To all whom it may concern:

Be it known that I, Albert E. Guy, major, Ordnance Department, United States Army, a citizen of the United States, stationed at Washington, D. C., have invented an Improvement in Applying Pressure to the Interior of Closed Vessels, of which the following is a specification.

The invention described herein may be used by the Government, or any of its officers or employees in prosecution of work for the Government, or by any other person in the United States, without payment of any royalty thereon.

This invention relates to a method wherein pressure is applied to the interior of closed vessels, said applications involving the law of expansion of fluids and solids under change in temperature.

The invention is used in the treatment of the interior walls of a vessel to increase their resistance to internal pressure and is intended particularly for gun tubes, which must withstand very high internal pressure each time a shot is fired.

It is also adapted for fitting linings in cylinders, tubes, and the like, and especially for relining gun tubes. It is very well adapted for use in connection with the process of treating tubes by pressure disclosed in my application filed October 17, 1918, Serial No. 263,399.

The objects of the invention are rapidity and ease of operation, low cost and adaptability to different conditions of manufacture and use. The invention consists in the method and in the apparatus hereinafter described and claimed.

The preferred means and mode of applying the invention to a gun tube is as follows, reference being made to the accompanying drawings which show suitable apparatus for carrying out the inventions. The same characters are used to designate similar parts in the several views.

Figure 1 of the drawings is a side view, partly in section, of a gun tube, wherein a liner is to be secured by an application of this method.

Fig. 2 is a similar view of the muzzle end of a gun tube showing a slightly modified arrangement of the parts when relining a gun tube after the liner has been rifled.

Referring to the drawings by numerals, 10 indicates the gun, the interior of which may be provided with one or more shoulders as indicated at 11 and may be slightly tapered toward the muzzle of the gun as shown at 12.

A liner 13 is inserted into the gun tube from the breech end, and has a snug fit throughout its entire length. Said liner, as will appear later, may be rifled in the usual manner, prior to its insertion into the gun tube.

A rod or core 14 is arranged to extend entirely through the gun, having at one end a large head or disk 15 adapted to bear against one end of the tube, and at its other end with a washer 16 mounted on a seat 17 near the end of the core to bear against the other end of the tube. The washer 16 is held firmly in position by a nut 18 threaded on the end of the core which extends beyond washer 16, thus locating the core in place.

As a seal to the ends of the gun tube, packings are inserted as shown at 19 and annular rings 20 secured by set screws 21 are arranged in contact with the packings to maintain same in contact with the members 15 and 16 and form a perfect joint between the parts.

A space 22 is provided between the core 14 and the inner wall of the liner in which a pipe 23 of relatively heavy walls or small bore is coiled about the core from end to end of the gun tube. Said pipe 23 is in communication at one end with a passage 24 formed in the muzzle end of the core 14 and at its other end with passage 25 at the breech end of said core.

The space 22 is filled with any substance having a higher coefficient of expansion than the containing parts of the gun.

A pipe 26 from any source (not shown) for the supply of a temperature changing fluid is connected by branch pipe 27 with the muzzle end of the coil 28 through passage 24, and a return or exhaust pipe 29 is in communication with the breech end of tube 23 through passage 25, and may be connected with a condenser 29.

In Fig. 2 of the drawings a slightly modified arrangement of the parts is shown, in which special provision is made for the fitting of a liner wherein the rifling has been cut, which must extend to the extreme muzzle end of the gun. The liner 30 in which the rifling is shown at 31, is of sufficient
length to extend beyond the end of the gun tube as shown at 32. The portion 32 of the liner has mounted thereon a retaining ring or band 33, which may be held in place by a washer 34 and nut 35, similar to corresponding members 16 and 18 of Fig. 1. Between the end of the gun and the retaining band 33 a small space 36 is provided to permit the insertion of a saw for removing the portion 32 of the liner after treatment by this method has been completed.

The pressure produced within the gun tube by the means described may be designed sufficient to stretch the inner wall of the gun beyond the elastic limit of the steel, and a permanent deformation or “set” of the inner layers of the steel is the result. The operation is stopped before the outer layers are stretched to their elastic limit. When the pressure is relieved, the outer layers of the steel tend to return to their original size, thereby compressing the inner layers, which have been stretched too far to return to their original size and which remain slightly stretched and hence under compression from the outer layers. The condition of the metal in the inner and outer regions of the gun tube after treatment by this method is similar to that of a composite gun formed by shrinking outer bands on the inner tube to compress the metal.

The operation is obvious and consists of filling the space 32 surrounding the core, with a substance having a greater coefficient of expansion than the surrounding metal, and confining same therein by sealing the end of the space. A temperature changing fluid may then be passed through the pipe 23 to expand the filler and produce the desired result. The pipe 23 has walls of sufficient thickness to withstand high external pressure, but the piping 27 and 28 and fittings need not be of special thickness since they may not be subjected to either internal or external pressure.

While the apparatus shown is of a character to clearly illustrate the application of the improved method, changes may be made in the form of apparatus within the scope of the appended claims.

What I claim is:

1. The method of generating pressure in the interior of the bore of a tube, consisting of filling and sealing the tube and passing a temperature changing medium through the interior of the tube.

2. The method of generating pressure in the interior of a sealed tube containing a filler and a core of predetermined relative proportions, consisting of causing the expansion of the filler by passing a temperature changing medium therethrough.

3. The method of securing a liner in a sealed tube containing a filler and a core of proportions, consisting of applying a temperature changing medium to the filler without detriment effect to the metal of the tube.

4. The method of generating pressure inside the bore of a sealed tube, consisting of filling the tube and changing the temperature of the filler by a circulating medium.

5. The method of generating pressure inside the bore of a sealed tube, consisting of filling the tube and applying a temperature changing medium to the filler only.

6. The method of generating pressure inside the bore of a tube, consisting of filling the tube and applying a circulating temperature changing medium to the filler only.

7. The method of generating pressure inside the bore of a tube, consisting of forming a space adjacent the inner wall of the tube, filling the space with a substance, sealing and heating the space by a circulating medium.

ALBERT E. GUY.