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WELL FLOWING APPARATUS

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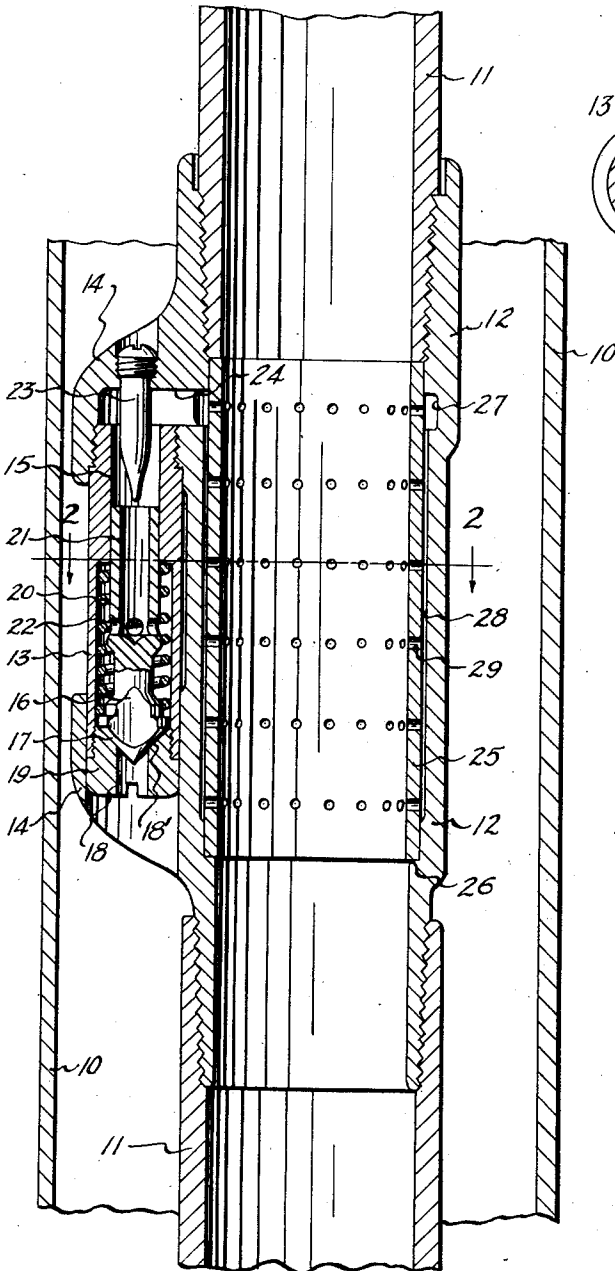


Fig. 1

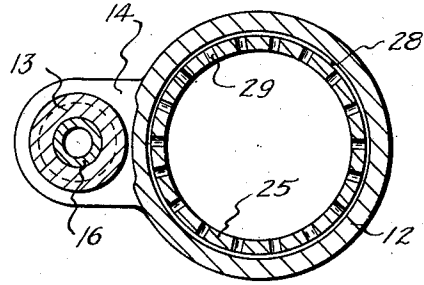


Fig. 2

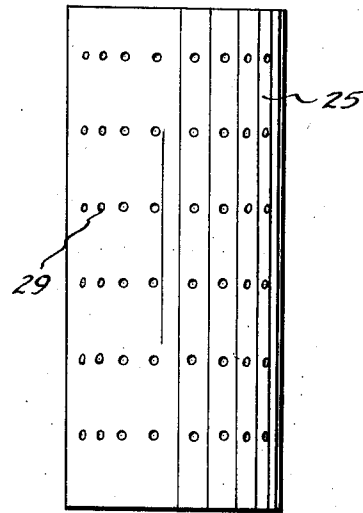


Fig. 3

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## WELL FLOWING APPARATUS

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3 Claims. (Cl. 103-232)

This invention relates to new and useful improvements in well flowing apparatus.

One object of the invention is to provide an improved apparatus for introducing a lifting fluid into the column of liquid in a well, wherein the lifting fluid is admitted into the column through perforations so as to enter the column in a plurality of small jets or streams, with a control valve at the perforations to control the flow thereto.

An important object of the invention is to provide an improved apparatus for admitting a lifting fluid into the liquid column within a well, said apparatus having a lifting fluid inlet controlled by a valve and a perforated elongate sleeve communicating with the inlet and so arranged that the fluid is spread in a thin sheet around the sleeve before it passes through the perforations therein, whereby the formation of "slippage bubbles" is eliminated and a smooth lifting or flow of the column produced.

A further object of the invention is to provide an improved apparatus of the character described, wherein a valve controls the admission of lifting fluid to the perforated sleeve so that any number of devices may be connected in a tubing string and each will be individually controlled by its own valve.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawing, in which an example of the invention is shown, and wherein:

Figure 1 is a transverse, vertical, sectional view of a device constructed in accordance with the invention.

Figure 2 is a horizontal, sectional view taken on the line 2-2 of Figure 1, and

Figure 3 is an elevation of the perforated sleeve.

In the drawing, the numeral 10 designates a well casing which has the usual well tubing 11 extending co-axially therethrough. As shown in Figure 1, a tubular flow valve body or housing 12 is externally screw threaded at its lower end and internally screw threaded at its upper end whereby it may be connected in the string of tubing 11. These flow or stage control valves are common in the art and are used for introducing a lifting fluid under pressure into the column of liquid standing in the well for aerating and lifting the liquid from the well. Since

the valve means is not an important feature of the invention and as there are a number of suitable valves which may be purchased on the open market for use with the invention it is not deemed necessary to go into a detailed description of the control valve structure and operation.

Therefore, for controlling the lifting fluid introduced in to the well liquid, any suitable valve may be used, but I have shown a valve 13 mounted between a pair of vertically aligned bosses 14 extending outwardly from one side of the body 12. The valve includes a cylindrical valve chamber 15 and a pressure pin 16 which is movable vertically therein. The lower end of the pin is formed with a conical valve face 17 which is adapted to engage an annular seat 18 which surrounds the bore 18 of a plug 19 located in the lower open end of the chamber 15. The bore 18 establishes communication between the chamber and the interior of the well casing 10. A spring 20 exerts its pressure to urge the pin 16 downwardly onto the seat 18 at all times, whereby the bore is closed. The upper end of the pin 16 is provided with an axial bore 21 extending from its upper end to substantially its mid-portion. Radial openings 22 establish communication between the lower end of the bore 21 in the pin 16 and the valve chamber 15. A metering pin 23 has one end secured in the upper boss and extends downwardly into the valve chamber 15 and is in alignment with the axial bore 21 of the pressure pin 16. This metering pin acts to throttle the flow of lifting fluid through the valve. The upper end of the chamber 15 has communication with the interior of the body 12 through a radial port 24 provided in the upper boss 14. It will be obvious that the valve controls the introduction of the lifting fluid from within the well casing into the chamber 15 and through the port 24 into the interior of the body 12. The valve is operated by the differential in pressure between the well casing and the well tubing.

For distributing the lifting fluid entering the body through the port 24, an elongate cylindrical sleeve 25 is disposed within the body. The sleeve is supported at its lower end upon an internal annular shoulder 26, provided within the lower end of the body, and extends upwardly therefrom to the lower end of the internal screw threads at the upper end of said body. It will be seen that when the tubing 11 is screwed into the upper end of the body, the lower end of said tubing engages the upper end of the sleeve

to hold said sleeve firmly in position on the shoulder 26.

The inner end of the port 24 connects with an internal annular groove 27 provided in the wall of the body 12 adjacent the upper end of the sleeve, and it will be seen that fluid introduced into the body through the port will enter said groove. Extending downwardly from the lower end of the groove 27 to a point just above the lower end of the sleeve, the bore of the body is enlarged over the outside diameter of said sleeve, whereby an annular elongate, vertical space 28 is formed between the body and the sleeve. It will be obvious that fluid in the groove 27 will flow downwardly into the annular space 28 between the sleeve and the body, which extends throughout substantially the length of the sleeve. The space 28 is narrow which causes the fluid to flow in a thin cylindrical sheet.

The sleeve 25 is provided with a plurality of comparatively small radial openings 29 extending through its walls for establishing communication between the annular space 28 and the interior of the sleeve. Thus, it will be seen that lifting fluid in the annular space may pass through the openings 29 in the sleeve into the fluid in the string of tubing 11. The provision of this sleeve having a large number of comparatively small openings extending therethrough is the important feature of this invention. It will be seen that lifting fluid flowing in a thin sheet passing through the openings in the sleeve, under pressure, will be introduced into the liquid standing in the well tubing in numerous small jets or streams, and, since the openings are provided throughout substantially the length of the sleeve, it will be seen that the fluid introduced therethrough will be equally distributed into the well liquid, thereby increasing aeration of said liquid.

The introduction of the lifting fluid into the liquid in the tubing in a large number of small streams circumferentially of the liquid column also reduces the possibility of the formation of large globules of the lifting fluid in the liquid, thereby preventing bubbling and eliminating slippage incident thereto. Heading or surging of the well liquid is eliminated and a smooth even flow of the aerated liquid is obtained. This better mixing of the lifting fluid with the well liquid which gives a steady flow of the aerated liquid also reduces the number of control valves necessary to raise the liquid from the well since the slippage loss is substantially eliminated and the full lifting power of the lifting fluid is utilized.

Since the openings in the sleeve are spaced from each other, both longitudinally and cir-

cumferentially of the sleeve, it will be seen that the lifting fluid is introduced into the well liquid throughout substantially the length of the sleeve, and that the lifting fluid is distributed equally throughout a column of the well liquid of substantially the same length as said sleeve, thereby increasing the aeration of said liquid column.

It is noted that the screen 25 may be removed from the body 12 for cleaning, replacement or any other purpose by unscrewing the well tubing 11 in the upper end of said body, whereupon the screen is freed and may be readily removed therefrom.

What I claim and desire to secure by Letters Patent, is:

1. A well flowing device including, a housing having a bore providing a liquid flow passage and arranged to be connected in a string of well tubing, a valved inlet on the housing directly controlling the admission of well pressure fluid, the housing having a passage extending from the inlet, in combination with a perforated sleeve in the bore of the housing controlling the admission of pressure fluid to the column of liquid flowing upwardly through the housing, said sleeve extending downwardly from said passage and spaced from the bore of the housing.

2. A well flowing device including, a housing having a bore providing a liquid flow passage and arranged to be connected in a string of well tubing, an inlet on the housing directly controlling the admission of well pressure fluid, the housing having a passage extending from the inlet, in combination with a perforated sleeve in the bore of the housing controlling the admission of pressure fluid to the column of liquid flowing upwardly through the housing, said sleeve extending downwardly from said passage, the housing having a vertical restricted passage surrounding the sleeve and extending downwardly from the inlet for spreading the inlet fluid flow into a thin sheet.

3. A well flowing device including, a housing having means at its ends for connecting it in a string of well tubing and provided with a bore located to be aligned with the bore of the tubing, the housing having a valved inlet to its bore and provided with a counterbore, the valved inlet controlling the admission of pressure fluid to said housing, and a perforated sleeve mounted in the counterbore of the housing in such close relation thereto as to provide a vertically restricted passage surrounding said sleeve for spreading the influent pressure fluid into a thin sheet and excluding extraneous matter therefrom.

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