. | Shell | ° ′ | Yards. | |
| 8-INCH SIEGE HOWITZER. On siege carriage. | 4. | 45 lbs. | 0 | 251 | |
| | | " | 1 | 435 | |
| | | " | 2 | 618 | |
| | | " | 3 | 720 | |
| | | " | 4 | 992 | |
| | | " | 5 | 1241 | |
| | | " | 12 30 | 2280 | |
| | | Shell | | | |
| 8-INCH SEA-COAST HOWITZER. On barbette carriage. | 4. | 45 lbs. | 1 | 405 | |
| | | " | 2 | 652 | |
| | | " | 3 | 875 | |
| | | " | 4 | 1110 | |
| | | " | 5 | 1300 | |
| | 6. | " | 1 | 572 | |
| | | " | 2 | 828 | |
| | | " | 3 | 947 | |
| | | " | 4 | 1168 | |
| | | " | 5 | 1463 | |
| | 8. | " | 1 | 646 | |
| | | " | 2 | 909 | |
| | | " | 3 | 1190 | |
| | | " | 4 | 1532 | |
| | | " | 5 | 1800 | |
| | | Shell | | | |
| 10-INCH SEA-COAST HOWITZER. On barbette carriage. | 12. | 90 lbs. | 1 | 580 | |
| | | " | 2 | 891 | Time, flight 3. sec. |
| | | " | 3 | 1185 | " " 4. " |
| | | " | 3 30 | 1300 | |
| | | " | 4 | 1426 | " " 5.25 " |
| | | " | 5 | 1650 | " " 6. " |
| | | Shot | | | |
| 8-INCH COLUMBIAD. On barbette carriage. | 10. | 65 lbs. | 1 | 932 | Axis of gun 16 feet above the water. |
| | | " | 2 | 1116 | |
| | | " | 3 | 1402 | |
| | | " | 4 | 1608 | |
| | | " | 5 | 1847 | |
| | | " | 6 | 2010 | |
| | | " | 8 | 2397 | Shot ceased to ricochet on the water. |
| | | " | 10 | 2834 | |
| | | " | 15 | 3583 | |
| | | " | 20 | 4322 | |
| | | " | 25 | 4875 | |
| | | " | 27 | 4481 | |
| | 15. | " | 27 30 | 4812 | |

*Ranges of Heavy Ordnance.*

| KIND OF ORDNANCE. | Powder. | Ball. | Elevation. | Range. | REMARKS. |
|---|---|---|---|---|---|
| | Lbs. | Shell | ° ′ | Yards. | |
| 8-INCH COLUMBIAD— Continued. | 10. | 50 lbs. | 1 | 919 | |
| | | " | 2 | 1209 | |
| | | " | 3 | 1409 | |
| | | " | 4 | 1697 | |
| | | " | 5 | 1813 | |
| | | " | 6 | 1985 | |
| | | " | 8 | 2203 | |
| | | " | 10 | 2657 | |
| | | " | 15 | 3556 | |
| | | " | 20 | 3716 | |
| | | " | 25 | 4387 | |
| | | " | 27 | 4171 | |
| | 15. | " | 27 30 | 4468 | |
| 10-INCH COLUMBIAD. On barbette carriage. | 18. | Shot 128 lbs. | 0 | 394 | Axis of gun 16 feet above the water. |
| | | " | 1 | 752 | |
| | | " | 2 | 1002 | |
| | | " | 3 | 1230 | |
| | | " | 4 | 1570 | |
| | | " | 5 | 1814 | |
| | | " | 6 | 2037 | Shot ceased to ricochet on water. |
| | | " | 8 | 2519 | |
| | | " | 10 | 2777 | |
| | | " | 15 | 3525 | |
| | | " | 20 | 4020 | |
| | | " | 25 | 4304 | |
| | | " | 30 | 4761 | |
| | | " | 35 | 5433 | |
| | 20. | " | 39 15 | 5654 | |
| | 12. | Shell 100 lbs. | 1 | 800 | |
| | | " | 2 | 1012 | |
| | | " | 3 | 1184 | |
| | | " | 4 | 1443 | |
| | | " | 5 | 1604 | |
| | 18. | " | 0 | 448 | |
| | | " | 1 | 747 | |
| | | " | 2 | 1100 | |
| | | " | 3 | 1239 | |
| | | " | 4 | 1611 | |
| | | " | 5 | 1865 | |
| | | " | 6 | 2209 | |
| | | " | 8 | 2489 | |
| | | " | 10 | 2848 | |
| | | " | 15 | 3200 | |
| | | " | 20 | 3885 | |
| | | " | 25 | 4150 | |
| | | " | 30 | 4651 | |
| | | " | 35 | 4828 | Time of flight 35 sec. |

*Ranges of Heavy Ordnance.*

| KIND OF ORDNANCE. | Powder. | Ball. | Elevation. | Range. | REMARKS. |
|---|---|---|---|---|---|
| | Lbs. | Shell, | ° ′ | Yards. | |
| 12-INCH COLUMBIAD.... | 20. | 172 lbs. | 10 | 2770 | Time of flight 11 sec. |
| | | " | 15 | 3731 | " 16 " |
| | | " | 22 | 4280 | " 20 " |
| | | " | 25 | 4718 | " 26 " |
| | | " | 30 | 5004 | |
| | | " | 35 | 5339 | " 32 " |
| | | " | 37 | 5266 | " 31 " |
| | | " | 39 | 5064 | |
| | 25. | " | 10 | 2881 | " 11.5 " |
| | | " | 15 | 3542 | " 15 " |
| | | " | 30 | 5102 | |
| | | " | 35 | 5409 | " 32 " |
| | | " | 37 | 5373 | " 32 " |
| | | " | 39 | 5506 | " 36 " |
| | | Shell, | 35 | 5644 | |
| | | 180 lbs. | 39 | 5615 | |
| | 28. | " | 35 | 5671 | |
| | | " | 39 | 5761 | $3\frac{1}{3}$ miles. Time 36 sec. |
| 13-IN. SEA-COAST MORTAR | 20. | Shell, 200 lbs. | 45 | 4325 | |
| 12-IN. SEA-COAST MORTAR | 20. | Shell, 200 lbs. | 45 | 4625 | Experimental. |
| 10-IN. SEA-COAST MORTAR | 10. | Shell, 98 lbs. | 45 | 4250 | Time of flight 36 sec. |
| 10-INCH SIEGE MORTAR.. | 1. | Shell, | 45 | 300 | Time of flight 6.5 sec. |
| | 1.5 | 90 lbs. | 45 | 700 | " 12 " |
| | 2. | " | 45 | 1000 | " 14 " |
| | 2.5 | " | 45 | 1300 | " 16 " |
| | 3. | " | 45 | 1600 | " 18 " |
| | 3.5 | " | 45 | 1800 | " 19 " |
| | 4. | " | 45 | 2100 | " 21 " |
| | Lbs. oz. | Shell, | | | |
| 8-INCH SIEGE MORTAR. | 0 $10\frac{3}{4}$ | 46 lbs. | 45 | 500 | Time of flight 10 sec. |
| (From Griffith's Artillerist's Manual.) | $13\frac{3}{4}$ | " | " | 600 | " 11 " |
| | 1 | " | " | 750 | " $12\frac{1}{4}$ " |
| | 1 2 | " | " | 900 | " 13 " |
| | 1 $3\frac{1}{2}$ | " | " | 1000 | " $13\frac{1}{2}$ " |
| | 1 $4\frac{3}{4}$ | " | " | 1100 | " 14 " |
| | 1 6 | " | " | 1200 | " $14\frac{1}{2}$ " |

*Ranges of Heavy Ordnance.*

| KIND OF ORDNANCE. | Powder. | Ball. | Elevation. | Range. | REMARKS. |
|---|---|---|---|---|---|
| | Oz. | Shell, | ° | Yards. | |
| 24-POUNDER COEHORN MORTAR. | 0.5 | 17 lbs. | 45 | 25 | |
| | 1. | " | " | 68 | |
| | 1.5 | " | " | 104 | |
| | 1.75 | " | " | 143 | |
| | 2. | " | " | 165 | |
| | 2.75 | " | " | 260 | |
| | 4. | " | " | 422 | |
| | 6. | " | " | 900 | |
| | 8. | " | " | 1200 | |

*Ranges of Hale's War Rockets.*

| ELEVATION. | RANGE, (FIRST GRAZE.) | | REMARKS. |
|---|---|---|---|
| | 2¼-inch. | 3¼-inch. | |
| | Yards. | Yards. | |
| 4° to 5° | 500 to 600 | 500 to 600 | The rockets were fired from a trough 10 feet long. |
| 8° | 700 | 800 to 1000 | |
| 10° | 800 to 900 | 1000 to 1200 | |
| 15° | 1200 | 1200 to 1400 | Weight of 2¼-inch rocket, 6 lbs. |
| 47° | 1760 | 2200 | " 3¼-inch " 16 lbs. |

INITIAL VELOCITIES OF CANNON BALLS.

From experiments made with the ballistic pendulum, at Washington Arsenal.

| Kind of Ordnance. | PROJECTILE. | | Charge of powder. | Initial velocity. |
|---|---|---|---|---|
| | Kind. | Weight. | | |
| | | Lbs. | Lbs. | Feet. |
| 6-pdr. field gun. | Shot..... | 6.15 | 1.25 | 1439 |
| | | | 1.5 | 1563 |
| | | | 2. | 1741 |
| | Sph. case... | 5.5 | 1. | 1357 |
| | Canister.... | 6.8 | 1. | 1230 |
| 12-pdr. field gun. | Shot..... | 12.3 | 2.5 | 1486 |
| | | | 3. | 1597 |
| | | | 4. | 1826 |
| | Sph. case... | 11. | 2. | 1392 |
| | Canister.... | 13.5 | 2. | 1262 |

*Initial Velocities*—Continued.

| Kind of Ordnance. | PROJECTILE. | | Charge of powder. | Initial velocity. |
|---|---|---|---|---|
| | Kind. | Weight. | | |
| | | Lbs. | Lbs. | Feet. |
| 12-pdr. field howzer. | Shell..... | 8.9 | 1. | 1054 |
| | | | 1.25 | 1178 |
| | Sph. case... | 11. | 1. | 953 |
| | Canister.... | 9.64 | 1. | 1015 |
| 12-pdr. siege and garrison gun. | Shot..... | 12.3 | 2. | 1378 |
| | | | 3. | 1674 |
| | | | 4. | 1906 |
| | Shell..... | 8.9 | 2. | 1611 |
| | | | 3. | 1929 |
| 12-pdr. gun 25 cal. long. | Shot..... | 12.3 | 2. | 1411 |
| | | | 3. | 1734 |
| | | | 4. | 1933 |
| | | | 5. | 2098 |
| | | | 6. | 2239 |
| | | | 7. | 2300 |
| | | | 8. | 2324 |
| 24-pdr. siege and garrison gun. | Shot..... | 24.25 | 3. | 1240 |
| | | | 4. | 1440 |
| | | | 6. | 1680 |
| | | | 8. | 1870 |
| | Shell..... | 17. | 3. | 1470 |
| | | | 4. | 1670 |
| | Canister.... | 29. | 3. | 1135 |
| | | | 4. | 1303 |
| | Grape..... | 30.6 | 3. | 1108 |
| | | | 4. | 1272 |
| 32-pdr. sea-coast gun. | Shot..... | 32.3 | 4. | 1250 |
| | | | 5.33 | 1430 |
| | | | 8. | 1640 |
| | | | 10.67 | 1780 |
| | Shell..... | 23.4 | 4. | 1450 |
| | | | 5.33 | 1657 |
| | Canister.... | 37. | 4. | 1172 |
| | | | 5.33 | 1342 |
| | Grape..... | 39.75 | 4. | 1133 |
| | | | 5.33 | 1297 |

*Initial velocities of Balls fired from Small Arms.*

| KIND OF ARM. | Charge. | No. of balls to the lb. | Initial velocity. |
|---|---|---|---|
| | Grains. | | Feet. |
| Musket..... | 110 | 17 | 1500 |
| Rifle..... | 70 | 32 | 1750 |
| Hall's Carbine.. | 70 | " | 1240 |
| Pistol..... | 35 | " | 947 |

*Loss of velocity by the Windage of the Ball.*

| KIND OF GUN. | Charge of powder. | Initial velocity of ball | | Loss of velocity by a windage of $\frac{1}{40}$ diameter. | |
|---|---|---|---|---|---|
| | | Without windage. | With windage of $\frac{1}{40}$ diameter. | | |
| | Lbs. | Feet. | Feet. | Feet. | Per ct. |
| 32-PDR. SEA-COAST..... | 4. | 1444 | 1271 | 173 | 12 |
| 24-PDR. SIEGE..... | 4. | 1600 | 1433 | 167 | 10 |
| | 6. | 1890 | 1723 | 167 | 9 |
| 12-PDR., 25 calibres..... | 2. | 1617 | 1444 | 173 | 11 |
| | 3. | 1915 | 1742 | 173 | 9 |
| | 4. | 2124 | 1951 | 173 | 8 |
| 12-PDR. FIELD, 16 calibres... | 2. | 1528 | 1370 | 158 | 10 |
| | 3. | 1793 | 1635 | 158 | 9 |
| | 4. | 1992 | 1834 | 158 | 8 |
| 6-PDR. FIELD..... | 1.5 | 1734 | 1560 | 174 | 10 |

The loss of velocity by a given windage is directly as the windage and inversely as the diameter of the bore, very nearly.

For a formula for computing the initial velocity of a ball, see CHAP. XV ; Article *Ballistics*.

## PENETRATION OF SHOT AND SHELLS.

The following tables and notes, (when not otherwise specified,) are extracted from a report of experiments made at Metz in 1834.

The charges, when expressed in fractions, denote the proportion of powder to the nominal weight of the shot; the calibres are those of the French guns, the exact relation of which to those of the United States ordnance will be found by reference to the table of foreign ordnance in CHAPTER I.

The French 36-pdr. corresponds nearly with our 42-pdr; the 16-pdr. with our 18-pdr.; the 8-pdr. with our 9-pdr.; and the 6-inch with our 32-pdr. The diameter of the French 8-inch howitzer is 8.782 inches in our measure. The musket is of the same calibre as ours.

### *Penetration of Shot in Masonry.*

Rubble work of good quality; scarp wall built by Vauban.

| Calibre. | Charge. | DISTANCE IN YARDS. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 27 | 55 | 109 | 219 | 328 | 438 | 656 | 875 | 1094 |
| | | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| 36 | 1-3d | 26.78 | 26.39 | 25.60 | 23.83 | 22 25 | 20.87 | 17.92 | 14.96 | 12.21 |
| 24 | 1-2nd | 25.60 | 25.20 | 24.22 | 22.45 | 20.87 | 19.30 | 16.25 | 13.39 | 10.83 |
| | 1-3d | 24.22 | 23.83 | 22.84 | 21.07 | 19.50 | 18.12 | 15.16 | 12.21 | 9.85 |
| | 1-4th | 22.65 | 22.25 | 21.46 | 19.89 | 18.22 | 16 74 | 13.78 | 11.23 | 9.06 |
| | 1-6th | 20.08 | 19.69 | 18.90 | 17.33 | 15.75 | 14.38 | 11.81 | 9.65 | 7.88 |
| | 1-8th | 17.33 | 16.93 | 16.15 | 14.57 | 13 20 | 11.81 | 9.65 | 7.88 | 6.50 |
| 16 | 1-2nd | 22.45 | 21.86 | 20.87 | 19.10 | 17.53 | 15.95 | 12.80 | 10.05 | 7.68 |
| | 1-3d | 21.07 | 20.68 | 19.69 | 17.92 | 16 35 | 14.77 | 11.81 | 9.26 | 7.29 |
| | 1-4th | 19.50 | 19.10 | 18.22 | 16.74 | 15.16 | 13.78 | 10.83 | 8.47 | 6.69 |
| | 1-6th | 17.13 | 16.74 | 16.15 | 14.57 | 13.00 | 11.62 | 9.06 | 7.29 | 5.91 |
| | 1-8th | 14.96 | 14.57 | 13.78 | 12.21 | 10.83 | 9.45 | 7.48 | 6.11 | 5.12 |
| 12 | 1-3d | 18.90 | 18.51 | 17.53 | 15.95 | 14.57 | 13.00 | 10.05 | 7.68 | 6.11 |
| | 1-4th | 17.72 | 17.33 | 16.54 | 14.96 | 13 39 | 11.81 | 8.86 | 6.89 | 5.51 |
| | 1-6th | 15.56 | 15.16 | 14.38 | 13.00 | 11.42 | 10.05 | 7.48 | 6.11 | 4.93 |
| | 1-8th | 13.78 | 13.39 | 12.60 | 11.03 | 9.65 | 8.27 | 6.50 | 7.68 | 4.33 |
| 8 | 1-3d | 15.95 | 15.56 | 14.77 | 13.19 | 11.62 | 10.24 | 7.48 | 5.51 | 4.14 |

By multiplying the numbers expressing the penetrations in this table by 1.25, we have the penetration in masonry of medium quality; by 1.75, in brick masonry; by 0.46, in hard calcareous stone (solid.)

According to the experiments, the holes made in masonry such as that referred to in the table, by shot striking it perpendicularly at a short distance, are formed of an exterior, funnel-shaped opening, the mean diameter of which is about 5 times that of the shot, and of an interior part nearly cylindrical. The exterior cone appears to be produced by the reaction of the masonry, some fragments of which are projected backwards, to the distance of 45 or 50 yards. The

train of fragments in front of the hole extends about 20 feet. Around the exterior opening, the masonry is loosened to a distance about one-half greater than the diameter of the opening; say 45 in. by the 24-pounder shot; 35.5 inches by the 16-pdr.; 31.5 in. by the 12-pounder. This loosening indicates the proper distance between the first shots from a breaching battery. Nearly all the shot are broken, even at the charge of one-fourth, and the fracture is generally in meridional planes, the pole of which is the point which strikes first. On the shot which are not broken, and on the fragments of those which are broken, small cracks or furrows, sometimes 0.02 in. deep, are observed, radiating from the same point.

The effect of shells fired horizontally against masonry is very small; they are broken at the moment of striking, or if fired with very low charges, so as not to break, they produce a very slight impression.

*Penetration in Oak Wood.*

| CALIBRE. | CHARGE. | DISTANCE IN YARDS. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 27 | 55 | 109 | 219 | 328 | 438 | 656 | 875 | 1094 |
| *Guns.* | | In. | In. | In. | In. | In. | In. | In | In. | In. |
| 36 | 1 3d | 65.4 | 64.2 | 62.2 | 58.3 | 54.3 | 50.8 | 44.1 | 37.4 | 31.5 |
| 24 | 1-2nd | 63.0 | 61.4 | 59.1 | 54.7 | 50.8 | 47.3 | 40.2 | 33.5 | 27.6 |
| | 1 3d | 59.1 | 57.9 | 55.9 | 51.6 | 47.6 | 44.1 | 37.4 | 30.7 | 24.8 |
| | 1-4th | 55.5 | 54.3 | 52.3 | 48.4 | 44.9 | 41.3 | 35.0 | 28.4 | 22.8 |
| | 1-6th | 49.2 | 48.4 | 46.5 | 42.9 | 39.4 | 36.2 | 29.5 | 24.0 | 19.3 |
| | 1-8th | 42.5 | 41.6 | 40.2 | 36.6 | 32.7 | 30.3 | 24.4 | 19.7 | 15.8 |
| 16 | 1 2nd | 54.7 | 53 2 | 50.8 | 46.5 | 42.5 | 39.0 | 31.9 | 25.6 | 19.7 |
| | 1-3d | 51.2 | 50.0 | 48.0 | 43.7 | 40.2 | 36.6 | 29.9 | 23.6 | 18.5 |
| | 1-4th | 47.7 | 46.5 | 44.5 | 40.9 | 37.4 | 33.9 | 27.6 | 21.7 | 16.9 |
| | 1 6th | 42.1 | 41.4 | 39.8 | 36 2 | 32.7 | 29.5 | 23.2 | 17.7 | 14.2 |
| | 1-8th | 37.0 | 36.2 | 34.3 | 30.7 | 27.6 | 24.4 | 19.3 | 15.0 | 11.8 |
| 12 | 1-3d | 46.1 | 44.9 | 42.9 | 38.6 | 35.0 | 31.9 | 25.6 | 19.7 | 14.6 |
| | 1-4th | 43.3 | 42.1 | 40.2 | 36.6 | 33.1 | 29.9 | 23.6 | 18.1 | 13.4 |
| | 1-6th | 37.8 | 37.0 | 35.4 | 31.9 | 28.4 | 25.2 | 19.3 | 15.0 | 11 4 |
| | 1-8th | 33.9 | 33.1 | 31.1 | 27.6 | 24.4 | 21.7 | 16 5 | 13.0 | 9.8 |
| 8 | 1-3d | 39.4 | 38.2 | 36.2 | 32.3 | 28 7 | 25.6 | 19.3 | 13.8 | 10.6 |
| *Howitzers.* | Lbs. | | | | | | | | | |
| 8-in. Siege. | 4.4 | 28.4 | 27.6 | 26.0 | 22 4 | 19.3 | 16.5 | 13.0 | 10.6 | 9.1 |
| | 3.3 | 23.2 | 22.4 | 20 9 | 18.1 | 15.8 | 13.8 | 11.0 | 9.5 | 8.3 |
| | 2.2 | 16.1 | 15.4 | 14.2 | 12 6 | 11.4 | 10.2 | 8.7 | 7.9 | 7.5 |
| | 1.1 | 39.1 | 8.7 | 8.3 | 8 3 | 7.5 | 7.1 | 6.7 | 6.3 | 5.9 |
| 6-in. | 3.3 | 33.1 | 31.9 | 30 3 | 26.8 | 23.6 | 20.5 | 15.0 | 11.8 | 9.8 |
| | 2.2 | 27.6 | 26.8 | 25.2 | 21.7 | 18.5 | 15.8 | 11.4 | 9.1 | 7.9 |
| | 1.65 | 22.8 | 22.1 | 20.5 | 17.3 | 14.6 | 12.6 | 9.8 | 8.3 | 7.1 |
| 24 pdr. | 2.2 | 27.6 | 26.8 | 25.2 | 21.7 | 18.1 | 15.0 | 10.2 | 7.9 | 6.3 |
| | 1.1 | 18.9 | 18.1 | 16.5 | 13.4 | 11.0 | 9.5 | 7.5 | 6.3 | 5.1 |
| 12-pdr. Mountain. | 0.6 | 15.0 | 14.2 | 12.6 | 10.2 | 8.3 | 7.1 | 5.9 | 4.7 | 3.9 |
| | Grains. | | | | | | | | | |
| *Musket Balls* - - - | 154 | 3.35 | 3.15 | 2.56 | 1.77 | 1.06 | 0.71 | 0.32 | | |

The penetrations in other kinds of wood are deduced from those in the preceding table by multiplying by 1, for beech and ash; by 1.3, for elm; by 1.8, for white pine and birch; by, 2 for poplar.

In oak, the fibres are displaced laterally by the passage of the shot and afterwards close up again, so as to leave an opening scarcely sufficient for measuring the depth of penetration. This effect explains the cause of vessels not being always sunk by shot striking below the water line; but the timber is split longitudinally even by the smallest shot, in a length of 6.5 feet; the splinters are driven to the distance of 42 to 50 feet, and the largest timbers are soon destroyed.

In white pine nearly all the fibres struck by the shot are broken, but the effect does not extend much beyond the opening made; this material is therefore preferable to oak for structures which are not intended to be proof against cannon shot.

*Penetration in Compact Earth*, (half sand, half clay.)

| CALIBRE. | CHARGE. | DISTANCE IN YARDS. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 27 | 55 | 109 | 219 | 328 | 438 | 656 | 875 | 1094 |
| *Guns.* | | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| 36 | 1 3d | 109.1 | 106.3 | 102.4 | 97.3 | 93.4 | 89.4 | 82.3 | 75.6 | 69.7 |
| 24 | 1-2nd | 108.2 | 107.2 | 99.3 | 91.0 | 84.3 | 79.6 | 72.5 | 66.2 | 60.6 |
| | 1 3d | 100.4 | 97.7 | 92.6 | 85.9 | 81.1 | 77.2 | 70.1 | 63.8 | 58.3 |
| | 1-4th | 92.6 | 90.2 | 86.6 | 81.5 | 77.6 | 74.0 | 67.3 | 61.8 | 57.1 |
| | 1-6th | 83.5 | 82.3 | 79.9 | 75.6 | 72.2 | 68.9 | 62.6 | 57.1 | 52.4 |
| | 1-8th | 76.4 | 74.8 | 72.4 | 68.9 | 65.8 | 63.0 | 57.5 | 52.0 | 47.3 |
| 16 | 1-2nd | 94.5 | 91.0 | 85.9 | 77.6 | 72.2 | 67.7 | 61.4 | 55.9 | 50.4 |
| | 1-3d | 86.6 | 83.5 | 79.6 | 73.6 | 69.3 | 65.8 | 59.9 | 54.4 | 49.2 |
| | 1-4th | 80.7 | 78.3 | 75.2 | 69.7 | 66.5 | 63.4 | 57.9 | 52.4 | 47.3 |
| | 1-6th | 72.9 | 70.9 | 68.1 | 63.0 | 61.8 | 59.1 | 53.6 | 48.8 | 44.5 |
| | 1-8th | 63.0 | 65.4 | 63.8 | 60.6 | 57.9 | 55.1 | 50.4 | 45.7 | 41.3 |
| 12 | 1 3d | 65.0 | 63.4 | 59.9 | 54.7 | 50.8 | 48.2 | 42.9 | 38.6 | 35.0 |
| | 1 4th | 60.6 | 59.1 | 55.9 | 52.0 | 48.8 | 46.1 | 41.3 | 37.4 | 33.9 |
| | 1-6th | 54.7 | 53.6 | 50.8 | 48.2 | 45.3 | 42.9 | 38.6 | 35.0 | 32.3 |
| | 1-8th | 50 0 | 48.8 | 47.3 | 44.5 | 41.7 | 39.8 | 36.2 | 33.1 | 30.7 |
| 8 | 1-3d | 56.3 | 54.7 | 52.0 | 46.9 | 43.3 | 40.2 | 35.4 | 31.9 | 28.7 |
| *Howitzers.* | Lbs. | | | | | | | | | |
| 8-in. Siege. | 4.4 | 48.4* | 47.3* | 45.3* | 41.7 | 38.6 | 35.4 | 30 3 | 26.0 | 23.2 |
| | 3.3 | 42 9* | 41.7 | 40.2 | 37.0 | 33.9 | 31.1 | 27.2 | 24.0 | 21.7 |
| | 2.2 | 34.7 | 33.9 | 32.3 | 29.5 | 27.6 | 25.6 | 22.8 | 20.9 | 19.3 |
| | 1.1 | 22.8 | 22.4 | 21.7 | 20.9 | 20.1 | 19.3 | 17.7 | 16.5 | 15.8 |
| 6-in. | 3.3 | 52.8* | 51.2* | 48.8 | 45.0 | 41.0 | 37.4 | 30.7 | 25.2 | 22.1 |
| | 2.2 | 45.3 | 44.1 | 42.5 | 38.6 | 35.0 | 31.9 | 26.4 | 22.4 | 19.7 |
| | 1.65 | 39.8 | 38.6 | 37.0 | 33.5 | 30.7 | 28.0 | 23.6 | 20 5 | 18.1 |
| 24-pdr. | 2.2 | 44.5* | 42.9* | 41.0* | 36.6 | 32.7 | 29.1 | 23.2 | 18.9 | 16.1 |
| | 1.1 | 33.5 | 32.3 | 30.7 | 27.6 | 24.8 | 22.4 | 18.1 | 15.4 | 13.4 |
| Mountain 12-pdr. | 0.6 | 27.2 | 26.4 | 24.8 | 21.7 | 19.3 | 17.3 | 14.6 | 12.2 | 10.2 |
| | Grains. | | | | | | | | | |
| *Musket Balls* - - - | 154 | 9.85 | 9.45 | 8.66 | 5.91 | 4.33 | 3.15 | 1.58 | | |

*With these charges, and at these distances, the shells were often broken.

The penetrations in other kinds of earth are found by multiplying the above by 0.63, for sand mixed with gravel.

" 0.87, for earth mixed with sand and gravel, and weighing twice as much as water.

" 1.09, for compact mould and fresh earth mixed with sand, or half clay.

" 1.44, for wet potter's clay.

" 1.50, for light earth, settled.

" 1.90, for do. fresh.

In general, sand, sandy earth mixed with gravel or small stones, chalk and tufa, resist shot better than the productive earths, or clay, or earth that retains water.

## *Penetration of Shells.*

| Elevation. | Distance. | IN COMPACT EARTH. | | | IN OAK WOOD. | | | IN MASONRY. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 8-in. | 10-in. | 12-in. | 8 in. | 10-in. | 12-in. | 8-in. | 10-in. | 12-in. |
| | Yds. | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| 30° | 656 | 7.88 | 17.72 | 19.69 | 3.94 | 7.88 | 8.66 | 1.97 | 3.54 | 3.94 |
| | 1312 | 9.85 | 25.60 | 27.57 | 4.73 | 11.81 | 13.78 | 2.36 | 4.73 | 5.12 |
| 45° | 656 | 11.81 | 19.69 | 21.66 | 5.91 | 9.85 | 10.63 | 3.15 | 3.94 | 4.33 |
| | 1312 | 15.75 | 27.57 | 29.54 | 7.88 | 13.78 | 15.75 | 3.94 | 5.51 | 5.91 |
| 60° | 656 | 19.69 | 29.54 | 31.50 | 8.66 | 13.00 | 14.57 | 4.33 | 5.91 | 6.30 |
| | 1312 | 21.66 | 31.50 | 33.47 | 9.85 | 13.78 | 15.75 | 4.73 | 6 30 | 6.69 |
| Falling with maximum velocity - | | 23.63 | 33.47 | 35 44 | 9.85 | 13.78 | 15.75 | 4.73 | 6.69 | 7.09 |

The penetrations in other kinds of earth, wood, and stone, may be obtained by using the co-efficients given for the other tables.

## *Penetration in Fascines, Wool, &c.*

At the distance of 24 yards, a musket ball penetrates 20 in. into a gabion stuffed with sap fagots; the ball from a wall piece, 23.63 in. The resistance of fascines decreases very rapidly by the twigs being broken or separated by the balls.

A *rolling gabion*, stuffed with fascines, is proof against the ball of a wall piece at 15 yards; at the distance of 200 yards, and even more, it is pierced through by cannon balls of the smallest calibre.

The penetration of balls in wool is more than double of that in compact earth, even when the wool is contained in close, well quilted matrasses, pressed between hurdles. At 40 yards, a musket ball penetrates more than 40 inches into woollen matrasses thus placed together.

### *Effects of Shot on Cast Iron.*

Shot projected with even a small velocity will break pieces of cast iron of very large dimensions. A 24-pdr. ball fired with a charge of 1-12th and moving with a velocity of 883 feet in a second, split, in two shots, to the depth of 40 inches, a block of cast iron 12 inches wide by 40 inches thick. The fragments of the block and of the broken shot are projected with sufficient velocity to produce the most destructive effects.

According to these results, cast iron cannot be advantageously used either for gun carriages, or for revetments of fortifications.

### *Penetration in Masonry.*

Experiments at Fort Monroe Arsenal, in 1839.

| CALIBRE. | Charge. | Distance. | MEAN PENETRATION. | | |
|---|---|---|---|---|---|
| | | | Dressed granite. | Potomac free stone, | Hard brick. |
| *Shot.* | Lbs. | Yards. | In. | In. | In. |
| 32-pounder gun..... | 8 | 880 | 3.5 | 12. | 15.25 |
| *Shell.* | | | | | |
| 8-inch sea-coast howitzer... | 6 | 880 | 1. | 4.5 | 8.5 |

The solid shot broke against the granite, but not against the free stone or brick.

The shells broke into small fragments against each of the three materials.

The circumstances attending the penetration of the shot and shells corresponded with those above stated in the experiments at Metz. The wall used as a target was built of dressed stone and of the best bricks, laid in hydraulic cement; but being an isolated wall, (10 feet square of each material, and 5 feet thick, with 3 counterforts,) and being battered before the masonry was perfectly set, the effect of the projectiles in *shattering* the masonry around the point struck was greater than indicated by the experiments referred to.

### *Penetration in a Target of White Oak Timber, 5 feet thick.*

Experiment in New York Harbor, in 1814.

| GUN. | Charge. | Distance. | Diameter. | REMARKS. |
|---|---|---|---|---|
| | Lbs. | Yards. | Inches. | |
| 32-pdr. | 11 | 100 | 60 | Shot wrapped with leather, so as to destroy the windage. |
| | 11 | 150 | 54 | |

*Penetration of Lead Balls in Seasoned White Oak.*

Experiments at Washington Arsenal, in 1839.

| ARM. | Charge. | Distance. | Penetration. | REMARKS. |
|---|---|---|---|---|
| | Grains. | Yards. | Inches. | |
| Musket | 144 | 5 | 3.00 | Arms loaded with new musket powder. |
| Common rifle | 100 | " | 2.05 | |
| Hall's rifle | 100 | " | 2.00 | |
| Hall's carbine, musket calibre | 70 | " | 0.60 | |
| | 80 | " | 0.80 | |
| | 90 | " | 1.10 | Charges too great for service. |
| | 100 | " | 1.20 | |
| Pistol | 51 | " | 0.725 | |

Experiments made at West Point, in 1837.

| ARM. | Charge. | DISTANCE IN YARDS. | | | | | | | REMARKS. |
|---|---|---|---|---|---|---|---|---|---|
| | | 3½ | 9 | 50 | 100 | 150 | 200 | 300 | |
| | Grains. | In. | In. | In. | In. | In. | In. | In. | |
| Musket | 134 | 2 00 | 1.60 | 1.43 | 1. | 0.66 | 0.55 | 0.00* | *1 Ball in 10 imbedded. |
| | 125 | 1.60 | | | | | | | |
| | 90 | 1.60 | | | | | | | |
| Common rifle | 92 | 2.10 | 1.80 | 1.43 | 0.94 | 0.65 | 0.29 | 0.00† | †Indentation 0.2 in. |
| Hall's rifle | 70 | 1.12 | 1.70 | 0.63 | 0.53 | 0.40 | 0.00‡ | – | ‡2 Balls in 10 imbedded. |

The musket fired at 9 yards distance, with a charge of 134 grains, 1 ball and 3 buckshot, gave for the ball, a penetration of 1.15 in.; buckshot, 0.41 in.

*Penetration in a bundle of Musket Ball Cartridge Paper, No. 1.*

Musket, with 134 grains, at 13⅓ yards.....653 sheets.

Common rifle, 92 grains, at 13⅓ yards.....500 sheets.

## FIRING HOT SHOT.

FURNACES for heating shot are erected at the forts on the sea-coast. These furnaces hold 60 or more shot. The shot being placed, and the furnace cold, it requires 1 hour and 15 minutes to heat them to a red heat. After the furnace is once heated, a 24-pdr. shot is brought to a red heat in 25 minutes; the 32 and 42 require a few minutes longer. Two or three men are required to attend a furnace.

GRATES. In siege batteries, or in other situations where there are no furnaces, a *grate* is used for heating shot. This grate consists of 4 bars, 1.75 in. square, 3 feet long, placed diagonally, 4 in. apart, resting on 3 iron stands with legs 1 foot high.

*To use the grate:* Make an excavation 1 foot deep and 1 foot wide, with no slope at the sides or in rear, open in front. Place the grate in it, on stones or bricks, rising about 4.5 in. above the bottom; make a roof over it with hoops of flat iron, covered with sods and with 18 in. of earth, leaving in the back part a chimney 6 in. square. Put the shot on the grate, leaving about one-fourth of the length free, in front; on this part, and under the front of the grate, put the wood, cut into pieces about 14 in. long and 2 in. or 2.5 in. thick. Make use of a thick sod, as a register, to regulate the draught of the chimney, so that no flame shall issue from the front of the furnace. This little furnace, which will contain about fifteen 24-pdr. balls, heats them to a red heat in 1 hour, and will supply 3 guns; it requires the attendance of one man.

IMPLEMENTS. 2 *Pokers*, for stirring the fire, made of $\frac{3}{4}$ in. round iron, $5\frac{1}{2}$ feet long, the end bent at a right angle—2 *Iron forks*, for taking out the shot. These forks are immersed alternately in water to cool them—1 *Rasp*, to rub the scales from the balls when they have been overheated—1 *Pair tongs* with circular jaws, for taking up shot—1 *Iron rake*, to remove the cinders, &c., from the ash pit—1 *Trough or tub*—1 *Bucket*—1 *Barrel*—1 *Rammer*, with the head covered by a circular plate of sheet iron, of rather larger diameter than the ball; to remove the clay which may stick to the sides of the bore when clay wads are used—1 *Ladle*, (to each piece,) for carrying the balls, formed of an iron ring the interior of which is beveled to fit the ball, with 2 arms inserted into wooden handles; for small calibres it is made with 1 handle.

WADS, may be made of good clay, free from sand or gravel, moistened just enough to work well; the wads are cylindrical, 1 calibre long. But it is preferable to use *hay wads* that have been steeped in water for 15 minutes and allowed to drip.

CARTRIDGES for hot shot, are made of cannon cartridge paper or parchment

well pasted, to prevent the powder from sifting out; they should be carefully examined before use, to see that there are no holes in them. It is best to use two cartridge bags, one within the other.

MANNER OF LOADING. Elevate the muzzle sufficiently to allow the ball to roll in; ram the cartridge home carefully, and a *dry* hay wad over it; then a wet hay or clay wad; prick and prime; insert the ball, and put a wet hay or clay wad over it; this second clay wad may be only $\frac{1}{2}$ calibre long. It is a good precaution also to pass a wet sponge into the gun just before putting in the shot. When wet hay wads are used, steam is seen to issue from the vent as soon as the ball gets home; this is the effect of the heat of the ball upon the water contained in the wad; no danger can result from it, as the ball may be allowed to cool in the gun without the charge taking fire; but it is better to fire without much delay, as this steam would injure the powder.

The penetrations of cold and hot shot into wood are equal under the same circumstances. A red hot shot retains sufficient heat to set fire to wood after having struck the water several times. The fire is communicated more rapidly and certainly to the wood when the ball does not penetrate more than 10 or 12 inches, because at a greater depth the communication with the external air is not sufficiently free. It is proper therefore to fire with small charges, $\frac{1}{4}$ to $\frac{1}{6}$ wt. of the shot, according to the distance, in order that the shot may remain in the wood and not penetrate too deep.

*Expansion of Shot heated to a white heat.*

| CALIBRE. | 8-IN. | 42 | 32 | 24 | 18 | 12 |
|---|---|---|---|---|---|---|
| Expansion ....In. | 0.149 | 0.11 | 0.10 | 0.08 | 0.06 | 0.04 |

Heated shot do not return to their original dimensions on cooling, but retain a permanent enlargement, as will appear from the following table, giving the mean of 16 trials by Lieutenant Rodman, of the Ordnance Department:

| *8-inch Shot.* | FIRST HEATING. | | | SECOND HEATING. | | |
|---|---|---|---|---|---|---|
| | Diam. | Expansion. | | Diam. | Expansion. | |
| | In. | In. | Per cent. | In. | In. | Per cent. |
| Original..... | 7.840 | ..... | 0.000 | | | |
| White heat..... | 7.989 | 0.149 | .019 | 8.017 | 0.177 | 0.022 |
| Cherry red..... | 7.963 | .123 | .016 | | | |
| After cooling..... | 7.895 | .054 | .007 | 7.939 | .099 | .012 |