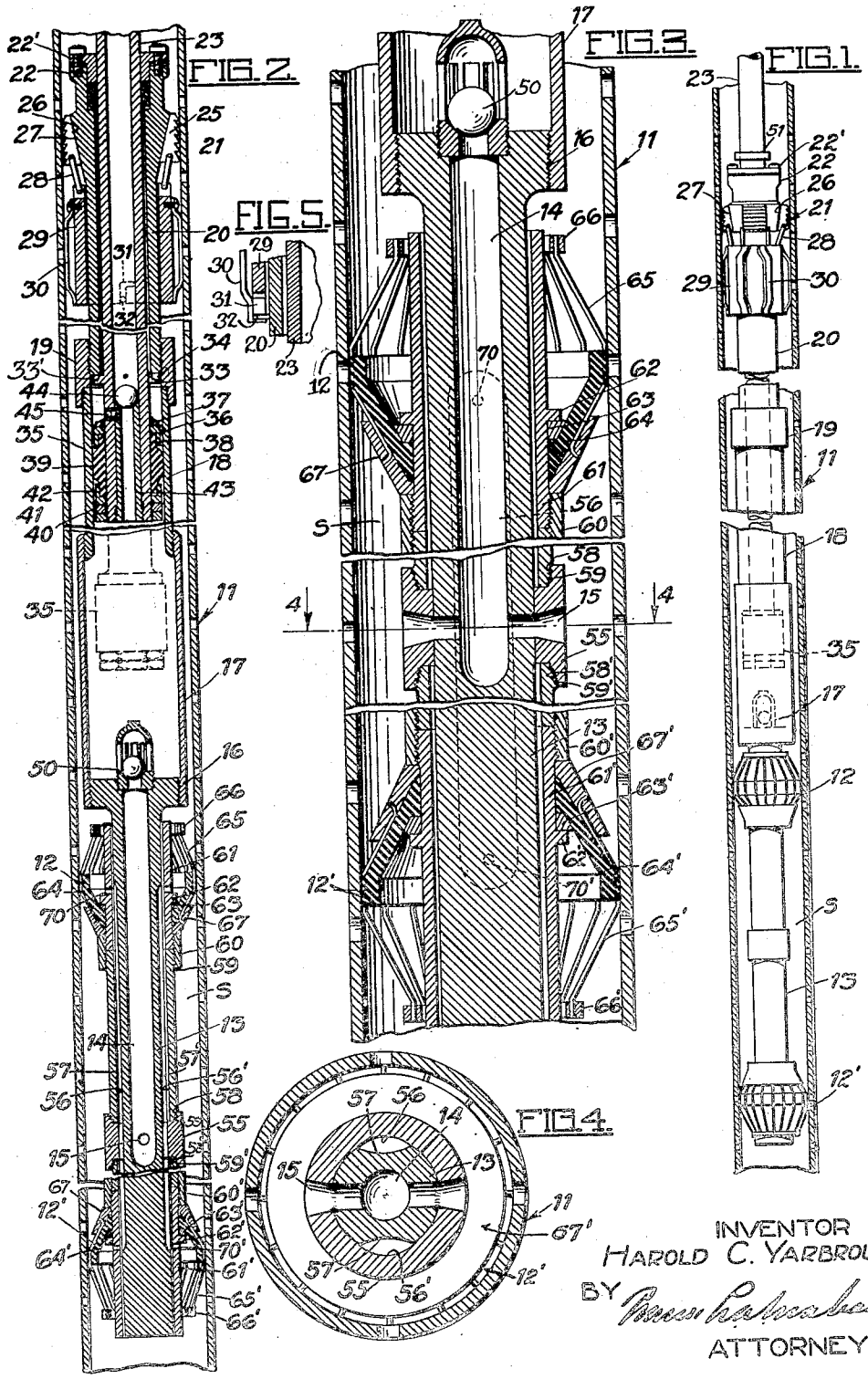
July 4, 1933. H. C. YARBROUGH 1,916,875

COMBINATION WELL CLEANER AND PUMP

Filed Feb. 12, 1932



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Patented July 4, 1933 1,916,875

UNITED STATES PATENT OFFICE

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COMBINATION WELL CLEANER AND PUMP

Application filed February 12, 1932. Serial No. 592,576.

This invention has to do in a general way with cleaning devices and is more particularly related to devices for cleaning and reviving wells. The device contemplated by this invention is especially adapted for use in cleaning oil wells where the fissures or interstices in the formation and the perforations in the strainer casing frequently become clogged with sand, tar and the like, with a consequent restriction of the flow of the oil into the casing, reducing the production flow and impairing the producing efficiency of the well.

It is well known to those familiar with petroleum production methods that an oil well contains an imperforate casing which extends down to the oil producing sand or zone where it is attached to what is known as a strainer casing. This casing is similar to the first mentioned casing, except for the fact that it is provided with slots or perforations through which the oil is forced into the casing from the surrounding sand by the rock pressure.

It is a theory, regarding the action of this strainer casing, that the continued movement of the oil and gas from the formation into the casing, forms channels or fissures in the oil formation adjacent these perforations. After the well has been flowing for some time and the natural gas pressure begins to diminish, there is a tendency for sand, asphaltic bodies and tar to accumulate in these fissures and also to clog the slots or perforations in the strainer casing, and it is the cleaning of slots clogged in this manner and the reopening of fissures, which are filled in the manner described above, which constitutes the fundamental object of this invention.

I am aware of the fact that attempts have been made to accomplish the results outlined above by applying high pressure within the strainer casing. The results of such efforts have not been at all satisfactory due to the fact that the pressure applied must necessarily be much greater than the natural rock pressure surrounding the strainer casing, and the foreign material contained in the slots or perforations is merely forced out into the fissures, and as soon as the pressure is withdrawn, the natural gas pressure in the well forces this material back into the perforations, or it remains clogging the interstices or fissures preventing the inflow of oil and gas.

It is the primary object of this invention to produce a device of simple form and construction which may be used in conjunction with the standard or conventional oil well equipment and which is constructed in a manner such that the natural rock pressure and the hydrostatic pressure in the well is utilized to assist in clearing the fissures and cleaning the strainer casing perforations. In this manner the foreign material, such as sand, tar, asphaltic bodies and the like, is drawn into the well tubing and expelled from the well so that the strainer casing and the adjacent formation is left clear of all such material.

These objects are accomplished by the sudden application of a high vacuum or suction to a confined and limited area of the strainer casing. It is a noteworthy feature of the preferred form of my invention that the weight of the well tubing is utilized to operate the piston which creates this suction. It is a further noteworthy feature of this invention that the mechanism contemplated thereby is releasably supported within the casing so that it may be easily adjusted from the surface of the ground to clean any desired area of the strainer casing within the well.

In addition to the feature of providing an effective and efficient strainer casing cleaner, the mechanism contemplated by this invention may advantageously be operated as a pump in which event the suction is not necessarily applied to a confined area of strainer casing but may be applied in a manner similar to an ordinary pump. When used as a pump the sudden application of a violent suction to the oil in the strainer casing maintains clearance in the perforations and fissures and prevents clogging over a much greater period of time than the conventional type of pump in which the suction is gradually applied.

The details in the construction of a pre-

ferred form of my invention, together with other objects attending its production, will be best understood from the following description of the accompanying drawing, which are chosen for illustrative purposes only, and in which—

Fig. 1 is an elevational view partly broken away showing a strainer casing with a preferred form of my invention suspended therein;

Fig. 2 is a sectional view illustrating the details in the construction of the device shown in Fig. 1;

Fig. 3 is an enlarged section of the packing mechanism taken in a plane at right angles to the section plane of Fig. 2;

Fig. 4 is a plan section which may be considered as having been taken in a plane represented by the line 4—4 in Fig. 3.

Fig. 5 is a fragmentary section taken through the bayonet joint shown in Fig. 2.

More particularly describing the invention as herein illustrated, reference numeral 11 indicates a strainer casing of the type ordinarily suspended in the lower end portion of an oil well which is shown as containing a device of the type contemplated by this invention.

As was pointed out in the early part of this specification, the device contemplated by this invention is designed to apply a sudden and violent suction to predetermined areas within the strainer casing, such areas being of limited proportions.

The area to be acted upon is confined by a pair of spaced packing members which may be in the nature of swab cups or other suitable packing means, which are indicated by reference numerals 12 and 12′, such means being supported by what I may broadly term a mandrel member generally indicated by reference numeral 13.

The mandrel is provided with a passage 14, through which suction is applied to the space confined by the packing members 12 and 12′ through an opening or openings indicated by reference numeral 15.

The upper end portion of the mandrel is secured at 16 to what I may term an expansion barrel 17, which in turn is secured at its upper end to a plunger barrel 18 and the plunger barrel is secured through a bushing 19 to a suspension sleeve 20.

The entire unit is releasably supported within the strainer casing 11 by means of a slip mechanism indicated generally by reference numeral 21.

The upper end portion of the suspension sleeve 20 is provided with a packing gland 22 secured therein in any suitable manner, such as by means of a clamping bushing 22′, and this gland slidably receives a tubing section 23 which is secured at its upper end to an ordinary pump tubing, not shown.

As was mentioned above, the slip mechanism may be of any preferred type, but is shown as comprising a plurality of serrated slips 25 which have tapered inner surfaces 26 adapted to engage a corresponding tapered surface 27 on the upper end of the suspension sleeve.

These slips are secured through the medium of toggle links 28, to a slip control sleeve 29 which has a plurality of spring members 30 provided on its outer surface so as to frictionally engage the interior of the strainer casing.

This slip control sleeve 29 is provided with a bayonet slot 31 which is adapted to slide over a pin 32 formed on the outer surface of the suspension sleeve 20.

The inner surfaces 26 of the slips are provided with dovetail slots not shown) adapted to be received in corresponding projections on the outer surface 27, or vice versa, so that the slips are always held in close engagement with the tapered surface on the suspension sleeve, and the arrangement of the bayonet slot and pins 31 and 32 is such that when the pin 32 is in the offset portion of the bayonet slot the slips are held in a position such that they will not engage the interior of the strainer casing. However, when the tubing is rotated, such rotation is effective through the notch 33 formed in a flange 33′ on the tubing 23 and boss 34 which extends downwardly from the lower edge of the sleeve 20 to rotate the suspension sleeve 20, so that the pin is brought into registration with the longitudinal portion of the slot, the tubing and its associated parts may move downwardly relative to the slip control ring 29 which is held in position by the spring members 30, such downward movement being effective to force the slips 25 out into engagement with the interior of the strainer casing so that the entire unit is supported by the slips. As pointed out above, this is merely a preferred form of construction which lends itself to the particular form of tool as shown herein, and may be modified or varied without in any way changing the scope of my invention.

For the purpose of applying suction to a limited or confined area in the strainer casing, I provide on the lower end portion of the tubing 23 a piston member 35 which is shown as comprising an upper collar 36 slidably mounted on the lower end portion of the piston tubing so as to engage a ring or boss 37 which is either formed or welded on the tubing. The collar 36 is provided with a downwardly extending skirt 38 which projects downwardly over an upper reduced portion of a centrally expanded rubber or composition piston or packing member 39. The packing member is forced into place by a nut 40 which engages a sleeve 41, such sleeve having a skirt 42 which encloses the lower reduced end portion of the member 39.

The interior of the tubing is provided with

a short pipe section 43, the upper end portion of which extends above the upper edge of the piston unit and has formed thereon a seat for a ball valve 44.

Reference numeral 45 indicates an inwardly operating check valve provided to drain the fluid from the upper portion of the plunger barrel back into the lower portion thereof during an upper stroke of the piston, as will be hereinafter more completely described.

In addition to the feature of applying suction to a limited or confined area in the strainer casing, I have found that the sudden and violent application of such suction is extremely important to the accomplishment of the desired results.

The expansion barrel or fluid receiving chamber 17 is provided for accomplishing this result and it will be noted that this barrel is of greater diameter than the plunger barrel 18, so that the piston as it moves downwardly through the elongated working barrel or suction chamber 18, creates a high vacuum which is suddenly and violently released as the plunger or piston enters the fluid receiving chamber or expansion barrel. The release of this vacuum is effective to create a suction through a valve 50 into the passage 14 which is effective to suddenly evacuate the confined space between the packing members 12 and 12′, such evacuation being accompanied by a rush of oil, gas, etc., through the perforations of the strainer pipe, thus cleaning the perforations and clearing the fissures adjacent thereto. The majority of material thus entering the space "S" between the packing members is drawn by the high vacuum in the expansion chamber 17 and the barrel 18 up through the valve 50, rising through the expansion chamber and into the barrel. As the tubing is drawn upwardly, following this operation, the plunger, as it enters the barrel, operates as a pump to draw all of the material which has entered the space "S" into the chamber 17 where it is held by the valve 50. Any material which has entered barrel 18, prior to the entrance of the plunger, is lifted upwardly through the barrel and is forced through the check valve 45 back into the expansion chamber. On the next down stroke, all of the material in the barrel 18 and the expansion chamber 17 is forced through the valve 44 into the tubing 23 where it may either be pumped from the well, if the operation is continued over a sufficiently long period of time, or may be withdrawn from the well with the tubing.

The reciprocating operation just described, may be carried out by attaching the tubing to the walking beam, but is preferably effected by attaching the tubing to the blocks and coupling mechanism ordinarily provided on the derrick structure. In actual operation, the device is lowered to, what the driller knows to be, the lower end portion of the strainer casing, and is given one or more strokes of the type just described. The operator knowing the length of the stroke of the barrel can easily control the operation at the surface of the ground, but to prevent the inadvertent engagement of the bottom of the expansion barrel by the piston, I provide a stop 51 on the tubing above the packing gland, as shown in Fig. 2. The device, after each "pumping" step is raised by lifting the tubing a distance corresponding to the distance between the two packing members, and the operation is then repeated and so on until the full length of strainer casing has been cleaned.

It will be understood that various types of construction may be followed in the assembly of the packing unit and that the conventional type of packers may be used therein at 12 and 12′. It is important, however, in order to facilitate the downward movement of the unit into the well, that means be provided for by-passing any fluid which is in the casing, around or through the packing unit. In order to accomplish this, I prefer to construct the packing unit by mounting a bushing 55 at an intermediate point on the mandrel, the opening or openings 15 being drilled through both the bushing and the mandrel into the passage 14.

The construction of this bushing is best illustrated in Figs. 3 and 4, where it will be noted that the bushing is provided with a pair of diametrically disposed channels or grooves 56 and 56′ which are offset relative to the opening 15. These grooves correspond with another pair of channels 57 and 57′ which are milled in the outer surface of the mandrel and extend throughout its length to points within the swab cups or packing members.

The bushing 55 is secured to the mandrel in any suitable manner such as by welding along its four edge portions adjacent the mandrel and along the joining line in the passage 15 which extends through both the bushing and the mandrel. The two opposite ends of the bushing are provided with internal threads indicated by reference numerals 58 and 58′ and these threads are in engagement with threaded end portions of the sleeves or nipples 59 and 59′.

The sleeves or nipples 59 and 59′ have their outer ends threaded for reception in collars 60 and 60′, which in turn engage sleeves 61 and 61′, which support the packing members 12 and 12′.

The sleeves 59 and 59′ are provided with stop rings 62 and 62′ which are welded or otherwise secured thereon, and are adapted to be engaged by cup retaining rings 63 and 63′. In the construction shown the packing cups are indicated at 64 and 64′. These cups are made of a resilient material and are adapted to be held against unlimited outward movement by retaining wires 65 and

65′, such wires having their outer ends secured in a guide ring 66 or 66′. The cups are clamped into position by means of clamping cups 67 and 67′ which are forced into pressure engagement with the cups 64 and 64′ by the collars 60 and 60′. The clamping cups 67 and 67′ also comprise the means for holding the inner ends of the retaining wires 65 and 65′.

The packer just described is a conventional type of packing or swab cup and the details in its construction comprise no part of this invention, it being understood that various other structures may advantageously be used to form the confined space or chamber contemplated by this invention.

I consider it preferable to make the internal diameter of the sleeves or nipples 59 and 59′ and 61 and 61′ slightly greater than the external diameter of the mandrel so as to cooperate with the channels 56 and 56′ in the mandrel to form a by-pass or free passage for fluid in the casing as the unit is being lowered into position.

In order that there will be no fluid accumulation in the cups during the lowering or pulling of the unit, I provide apertures 70 and 70′ in both ends of the mandrel in the spaces confined by the cups. These apertures communicate with the ends of the spaces formed by the milled channels 56 and 56′ so that there is a free passage for the flow of fluid through the packing unit as it is being lowered into or withdrawn from the well, such passage being constructed so that it will not interfere in any way with the function of the packers in sealing and confining the space "S".

It will be apparent from the foregoing description that the device contemplated by this invention is of simple form and construction and that the invention contemplates broadly a method in which a confined space in the strainer casing is suddenly exposed to a violent suction. The device is constructed so that all material removed from the fissures and perforations in the casing by the mentioned suction is expelled from the well.

In this connection it is again emphasized that the invention contemplates a novel pump mechanism which may be used independently of the packing unit to act upon the pumped fluid with sudden suction impulses so that the attending rush of fluid into the strainer casing prevents the clogging of the perforations therein. Furthermore, in the form of my invention described herein, the device is constructed so that the weight of the tubing is effective to force the piston down through the barrel, creating the vacuum for the suction stroke. It will be understood in this connection that the tubing in a well of this nature may weigh several tons and that there is therefore a great deal of power available for this suction stroke. Furthermore, this manner of operation facilitates the control of the device since the release of the suction when the piston enters the expansion chamber causes a sudden or jerking movement of the piston which can be more easily controlled by the cables on the derrick if the piston is moving downward, than would be the case if the device were being operated by pulling the piston up through a working barrel to obtain the suction stroke.

It will be understood, however, that such a device might be constructed and might be efficiently operated to obtain the same result contemplated by this invention. I therefore wish to emphasize that while I have herein described and illustrated one preferred form of my invention, the invention is not limited to the precise construction as described above, but includes within its scope whatever changes fairly come within the spirit of the appended claims.

I claim as my invention:

1. An apparatus for cleaning perforated pipe and the like embodying: packing means adapted to be inserted in said pipe and to form a confined space of limited proportions therein; means including a conduit for applying suction to said confined space; and a by-pass conduit interposed between said packing means and opening into said pipe outside of said confined space.

2. The method of cleaning perforated pipe and the like which comprises placing restrictions in said pipe so as to form a confined space of small volume; and suddenly applying a violent suction to the space thus formed.

3. An apparatus for cleaning perforated pipe and the like embodying: a mandrel; packing members mounted on said mandrel in spaced relation with each other and adapted to engage the interior of said pipe so as to form a confined space therein; means including a conduit for applying suction to the space confined by said packing members; and a by-pass conduit interposed between said packing members, said by-pass conduit opening into the spaces in said pipe outside of said confined space.

4. An apparatus for cleaning perforated pipe and the like embodying: a mandrel; packing members mounted on said mandrel in spaced relation with each other and adapted to engage the interior of said pipe so as to form a confined space therein, said mandrel being provided with a passage communicating with the space between said packing members; means for applying suction through said passage to said space; and a by-pass conduit interposed between said packing members for conducting fluid in said pipe from one side of said confined space to the other.

5. An apparatus for cleaning perforated

pipe and the like embodying: a mandrel; sleeve members on said mandrel; packing means on said sleeve members in spaced relation with each other; means for mounting said sleeves on said mandrel so that there is an uninterrupted passage between the sleeves and the mandrel; and means for applying suction to the space between said packing members.

6. An apparatus for cleaning perforated pipe and the like embodying: a mandrel; sleeve members on said mandrel; packing means on said sleeve members in spaced relation with each other; means for mounting the sleeves on the mandrel so that there is an uninterrupted passage between the sleeves and the mandrel, said mandrel having a passage therein which has an opening into the space defined by said packing members; and means for applying suction through said passage and said opening to the space between said packing members.

7. A cleaning device of the class described embodying: a working barrel; an expansion chamber of larger diameter than said working barrel associated with said working barrel; a plunger in said working barrel; means for moving said plunger through said working barrel into said expansion chamber; a pair of packing members; means for supporting said packing members in spaced relation with each other; and passage means connecting said expansion chamber with the space between said packing members.

8. A device for cleaning perforated pipe and the like embodying: a working barrel; an expansion chamber of larger diameter than said working barrel mounted on said working barrel; a plunger in said working barrel; means for moving said plunger through said working barrel into said expansion chamber; packing means for sealing a confined space in said pipe; and a conduit connecting said confined space with said expansion chamber.

9. A device for cleaning perforated pipe and the like embodying: a working barrel; releasable means for securing said working barrel in said pipe; an expansion chamber of larger diameter than said working barrel mounted on said working barrel; a plunger in said working barrel; means for moving said plunger through said working barrel into said expansion chamber; packing means for sealing a confined space in said pipe; and a conduit connecting said confined space with said expansion chamber.

10. A device for cleaning perforated pipe embodying: a working barrel; releasable means for securing said working barrel in said pipe; an expansion barrel of larger diameter than said working barrel secured to said working barrel; a plunger in said working barrel; means for moving said plunger through said working barrel into said expansion barrel; a mandrel attached to said expansion barrel; and a pair of spaced packing members mounted on said mandrel and engaging the interior of said pipe, said mandrel having a passage therein leading from said expansion barrel to the space between said packing members.

11. A device for cleaning perforated pipe embodying: a working barrel; releasable means for securing said working barrel in said pipe; an expansion barrel of larger diameter than said working barrel secured to said working barrel; a plunger in said working barrel; means for moving said plunger through said working barrel into said expansion barrel; a mandrel attached to said expansion barrel; a bushing mounted on said mandrel at an intermediate point thereon; a pair of oppositely extending sleeves secured to said bushing and extending therefrom in spaced relation with said mandrel; and a packing member mounted on each of said sleeves, said mandrel having a passage therein leading from said expansion barrel to the space between said packing members.

12. A device for cleaning perforated pipe embodying: a working barrel; releasable means for securing said working barrel in said pipe; an expansion barrel of larger diameter than said working barrel secured to said working barrel; a plunger in said working barrel; means for moving said plunger through said working barrel into said expansion barrel; a mandrel attached to said expansion barrel; a bushing mounted on said mandrel at an intermediate point thereon; a pair of oppositely extending sleeves secured to said bushing and extending therefrom in spaced relation with said mandrel; and a packing member mounted on each of said sleeves, said bushing being channeled so as to provide an uninterrupted passage between said sleeves and said mandrel, said mandrel having a passage therein leading from said expansion barrel to the space between said packing members.

13. A device for cleaning perforated pipe embodying: a working barrel; releasable means for securing said working barrel in said pipe; an expansion barrel of larger diameter than said working barrel secured to said working barrel; a plunger in said working barrel; means for moving said plunger through said working barrel into said expansion barrel; a mandrel attached to said expansion barrel; a bushing mounted on said mandrel at an intermediate point thereon; a pair of oppositely extending sleeves secured to said bushing and extending therefrom in spaced relation with said mandrel; and oppositely disposed packing cups mounted on said sleeves; said mandrel being provided with a passage communicating with the space between said cups, and said sleeves being

provided with ports situated in said cups and communicating with the space between said sleeves and said mandrel.

14. A device for cleaning perforated pipe and the like embodying: a working barrel; a suspension sleeve secured to the upper end of said working barrel; means on said suspension sleeve for securing said working barrel in said pipe; packing means in said suspension sleeve; a tubing extending through said packing means into said working barrel; a plunger mounted on said tubing in said working barrel; an expansion barrel mounted on the lower end of said working barrel adapted to receive said plunger; a mandrel mounted on the lower end of said expansion barrel; packing members mounted on said mandrel in spaced relation with each other and engaging the interior of said pipe; and a valved passage in said mandrel, connecting said expansion barrel with the space between said packing members.

15. A device for cleaning perforated pipe and the like embodying: a working barrel; a suspension sleeve secured to the upper end of said working barrel; means on said suspension sleeve for securing said working barrel in said pipe; packing means in said suspension sleeve; a tubing extending through said packing means into said working barrel; a plunger mounted on said tubing in said working barrel; a valve in said plunger; an expansion barrel mounted on the lower end of said working barrel adapted to receive said plunger; a mandrel mounted on the lower end of said expansion barrel; packing members mounted on said mandrel in spaced relation with each other and engaging the interior of said pipe; and a valved passage in said mandrel, connecting said expansion barrel with the space between said packing members.

16. A device for cleaning perforated pipe and the like embodying: a working barrel; a suspension sleeve secured to the upper end of said working barrel; means on said suspension sleeve for securing said working barrel in said pipe; packing means in said suspension sleeve; a tubing extending through said packing means into said working barrel; a plunger mounted on said tubing in said working barrel; an expansion barrel mounted on the lower end of said working barrel adapted to receive said plunger; a mandrel mounted on the lower end of said expansion barrel; packing members mounted on said mandrel in spaced relation with each other and engaging the interior of said pipe, said mandrel having a passage therein connecting said expansion chamber with the space between said packing members; and a valved port in said tubing immediately above said plunger.

17. A device for cleaning perforated pipe and the like embodying: a working barrel; an expansion barrel attached to said working barrel; a tubing in said working barrel; a plunger mounted on said tubing in said working barrel and adapted to move into said expansion barrel; packing means for sealing a confined space in said pipe; and a conduit connecting said expansion chamber with said confined space, said tubing being provided with a valved port immediately above said plunger.

18. The method of cleaning the strainer casing in a well which comprises placing restrictions in said strainer casing so as to form a confined space therein; suddenly applying a violent suction to the space thus formed to draw material through the strainer casing into a suction chamber; and expelling from the well the material thus received in said suction chamber.

19. An apparatus for cleaning perforated pipe and the like embodying: a mandrel; packing members mounted on said mandrel in spaced relation with each other and adapted to engage the interior of said pipe so as to form a confined space therein; a working barrel; conduit means communicating between the said confined space and said working barrel; and a piston in said working barrel forming a sealed chamber in the upper end thereof, said conduit means being arranged so that the downward movement of said piston beyond a predetermined point is effective to suddenly establish communication between the upper end of said working barrel and said confined space.

20. An apparatus for cleaning perforated pipe and the like embodying: packing means adapted to be inserted in a pipe and to form a confined space of limited proportions therein; a working barrel; a piston in said working barrel forming a sealed chamber in the upper end thereof; and conduit means communicating between said confined space and said working barrel, said conduit means being connected to said working barrel in a manner such that the downward movement of said piston beyond a predetermined point is effective to suddenly establish communication between the upper end of said working barrel and said confined space.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 4th day of February, 1932.

HAROLD C. YARBROUGH.