Sept. 11, 1956 C. D. POMEROY 2,762,439

WELL SCREEN WASHER

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Fig. 1

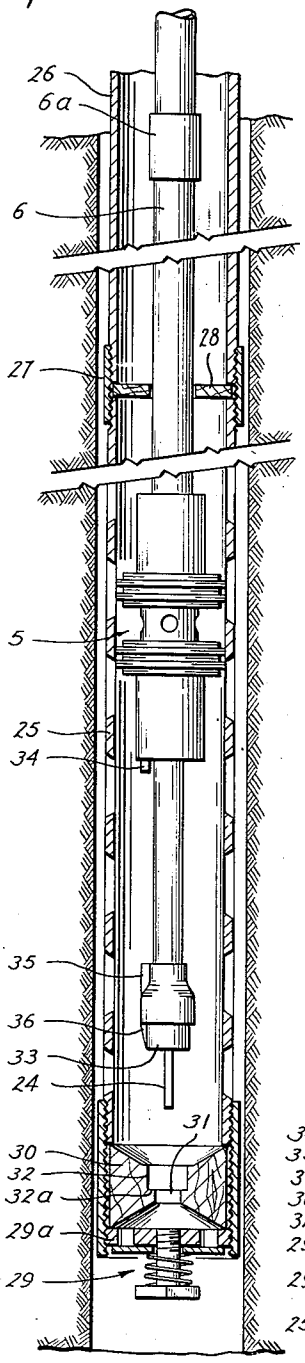


Fig. 2

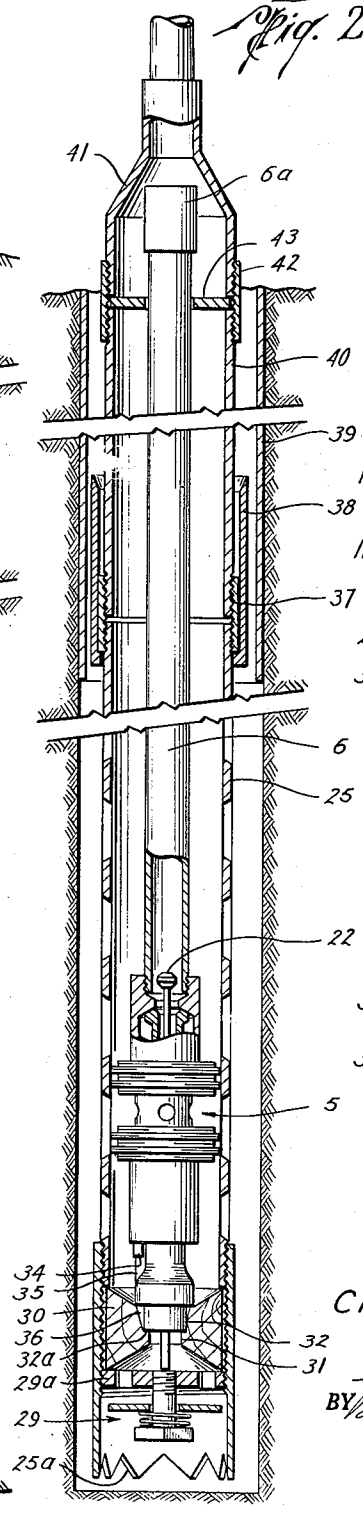
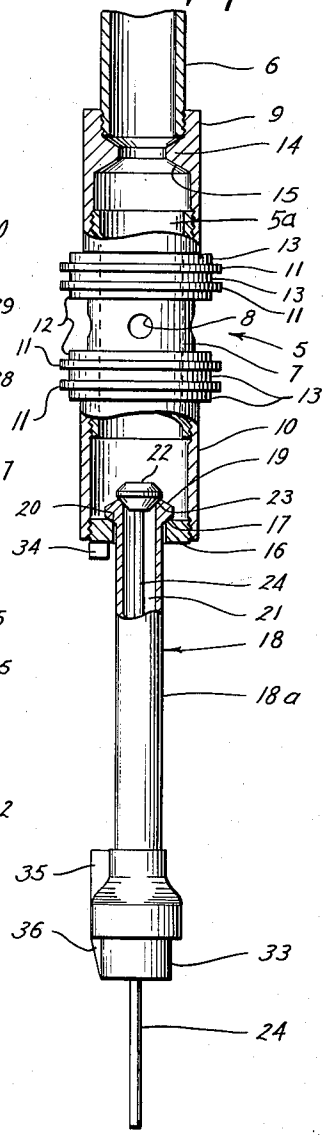


Fig. 3



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WELL SCREEN WASHER

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11 Claims. (Cl. 166—147)

This invention relates to well tools and more particularly to a tool for cleaning well screens.

A well screen is usually positioned opposite the producing stratum of a well to screen fluids passing into the well. Washing tools have heretofore been proposed for washing such well screens after they are positioned in the well. These tools are capable of selectively forcing wash fluids out through the bottom of the tool or through radial ports in the tool to wash the outside of the screen and the perforations in the screen respectively, but they are complicated and untrustworthy in operation unless springs or the like are provided to insure proper operation of the valves controlling fluid flow through the tool. Even with spring operated valves debris sometimes will prevent proper functioning of the valves. The tools further do not provide for a sealing engagement both between the tool and the bottom of the well screen and between the tool and the side wall of the well screen to confine flow of wash fluids to the desired areas.

It is an object of this invention to provide a well screen washing tool which will selectively pass fluids through the bottom of a well screen to wash the outside of the screen or pass fluids through any selected perforate area of the screen to clean the perforations wherein the wash fluids are confined and forced to pass through the intended portion of the well screen.

Another object of this invention is to provide a well screen washing tool which will selectively direct a wash fluid through the perforate portion of a well screen or by-pass the perforate portion and pass the fluid out through the bottom of the screen in which valves controlling flow through the tool are so arranged that fluids pumped into the tool will cause a pressure drop to occur across the valves and assist in freeing the valves in the event they should become inoperative.

Another object of this invention is to provide a well screen washing tool which is simple and rugged in construction and may be fabricated principally of short lengths of pipe.

Another object of this invention is to provide a well screen washing tool which has sufficient clearance between all moving parts that gravity seated valves may be used without fear of their failing to operate.

This invention is particularly adapted for use in cleaning screens in water wells and will be described and illustrated in such setting but it will be understood that the invention is useful in wells of any type in which a cylindrical screen is utilized.

In the accompanying drawings wherein there is illustrated by way of example one embodiment of this invention and wherein like referenced numerals indicate like parts:

Fig. 1 is a vertical section through a well bore and casing having a well screen suspended therefrom, illustrating a tool embodying this invention in a position to wash the perforatons of a selected section of the well screen;

Fig. 2 is a vertical section through a well bore and

casing in which the casing has been "cemented in," with the well screen, which in this instance is suspended from the tubing, also shown in vertical section, illustrating the tool of Fig. 1 in position to force wash fluids through the bottom of the screen, with parts broken away to illustrate the operation of the valves of the tool; and

Fig. 3 is an elevational view of the tool of Fig. 1 on a slightly enlarged scale with parts broken away to illustrate the details of the tool.

The washing tool illustrated has a tubular body portion suspended from a string of tubing in which an intermediate section is perforated to provide a fluid outlet. Sealing means are spaced above and below the outlet to confine the wash fluids to a selected area of the wash screen. Interiorly the body is provided with upper and lower partitions which provide valve seats co-operable with valve members to control flow through the outlets. A valved by-pass conducts fluids from the inlet of the tool to an outlet in the lower end of the tool when flow through the perforate section is cut off by engagement of the upper partition by the valve member.

Referring now to the details of the tool as best illustrated in Fig. 3, the numeral 5 indicates a body adapted to be suspended in a well from a string of tubing 6, through which a wash fluid is pumped from the surface. Body 5 is made up of a tubular center section 7, which is provided with a plurality of perforations 8, an upper collar 9 and a lower collar 10. A longitudinal bore 5*a* extends the length of the body and provides a fluid passageway interconnecting the upper collar 9 and the perforations 8.

Sealing means are circumferentially arranged above and below outlets 8 and prevent wash fluids from outlets 8 flowing along the tool between body 5 and the screen to be washed. Each sealing means may comprise one or more seal rings 11, as necessary to confine fluids from outlets 8 to a small section of the well screen and insure that the full force of the fluid is exerted against the perforations to be cleaned.

Rings 12, which serve as backup members for the seal rings, are secured to body 5, as by welding, one above and one below outlets 8. Seal rings 11 and spacer rings 13 are alternately spaced along the body and held against their respective backup rings 12 by upper collar 9 and lower collar 10, respectively. A threaded engagement is provided between the center section 7 and each of the collars 9 and 10 to provide for replacement of the sealing means. In making up this threaded engagement a seal is formed between body 5 and sealing means 11 preventing flow of wash fluids between the body and sealing means.

Sealing means 11 may be fabricated of any desired material which is resilient enough to allow engagement of the sealing means with the well screen while being moved therealong and yet stiff enough to confine the wash fluid to the area between the upper and lower groups of sealing means and direct the fluid against the section of the well screen exposed to this area. Rubber impregnated with cord or the like has been found to form a satisfactory seal ring.

Upper collar 9 is provided with a transverse partition 14 having a flow passage therethrough surrounded by valve seat 15. Lower collar 10 is provided with an apertured transverse partition 16 having a valve seat 17 surrounding the aperture. These valve seats are located above and below the perforate section of the body, that is, the section containing apertures 8.

By controlling fluid communication between the flow passage in the upper partition 14 and the outlets 8 the direction of fluid flow through the tool may be controlled.

A double acting valve 18 is slidably received in the bore 5*a* and has a portion extending through valve seat 17

to provide an actuator for the valve. The double acting valve **18** is provided with valve elements **19** and **20** adapted to engage seats **15** and **17**, respectively. These valve elements are preferably provided by a single outturned annular flange situated at the upper extremity of the double acting valve **18**. Body portion **18***a* of the double acting valve is tubular and is greater in length than the distance between valve seats **15** and **17** so that a portion of the double acting valve will always extend through the lower seat **17** and depend from the body. With this arrangement the valve may be gravity seated upon seat **17** to direct wash fluid through perforations **8** or upon engagement of stem **18***a* with the bottom of the well screen, be moved into engagement with seat **15** to prevent fluid communication between the inlet and perforate section, upon further lowering of tubing **6**.

A valved by-pass conduit is provided to conduct fluid through the tool and out its lower end when the valve is seated upon seat **15**. This by-pass should be exposed to fluids upstream of seat **15** and the valve controlling flow through the by-pass should be unseated when valve **18** engages seat **15**.

In the illustrated embodiment this by-pass conduit is provided by a longitudinal bore **21** extending through the valve **18** to by-pass fluids therethrough when the valve engages seat **15**. This bore has one terminus exposed to the flow passage in upper partition **14** when the valve engages seat **15**, and the other terminus opening into the bottom end of valve body **18***a*. A gravity seated check valve **22** cooperates with a seat **23**, which surrounds bore **21**, to control flow through bore **21**. Check valve **22** is provided with a depending actuator stem **24** which extends through bore **21** to a point below the lower end of double acting valve **18** and provides a means for maintaining the check valve **22** off its seat while the double acting valve **18** is seated against the upper seat **15**.

Thus, while the tool is hanging free in the well and not in engagement with the bottom of the well screen, double acting valve **18** will be gravity seated upon seat **17** and check valve **22** will be gravity seated upon seat **23**. With the parts in this position wash fluids pumped into the tool through tubing **6** will be forced through perforations **8**. When the tool is lowered until it engages the bottom of the well screen the depending portion of the valve **18** will cause the valve to be telescoped into body **5** and seated upon seat **15**. At the same time actuator stem **24** will have engaged the bottom of the well screen and moved check valve **22** off its seat. With the valves thus disposed wash fluid introduced through tubing **6** will be by-passed through the tool and ejected through the depending portion of the valve **18**.

The partition **14**, valve elements **19** and **20**, and check valve **22** are all provided with rounded edges to prevent hanging up of any of the valves during operation.

The operation of the tool in a well in which the well casing is suspended from the surface is illustrated in Fig. 1. Well screen **25** is secured to casing **26** by a coupling **27**. Held between the adjacent ends of the casing **26** and screen **25** is a wood washer **28** which surrounds tubing **6** and prevents return flow from entering the casing. Thus, wash fluids pumped into the tubing **6** will be returned to the surface via the well bore and will wash its entire length.

The lower end of the well screen is closed by a conventional back pressure valve **29** which prevents entry of well fluids into the well screen through its lower end. Secured in the well screen immediately above the back pressure valve is a wood partition **30** having formed therein a fluid passageway **31** and a seat **32**. Seat **32** is of approximately the same diameter as valve **33**, which is formed on the depending portion of double acting valve **18** and surrounds bore **21**. Both valve **33** and seat **32** are cylindrical in configuration so that valve **33** can be forced into seat **32** until the valve engages shoulder **32***a* formed in partition **30**.

In assembling the well screen, the washing tool is placed in the screen and valve **33** seated in seat **32**. Wood washer **28** is positioned in coupling **27** and tubing **6** passed through the aperture in washer **28** and threaded into upper collar **9**. Coupling **27** is then threaded onto casing **26**. Tubing **6** is provided with a box type coupling **6***a* at its upper end in which a string of tubing may be stabbed after the screen has been positioned in the bottom of the well.

Assuming the screen to be positioned in the well, the tubing string is "run in" and stabbed into coupling **6***a*. Lugs **34** and **35** engage and together with knife **36** which is forced into wood partition **30** during the seating of valve **33**, prevent turning of coupling **6***a* while this joint is being made up.

Wash fluids may now be pumped into the well and as the double acting valve **18** is in engagement with seat **15** the wash fluids will be by-passed through the tool and out the back pressure valve **29**. By reference to Fig. 2 it will be noted that stem **24** passes through passageway **31** and engages the spider **29***a* of the back pressure valve. Stem **24** should be long enough to compensate for any space which may be left betewen partition **30** and the back pressure valve **29** to insure that the check valve is unseated when the double acting valve **18** is engagement with seat **15**. Wood washer **28** will prevent wash fluid from returning to the surface via the casing and the wash fluid will be forced to flow upwardly along the exterior of both the screen and the casing, washing the exterior of the screen and the entire length of the well bore. After this operation is completed the tubing string is picked up and valve **33** pulled free of its seat. Gravity will then seat check valve **22** on its seat and double acting valve **18** on its lower seat **17**. With the parts in this position fluids pumped from the surface will be passed through perforations **8**. Sealing members **11** which engage screen **25** confine the wash fluid to a small area of the screen. The tool may be raised and lowered along the screen to clean the screen a section at a time.

After the screen has been thoroughly washed the tool is raised and wood washer **28** shattered to allow withdrawal of the tool.

The operation of the tool in a well in which the casing has been cemented in is illustrated in Fig. 2. The well screen is again assembled with the tool in its Fig. 2 position but, as the well screen must be run into the well on the tubing string the manner of supporting the well screen and tool is somewhat different. Screen **25** is provided with a coupling **37** having left-handed threads. Coupling **37** carries a lead collar **38** which may be expanded to engage the casing **39** after the tool has been withdrawn. A length of tubing **40** having left-handed threads on its lower end is secured to coupling **37**. The upper end of tubing **40** is attached to a reducing joint **41** by a coupling **42**. Secured between the abutting ends of reducing joint **41** and tubing **40** is a metal washer **43**. Tubing **6** is slidably and rotatably received in an aperture in washer **43** and is passed through the washer and secured to upper collar **9** before reducing coupling **41** is secured to coupling **42**. Thus assembled the well screen and washer are run into the well on the end of the tubing until the screen reaches the bottom of the hole. Double acting valve **18** will at this time be seated upon upper seat **15** and wash fluids may be pumped through the tool and out through the back pressure valve **29** to flow along the outside of the screen and back through the casing annulus to wash the outside of the screen. The screen is then lowered until it engages the bottom of the well. The lower end of the screen is provided with a jagged end portion **25***a* which prevents turning of the well screen while the coupling **37** is broken. It will be noted that the rotatable engagement between washer **43** and tubing **6** allows the well tubing to be rotated without rotating the washing tool. Due to the engagement of lugs **34** and **35**, rotation of the tool would cause rotation of the screen with the well tubing if it

were not for this rotatable joint. After coupling **37** is broken out the tubing string may be raised, coupling *6a* being engaged by washer **43** to suspend the tool from the tubing string, and the perforated portion of the well screen washed as before.

After the screen has been thoroughly washed the tubing string and tool may be withdrawn and lead collar **38** expanded against casing **39**, in a manner well known to those skilled in the art, to complete the joint between the casing and screen.

It will be appreciated that in the arrangement of valves and seats illustrated substantial clearances are provided between all moving parts. These clearances insure free actuation of the several valve members and remove substantially all danger of freezing-up of the valve members due to debris in the tool. However, in the event the valves should not function properly the fluids being pumped into the tool will cause a pressure drop across the valve members tending to move them downwardly. The tool may also be lowered until stem **24** and portion **18***a* of the double acting valve engage the bottom of the screen. The weight of the string may then be exerted to move the valves upwardly relative to the tool. The alternate application of forces upwardly and downwardly should free the valves and restore normal operation of the tool.

The washing tool of this invention may be easily and economically fabricated by utilizing short lengths of pipe. For instance, the body section can be a short length of pipe threaded at both ends. Collars **9** and **10** can be pipe couplings in which partitions have been inserted. Double acting valve **18** can be fabricated of still another length of pipe. Thus, the tool is both simple and rugged in structure, and may be manufactured at a minimum cost.

It will be appreciated that the tool may be run in on a tubing string to clean previously installed screens which have become clogged during use.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the structure.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. In combination, a well screen having actuator means in its lower end and a tool for washing said screen comprising, a body adapted to be suspended from a string of tubing and having a longitudinal bore extending therethrough, a perforate section intermediate the ends of the body, sealing means circumferentially arranged about the exterior of the body and positioned above and below the perforate section and adapted to engage the well screen, a first valve seat in the bore above the perforate section and a second valve seat in the bore below the perforate section, a double acting valve slidable in said bore and alternately coacting with said seats to control flow through the perforate section, said double acting valve extending through said second seat and having a portion of its length below the body, said valve gravity actuated toward said second seat and moved toward said first seat by a continued lowering of the body after said extending portion of the valve has engaged the actuator means in the screen, a longitudinal bore in the double acting valve, a gravity actuated check valve in the bore in the double acting valve, and an actuator rod depending from the check valve and extending below the double acting valve member when the check valve is seated, said check valve actuator rod adapted to engage said actuator means and unseat the check valve as the tool is lowered into the screen and before the double acting valve is unseated from said second seat.

2. In combination, a well screen having an apertured partition in its lower end, a valve seat in said partition, a back pressure valve in the bottom of the screen, and a tool for washing said screen comprising, a body adapted to be suspended from a string of tubing and having a longitudinal bore extending therethrough, a perforate section intermediate the ends of the body, sealing means circumferentially arranged about the exterior of the body and positioned above and below the perforate section and adapted to engage the well screen, a first valve seat in the bore above the perforate section and a second valve seat in the bore below the perforate section, a double acting valve slidable in said bore and alternately coacting with said seats in said bore to control flow through the perforate section, said double acting valve extending through said second seat and having a portion of its length below the body, said valve gravity actuated toward said second seat and moved toward said first seat by a continued lowering of the body after said extending portion of the valve has engaged said apertured partition in the screen, a longitudinal bore in the double acting valve and a valve member on said extending portion of the double acting valve adapted to engage the seat in said apertured partition in the well screen and direct flow of fluid from said last mentioned bore through the apertured partition, a gravity actuated check valve in the bore in the double acting valve, and an actuator rod depending from the check valve and extending below the double acting valve member when the check valve is seated, said check valve actuator rod adapted to engage said back pressure valve and unseat the check valve as the tool is lowered into the screen and before the double acting valve is unseated from said second seat.

3. A well screen washing tool comprising, an elongate body adapted to be suspended from a string of tubing, said body having a longitudinal bore extending therethrough and a perforate section intermediate its ends, sealing means circumferentially arranged about the exterior of the body and positioned above and below the perforate section and adapted to engage a well screen being washed, upper and lower partitions in the bore positioned above and below the perforate section respectively, a flow passage through the upper partition, a valve seat in said upper partition, a double acting valve extending through an aperture in the lower partition, a valve seat in said lower partition, said double acting valve adapted to alternately coact with the seat in the upper partition and the seat in the lower partition to control flow through the perforate section, a longitudinal bore in the double acting valve, a check valve controlling flow through said last mentioned bore, and actuator rod means maintaining the check valve in open position when the double acting valve is in engagement with the seat in the upper partition, said double acting valve having a portion extending below the body whereby arresting movement of the extending portion of the valve while lowering the tool will cause such portion to telescope into the body and seat the double acting valve in the seat in the upper partition.

4. The tool of claim 3 in combination with a well screen, an apertured partition in the screen adjacent its lower end, and a valve seat in the well screen partition controlling flow through the aperture therein, said portion of the double acting valve extending below the body provided with a valve member adapted to sealingly engage said seat in the well screen partition with the longitudinal bore in the double acting valve in fluid communication with the aperture in the well screen partition to direct fluid passing through the tool through the lower end of the well screen when the double acting valve is seated upon the upper seat.

5. A well screen washing tool comprising, a body adapted to be suspended from a string of tubing and having a fluid inlet in its upper end and a fluid outlet itnermediate its ends, a fluid passageway in the body in-

terconnecting the inlet and outlet, a valve seat in said passageway, a valve member coacting with said seat to control flow through the passageway, said valve member having a portion extending below the body which carires an abutment adapted to engage the bottom of the screen to be washed as the tool is lowered in the screen and upon further lowering of the body to move the valve member into engagement with its seat to prevent fluid communication between the inlet and outlet, said valve member gravity actuated away from said seat when the extending portions is hanging free from the body, a valved by-pass conduit in said valve member for conducting fluids through the tool when said first mentioned valve member is seated, and means maintaining the valve in the by-pass conduit off its seat while said first mentioned valve member is seated, said conduit having a first terminus exposed to said inlet when the valve member is seated and a second terminus in said extending portion.

6. A well screen washing tool for washing a screen provided with an actuator part at its lower end comprising, a body adapted to be suspended from a string of tubing and having a fluid inlet in its upper end and a fluid outlet intermediate its ends, a fluid passageway in the body interconnecting the inlet and outlet, a valve seat in said passageway, a valve member coacting with said seat to control flow through the passageway, said valve member having a portion extending below the body adapted to engage the actuator part carried by the well screen as the tool is lowered in the screen and upon further lowering of the body to move the valve member into engagement with its seat to prevent fluid communication between the inlet and outlet, a by-pass conduit in the valve member, a check valve in the by-pass conduit, and means maintaining the check valve off its seat while the valve member is seated, said conduit having a first terminus exposed to said inlet when the valve member is seated and a second terminus in said extending portion of the valve member, whereby fluid communication is established between the inlet and the second terminus when the valve member is seated.

7. A well screen washing tool for washing a screen provided with an actuator part at its lower end comprising, a body adapted to be suspended from a string of tubing and having a fluid inlet in its upper end and a fluid outlet intermediate its ends, sealing means circumferentially arranged about the exterior of the body and positioned above and below the outlet and engageable with the well screen, a fluid passageway in the body interconnecting the inlet and outlet, a valve seat in said passageway, a valve member coacting with said seat to control flow through the passageway, said valve member having a portion extending below the body adapted to engage the actuator part carried by the well screen as the tool is lowered in the screen and upon further lowering of the body to move the valve member into engagement with its seat to prevent fluid communication between the inlet and outlet, a by-pass conduit in the valve member, a check valve in the by-pass conduit, and means maintaining the check valve off its seat while the valve member is seated, said conduit having a first terminus exposed to said inlet when the valve member is seated and a second terminus in said extending portion of the valve member, whereby fluid communication is established between the inlet and the second terminus when the valve member is seated.

8. A well screen washing tool for washing a screen provided with an actuator part at its lower end comprising, an elongate body adapted to be suspended from a string of tubing, and having a fluid inlet at its upper end and a fluid outlet intermediate its ends, said body having a longitudinal bore extending therethrough and interconnecting the inlet and outlet, a double acting valve in the bore alternately engageable with an upper seat formed in the bore above the outlet to prevent fluid communication between the inlet and outlet and with a lower seat bored in the bore below the outlet to close off the lower end of the bore and direct flow through the outlet, said double acting valve having a portion extending through the lower seat and adapted to engage the actuator part carried by the well screen to be washed as the tool is lowered in the screen and upon further lowering of the tool to move the valve into engagement with the upper seat, said double acting valve being gravity actuated and seating upon the lower seat when said extending portion of the valve member is not in engagement with said actuator part, a by-pass conduit in the double acting valve, a check valve controlling flow through said conduit, and means for unseating the check valve while the double acting valve is in engagement with the upper seat, said conduit having a first terminus exposed to said inlet when the double acting valve is in engagement with the upper seat and a second terminus in said extending portion of the valve whereby fluid communication is established between the inlet and the second terminus when the double acting valve is in engagement with the upper seat.

9. A well screen washing tool for washing a screen provided with an actuator part at its lower end comprising, an elongate body adapted to be suspended from a string of tubing and having a fluid inlet in its upper end and a fluid outlet intermediate its ends, said body having a longitudinal bore extending therethrough and interconnecting the inlet and outlet, sealing means circumferentially arranged about the exterior of the body and positioned above and below the fluid outlet and engageable with the well screen, a double acting valve in the bore alternately engageable with an upper seat formed in the bore above the outlet to prevent fluid communication between the inlet and outlet and with a lower seat formed in the bore below the outlet to close off the lower end of the bore and direct flow through the outlet, said double acting valve having a portion extending through the lower seat and adapted to engage the actuator part carried by the well screen to be washed as the tool is lowered in the screen and upon further lowering of the tool to move the valve into engagement with the upper seat, said double acting valve being gravity actuated and seating upon the lower seat when said extending portion of the valve member is not in engagement with said actuator part, a by-pass conduit in the double acting valve, a check valve controlling flow through said conduit, and means for unseating the check valve while the double acting valve is in engagement with the upper seat, said conduit having a first terminus exposed to said inlet when the double acting valve is in engagement with the upper seat and a second terminus in said extending portion of the valve whereby fluid communication is established between the inlet and the second terminus when the double acting valve is in engagement with the upper seat.

10. A well screen washing tool for washing a screen provided with an actuator part at its lower end comprising, an elongate body adapted to be suspended from a string of tubing and having a fluid inlet in its upper end and a fluid outlet intermediate its ends, said body having a longitudinal bore extending therethrough and interconnecting the inlet and outlet, and a double acting valve in the bore alternately engageable with an upper seat formed in the bore above the outlet to prevent fluid communication between the inlet and outlet and with a lower seat formed in the bore below the outlet to close off the lower end of the bore and direct flow through the outlet, said double acting valve having a portion extending through the lower seat and adapted to engage the actuator part carried by the well screen to be washed as the tool is lowered in the screen and upon further lowering of the tool to move the valve into engagement with the upper

seat, said double acting valve being gravity actuated and seating upon the lower seat when said extending portion of the valve member is not in engagement with said actuator part, a by-pass conduit in the double acting valve, a check valve controlling flow through said conduit, said check valve having an actuator stem projecting below the extending portion of the double acting valve when the check valve is seated and adapted to engage the actuator part carried by the well screen to be washed to unseat the check valve and permit flow through the by-pass conduit in the double acting valve when the upper seat is engaged by the double acting valve, said conduit having a first terminus exposed to said inlet when the double acting valve is in engagement with the upper seat and a second terminus in said extending portion of the valve whereby fluid communication is established between the inlet and the second terminus when the double acting valve is in engagement with the upper seat.

11. A well screen washing tool comprising, an elongate body adapted to be suspended from a string of tubing, said body having a longitudinal bore extending therethrough and a perforate section intermediate its ends, sealing means circumferentially arranged about the exterior of the body and positioned above and below the perforate section and adapted to engage a well screen being washed, upper and lower partitions in said bore

positioned above and below the perforate section respectively, a flow passage through the upper partition, a valve seat in said upper partition, a double acting valve having a tubular body portion extending through an aperture in the lower partition and having a portion extending below the body, a valve seat in said lower partition, said double acting valve adapted to alternately coact with the seat in the upper partition and the seat in the lower partition to control flow through the perforate section, a gravity actuated check valve and seat therefor in the bore of the tubular body portion controlling flow through the double acting valve, and an actuator rod depending from the check valve and extending below the extending portion of the double acting valve below the body when the check valve is seated, whereby arresting downward movement of first the actuator rod and then the extending portion of the double acting valve as the tool is lowered in a screen will unseat the check valve and seat the double acting valve in the valve seat in the upper partition.

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