Nov. 5, 1940. H. GRAD 2,220,822

PUMP PLUNGER

Filed July 24, 1939

FIG. 1.

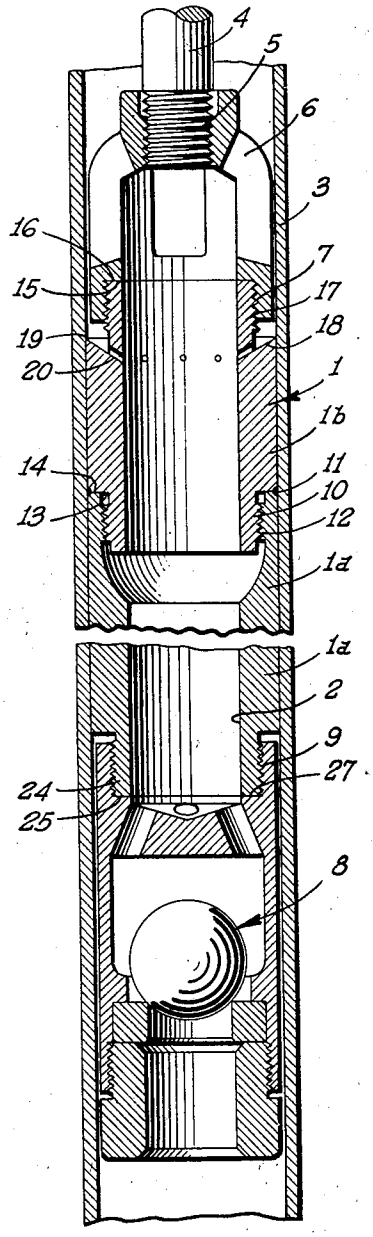


FIG. 2.

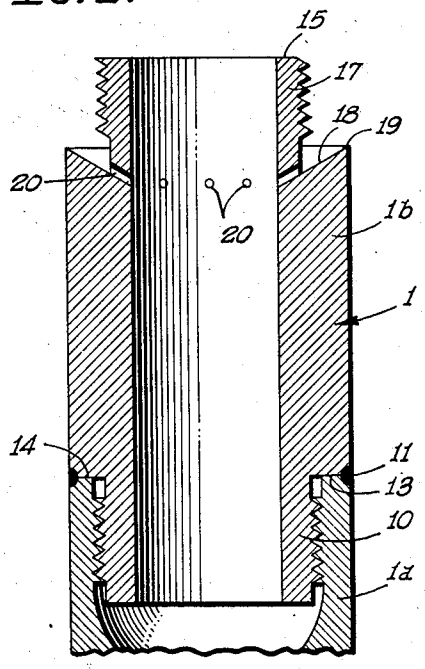
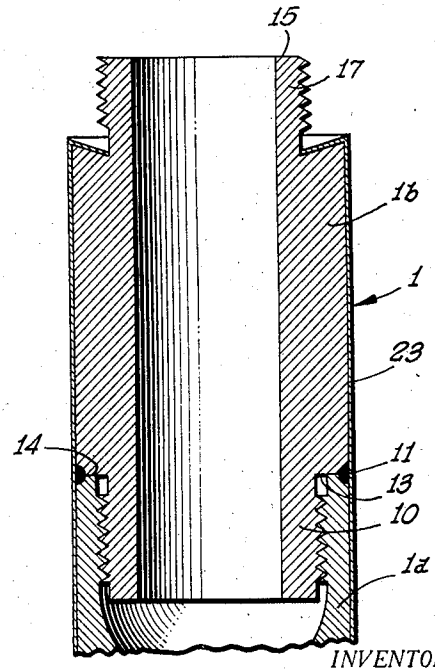


FIG. 3.



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PUMP PLUNGER

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3 Claims. (Cl. 103—225)

My invention relates to pump plungers and methods of constructing the same and has particular reference to the construction of deep well pumps of the type in which an elongated metallic plunger is adapted to so closely fit its working barrel or liner as to form a fluid-tight seal therewith without the necessity of employing cups, rings or other packing interposed between the plunger and the liners.

In deep well pumps of the type to which my invention relates, it is the common practice to construct a plunger from a suitable length of metal tubing which is carefully machined or ground throughout its length to fit snugly within the barrel or liners employed in the pump so that throughout substantially the entire length of the metal plunger the space between the walls of the plunger and the liner is just such as will permit the ready reciprocation of the plunger in the barrel. Considerable difficulty has been heretofore encountered in constructing plungers of this type, particularly since the ends of the plunger to which working valves, valve pullers, adaptors or connectors by which the sucker rods are coupled to the plunger tend to expand radially when such attachment devices are coupled thereto.

Heretofore it has been the practice to form a female coupling member at one or both ends of the plunger and to provide male coupling members upon the valves or other attachments to be secured thereto. When the attachments are screwed up tight, the effect of the forces exerted between the cooperating threads of the coupling members is to produce radial forces tending to enlarge the plunger end, frequently causing the plunger to become so large as to bind or gall within the barrel or liner in which it works.

An effort has been made to overcome this difficulty by undercutting or reducing the diameter of the plunger tube or cylinder at its ends, the amount of such reduction being calculated to be sufficient that when the attachments are screwed on the expansion will just bring the plunger ends outwardly to the correct diameter to fit the barrel. While this practice may be satisfactory for shop assembly, when the attachments are removed and replaced in the field there is no assurance that the same degree of force will be exerted in tightening the attachments and the injurious expansion of the plunger ends may occur. Thus when the plunger is again put in service, it may fit so tightly within the barrel or liner as to score or injure either the plunger or the liner or both.

Moreover, in deep well pumps of this character the fluids handled frequently carry sand, grit or like substances which precipitate out of the liquid and which tend to accumulate on the surface of the pump barrel or liners. Unless the plunger end accurately fits the bore of the liners such debris will wedge between the plunger and liner, resulting in injury or destruction of the plunger or liner or both. If, on the other hand, the plunger end accurately fits the liner, the accumulations will be scraped loose upon each stroke of the plunger and damage will be avoided.

Again, as is well known, the greater portion of the wear of plungers in this type of pump occurs at the extreme ends of the plungers and it has heretofore been the practice to construct the plungers throughout of expensive material having the necessary hardness and wear resistant qualities to provide against the undue wear of the plunger ends.

It is therefore an object of my invention to provide a pump plunger wherein the body portion of the plunger may be constructed of any suitable inexpensive material sufficient merely to carry the loads imposed upon it and to present reasonably accurate outer surfaces to the barrel or liners, and in which the plunger ends are formed from separate pieces of metal especially selected for hardness and wearing qualities.

Another object of my invention is to provide a plunger construction of the character set forth in the preceding paragraph wherein the plunger body and its ends may be separately constructed, assembled in the shop, permanently secured together and then accurately machined or sized so as to fit within a selected pump liner diameter.

Another object of my invention is to provide a plunger of the character set forth wherein the plunger ends are provided with male coupling members to which female coupling members of attachments may be secured to thereby obviate radial expansion of the plunger ends with its attendant disadvantages.

Another object of my invention is to provide a plunger construction wherein the ends of the plunger may be constructed separately from the body of the plunger and permanently secured thereto, and in which the metal which may be expanded out or splayed out at the junction between the plunger body and the ends is subsequently dressed down to provide a diameter at that point which is uniform with the diameter of the plunger body and plunger ends.

Another object of my invention is to provide a construction of the character set forth wherein the ends of the plunger, being selected particu-

larly for their hardness and wear resistance, may be effectively employed to cut or scrape sand or other accumulations from the liners upon each stroke of the plunger.

Other objects and advantages of my invention will be apparent from a study of the following specifications, read in connection with the accompanying drawing, wherein:

Fig. 1 is a vertical sectional view taken from a typical deep well pump and illustrating my new form of plunger associated therewith;

Fig. 2 is a fragmentary vertical sectional view of one end of a plunger constructed in accordance with my invention; and

Fig. 3 is a fragmentary vertical sectional view of a modified form of plunger constructed in accordance with my invention.

Referring to the drawing, I have illustrated a plunger 1 which may be formed from a suitable tubular piece of metal having an internal passage or bore 2 extending therethrough and through which liquids to be pumped may pass. The external wall of the plunger 1 is accurately machined, ground or otherwise sized to fit accurately within a pump barrel 3 or, as will be understood by those skilled in this art, within suitable accurately sized liners employed within the barrel or jacket of the pump.

Reciprocation of the plunger 1 within the barrel or liner 3 may be accomplished in the usual manner as by connecting a string of sucker rods (not shown) to a pump rod 4 extending into the barrel of the pump and threadedly connected, as indicated at 5, to the upper end of an adapter 6 which is in turn provided with a female threaded coupling member 7 to which the upper end of the plunger 1 is secured.

The form of pump illustrated in Fig. 1 includes a working valve 8 at the lower end of the plunger 1 threadedly secured thereto, as indicated at 9, though it will be understood by those skilled in this art that working valves may be provided at either the upper or lower end of the plunger as may be desired.

The plunger 1 is illustrated as being constructed of a body portion 1*a* which may be formed from a suitable tubular length of material such as cast iron or other relatively inexpensive material while a separate end portion 1*b* may be provided upon either or both of the ends of the body portion to constitute the plunger ends. The plunger ends 1*b* may be constructed from special steels having the special characteristics of hardness and resistance to wear under the conditions encountered in the pumping of deep wells, the plunger ends representing in effect a relatively short nipple or bushing which is permanently attached to the less expensive body portion 1*a* and hence the whole unit can be economically constructed.

The preferred manner of producing the composite plunger 1 is to form the body portion of the desired wall thickness and to counter-bore the ends thereof to receive a male coupling member 10 formed upon and extending from the plunger end 1*b*. The male coupling member on the plunger end 1*b* may then be inserted into the counter-bored portion of the body 1*a* and permanently secured thereto by any suitable means such as welding indicated at 11.

While the counter-bore in the plunger body may be smooth and form a press fit with a smooth surfaced male coupling 10 on the plunger end 1*b*, I prefer to provide threads 12 upon the counter-bore and the coupling member 10 so that there is a mechanical interconnection of the plunger body and plunger end independent of the welding at 11. The shoulder 13 formed on the plunger end 1*b* at the junction between the normal diameter of the plunger end and the reduced coupling member 10 constitutes an abutment against which the upper end 14 of the plunger body may bear so that if upon tightening the plunger end upon the body any radial expansion of the metal occurs at the junction between the plunger body and plunger end, such enlargement of the diameter at this point may be dressed down in order to insure that the diameter at this point will be uniform with the normal diameter of the plunger body and plunger end, such dressing down or sizing also removing any excess metal at this point which may result from the welding operations.

While I prefer to employ welding as the means for permanently joining the plunger body and ends together, it will be apparent that other ways of permanently securing the members may be employed, such as by riveting the two adjoining sections or portions of the plunger together, peening the material of the plunger or body into annular recesses provided upon them for this purpose or by corroding the contacting portions of the plunger body and plunger ends until a permanent adherence is produced.

The primary consideration is that the plunger end and body portions should be permanently secured together so as to preclude possibility of separation and rejoining thereof in the field.

The plunger end 1*b* is provided at its upper end with a reduced diameter portion 17 which is threaded to form a male coupling end to which the adaptor 5 or other attachment may be secured. The male coupling member 17 so provided permits the tightening down of the attachment members upon the plunger until the shoulder 15 on the coupling abuts the internal shoulder 16 on the attachment, thus avoiding expansive forces which tend to expand or enlarge the diameter of the plunger end. The attachments may then be readily taken off or put on to the plunger in the field without danger of deformation of the plunger with its attendant injurious results.

It should be noted that employing my construction of a plunger end 1*b* formed of hard wear-resistance material and provided with the reduced diameter portion necessary to provide the male coupling end on the plunger permits the plunger end 1*b* to operate effectively for a scraper for removing sand or other accumulations which may cling to the interior of the barrel or liner. The shoulder 18 formed between the main and reduced diameters of the plunger end may be angled downwardly, as indicated particularly in Fig. 2, to provide a cutting or scraping edge 19 which, by reason of the hardness and wear-resistant characteristics of the plunger end, will be maintained relatively sharp and effective throughout a long period of operation. In constructions in which the working valve is located at the lower end of the plunger, the sand or debris scraped off by the scraping edge 19 may be effectively disposed of by providing a plurality of flushing holes 20 which communicate with the internal bore of the plunger and through which any loosened accumulations may be washed.

It has recently become the practice to provide hard surface coatings upon plungers and coatings such as chromium plating or similar material may be readily applied to a plunger of my composite construction, the very characteristics

of hardness and wear resistance for which the plunger end members 1b are selected providing the most desirable backing for such chromium plating since it is well known that the harder the body material upon which the chromium plating is applied, the more permanent and wear resistant such plating surface will be. In Fig. 3, I have illustrated such chromium plating or other hard surface coating 23 as being applied to the composite plunger after the plunger has been completely assembled and correctly sized, the chromium plating along the end portion 1b providing a harder and more wear resistant surface at that point than at any other point along the plunger. Thus the advantage of the hard underlying material for the chromium plating may be provided while the advantage of the male coupling end on the plunger of avoiding radial expansive forces is achieved, obviating the cracking or injuring of the relatively thin chromium coating on the plunger end that would ensue if a female coupling member were employed.

Providing the composite plunger of the character set forth also has the advantage of providing for less waste space within the barrel since the plunger end section 1b, constituting an effective part of the plunger, dispenses with the present necessity for employing adapters interposed between the ends of the plunger and the attachment members to be associated with the plunger and allows a closer coupling of the effective portion of the plunger and these attachment members. Thus the overall length of the plunger and attachment assembly is shortened, providing for an increase in the effective length of stroke with a given length of barrel.

While for purposes of simplicity of illustration, I have shown the separately formed end section 1b as applied only to the upper section of the plunger 1, it will be understood by those skilled in this art that an identically separate end portion may be employed at the lower end of the plunger. On the other hand, it may be desired to merely reduce the diameter of the lower end of the plunger body 1a to form a male coupling member 24 at that end of the plunger to which working valves or other attachments may be secured, the extreme lower end of the reduced diameter portion of the plunger body 1a forming an abutment shoulder 25 against which internal shoulders 27 on the attachment devices may abut. Thus the tightening of such attachments at the lower end of the plunger will not produce forces tending to radially expand or enlarge the lower end of the plunger.

It will therefore be observed that I have provided a new plunger construction wherein the body portion of the plunger may be formed of any desired inexpensive material and in which the ends of the plunger may be peculiarly designed and constructed of materials most desirable to resist wear and to provide male coupling members by which attachments may be secured to the plunger.

While I have shown and described the preferred embodiment of my invention, I do not desire to be limited to any of the details of construction shown or described herein, except as defined in the appended claims.

I claim:

1. A pump plunger for use within an accurately sized bore in the barrel of a pump, the combination of an elongated tubular plunger body constructed of one material sized to make a sealing fit within the bore of said pump, a tubular plunger end member constructed of a different material selected for hardness and wear resistance and sized to make a sealing fit within the bore of said pump, a male coupling member of reduced diameter formed upon one end of said plunger end member for reception in a female coupling member of an attachment, and means permanently securing the other end of said end member to said plunger body.

2. A pump plunger for use within an accurately sized bore in the barrel of a pump, the combination of an elongated tubular plunger body constructed of one material sized to make a sealing fit within the bore of said pump, a tubular plunger end member constructed of a different material selected for hardness and wear resistance and sized to make a sealing fit within the bore of said pump, means permanently securing said end member to said plunger body, a male coupling member of reduced diameter formed upon the free end of said plunger end member for reception in a female coupling member of an attachment, said male coupling member being of a length in excess of the length of the female coupling member of said attachment to provide an annular recess at the shoulder formed at the junction of the two diameters of said plunger end, and relief ports extending through said plunger end to the interior thereof and communicating with the exterior thereof at said shoulder.

3. A pump plunger for use within an accurately sized bore in the barrel of a pump, the combination of an elongated tubular plunger body constructed of one material sized to make a sealing fit within the bore of said pump, a tubular plunger end member constructed of a different material selected for hardness and wear resistance and sized to make a sealing fit within the bore of said pump, means permanently securing said end member to said plunger body, a male coupling member of reduced diameter formed upon the free end of said plunger end member for reception in a female coupling member of an attachment, said male coupling member being of a length in excess of the length of the female coupling member of said attachment to provide an annular recess at the shoulder formed at the junction of the two diameters of said plunger end, said shoulder sloping inwardly and downwardly from the periphery of said plunger end, and relief ports extending through said plunger end to the interior thereof and communicating with the exterior thereof at said shoulder.

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