Oct. 5, 1926.

1,602,282

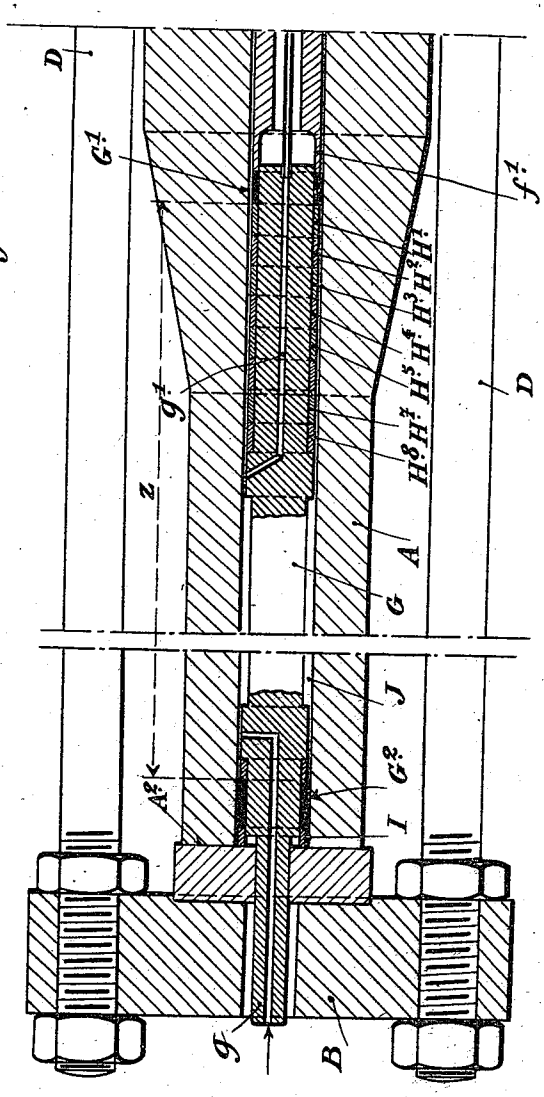
N. E. METHLIN

SELF HOOPING OF METAL TUBES

Filed July 27, 1925

6 Sheets-Sheet 1

Fig. 1



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Filed July 27, 1925 6 Sheets-Sheet 2

Fig. 1A

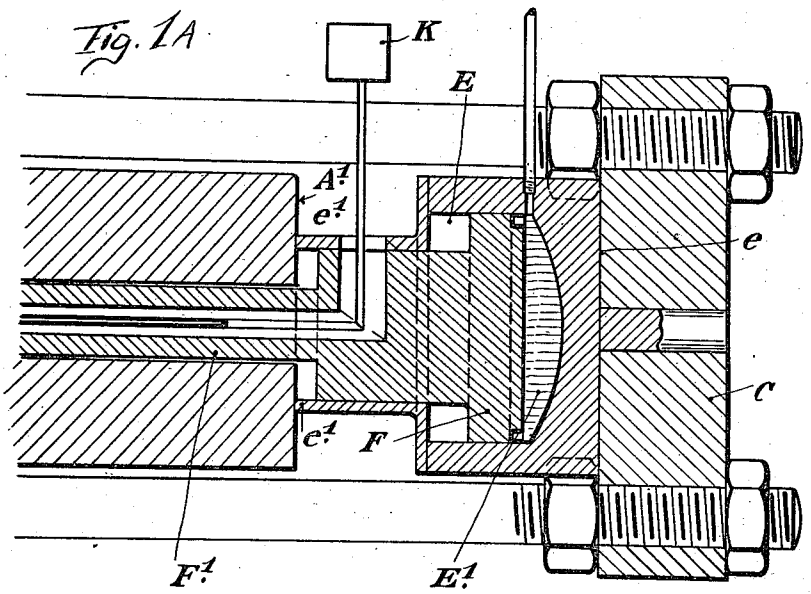
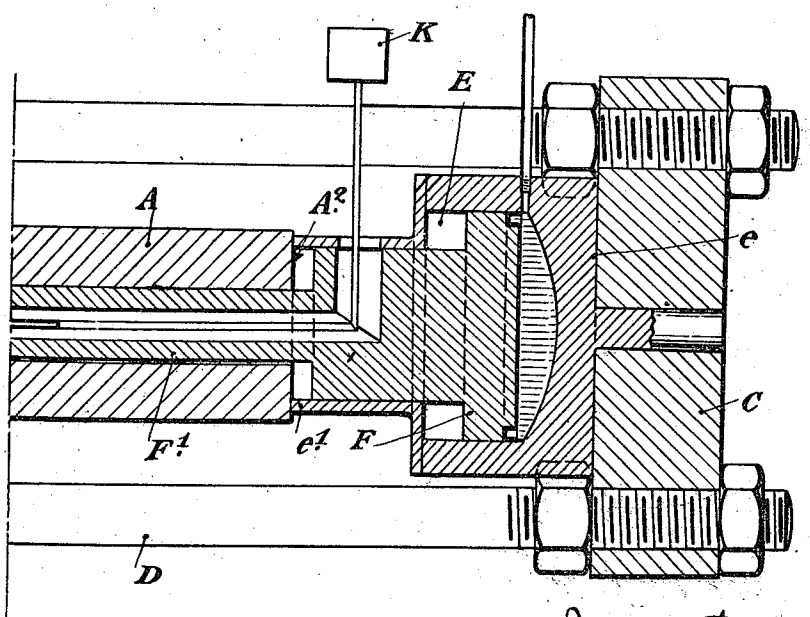


Fig. 2A



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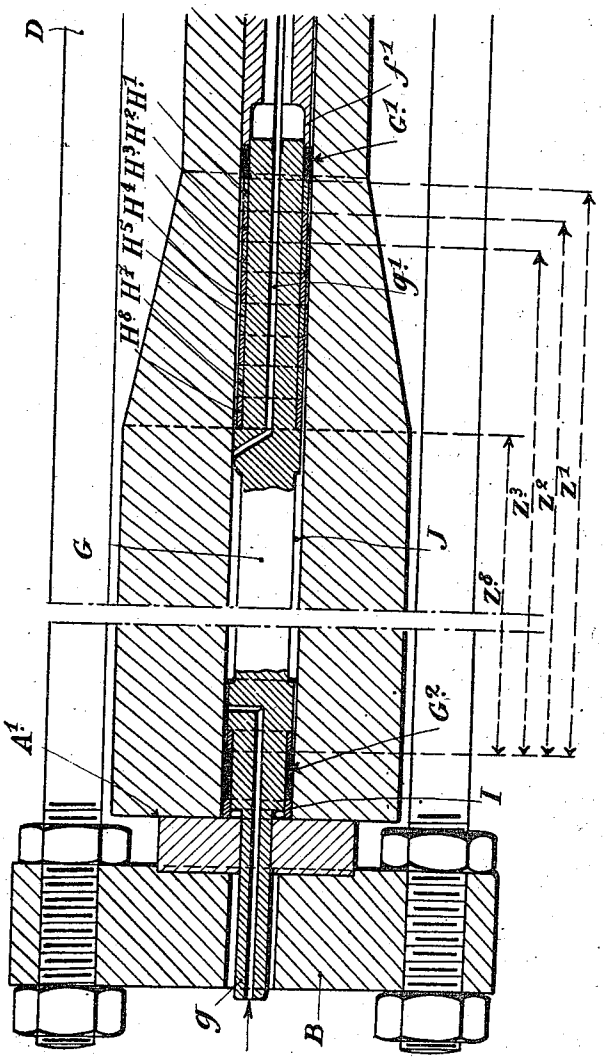
6 Sheets-Sheet 3

Fig. 2.



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Filed July 27, 1925 6 Sheets-Sheet 4

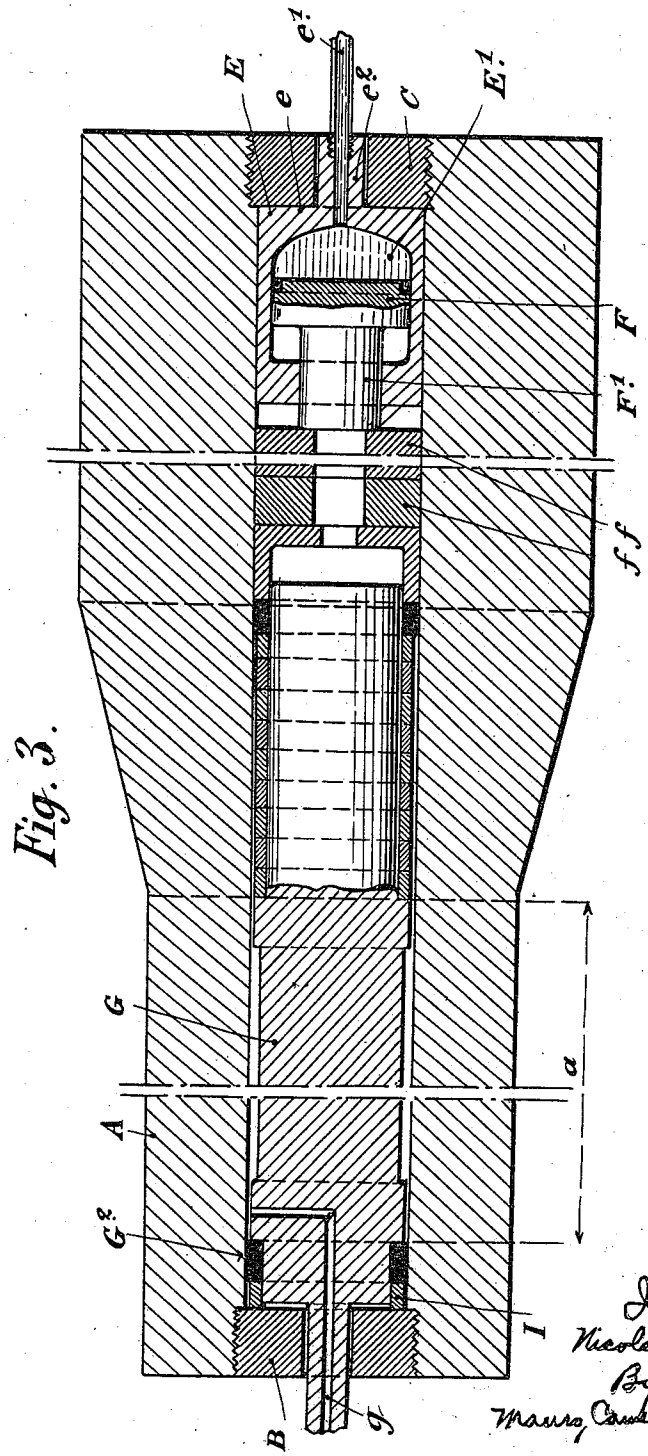

Fig. 3.

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SELF HOOPING OF METAL TUBES

Filed July 27, 1925

6 Sheets-Sheet 5

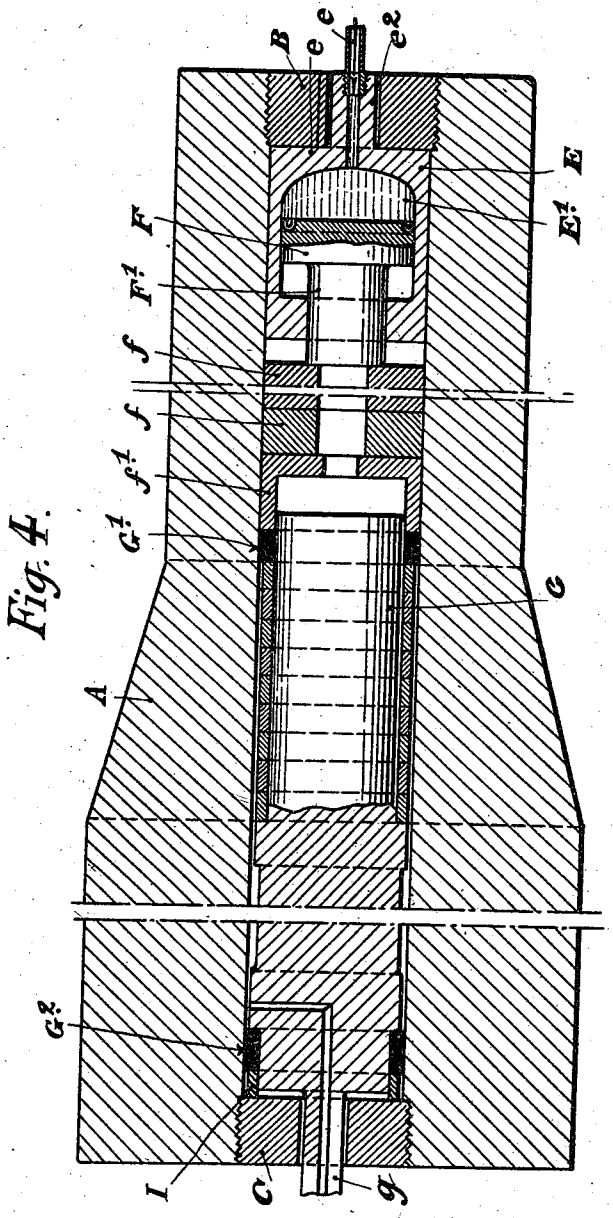

Fig. 4.

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1,602,282

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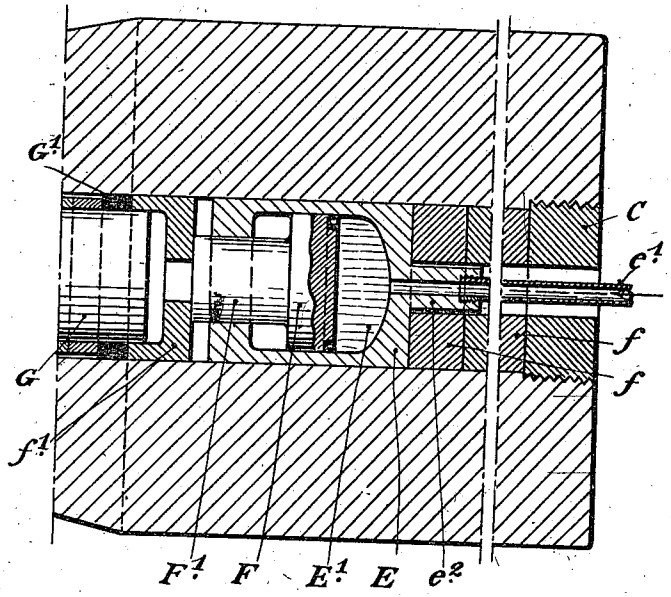
SELF HOOPING OF METAL TUBES

Filed July 27, 1925 6 Sheets-Sheet 6

Fig. 5.



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UNITED STATES PATENT OFFICE.

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SELF-HOOPING OF METAL TUBES.

Application filed July 27, 1925, Serial No. 46,438, and in France December 4, 1924.

This invention relates to a method and means for producing hooping effects in metal tubes.

Considerable difficulty has heretofore been experienced in securing fluid tightness of the joints employed in apparatus of this type between the "self-hooping" mandrel and the tube to be self-hooped. It has heretofore been proposed, for example in the patent to Eugene Schneider, No. 1,540,654, dated June 2, 1925, to employ movable head joints which are acted upon by the pressure of the self-hooping fluid or liquid on one joint face while on the opposite side the same pressure is exerted upon a smaller section of the head joint. It has also been proposed to employ a self-hooping mandrel but as heretofore used it has been necessary for this mandrel to be made of a metal of very great strength, capable of withstanding not only the transverse compressive stress resulting from the pressure of the liquid or fluid employed, but also the longitudinal tensile stress resulting from the type of apparatus employed.

According to the present invention, the hooping effect is obtained in a metal tube of very great strength by means of a "self-hooping" mandrel, and the operation is carried out with the use of extremely simple joints provided between the self-hooping mandrel and the inner wall of the tube the fluid tightness of which joints is obtained by means of a counter pressure, hydraulic or pneumatic, which is independent of the hydraulic "self-hooping" pressure. The new method also prevents any pull from being exerted on the self-hooping mandrel, the mandrel being so constructed that it simply resists the compressive forces corresponding to the pressure of the "self-hooping" liquid.

The invention will be readily understood by reference to the accompanying drawings illustrating two embodiments of the inventive idea. It is to be expressly understood, however, that these drawings are for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings:—

Fig. 1 is a longitudinal sectional elevation illustrating one embodiment of the present invention with Fig. 1ª an extended view showing opposite end;

Fig. 2 is a view similar to Fig. 1, illustrating one manner in which the self-hooping pressure may be applied to the rear and slide cylinders of a gun, i. e., that portion of the gun forward to the breech with Fig. 2ª an extended view showing opposite end;

Fig. 3 is a sectional elevation of another embodiment of the present invention and illustrates a gun tube of large bore in process of being self-hooped, the members being arranged with a view to self-hooping the chase of the gun, i. e., the portion of the gun immediately in the rear of the muzzle;

Fig. 4 is a corresponding longitudinal sectional elevation showing the members arranged for self-hooping the rear cylinder of the gun for the portion of greatest thickness; and

Fig. 5 is a detail sectional view illustrating one manner in which the elements of the embodiments of the invention illustrated in Fig. 3 may be arranged.

Referring to the drawings and particularly to Fig. 1, A is the tube to be "self-hooped" which is mounted between two cross heads B and C connected to each other by means of tie rods D. These cross heads may be arranged as in the apparatus which forms the subject matter of the patent to Eugene Schneider No. 1,338,871, dated May 4, 1920, that is to say they may be arranged so as to be freely movable, by means of rollers, upon suitable supports.

The device according to the invention is characterized by the provision, between one of the cross heads (C for example) and the corresponding end of the tube A to be "self-hooped", of a pressure cylinder E one of the ends e of which may bear against this cross head, the other end e^1 bearing against the tube A. A piston F moves in this cylinder E. The said piston comprises a rod F^1 the section of which corresponds to the smaller diameter of the tube A, and the free end f^1 of the piston bears against the joint G^1, which is preferably constituted by a suitable packing ring, between the "self-hooping" mandrel G and the tube A.

It will at once be seen that if a liquid or a fluid under pressure is admitted into the chamber of the pressure cylinder, that is to say into E^1, this pressure acts at the

same time on the end of the cylinder and on the piston F, and is transmitted, increased in the ratio of the cross section of the piston F to the annular section of the end of the rod F^1, to the joint G^1. If on the other hand, as shown in Figure 1, the tube A presses against the cross head B, the pressure in E^1 which is exerted upon the end of the cylinder E, is transmitted, through tie-rods D, to the cross head B, and, through the latter to rings or annular keys I disposed between the "self-hooping" mandrel G and the tube A.

That is to say, the joints G^1, G^2 are acted upon by a pressure exerted from the outside towards the inside, that tends to force said joints longitudinally of the tube toward one another, and which is entirely independent of the "self-hooping" pressure, and which is exerted in the form of a counter pressure. At the same time the mandrel G is acted upon by the pressure of the "self-hooping" liquid in the radial direction alone. The "self-hooping" liquid is supplied to this part, in the usual manner, through a duct g formed in the interior of the mandrel, G, and the annular space J between the tube A and the mandrel G, which is full of liquid under pressure, may be put in communication with a pressure indicator K, through the duct g'.

In the embodiment illustrated in Figures 1 and 2, it has been assumed that the hooping effect is to be obtained on a tube A such as a tube for a gun barrel, the hooping effect produced in the different zones of this tube varying, the latter being themselves of different external diameters. In this case recourse is had to an arangement of intermediate annular keys H^1, H^2, H^3 . . . H^7 between any two of which may be interposed, at points which consequently vary, the joints G^1.

For the "self-hooping" of the cylindrical part of smaller external diameter and a section of the tapering part, that is to say, the whole of the zone Z, the members will occupy the positions shown in Figure 1, in which the "self-hooping" liquid, admitted between the joints G^1, G^2 passes freely between the external surface of all the keys and the internal surface of the tube A. When the zone Z has been completely "self-hooped", the tube A is taken down, and it is mounted again so that its end face A^1 presses against the cross head B, while its face A^2 presses at e^1, against the pressure cylinder E, the mandrel G and the piston F^1 remaining in the positions shown in Figure 1.

The tube is shown in this position in Figure 2.

After this has been done liquid is admitted under pressure between the two joints G^1, G^2 for the "self-hooping", at a higher pressure, of the whole of the zone Z^1 (Fig. 2).

The joint G^1 is then moved successively and is first placed between the keys H^1 and H^2, the key H^1, which has been moved, pressing against the free end of the piston rod.

By gradually moving the point G^1 along so that it occupies successively the place of the keys H^3, H^4 . . . H^8, the zones Z^2, Z^3 . . . Z^7 are "self-hooped" at increasing pressures in succession. Finally the end part Z^8 of greatest diameter is "self-hooped" with an internal pressure greater than those utilized for the different successive zones of the tapering part.

The keys H^1, H^2, H^3 etc., are naturally of such a thickness that a sufficient amount of clearance is left between them and the internal wall of the tube to be "self-hooped", so that fluid tightness is each time only obtained between the joints proper G^1, G^2 and the wall of the tube.

The rod F^1 of the piston F may be subdivided, which will enable use to be made of rod sections the number of which varies according to the length of the tube to be "self-hooped".

In the form of construction of the device shown in Figures 3 to 5 use is also made of a pressure cylinder, but the apparatus is greatly simplified due to the fact that the whole of the said presure cylinder is placed in the interior of the tube to be "self-hooped"; the cross heads are here replaced by plugs closing the ends of the tube to be "self-hooped", and the counter pressure is applied on one of the joints by the direct action of the piston of the pressure cylinder, while it is transmitted to the other joint by the body of the tube to be "self-hooped", through the medium of a ring pressing upon the closing plug at the opposite end.

Referring now to Figs. 3 and 4, A is the tube to be "self-hooped" which may be mounted on any support not shown. In the interior of the tube is placed a pressure cylinder E which may be fixed to the tube A or bear by one of its ends e against a closing device C screwed or fixed in any other suitable manner in the said tube A.

In the pressure cylinder E, thus arranged in the tube A, moves a piston F provided with a rod F^1, the end of which presses directly, or preferably through the medium of a more or less large number of washers f and a ring f^1 against one of the joint packings G^1, which is to be made fluid tight. The liquid or the fluid under pressure is fed into the pressure cylinder through the tubular duct e^2, passing through an aperture formed in the centre of the plug, C, and through a pipe e^1 connected up to this tubular duct.

G is the "self-hooping" mandrel, pierced, near its end, with a duct g through which liquid under pressure is admitted; G^2 is the joint at the opposite end to G^1; this joint is disposed between a shoulder formed on the mandrel G and a ring I which bears against the closing device B screwed into the corresponding mouth of the tube A.

If a liquid or a fluid under pressure is admitted into the chamber E^1 of the pressure cylinder, this pressure is exerted at the same time on the end of the cylinder E and the head of the piston F and is transmitted to the joint packing G^1, increased in the ratio of the cross section of the piston head F to the section of the ring f^1 that engages said packing.

This same pressure is transmitted, through the tube A, to the ring I, and, through the latter, to the packing G^2.

Figure 3 shows the tube, with the members arranged for the "self-hooping" of the part of the tube comprised between the two joints G^2 and G^1, the "self-hooping" pressure applied being sufficient to produce the desired deformation of the part of the tube a comprised between the muzzle of the barrel and the tapering connecting part formed by the central part of the tube.

When the "self-hooping" of this part of the tube is ended, the closing devices C and B are taken out and the tube A is disengaged by sliding it on the "self-hooping" mandrel and the pressure cylinder; this separation being completed, the tube is slipped on again in the reverse direction, as shown in Figure 4.

When the closing devices B and C have been replaced, the members occupy the positions shown in Figure 4 and it is possible, as in the case of the device shown in Figures 1 and 2; by successively displacing the joints G^1, to proceed, by successive zones, to "self-hoop", the central and back parts of the tube A. By making use of a varying number of washers f the same pressure cylinders E—F—F^1 may be used for tubes of the same bore but of different length.

As shown in the modification in Figure 5, the washers f instead of being disposed in a varying number between the end of the piston rod F, F^1 and bearing ring f^1 may be placed between the supporting closing device (C or B according to the stages of the operation) and the cylinder E of the pressure cylinder.

Claims:—

1. A method for "self-hooping" metal tubes which consists in subjecting the inner surface of the tube to be treated to a hydraulic deforming pressure and in simultaneously applying a hydraulic counter-pressure to the tube independent of said deforming pressure to prevent leakage of said deforming pressure from the tube.

2. Apparatus of the class described comprising, in combination with a tube to be self-hooped, means for introducing a hydraulic deforming pressure into a portion of the tube to be treated, limiting means for said portion, and means for applying a hydraulic counter-pressure independent of said deforming pressure to said limiting means for preventing leakage of the deforming pressure from said portion.

3. Apparatus of the class described comprising, in combination with a tube to be self-hooped, means for introducing a hydraulic deforming pressure into a portion of the tube to be treated, and means for confining said pressure to the portion to be treated including means for applying a hydraulic counter-pressure to the tube at the limits of said portion to prevent leakage of said deforming pressure from said portion.

4. Apparatus of the class described comprising, in combination with a tube to be self-hooped, a mandrel positioned within said tube, joint packings surrounding the mandrel and engaging the inner surface of said tube, means for conducting a fluid under pressure into the space between said mandrel, tube and packings, and means for applying a pressure independent of the self-hooping pressure to said joint packings for preventing leakage of said fluid past said packings.

5. Apparatus of the class described comprising, in combination with a tube to be self-hooped, a mandrel positioned in said tube, joint packings surrounding the mandrel and engaging the inner surface of said tube, means for conducting a fluid under pressure into the space between said mandrel, said tube and packings, and means having engagement with one of said joint packings for applying a pressure independent of the self-hooping pressure to said joint packings for preventing leakage of said fluid past said packings.

6. Apparatus of the class described comprising, in combination with a tube to be self-hooped, a mandrel positioned within said tube and having a duct therein through which fluid may be introduced for applying a self-hooping pressure to the inner surface of said tube, joint means surrounding the mandrel and engaging the inner surface of said tube, and means including a piston for applying a pressure independent of the self-hooping pressure to said joint means for preventing leakage of said fluid past the joint means.

7. Apparatus of the class described comprising, in combination with a tube to be self-hooped, a mandrel for said tube, joint packings surrounding the mandrel and engaging the inner surface of said tube, a plurality of annular members surrounding said mandrel and having an exterior diameter less

than the interior diameter of the tube, means for conducting a fluid under pressure into the space between said mandrel, said tube, said annular members and said packings, and means for applying a pressure independent of the self-hooping pressure to said joint packings for preventing leakage of said fluid past said packings.

8. Apparatus of the class described comprising in combination, a mandrel adapted to be positioned in a tube to be self-hooped, said mandrel having a passage therein through which fluid may be introduced for applying a self-hooping pressure to the inner surface of said tube, joint means between the mandrel and tube, and means including a piston having an extending portion, the latter having engagement with said joint means, for applying a pressure independent of the self-hooping pressure to said joint means for preventing leakage of said fluid, the pressure area of said piston being greater than the sectional area of the extending portion in engagement with said joint means.

9. Apparatus of the class described comprising, in combination with a tube to be self-hooped, a pair of crossheads, tie rods connecting said crossheads, a mandrel in said tube having an opening therethrough for introducing a self-hooping fluid under pressure into said tube, packing surrounding said mandrel and having engagement with said tube, a cylinder secured to one of said crossheads, a piston provided with an extension in said cylinder, said extension having engagement with one of said packings and having a cross-sectional area less than the area of said piston, and means for introducing a fluid under pressure into said cylinder, said fluid being independent of the self-hooping fluid.

In testimony whereof I have signed this specification.

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