June 18, 1940. P. L. SCOTT 2,204,626

PUMP LINER

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Fig. 1.

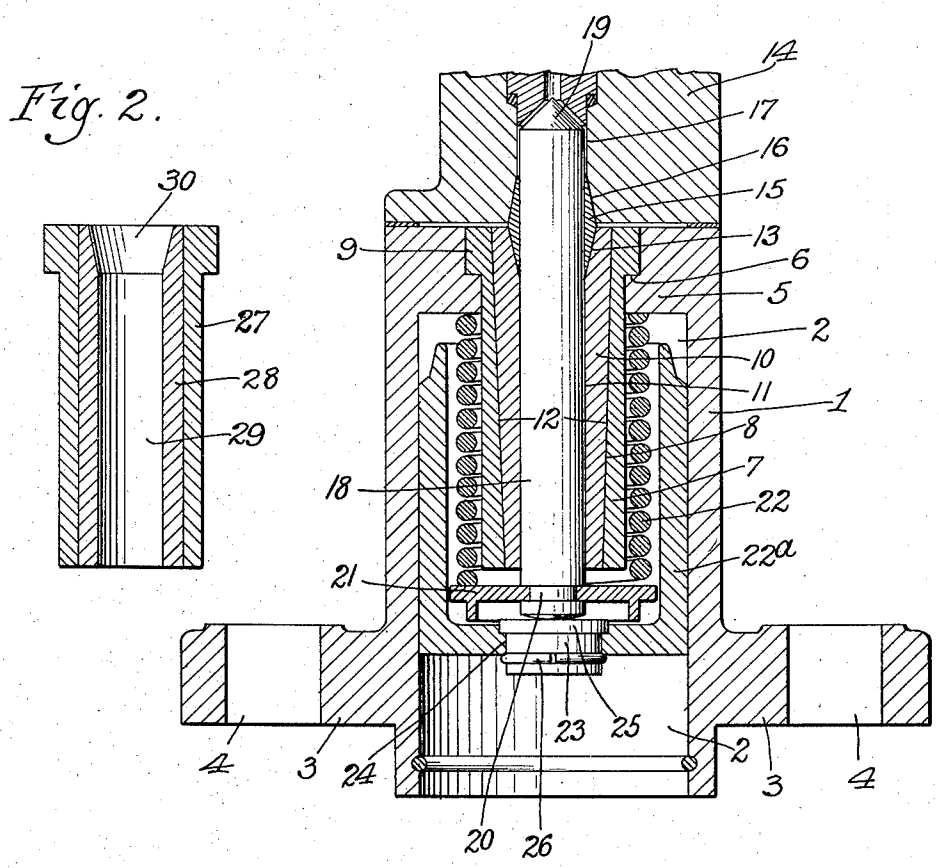


Fig. 2.

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PUMP LINER

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9 Claims. (Cl. 308—4)

This invention relates to the construction and the method of constructing a barrel in which a member is to reciprocate and in which tight fits are essential.

The invention may be embodied in many constructions. One for which it is particularly well suited comprises a pump. When embodied in a pump the invention includes the pump barrel which is formed of a liner and a jacket or outer member. The liner is perforated to receive a piston which may reciprocate within it. The invention is not limited in its application to a pump and where applied to a pump it is not limited to any particular form or construction of pump. Therefore, in the present drawing, which illustrates two forms of a pump barrel construction, only so much of the pump is shown as to indicate the general arrangement of the parts.

An object of the invention is to provide means whereby the pump liner is put under initial compression, that is to say, whereby it is compressed initially before use. Another object of the invention is to provide a pump barrel in which the tendency to distortion of the liner is overcome and in which any "growth" of the metal of the liner which occurs will be largely inwardly, tending thus to close the bore against the piston or plunger so that during the lift of the pump the bore does not grow larger and leakage is thus avoided.

Another object is to provide a method of manufacturing a pump or other barrel having the properties described.

Other objects will appear from time to time in the specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawing, wherein—

Figure 1 is a longitudinal section through a portion of a pump and pump barrel, illustrating one form of the barrel construction; and

Figure 2 is a similar sectional detail illustrating a modified form of barrel construction.

Like parts are designated by like characters throughout the specification and drawing.

1 is a portion of a pump housing which is provided with a cavity 2. The housing may have ears or other lateral projections 3, perforated as at 4 to receive fastening means by which the pump may be secured to any desired base. Adjacent its upper end the pump housing 1 is provided with an inwardly extending part 5 which partially closes the cavity 2 at that end. The portion 5 may be shouldered as at 6.

The barrel construction includes in general a plunger enclosing and guiding assembly including two parts, the first being a jacket or surrounding member 7 which is preferably provided with an inner tapered bore 8 and may have a laterally extending shoulder or flange 9 of such size as to be seated in the perforation or opening in the housing portion 5 and being seated also against the shoulder 6. The jacket or surrounding portion may be of any suitable material but is preferably of one strongly resistant to deformation, that is to say, more resistant to deformation than the liner. Frequently in practice the jacket member may be of steel.

In the form of the invention illustrated in Figure 1 a liner 10 is provided. This liner has a cylindrical bore 11 and its exterior is tapered as at 12, the taper corresponding to the taper 8 of the jacket 7. While the liner need not be of the same length as the jacket 7 it frequently is. The liner may also be flared adjacent one end as at 13 to receive a sealing or joint-making member in a manner which will shortly be described.

In the form illustrated in Figure 1, 14 is a second housing portion co-operating with the housing portion 1 in the formation of a complete pump housing. A sealing member 15 is positioned partly in the flared portion 13 of the liner 10 and partly in a flared portion 16 made at one end of the cavity or bore 17 within the housing section 14. The details of the pump housing need not further be described and no description of the passages to and from the pump is necessary because the barrel of the present invention may be applied to almost any type of pump, or in fact to almost any construction in which a member reciprocates within a barrel.

In the form shown in Figure 1 a piston 18 is provided which fits tightly within the bore 11 of the liner 10. This piston or plunger may be of any desired shape but in the form shown has a generally conical point 19. The plunger may be reciprocated by any desired means. As shown, however, the end of the plunger opposite the tapered end is rounded and adjacent this end there is formed an annular groove 20 into which is received a spring-retaining plate 21. A spring 22 surrounds the barrel, bears at one end against the portion 5 of the pump housing section 1 and bears at the other end against the plate 21. A cross head 22a is mounted within the cavity 2 of the housing section 1 for reciprocation. It surrounds the plunger, barrel and spring assembly above described. It may carry a contact member 23 which fits within a perforation 24 in

its bottom. This member in the form shown in Figure 1 is flanged as at 25 to fit against a corresponding shoulder formed in the bottom of the cross head. A spring 26 is sprung into a corresponding groove in the exposed end of the member 23 to hold it in place. The rounded head of the plunger 18 contacts the opposing surface of the member 23. It will be understood that the cross head may be reciprocated by any mechanism. It moves upward in the form shown in Figure 1 to compress the spring 22 and to force the plunger inwardly. When the spring is free for reverse movement it forces the cross head and plunger downwardly.

In manufacture the materials chosen may be for the liner a relatively soft material such as cast iron and for the jacket or sleeve surrounding it a relatively harder material such as steel. However, a liner and sleeve assembly can be made satisfactorily where both materials are of the same hardness. The "closing up" which occurs when the sleeve is compressed on the liner either by being driven on in the tapered form or by being shrunk or pressed or otherwise tightened about the liner, may occur where both materials are of the same hardness or have the same modulus of elasticity. In normal practice it is preferable to make the liner of a material having a greater modulus of elasticity than that of the sleeve but where it is desired the sleeve and liner may have similar or identical moduli of elasticity.

Cast iron has been spoken of as a suitable liner. Experience in the art of pumps has shown it to be a suitable material for many reasons. Experience has also shown that cast iron changes both its shape and size in the course of time. This effect is sometimes called "growth" or warpage and forms a serious objection to the use of the material as a liner for the barrel of a pump or other analogous device, and it is particularly objectionable where cast iron is to be used as a pump barrel for fuel pumps where relatively high pressures prevail. In those forms of the present device in which cast iron is used it is selected for its many advantageous qualities, among which are good bearing qualities, good wearing qualities and good machining qualities.

The liner, whether it be of cast iron or of other suitable material is made to approximately suitable shape and is then inserted in a sleeve or jacket of a material of high tensile strength. The two parts may be assembled by means of the taper fit shown in the form of Figure 1, the liner being forced into the tapered jacket or sleeve, producing a press fit and the liner is actually driven into the taper farther than it would readily go. This press fit produces a tension in the sleeve or jacket 7 and a corresponding compression in the liner 10 and preferably this compression will be made greater than the hydrostatic or other load which may be applied in use internally to the liner.

In the form of the device shown in Figure 2, a retaining sleeve or jacket 27 is used. Its outer shape and contour are essentially the same as that of the sleeve 7. Internally it is not tapered, however, and it is provided with a cylindrical bore. The liner 28, which fits within it, also is not tapered on its exterior. Interiorly it has a bore 29 which is preferably flared outwardly as at 30 for the reason above described in connection with the flare 13 in the liner 10. In the manufacture of the form of the device shown in Figure 2, the liner, which may be of cast iron or other suitable material, is fitted and positioned within the sleeve 27 which may be of steel or other material of high tensile strength with a shrink fit or a press fit or otherwise, so that tension is produced in the sleeve and compression in the liner. The results of this form of construction are generally the same, therefore, as those of the form of Figure 1 and the effect of each is to produce a compression of the liner before use and to produce a construction in which "growth" or other change in the shape or size of the liner cannot occur to as great an extent outwardly and cannot result, therefore, in an enlargement of the bore, and any such growth which may occur will be largely inward and largely radially, thus tending to close the bore against the plunger, compensating for wear and counteracting the normal tendency of such liner material to grow outwardly and to move away from the plunger and thus to produce leakage.

Heretofore an accurate mating between a plunger and barrel in a packingless pump, that is too say, in which the main sealing effect is obtained by the nicety of fit between a plunger and barrel of relatively hard materials rather than by soft and easily compressible materials, has proved a very serious problem. General practice has involved hand lapping operations to extreme accuracies which has proved both costly and required excessive amounts of time. This is because no way has previously been known to handle these hard materials except by some form of cutting or abrasion. My invention overcomes this difficulty in that even though the materials are hard they do have slight elasticity and I am taking advantage of this slight elasticity to change the size a minute amount which, however, is sufficient to produce the desired fit.

I claim:

1. In combination in a pump having a barrel and a piston, a multi-part barrel having a cylindrical bore, adapted to receive a piston, one of said parts comprising a unitary, ferrous liner, a second part situated outside of said liner and acting thereupon, said second part being fixed with relation to said liner during pump operation and exerting a predetermined degree of initial compression upon said liner said compression reducing the diameter of the bore of said liner in minute amount and causing it to fit and mate with the plunger to microscopic accuracy and producing stresses within the material of said liner which stresses are well within the elastic limit of the material used.

2. In combination in a pump having a barrel and a piston, a multi-part barrel having a cylindrical bore, adapted to receive a piston, one of said parts comprising a unitary liner formed of hard metal, a second part situated outside of said liner and acting thereupon, said second part being fixed with relation to said liner during pump operation and exerting initial compression upon said liner and producing stresses within the material of said liner, said compression causing within the material of said liner stress greater than that produced therein by internal loading during normal operation of the pump.

3. In combination in a pump having a barrel and a piston, a multi-part barrel having a cylindrical bore, adapted to receive a piston, one of said parts comprising a unitary liner, and being formed of a relatively hard material having a tendency to "grow", a second part situated out-

side of said liner and acting thereupon, said second part being fixed with relation to said liner during pump operation and exerting initial compression upon said liner and producing stress within the material of said liner.

4. In combination in a pump having a barrel and a piston, a multi-part barrel having a cylindrical bore, adapted to receive a piston, one of said parts comprising a unitary liner and being formed of a relatively hard, ferrous material having a tendency to "grow", a second part situated outside of said liner being fixed with relation to said liner during pump operation and acting thereupon to compel said "growth" to occur largely inwardly, said second part exerting initial compression upon said liner and producing stress within the material of said liner.

5. In combination in a pump having a barrel and a piston, a multi-part barrel having a cylindrical bore, adapted to receive a piston, one of said parts comprising a unitary liner formed of relatively hard metal and being exteriorly tapered, a second part correspondingly interiorly tapered situated outside of said liner and acting thereupon, said second part being fixed with relation to said liner during pump operation and exerting initial compression upon said liner and producing stress within the material of said liner.

6. In combination in a pump having a barrel and a piston, a multi-part barrel having a cylindrical bore, adapted to receive a piston, one of said parts comprising a unitary liner formed of relatively hard metal and being exteriorly tapered, a second part correspondingly interiorly tapered situated outside of and in contact with said liner and acting thereupon, said second part being fixed with relation to said liner during pump operation and exerting compression initially upon said liner and producing stress within the material of said liner.

7. In combination in a pump having a barrel and a piston, a multi-part barrel having a cylindrical bore, adapted to receive a piston, one of said parts comprising a liner of one modulus of elasticity, a second part situated outside of said liner and acting thereupon, said second part being fixed with relation to said liner during pump operation and having a lower modulus of elasticity than said liner and exerting compression upon said liner and producing stress within the material of said liner.

8. In combination in a pump having a barrel and a piston, a multi-part barrel, one of said parts comprising a liner, a second part situated outside of said liner and acting thereupon, said second part exerting compression upon said liner and producing stress within the material of said liner, said liner being of a material having a greater modulus of elasticity than that of the outer member of the barrel.

9. In combination in a pump having a barrel and a piston, a multi-part barrel, one of said parts comprising unitary a liner formed of relatively hard iron, a second part formed of relatively harder steel situated outside of said liner and acting thereupon, said second part exerting compression initially upon said liner and producing stress within the material of said liner.

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