July 9, 1968 J. W. BATEMAN 3,391,743

CIRCULATING TYPE STRADDLE WASHER

Filed Jan. 16, 1967 2 Sheets-Sheet 1

Fig. 1.

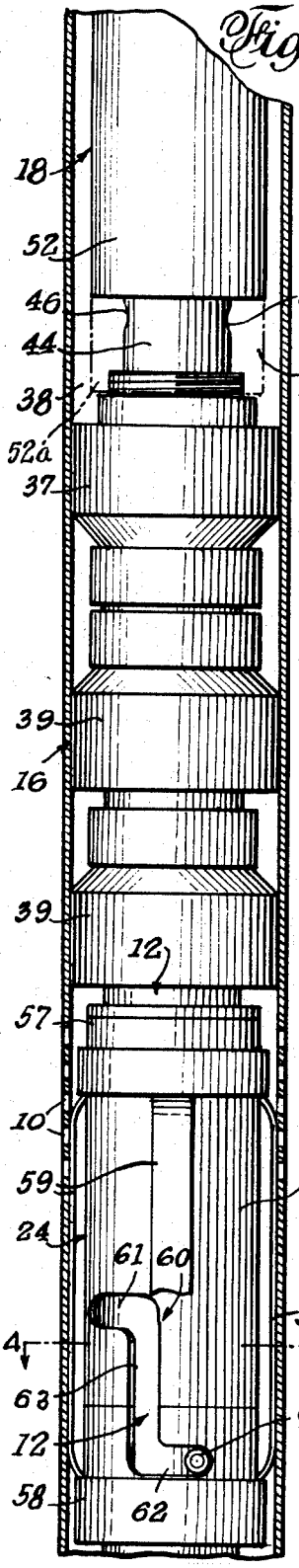


Fig. 2.

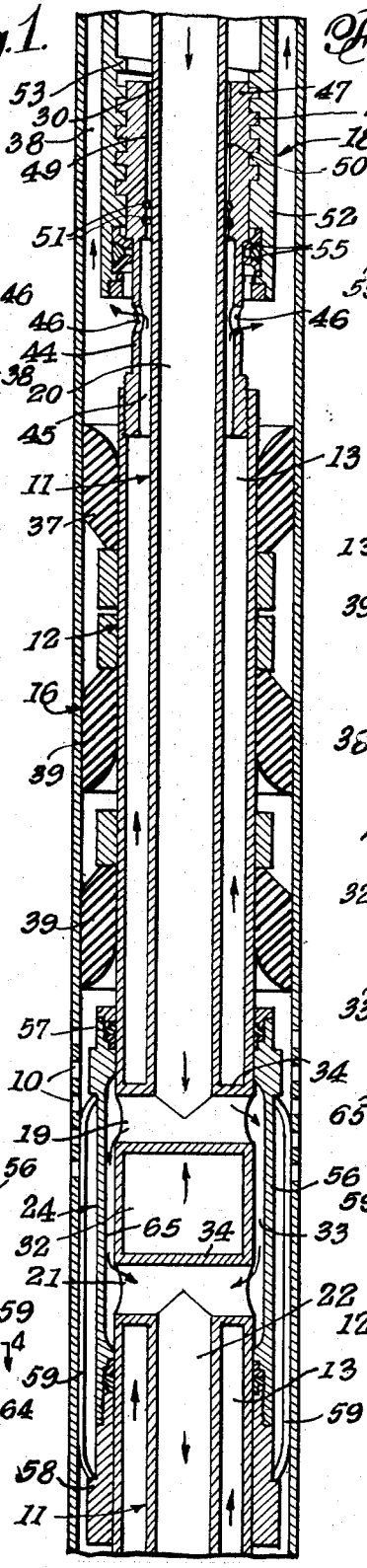


Fig. 4.

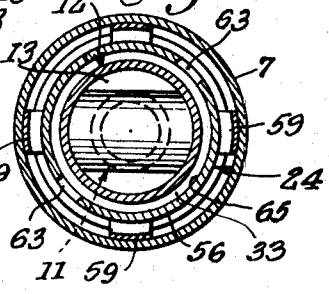
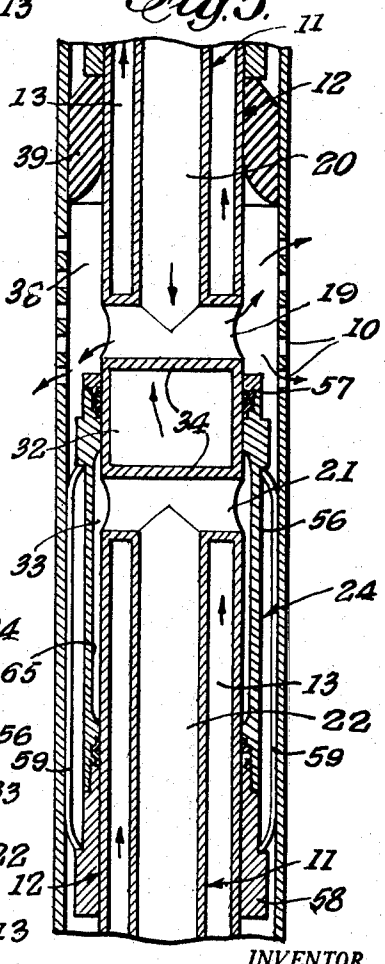


Fig. 3.



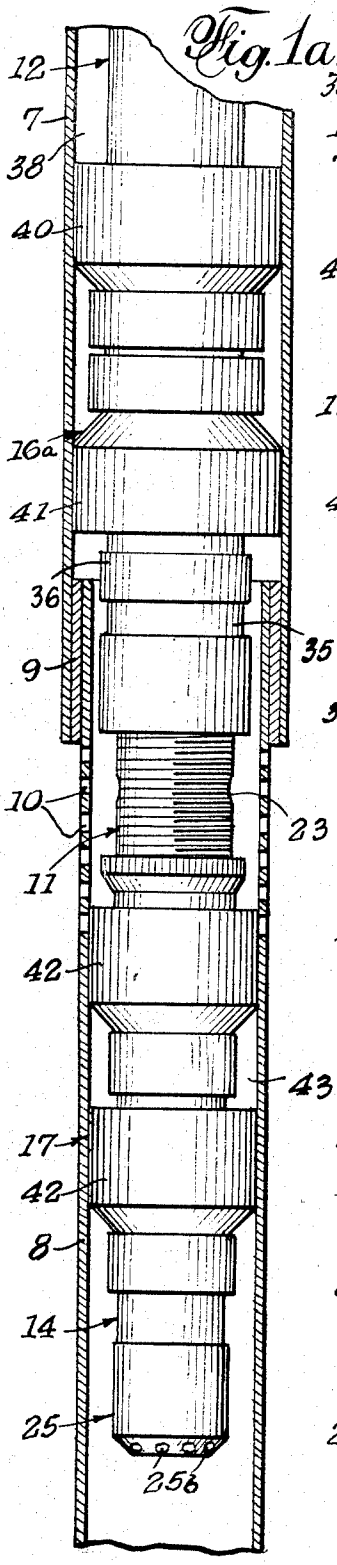
INVENTOR.
J W BATEMAN
BY
C. G. Stratton
ATTORNEY

July 9, 1968 J. W. BATEMAN 3,391,743

CIRCULATING TYPE STRADDLE WASHER

Filed Jan. 16, 1967 2 Sheets-Sheet 2

Fig. 1a.



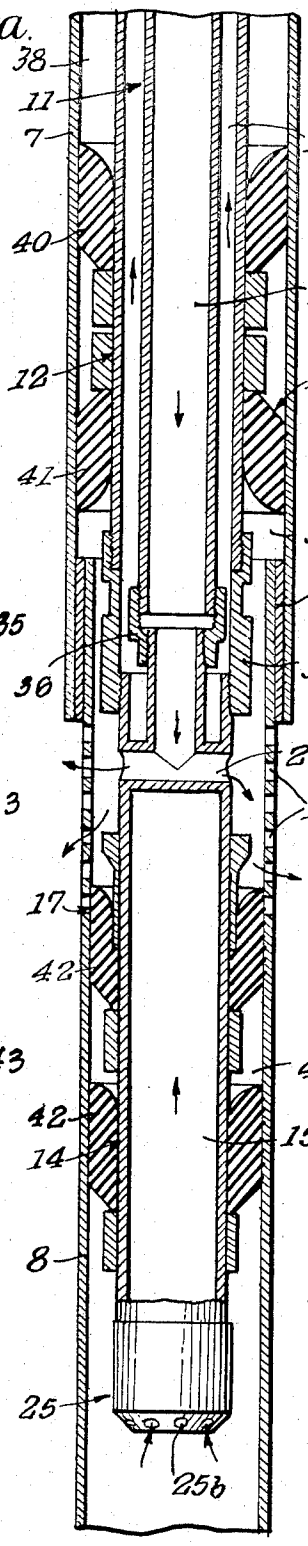


Fig. 2a.

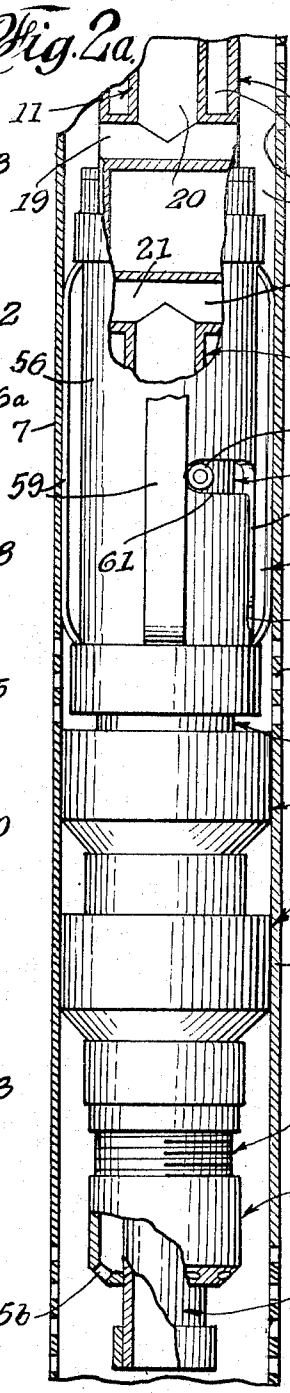


Fig. 5.

INVENTOR.
J W BATEMAN
BY C. G. Stratton
ATTORNEY

United States Patent Office

3,391,743

Patented July 9, 1968

3,391,743

CIRCULATING TYPE STRADDLE WASHER

J. W. Bateman, 5435 Summerdale St.,
Lynwood, Calif. 90262

Filed Jan. 16, 1967, Ser. No. 609,410
8 Claims. (Cl. 166—183)

ABSTRACT OF THE DISCLOSURE

A casing washer for locating perforations in a well casing, as well as for various types of washing, squeezing, testing of long or short straddles in the casing, a top valve being provided for selective testing at top or bottom annulus of casing string for leaks.

Background of the invention

For any of several reasons, well casings are provided with or develop holes or like perforations that require to be plugged to place the casing in condition for operation therein of a pump. Such holes or perforations may be located at known or unknown levels. Therefore, it is necessary to locate them before steps can be taken to plug them. Location is also required for jetting sand, mud, and the like, from the hole around the casing, whether solid or formed as a bridge, before the same may be washed out.

The present tool is adapted for performing either of such functions, selectively. Applicant presently has no knowledge of washers capable of performing the above functions.

This invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in a working position and easily disconnected therefrom, economical of manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description and which is based on the accompanying drawings. However, said drawings merely show, and the following description merely describes, preferred embodiments of the present invention, which are given by way of illustration or example only.

In the drawings, like reference characters designate similar parts in the several views.

Summary of the invention

The drawings show a typical well casing **7** of an upper, larger size, and a smaller lower size at **8**, with a joint **9** connecting these upper and lower casing parts. Perforations **10** are present in said casing.

The present washer is operable in said casing and comprises, generally, an inner flow tube **11** for receiving washing fluid from above and circulating the same downwardly in the washer; an outer flow tube **12** concentrically around said tube **11** and defining an annular passage **13** therebetween, the tube **12** terminating in a lower extension **14** having a passage **15** therein; longitudinally spaced sets of packers **16** and **16***a* secured to the outer flow tube **12** and in sealing engagement with the larger casing part **7**; a third set of packers **17** secured to the lower tube extension **14** and in sealing engagement with the smaller casing part **8**; a bypass flow valve **18** extending upwardly around the upper end of the inner flow tube **11** from the upper end of the outer flow tube **12**; a lateral port **19** at the lower end of the upper passage **20** in the tube **11**, the same opening laterally into the casing **7** below the set of packers **16**; a similar lateral port **21**, longitudinally spaced below the port **19**, at the upper end of the lower passage **22** of said tube **12**, also

opening into the casing **7** below said set of packers **16**; a third lateral port **23** at the lower end of the passage **22** and opening laterally into the casing **7** between the sets of packers **16***a* and **17**; a second bypass valve **24** mounted on the outer flow tube **12** between the sets of packers **16** and **16***a* and in operative association with the lateral ports **19** and **20**; and a cap **25** closing off the lower end of the passage **15** of the outer flow tube **12**.

An alternative washer structure has a modified arrangement of the bypass valve **24** with respect to the port **19**, a modified set of packers **17***a* to replace the set **17**, provides a longitudinal extension **26** on the lower end of the inner tube **11**, and provides the lower end of the outer tube **12** with a cap **25***a* through which the tube **26** extends.

Brief description of the drawings

FIG. 1 is an elevational view of the upper end of a preferred form of circulating type straddle washer according to the present invention.

FIG. 1a is a similar view of the lower end of the washer shown in FIG. 1.

FIG. 2 is a longitudinal sectional view of the portion of the washer shown in FIG. 1.

FIG. 2*a* is a similar view of the portion of the washer shown in FIG. 1*a*.

FIG. 3 is a longitudinal sectional view of the lower portion of the washer, as in FIG. 2, the parts being in a different operative position.

FIG. 4 is a cross-sectional view, as taken on the line 4—4 of FIG. 1.

FIG. 5 is an elevational view, partly in section, of a modification.

Description of the preferred embodiments

The upper end of the inner flow tube **11** extends by a suitable flow string, to the top of the well. Said tube **11** where it terminates at the port **19**, is longitudinally spaced from the lower portion, where it terminates at the port **21**. Thus, fluid flowing down in the passage **20**, can only exit from port **19** and fluid flowing in the casing **7** to said port can only exit from the openings **21**.

The lower end of said tube **11**, being spaced as at **32**, from the upper end, its passage **22** cannot directly receive fluid from said upper end, but only by way of a bypass passage **33** around the outside of the outer tube **12** and extending between the ports **19** and **21**. Such fluid discharges into the casing **7** or the casing part **8**.

The inner tube **11** and the outer tube **12** are fixedly secured to each other by the tubes **34** through which the ports **19** and **21** extend, said tubes **11** and **12** being coaxial to form the annular passage **13**. The extension **14** is shown as being connected by a coupling **35**. The continuity of the passage **22** to the port **23** is maintained by a coupling **36** which is small enough to allow continuity between the passages **13** and **15**, as shown in FIG. 2*a*.

The sets of packers **16**, **16***a* and **17** may be variously formed. In this case, the set **16** has an upper packer **37** that seals against downward flow in the annular passage **38** defined between the casing **7** and the outer tube **12**, and two packers **39** therebelow that seal against upward flow in said passage **38**. The packer set **16***a* has an upper packer **40** that seals against downward flow in passage **38**, and a lower packer **41** that seals against upward flow in said passage. The packer set **17** has two packers **42** that seal against downward flow in the annular passage **43** that is defined between the casing part **8** and the extension tube **14** and the coupling **35** that connects it to the outer tube **12**.

The bypass flow valve **18** is best shown in FIG. 2 as comprising a tubular extension **44** having a threaded connection with the upper end of the outer tube **12**, an annu-

lar passage 45 being formed between said extension 44 and the inner tube 11, orifices 46 in said extension communicating the passages 38 and 45. The upper end 47 of said extension is provided with a coarse-pitch thread 48, such as the square threads that are shown. The end 47 has a clearance bore 49, defining an annular passage 50 between said bore and the tube 20 extending therethrough. O-rings 51 seal the lower end of the passage 49. The previously mentioned openings 31 are located above said O-rings, thereby opening the passage 20 to the space above the tube 11 through said passage 49. An outer sleeve 52 has internal square threads 53 to engage the threads 48, its upper end, by a suitable flow string, extending to the top of the well. At its lower end, said sleeve is provided with packing rings 55 that seal against the outer surface of the tubular extension 44. When said sleeve is retracted, as in FIG. 2, the packing rings 55, by abutting a shoulder on the lower end of the extension end 47, are clear of orifices 46, thereby providing communication of the channel 38 with the channel 13. By turning the string to cause the sleeve 52 to run down on its threads to bring the packing rings 55 downwardly below the orifices 46, such communication between channels 38 and 13 is shut off.

The second bypass valve 24 is shown as a sleeve 56 that, by means of its opposite ends 57 and 58, is slidingly engaged with the outer surface of the outer tube 12. Said sleeve 56 is fitted with a set of belly springs 59 which resiliently press against the inner surface of the casing 7 and produce a friction that will retain the sleeve 56 in its adjusted position during rotative movement of the washer from above. Said sleeve 56 is provided with two oppositely disposed double bayonet slots 60 which have upper legs 61 extending in one direction and lower legs 62 extending in the opposite direction from vertical slot portions 63. A pin 64 is provided on the tube 12, one engaged in each bayonet slot. The sleeve 56 has an inner enlarged bore 65 between the ends 57 and 58, the mentioned bypass passage 33 retaining coincidence with said bore as the valve 24 is operated. It will be clear that with the pins 64 engaged with either of the legs 61 or 62 of the bayonet slots 60, the valve 24 will move vertically, in either direction with the washer. By rotating the washer to extract the pins 64 from legs 62, the sleeve remains frictionally in position while the washer is being moved upwardly until the pins encounter the upper end of the slot portions 63. Now, the washer is continued to be turned to enter the pins 64 into the legs 61. In this manner, the two ports 19 and 21 from a position, as in FIG. 2, where both are in bypassing register with the bore 65, are moved to a position, as in FIG. 3, where port 21 remains sealed off in the bore 65 while the port 19 is now in communication with the passage 38 between the packers 39 and 40. By reversing the rotative movement of the washer, the bypass valve may be moved from the position of FIG. 3 to that of FIG. 2. With the pins 64 in either of the legs 61 or 62, the valve 24 moves bodily with the washer as the same is moved longitudinally in either direction.

When the above described form of washer, shown in FIGS. 1 to 4, is lowered into the casing by means of the string of pipe connected to the upper threaded end 54 of the sleeve 52, the different sets of packers 16, 16*a* and 17 will readily slide within the walls of the casing parts 7 and 8. When the washer has reached the position shown in FIGS. 1*a* and 2*a*, the same is ready to carry out the above-mentioned washing, testing and hole-locating operations. The upwardly facing packers 37, 40, and 42 are in position to seal against downward flow past them in passages 38 and 43; the downwardly facing packers 39, 41 and 42 are in position to seal against upward flow in said passages; and the belly spring 59 of the bypass valve 24 retains the position of the sleeve 56 of said valve under torque forces generated when the washer is turned from above, in either direction.

In order to test whether or not the casing 7, above the packer 37 has holes, the sleeve 52, by means of the string of pipe extending to the top of the well, is turned so it will run down on the square threads to a low position, indicated by the dot-dash lines 52*a* of FIG. 1 and in which the packer rings 55 on the sleeve seal against the tubular extension 44 below the orifices 46 in said extension. Now, fluid is pumped, from above, into the passage 38. Since the orifices 46 are sealed off and the packer 37 is forced by the fluid pressure into tight sealing engagement with the casing 7, said passage 38 will receive only such fluid as remains trapped therein, if the casing has no holes, but will continue to receive such fluid beyond the capacity of the passage 38, when the same is lost through any holes there may be in the casing above said packer 37.

If the above operation shows that there are no holes in the casing, the washer may then be operated to locate holes below packer 37 or carry out any of its other functions, as herein above mentioned. If holes are indicated, their location may be ascertained by pulling the string upwardly until the packer 37 reaches a position above the topmost holes, which is indicated by non-acceptance of additional fluid by passage 38. Holes at different levels may be located by again lowering the washer, in a step-by-step operation and observing the acceptance or non-acceptance by the passage 38 of fluid as before.

Whether or not the above hole-locating functions are first performed, the present washer is readied for washing, cleaning, testing or locating holes in the casing 7 and its lower extension 8 by first turning the sleeve 52 by means of the string of pipes that suspends it in a direction to run said sleeve up on its square threads to the full line positon thereof shown in FIG. 2, thus opening the orifices 46 so they communicate the passages 13 and 38. Now, by adjusting the bypass valve 24 by turning the washer to withdraw the pins 64 on the tube 12 from the legs 61 of the bayonet slots 60, the washer, from above, may be lowered to the bypass position of FIGS. 1 and 2 which is retained by the pins 64 being entered into the slot legs 62.

Now, fluid is pumped through the string of pipes, into the passage 20 in tube 11 through openings 31 therein, downwardly in said tube, out of the port 19 into the bypass passage 33, into the port 21, downwardly in the passage 22, and outwardly from the port 23 that opens into the passage 43 in the casing part 8. If there are no holes in said casing part or in the adjacent end of the casing 7, when the above passages and ports are filled with fluid, no more will be accepted, thereby advising that such is the case. If, as shown, said latter portions of the casing have holes 10 therein, the fluid discharging from the port 23 will pass therethrough and, by seeping downwardly around the outside of the casing part 8, find its way into said part, through the orifices 25*b* in the cap 25, into passage 15 and thence upwardly in passage 13 through orifices 46 into passage 38. The appearance of fluid in the latter passage and the amount thereof in proportion to the amount of fluid that is being pumped, shows the presence and location of such casing holes, and also enables a continued pumping operation to force mud, sludge and like obstructions out of the casing and through the holes. These dislodged particles will then be carried to the top in the return flow discharging from passage 38.

Holes 10 in the casing 7 may be located and, if desired, similarly cleaned out, by adjusting the bypass valve 24 to the position of FIG. 3, wherein the pins 64 are engaged in the slot legs 61 and the washer is raised so that port 21 remains in register with and is closed off by the sleeve 56 of said valve, and the port 19 is open to the passage 38 below the lower packer 39 of the set of packers 16. Thus, the fluid is pumped downwardly in the passage 20, and out of the port 19 into the passage 38 between said packer 39, above the bypass valve 24, and the packer 40 below said valve. If there are no holes in the casing 7 between said packers, the flow will back up, as hereinbefore described. In such case, the washer is raised in the

casing until such backup ceases, thereby indicating the presence of holes **10** in the casing between these two packers. The procedure that follows may be the same as hereinbefore described. Thereafter, other holes **10**, if any, may be located and/or cleaned out by raising the washer; the acceptance of pumped fluid will indicate the presence of holes at the different levels and nonacceptance that no holes are present.

In the embodiment shown in FIG. 5, the portion below the bypass valve is modified over that shown in FIGS. 1*a* and 2*a* of the earlier-described embodiment. The tube passage **20** of the tube **11** is extended into and opens on the end of the tube extension **26**, the latter etxending through the cap **25***a*. The set of packers **16***a* is omitted. Thus, the valve **24** is located between and is adjustable on the tube **12** between said sets of packers. The same dual jet action between the holes **10** and **10***a* of FIG. 5 may be afforded by similarly spaced holes between the sets of packers **16** and **16***a* of said earlier embodiment, since the fluid washes both the inside of the casing or liner. Also, full bypass of fluid at all times permits free movement in either perforated or non-perforated pipe. Also, it is a simple operation to move the washer from one position to another.

While the foregoing has illustrated and described what is now contemplated to be the best mode of carrying out the invention, the constructions are, of course, subject to modification without departing from the spirit and scope of the invention. Therefore, it is not desired to restrict the invention to the particular forms of construction illustrated and described, but to cover all modifications that may fall within the scope of the appended claims.

Having thus described this invention, what is claimed and desired to be secured by Letters Patent is:

1. A circulating type washer comprising:

(a) an inner flow tube for receiving washing fluid from above and circulating the same downwardly in the washer,

(b) an outer concentric flow tube affixed to the inner tube, an annular passage being defined between said tubes,

(c) two longitudinally spaced sets of packers on the outer flow tube adapted for flow-sealing engagement with a casing in which the washer is disposed,

(d) a longitudinally adjustable bypass flow valve, controlled from the top of the well, on the end of the outer flow tube above the upper set of packers, said valve being provided with bypass orifices that, when open, communicate the mentioned passage between the tubes and an annular passage in the casing around said valve,

(e) said inner tube being divided into longitudinally spaced upper and lower portions, the lower end of the upper portion having a laterally directed port open to the inner bore of said upper portion and the upper end of the lower portion having a laterally directed port open to the inner bore of said lower portion, and

(f) a second longitudinally adjustable bypass valve mounted on the outer flow tube between the mentioned two sets of packers and in operative association with said two lateral ports that, in one position, communicates said ports to conduct flow from the upper to the lower portion of the inner tube and, in a second position, closes the lower port and opens the upper port to the interior of the casing below said two sets of packers.

2. A washer according to claim **1**, provided with:

(a) a capped extension on the outer flow tube below the lower packers, and

(b) an extension on the lower end of the inner flow tube and extending through said capped extension.

3. A washer according to claim **1**, in which the first-mentioned bypass valve comprises:

(a) a tubular extension of the outer flow tube and is in sealing engagement with the inner flow tube, the mentioned bypass orifices below such engagement,

(b) a sleeve around said extension and threadedly connected therewith to move longitudinally along the extension upon rotational movement, in either direction from above, and

(c) packer rings on the lower end of the sleeve to seal against the outer tube, and the sleeve, in its lower position, closing the bypass orifices and thereby closing flow between the passage between the outer and inner tubes, and the inside of the casing.

4. A washer according to claim **3**, in which the threaded connection between the mentioned valve extension and sleeve comprises a coarse-pitch screw thread.

5. A washer according to claim **1** in which the second bypass valve comprises:

(a) a tubular member around the outer flow tube with its opposite ends in sealing engagement with said flow tube,

(b) friction springs carried by said tubular member in resilient sliding and anti-rotational engagement with the inside of the casing, and

(c) means operative under rotational and longitudinal movement of the outer flow tube from above, to lock the latter to said tubular member with the mentioned two lateral ports in either mentioned position, selectively.

6. A washer according to claim **5** in which the last-mentioned means comprises a radial pin on the outer surface of the outer tube, and a double-ended bayonet slot in the mentioned tubular member around the outer flow tube, said slot ends being oppositely directed, one to engage the mentioned pin when the outer tube is turned in one direction and the other to engage said pin when said tube is turned in the opposite direction.

7. A washer according to claim **1** provided with:

(a) a third set of packers on said outer tube below the second bypass valve to seal against said casing,

8. A washer according to claim **6**, provided with:

(a) a third laterally directed port on the lower end of the lower portion of the inner flow tube and opening into the casing below the third set of packers,

(b) a tubular extension on the lower end of the outer flow tube below the last mentioned laterally directed port, and

(c) a fourth set of packers on said extension.

References Cited

UNITED STATES PATENTS

2,341,832	2/1944	Verhenyl et al.	166—186 X
2,360,311	10/1944	Ausburn et al.	166—186 X
2,404,876	7/1946	Granger	166—186 X
2,426,164	8/1947	Breukelman	166—186 X
2,493,962	1/1950	Gray	166—183
2,575,603	11/1951	Taylor et al.	166—186 X
2,838,119	6/1958	Collins	166—186 X

DAVID H. BROWN, *Primary Examiner.*