

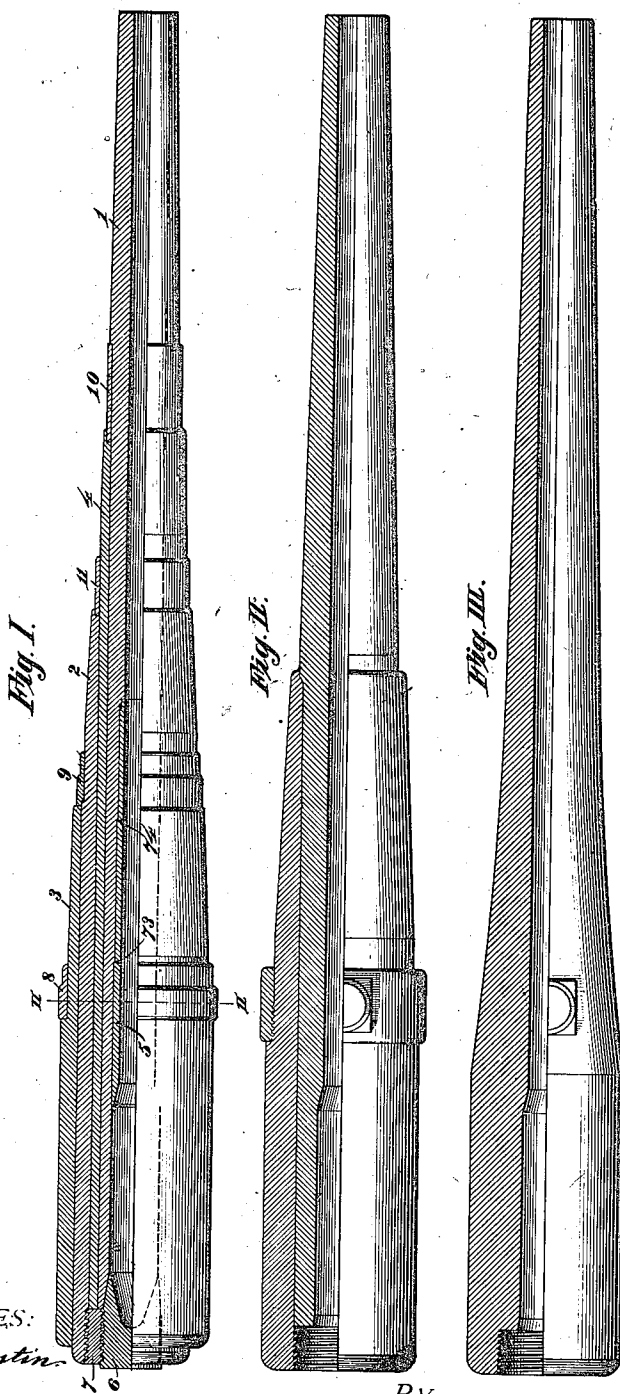
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A. H. EMERY.
PROCESS OF CONSTRUCTING GUNS.

APPLICATION FILED MAY 28, 1901.

NO MODEL.



WITNESSES:

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ALBERT H. EMERY, OF STAMFORD, CONNECTICUT.

PROCESS OF CONSTRUCTING GUNS.

SPECIFICATION forming part of Letters Patent No. 726,520, dated April 28, 1903.

Application filed May 28, 1901. Serial No. 62,261. (No model.)

To all whom it may concern:

Be it known that I, ALBERT H. EMERY, a citizen of the United States, and a resident of Stamford, county of Fairfield, and State of Connecticut, have invented certain new and useful Improvements in the Process of Constructing Guns, of which the following is a specification.

My invention relates to that class of guns so constructed that the exterior will be under strains of tension and the interior under strains of compression.

The object of my invention is to construct a gun having these conditions to the highest extent permitted by the character and quality of the metal used in the gun and consistent with the cost of and use required of the gun. Guns of this class have been made by three principal methods. First, cast-iron guns have been made and cooled partly or largely from the interior, which proved far more serviceable than the solid-cast guns or hollow-cast guns not water-cooled from the interior; but these guns were subject to unknown and not well-controlled strains, which proved sometimes sufficient to burst some of the large guns in the lathes before they were rough-dressed. Had these strains been somewhat less the guns might have been finished, but they would subsequently have burst with very slight powder-pressure, the initial strains in their outer part being almost up to rupture. Second, built-up guns of either cast iron and steel or all steel. These, especially the latter, have proved very much better, the best being made wholly of steel forgings, oil-tempered and annealed and assembled by heating and shrinking on the outer parts. In this construction the forging and tempering has usually been so conducted that each member by itself, before assembling with the others, usually has some and often large initial strains of tension on the interior and compression on the exterior, which is the reverse of what the conditions should be. When two members having these initial strains of tension on the interior and compression on the exterior are assembled together, their initial contact-faces may have and usually do have such relative diameters that after assembling the outer member will be largely or wholly under strains of tension and the inner

under strains of compression, as desired, and so the whole gun built up of such members should and usually does have large strains of tension on the exterior and compression on the interior; but guns so made will have their bores permanently deformed by enlargement by pressures much smaller than would have been required if metal of the same quality had been used in building the guns with each initial member so constructed that before assembling with the others it had a strain of tension on its exterior and of compression on its interior—that is, the same in kind and degree as the strains that the finished gun as a whole should have. The third class of guns that I would mention is closely allied to the first class in that it is cooled largely or wholly from the interior, but is made of much better material, it being made of steel, usually forged and oil-tempered and largely or wholly cooled from the interior. This gun may be very strong and very serviceable, but is dangerous, as it might be made of very high strong metal, which under the process of cooling largely or wholly from the interior may have such high and unknown initial strains of tension on the exterior that the increase of this strain when firing takes place may cause the gun to split from the exterior inward, so that while the gun is made of very strong material it is unsafe and may be easily burst.

My invention relates to guns of the second and third classes mentioned—that is, guns to be made of steel built up of several pieces or guns made of steel in one single piece. It will be noticed that guns of the first class and of the third class are made, respectively, of cast-iron and steel, in each of which in one stage of the manufacture the outer part, by cooling, is shrunk on the inner part, while guns of the second class, which are now made mostly or wholly of parts of forged tempered steel, are so made that each piece by itself may have strains existing in it the reverse of what they should be, the process of forging and oil-tempering both conducting, as ordinarily conducted, to produce a part for the gun having strains of compression in the exterior and tension on the interior. This condition should always be avoided, if practicable, and it may in general be wholly avoided

by expanding the part from the interior outward until the whole of the walls of said part are permanently stretched. This stretching should in general proceed not only considerably beyond the original limit of the metal's elasticity, but sufficient to give very considerable permanent enlargement of the diameter of the part being treated, and this stretching of the walls of the part by forcing the walls outward, causing them to be correspondingly extended radially, greatly increases the limit of elasticity and ultimate strength of the metal in the parts so treated and at the same time causes the whole metal in the part so treated to do its utmost to resist the internal forces used to strain or force it outward. In the same way a gun made of parts so treated and properly assembled or made in a single piece so treated is put in the best possible condition for metal of the quality used to resist the powder strains brought upon it in firing. Various methods might be followed for forcing or expanding these parts outwardly, any or all of which would tend to increase the elastic limit and ultimate strength of the metal and put the walls of the gun in the best condition to resist and withstand the strains of firing; but the process which I prefer for treating the parts or treating the gun as a whole, whether made of one piece or of several pieces, is the hydraulic process, hereinafter referred to.

My invention will now be fully described by reference to the accompanying drawings, in which—

Figures 1, 2, and 3 are longitudinal sectional views of three different constructions of gun embodying and illustrating my present invention.

Fig. 1 shows a form of construction suitable for large coast-defense guns and heavy guns for ships' use, where the gun is made up of several concentric members 1, 2, 3, 4, and 5, with a breech-block 6, screw-ring 7, trunnion-band 8, and small bands 9, 10, and 11. The principal members 1, 2, 3, 4, and 5 have preferably been separately expanded by heavy hydraulic pressure acting from the interior outward in the manner described in my applications filed, respectively, November 2, 1897, Serial No. 657,263, and May 29, 1901, Serial No. 62,388, according to which these parts after suitable preparation have been loosely assembled and then all expanded together by heavy internal hydraulic pressure until the permanent extension of the inner parts is so great that on the removal of the hydraulic pressure the inner parts will be under heavy strains of compression and the outer under heavy strains of tension owing to the enlargement of the interior parts. In the preferred structure this interior pressure has been continued and increased until the exterior parts have received a permanent extension. When this has been done, it will be found, if the gun is disassembled, that each separate member will have large strains of tension on its ex-

terior and compression on its interior, as is greatly to be desired. It will also be found that the tensile strength and elastic limit of each of these parts have been largely raised when the gun has been built in this way. In addition to this is the fact that we can properly use in the construction of these guns higher stronger metal for the separate parts to start with than we could properly use if the parts were forged, tempered, and assembled in the usual way by shrinking the parts together, and as the condition of the metal is further improved it will be seen that the gun which forms the subject of my invention is greatly superior to guns heretofore constructed.

When the gun is constructed as described, all the parts are doing their utmost and acting under the highest efficiency to oppose the internal pressure which has slowly strained them outward and greatly increased their ultimate strength, limit of elasticity, and efficiency, and are thus brought into the best conditions and relations for permanent use in the gun.

The desired conditions existing in my new gun may largely be produced in the manner described in my application filed April 6, 1900, Serial No. 11,904, according to which the parts are best cold-worked by heavy internal hydraulic pressure separately to develop in each individual part the degree of ultimate strength, limit of elasticity, and kind and extent of initial strains desired and then assembled as described.

Fig. 2 shows a simpler form of gun embodying my invention, well adapted for smaller calibers to carry high powder-pressures or for very large guns in which high pressures may be used, though not adapted for carrying such very high pressures as the gun shown in Fig. 1.

Fig. 3 shows a still simpler form of gun embodying my invention, which is very well adapted for guns of small caliber using high pressures or for very large and heavy guns in those cases where extreme pressures are not needed. If this gun, Fig. 3, is for field use, where a light strong gun is a necessity, it should be made from first-class steel or steel alloy well forged and rough-bored and rough-dressed and then thoroughly tempered, best from both interior and exterior, after which it receives the desired strains from the heavy slowly-acting internal hydraulic pressure, which removes all dangerous initial strains, increases the limit of elasticity and ultimate strength of the metal, leaving the piece after the removal of the hydraulic pressure with large strains of tension on the exterior and compression on the interior and best adapted to endure the high powder strains to which it will be subject in use.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The process of constructing guns, which

consists in slowly and permanently expanding its interior and exterior parts from the interior outward, sufficient to cause permanent strains of tension on the exterior and compression on the interior.

2. The process of constructing guns, which consists in slowly and permanently expanding its interior and exterior parts from the interior outward, sufficient to cause the whole gun to have tension on its exterior and compression on its interior, and concentric sections taken therefrom to have tension on their exterior and compression on their interior.

3. The process of constructing guns constructed of two or more concentric parts, which consists in slowly and permanently expanding the interior part outwardly against the exterior part, with sufficient pressure to put the exterior part under permanent strains of tension and the interior part under permanent strains of compression.

4. The process of constructing guns made of two or more concentric parts, which consists in slowly and permanently expanding the separate parts from the interior outward before assembling, and with sufficient pressure to cause their limit of elasticity and ultimate strength to be permanently raised, and to put permanent strains of tension on the exterior and compression on the interior of each part.

5. The process of constructing guns made of two or more concentric pieces, which consists in first expanding individual parts thereof from the interior outward by pressure sufficient to give permanent set to their walls and increase their limit of elasticity and ultimate strength, and causing each part so treated to have permanent strains of tension on the exterior and compression on the interior, before assembling, then assembling such parts together, and introducing internal pressure sufficient to slowly expand all the assembled parts from the interior outward until the in-

terior parts are given an additional permanent set, with an increase of diameter that causes the parts to be held firmly together, with tension on the exterior parts of the gun and compression on the interior parts of the gun.

6. The process of constructing guns made of two or more concentric pieces, which consists in first expanding individual parts thereof from the interior outward by pressure sufficient to give permanent set to their walls and increase their limit of elasticity and ultimate strength, and causing each part so treated to have permanent strains of tension on the exterior and compression on the interior, before assembling, then assembling such parts together, and introducing internal pressure sufficient to slowly expand all the assembled parts from the interior outward until both the exterior and interior parts are given an additional permanent set with such an additional increase of diameter in the interior part as will cause the parts to be held firmly together, with tension on the exterior parts of the gun, and compression on the interior parts of the gun.

7. The process of expanding an internal part of a gun or gun member against outer portions thereof, which consists in slowly introducing into the interior thereof heavy hydraulic pressure sufficient to give permanent set of extension to the interior part; and to increase its limit of elasticity and ultimate strength, and to permanently enlarge the diameter of such interior part, so that it will be put under strains of compression when the liquid pressure is removed.

The foregoing specification signed this 25th day of May, 1901.

ALBERT H. EMERY.

In presence of—

JOHN E. KEELER,
HERVEY S. KNIGHT.