March 7, 1950 P. H. BRACE ET AL 2,499,944

GUN TUBE LINER MATERIAL

Filed Oct. 4, 1946

Fig. 1.

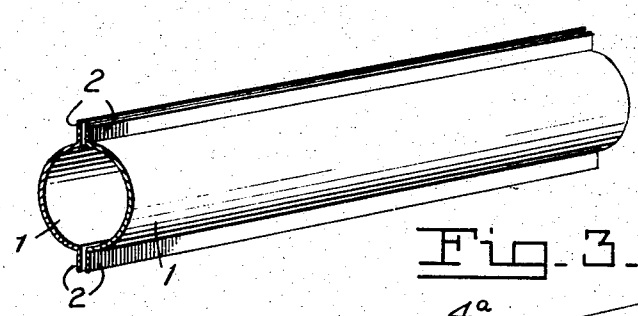


Fig. 2.

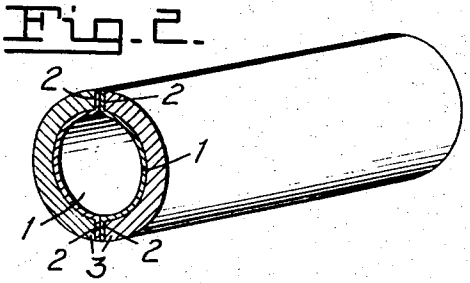


Fig. 3.

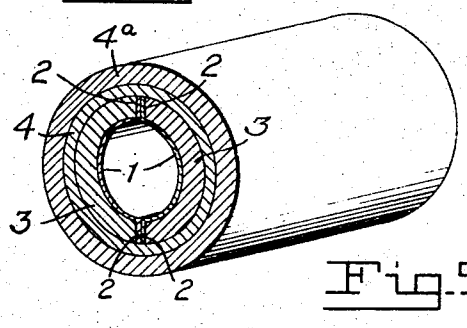


Fig. 4.

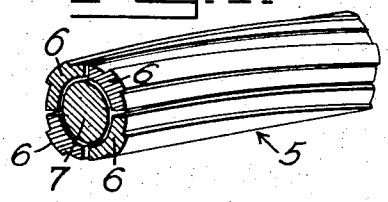


Fig. 5.

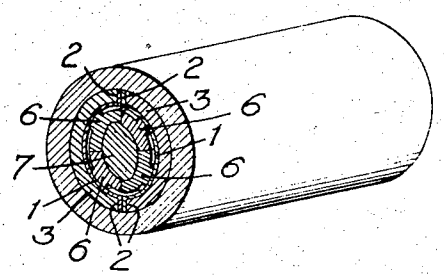


Fig. 6.

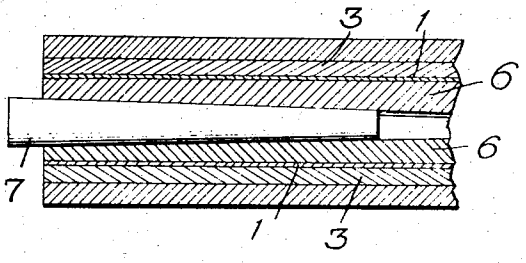
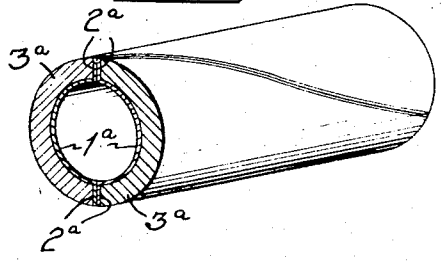


Fig. 7.



Inventors,

Porter H. Brace
J. Frank Schairer
John W. Marden

By J. H. Churchor H. E. Thibodeau

Attorneys

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GUN TUBE LINER MATERIAL

Porter H. Brace, Forest Hills, Pa., John Frank Schairer, Chevy Chase, Md., and John W. Marden, East Orange, N. J., assignors to the United States of America as represented by the Secretary of War

Application October 4, 1946, Serial No. 701,298

6 Claims. (Cl. 89—16)

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This invention relates to a liner for gun tubes, and particularly to a thin liner of resistant metal such as molybdenum, molybdenum-tungsten, molybdenum-cobalt and molybdenum-nickel alloys, tungsten and the like, as well as means for anchoring the resistant metal in the gun tube, and means for rifling the liner tube.

An object of our invention is to provide a gun tube lined with a sheet of metal resistant to high temperteures, wear and chemical erosion, with means for securely retaining said liner. Another object is to provide means for rifling a lined gun tube by embossing.

The manner in which the above and other objects are attained is disclosed in the specification and the appended drawings in which,

Figure 1 is a perspective cross section view of the liner of the resistant metal,

Figure 2 is a perspective cross section view of the liner assembled with a split liner retaining tube,

Figure 3 is a perspective cross section view of the completely assembled gun tube,

Figure 4 is a perspective cross section view of a mandrel for embossing the rifling on the liner in the gun tube,

Figure 5 is a perspective cross section view showing the mandrel in the gun tube,

Figure 6 is a longitudinal cross section view showing the mandrel in the gun tube,

Figure 7 is a perspective view of a modification showing helical liner sections.

Two sheets or strips of resistant metal such as molybdenum, molybdenum-tungsten, molybdenum-cobalt and molybdenum-nickel alloys and tungsten or the like are formed into liners of flanged semi-cylindrical shape as shown in 1—1 in Figure 1 and are then assembled with semi-cylinders 3—3 whose radial thickness corresponds to the width of flanges 2 of the liner 1—1.

The assembly shown in Figure 2 is then inclosed in a tube 4 as shown in Figure 3, by shrink or press fitting or in any other known manner. The assembly shown in Figure 2 may for this purpose be formed with a slight conical exterior taper, if desired, and the tube 4 may be bored to a mating conical surface to facilitate the final assembly of the gun tube, although this is not absolutely necessary, and both elements may be made cylindrical if desired.

For additional strength a further tube 4*a*, may be provided, or this may be omitted, if a more simple and inexpensive structure is desired. Built up gun tubes consisting of several concentrically disposed tube elements are old in the art and we do not broadly make any claim to this feature.

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In order to provide rifling in the gun tube bore as described above, without removing any material from the thin liner and thus weakening same, we prefer to emboss or impress the rifling upon the inside surface of the assembled tube. For this purpose we make use of a suitably hardened mandrel 5, split into several elements 6, as shown in Figure 4. A tapered mandrel spacer 7 is provided to force the split elements 6, into embossing or swaging engagement with the liner. The inner surfaces of the mandrel element are shaped to conform to the taper of the mandrel spacer. The longitudinally split mandrel construction also facilitates the removal of the mandrel after the swaging operation is completed.

As an alternative for the tapered mandrel a tube (not shown) of extensible or plastic material such as copper or the like may be positioned within the split mandrel 5 and hydraulic pressure is thereafter applied internally of the tube in any suitable manner to effect an expansion of the copper tube and force the split mandrel 5 into embossing engagement with the liner of resistant metal forming the bore. As a further alternative, the gun tube having the liner therein may be swaged directly onto the split mandrel 5 and the swaging operation may be performed either hot or cold to emboss the rifling grooves onto the bore of the gun tube.

It is desirable that the joints between the sections of the assembled gun tube conform in direction to the direction of the rifling. This may be effected by preforming the sections to a helical shape as shown in Figure 7, wherein the same reference numeral with the subscript *a* added show the same corresponding parts as in the Figure 2. While we have shown a two section inner assembly it is to be understood that our invention also comprehends the use of several helical sections, each part bearing one land of the rifling. The inner assembly may thus be built up of identical components.

With this helical construction, the further advantage is obtained that rotation of the bullet due to the rifling does not cause the bullet surface to rub circumferentially against the junction of adjacent sections of the liner 1, with consequent tearing tendency, but only adds to the rifling effect. It is contemplated, however, that the closeness of fit, together with the swaging operation will be effective to reduce the crevices at the junction of adjacent liner sections to a

minimum, so that a substantially continuous inner surface will be formed by the liner sections. To facilitate removal of the mandrel after the embossing operation is completed, the mandrel may be made of a low expansivity material, so that heating of the gun tube will tend to free it from the mandrel.

We claim:

1. Reinforced metal tubing comprising an outer tube, a split inner tube of substantial radial thickness firmly held within said outer tube, and a split liner of thin resistant material, each section of which has radially upturned flanges held between adjacent sections of said split inner tube.

2. The invention as recited in claim 1 and including rifling grooves impressed on said split liner and inner tube.

3. The invention as recited in claim 1 and including rifling grooves impressed on said split liner inner tube, the sections of said liner and inner tube being so formed that the joints between them conform in direction to the direction of the rifling.

4. A gun barrel comprising an outer tube, a split inner tube of substantial radial thickness firmly held within this outer tube by frictional engagement therewith, a split liner of sheet material, each section of which has flanges extending radially toward the outer tube for a distance corresponding to the thickness of said split inner tube and between adjacent sections of said liner tube, whereby the adjacent flanges of each two adjacent section of said split liner are held between two adjacent sections of said split inner tube.

5. The method of forming a gun tube having a thin liner of resistant material which comprises; forming strips of said resistant material into liner sections having radial flanges extending outwardly from the inner tube surface, assembling said liner section with adjacent flanges in side by side abutting relationship, forming a split tube of substantial radial thickness with sections corresponding to the said liner section, assembling said split tube about said liner section so that the adjacent radial edges of said split tube serve to clamp abutting flanges of said liner sections, and forcing said assembly into frictional engagement with an outer tube to hold said assembly together.

6. The method of forming a rifled gun tube having a thin liner of resistant material which comprises; forming strips of resistant material into liner sections having radially upturned edges, clamping the radially upturned edges on each said strip between adjacent sections of a split rigid inner liner, forcing said assembly into frictional engagement with an outer tube to hold said assembly together, inserting into the barrel a split mandrel consisting of sections corresponding to the liner sections, each mandrel section being provided with projecting means to produce one or more rifling grooves, and forcing said mandrel sections against the inner surface of said gun barrel to produce rifling corresponding in longitudinal direction to the longitudinal direction of the said liner sections.

PORTER H. BRACE.
JOHN FRANK SCHAIRER.
JOHN W. MARDEN.

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