

UNITED STATES PATENT OFFICE.

WILLIAM CROZIER, OF THE UNITED STATES ARMY.

WIRE-WOUND GUN.

SPECIFICATION forming part of Letters Patent No. 671,879, dated April 9, 1901.

Application filed January 20, 1898. Renewed February 26, 1900. Serial No. 6,616. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM CROZIER, captain in the Ordnance Department of the United States Army, stationed at Washington, in the District of Columbia, have invented certain new and useful Improvements in Wire-Wound Guns; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the class of guns in which a central tube is reinforced by layers of wire. It is a fact well known to constructors of ordnance that in guns of the class mentioned difficulty is encountered in securing proper longitudinal strength of the cannon, the wire envelop having no resistance in the direction of the axis of the bore. A feature of my invention consists of the manner of so locking together the parts of the gun that they cannot separate in a longitudinal direction under the action of the forces to which the gun is subjected, at the same time interrupting in a very slight degree the continuity of the wire envelop.

It is also a fact, not so generally recognized, that a wire-wrapped gun cannot be made of any greater theoretical tangential strength than can a gun built up of concentric cylinders shrunk one upon the other, the outer cylinders being of the same material as the tube, provided the radii of the cylinders be properly proportioned and their number be not less than four, for with such a built-up gun the limit of the compressive resistance of the tube under the action of the outer cylinders when assembled and of its resistance to extension under the action of the powder-pressure can be attained without overstraining any of the outer cylinders, and more than this cannot be gained either by greater strength or greater subdivision of the said outer parts. It is possible, however, to so assemble upon the central tube a wire envelop and cylinders of solid metal as to cause the wire to sustain a large proportion of the tangential strain, relieving the solid cylinder or cylinders, which can then be made of weaker and cheaper material without causing the strength of the finished gun to be in any de-

gree less than if the solid cylinder or cylinders were of the finest quality of material. The manner of effecting the combination so as to produce this result forms another feature of my invention.

It is also a fact, again not so generally recognized, that in a gun so constructed as to utilize the full resistance of the tube, both to compression and extension, the tangential resistance to the powder-pressure in the bore is an increasing function of the total thickness of the continuous wall surrounding the bore, so that if any portion of the wall of the piece be detached from the other portions, the continuity not being perfect in the direction of the radius for the purpose of separately supporting the whole or a part of the longitudinal strain, such detached portion, adding to the weight of the piece and contributing nothing to the strength to resist the principal strain which it has to support—viz., the tangential—is to a certain extent wasted. The manner of avoiding such waste forms another feature of my invention.

With this preliminary discussion, which is necessary to a complete understanding of my improvements, I will now proceed to describe the completed gun which embodies them.

In the accompanying drawings the upper half of Figure 1 represents a longitudinal section of the gun and the lower half a side elevation. Fig. 2 represents a section on the plane 2 2, on an enlarged scale; and Fig. 3 represents an enlargement of a part of Fig. 1.

Like letters denote like parts in the different views.

A is a tube of strong tough material, preferably of the best attainable grade of forged steel.

B is an envelop of wire wound over the rear portion of the tube, abutting at the rear against a ring c, of suitable form, screwed or otherwise attached to the tube, as at c, and abutting at the forward end against a series of rings D D' D² D³ D⁴ D⁵, which I denominate "step-rings."

B' is an envelop of wire wound upon the forward portion of the tube, abutting at the front end against a ring E, of suitable form, and at the rear end against the step-rings D to D⁵. The ends of the wires are fastened in

any of the usual ways. The wire over the rear portion of the tube is wound with such a tension and the envelop is of such thickness that the metal about the bore of the tube shall be compressed thereby to the full extent to which it is designed that it shall be compressed in the finished gun, leaving no further compression to be effected by any other part. The wire over the forward portion of the tube is of such quantity and quality and wound at such tension as to produce a predetermined compression of and compressive strain on the metal of this portion of the bore.

Over the rear portion of the gun, now composed of the wire-wound tube, is placed a jacket F with a very slight shrinkage, approaching as nearly as is mechanically possible a shrinkage of zero, the object being to insure that the jacket shall form an integral part of the wall of the gun without exerting any normal pressure upon the wire envelop. By a "shrinkage of zero" I mean that the jacket should be made with as nearly as practicable an interior diameter, before assembly, equal to the normal exterior diameter of the wire coil, any shrinkage being merely sufficient to cause the jacket to form an integral part of the structure without break of continuity, but not to increase in any way the initial compression on the tube. The jacket has upon its inner surface, near the forward end, a shoulder *f*, which abuts against the outer step-ring. The bushing H, containing the breech-block, (not shown,) is screwed into the rear end of the jacket, as at *h*, and backs up the ring C and overlaps the rear end of the tube A.

The trunnion-hoop K is screwed upon the jacket, as at *k*, near the forward end thereof. By this construction the jacket supports the longitudinal strain due to the resistance of the gun-carriage at the trunnions and to the inertia of the jacket F, the wire envelop B, and the tube A.

The inner step-ring D is shrunk upon the tube. The wire of the envelop B' is wound approximately half-way up the thickness of the ring. The second step-ring D' is then shrunk upon the surface of the wire envelop, abutting against the ring *c*, and so on until the step-rings are all placed and the winding of the envelop B' is completed, the outer ring being left, as shown, projecting approximately half its thickness. The winding of the envelop B is then effected. The step-rings, abutting first against the tube, then against one another, and ultimately against the jacket, form the connection between the tube and the jacket, by which the greater part of the longitudinal strain is transmitted to the latter. By their arrangement, each one except the inner and outer having wire both inside and outside of it, they interrupt as little as possible the continuity of the wire envelop extending throughout the length of the tube. They are put on with such shrinkage as to assist in the design of the gradual

diminution of the compression of the metal at the surface of the bore in proceeding from the breech toward the muzzle.

The ring M is shrunk on the jacket in front of the trunnion-ring and the bands P P' to P⁹ are shrunk on the wire envelop in front of the jacket. The dimensions and shrinkages of the bands M and P to P⁹ are so adjusted as to produce a proper finish and to assist in the gradual diminution of compression, they have but a comparatively slight strain to endure, and, like the jacket, may be made of cheap material, preferably cast-steel.

The rings P⁵ to P⁹, &c., are shrunk upon the forward portion of the chase. Their office is to furnish a protection for the wire envelop, and they may or may not be taken into consideration in estimating the strength of the gun.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a gun the combination of a tube, a wire envelop surrounding said tube, and a jacket placed outside the envelop with step-rings of successively-increasing diameter abutting against the tube, one another and the jacket and forming a rigid connection for transmitting longitudinal strain between the tube and jacket, substantially as described.

2. In a gun the combination of a tube, a wire envelop surrounding said tube, a jacket placed outside the envelop, and step-rings embedded in said wire envelop, and forming a rigid connection between the tube and the jacket, substantially as described.

3. In a gun, the combination of an inner tube provided with a shoulder at or near the trunnions, a wire envelop wound about said inner tube, a jacket inclosing the rear portion of said wire envelop and provided with a shoulder on its inner face forward of the shoulder on said tube, and a plurality of overlapping step-rings embedded in said wire envelop and interposed between said shoulders, substantially as described.

4. In a gun, the combination with an inner tube provided with an annular shoulder at or near the trunnions, a wire envelop wound about said inner tube, a jacket inclosing the rear portion of said wire envelop and provided with an annular shoulder on its inner face forward of the shoulder on the tube, and a plurality of overlapping step-rings placed one behind the other and abutting against each other, embedded in said wire envelop and forming an interposed rigid bearing between the shoulders on the tube and on the jacket, substantially as described.

5. In a gun, the combination of a tube, a wire envelop surrounding said tube, a jacket placed outside the envelop, and step-rings embedded in said wire envelop, and forming a rigid connection between the tube and the jacket, and a trunnion-band secured onto said jacket, substantially as described.

6. In a gun, the combination of an inner

tube provided with a shoulder at or near the trunnions, a wire envelop wound about said inner tube, a jacket inclosing the rear portion of said wire envelop and provided with a shoulder on its inner face forward of the shoulder on said tube, and a plurality of overlapping step-rings embedded in said wire envelop and interposed between said shoulders, and a trunnion-band secured onto said jacket, substantially as described.

7. In a gun, the combination with an inner tube provided with an annular shoulder at or near the trunnions, a wire envelop wound about said inner tube, a jacket inclosing the rear portion of said wire envelop and provided with an annular shoulder on its inner face forward of the shoulder on the tube, and a plurality of overlapping step-rings placed one behind the other and abutting against each other, embedded in said wire envelop and forming an interposed rigid bearing between the shoulders on the tube and on the jacket, and a trunnion-band secured onto said jacket, substantially as described.

8. In a gun, the combination of a tube, a wire envelop surrounding said tube, and a jacket placed outside the envelop with step-rings of successively-increasing diameter abutting against the tube, one another and the jacket and forming a rigid connection for transmitting longitudinal strain between the tube and jacket, and a trunnion-band secured onto said jacket, substantially as described.

9. In a gun the combination of a tube, a wire envelop surrounding said tube, a jacket placed outside the envelop with step-rings of successively-increasing diameter abutting against the tube, one another and the jacket and forming a rigid connection for transmitting longitudinal strain between the tube and jacket, and a bushing screwed into the rear of said jacket and forming an abutment for the rear end of said tube, substantially as described.

10. In a gun the combination of a tube, a wire envelop surrounding said tube, a jacket placed outside the envelop, step-rings embedded in said wire envelop, and forming a rigid connection between the tube and the jacket, and a bushing screwed into the rear of said jacket and forming an abutment for the rear end of said tube, substantially as described.

11. In a gun, the combination of an inner tube provided with a shoulder at or near the trunnions, a wire envelop wound about said inner tube, a jacket inclosing the rear portion of said wire envelop and provided with a shoulder on its inner face forward of the shoulder on said tube, a plurality of overlapping step-rings embedded in said wire en-

velop and interposed between said shoulders, and a bushing screwed into the rear of said jacket and forming an abutment for the rear end of said tube, substantially as described.

12. In a gun, the combination with an inner tube provided with an annular shoulder at or near the trunnions, a wire envelop wound about said inner tube, a jacket inclosing the rear portion of said wire envelop and provided with an annular shoulder on its inner face forward of the shoulder on the tube, a plurality of overlapping step-rings placed one behind the other and abutting against each other, embedded in said wire envelop and forming an interposed rigid bearing between the shoulders on the tube and on the jacket, and a bushing screwed into the rear of said jacket and forming an abutment for the rear end of said tube, substantially as described.

13. In a gun, the combination of a tube, a wire envelop surrounding said tube, a jacket placed outside the envelop, and step-rings embedded in said wire envelop, and forming a rigid connection between the tube and the jacket, a trunnion-band secured onto said jacket, and a bushing screwed into the rear of said jacket and forming an abutment for the rear end of said tube, substantially as described.

14. In a gun, the combination of an inner tube provided with a shoulder at or near the trunnions, a wire envelop wound about said inner tube, a jacket inclosing the rear portion of said wire envelop and provided with a shoulder on its inner face forward of the shoulder on said tube, a plurality of overlapping step-rings embedded in said wire envelop and interposed between said shoulders, and a trunnion-band secured onto said jacket, and a bushing screwed into the rear of said jacket and forming an abutment for the rear end of said tube, substantially as described.

15. In a gun, the combination of a tube, a wire envelop surrounding said tube, and a jacket placed outside the envelop with step-rings of successively-increasing diameter abutting against the tube, one another and the jacket and forming a rigid connection for transmitting longitudinal strain between the tube and jacket, a trunnion-band secured onto said jacket, and a bushing screwed into the rear of said jacket and forming an abutment for the rear end of said tube, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM CROZIER.

Witnesses:

JNO. J. COOK,
NATHAN HAZEN.