

May 24, 1955

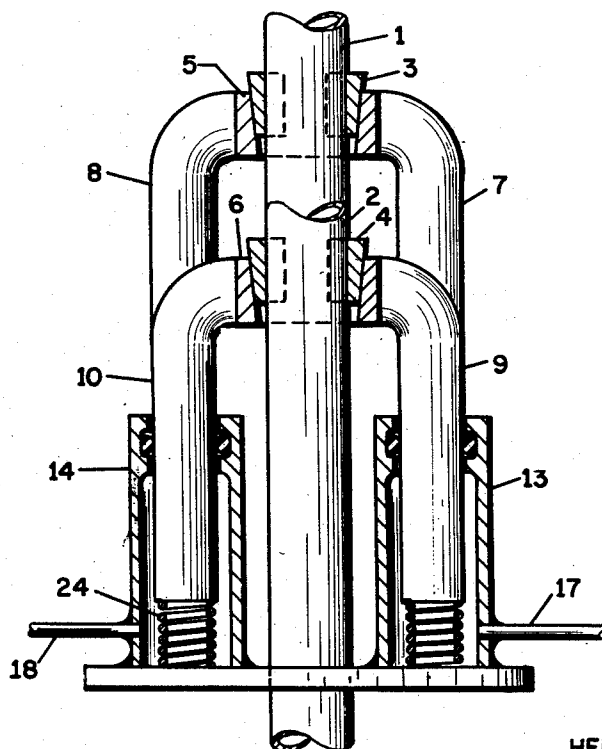
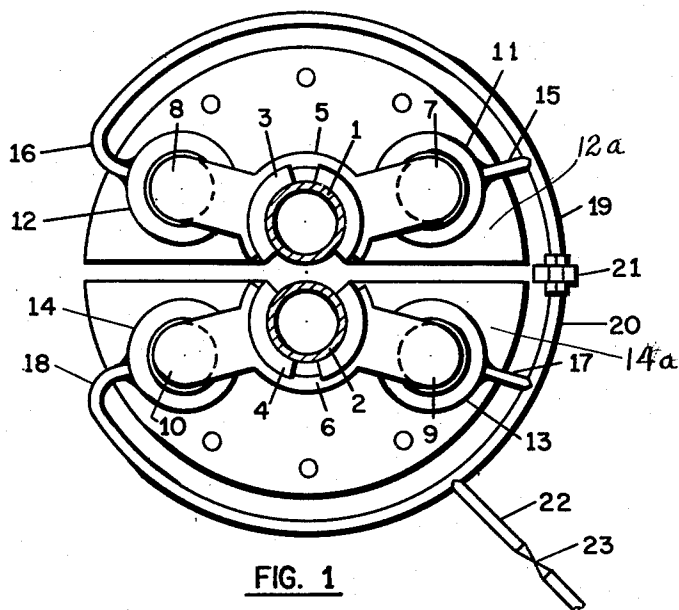
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2,708,975

RUNNING MULTIPLE PIPE STRINGS IN WELLS

Filed June 18, 1952

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

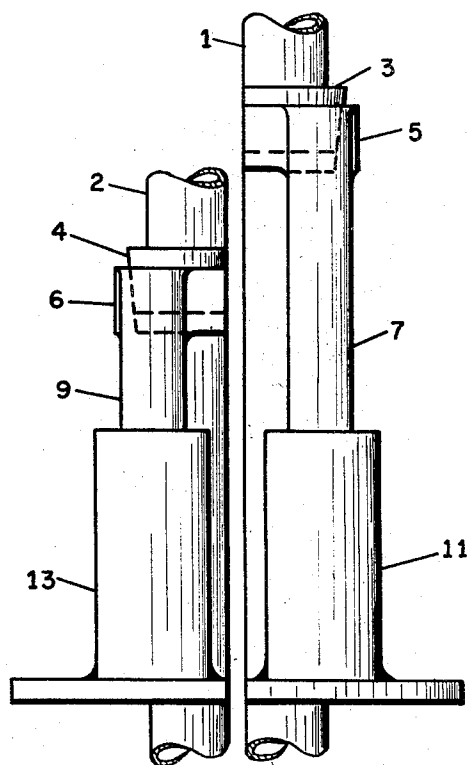


FIG. 3

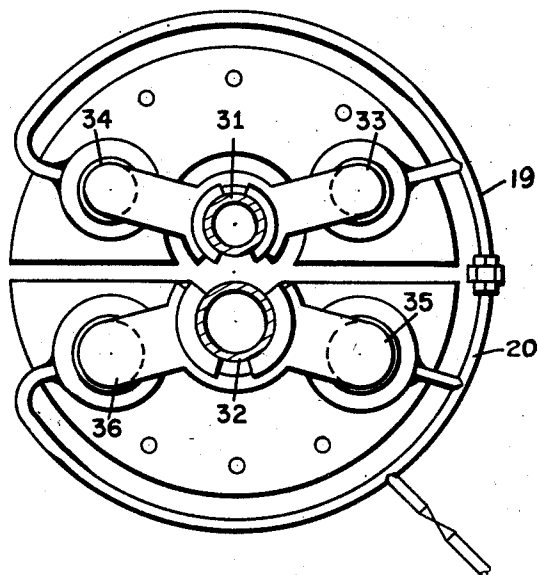


FIG. 4

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4 Sheets-Sheet 3

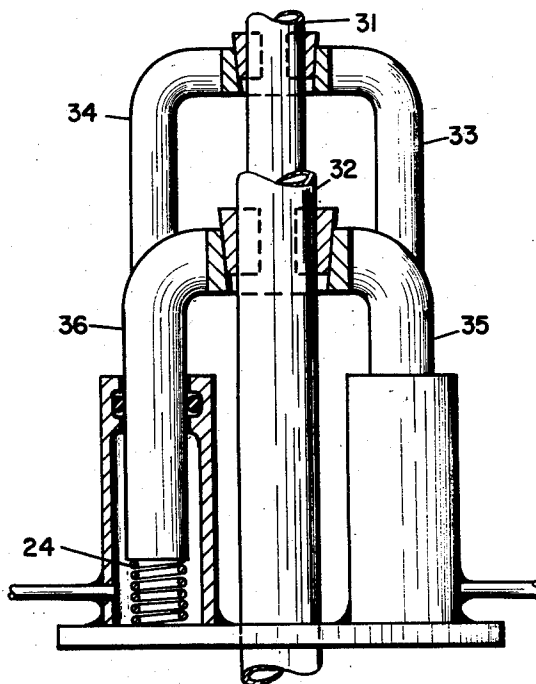


FIG. 5

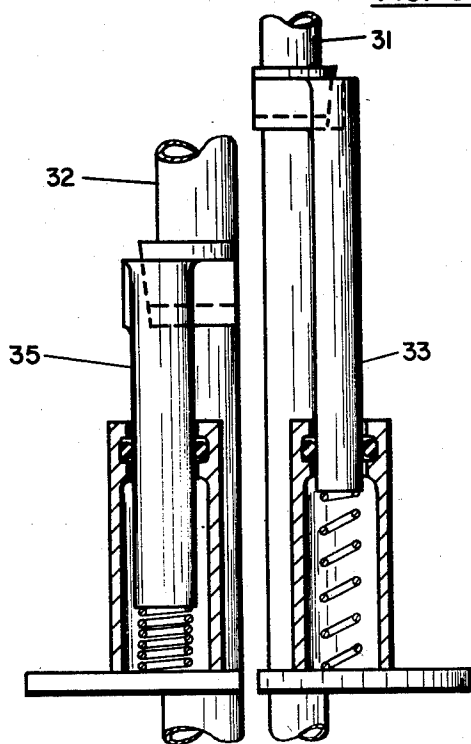


FIG. 6

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4 Sheets-Sheet 4

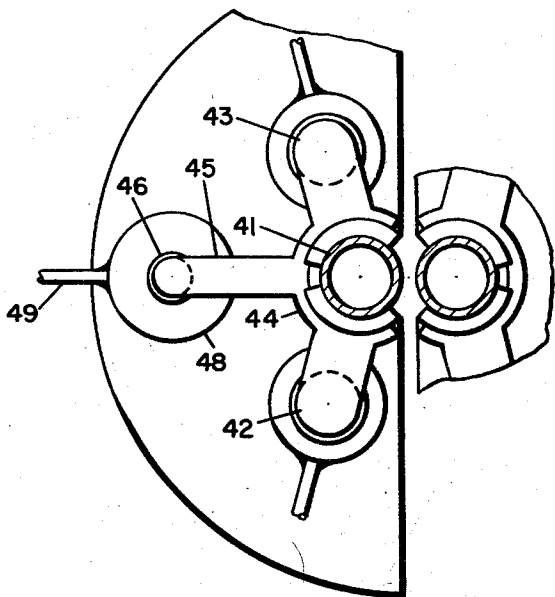


FIG. 7

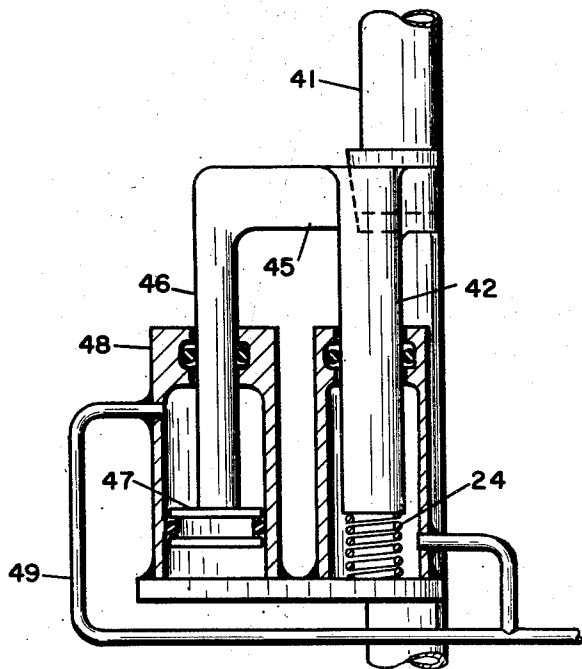


FIG. 8

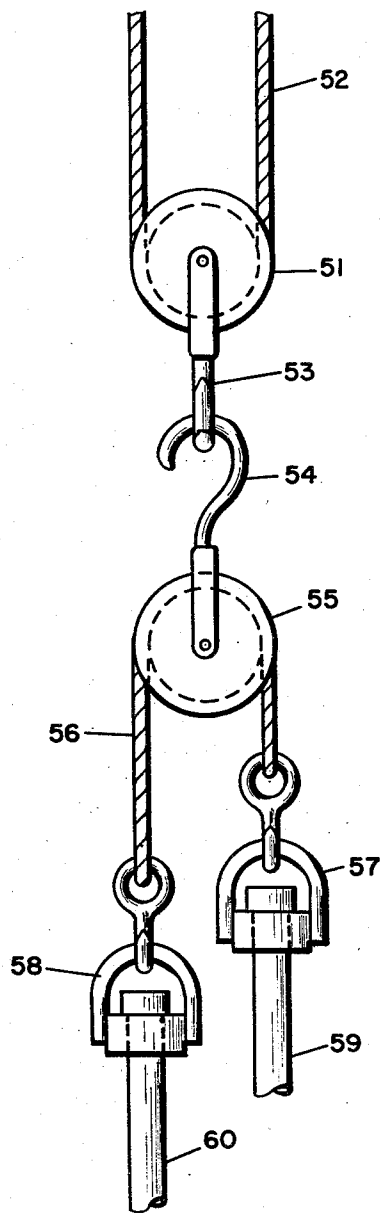


FIG. 9

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RUNNING MULTIPLE PIPE STRINGS IN WELLS

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Application June 18, 1952, Serial No. 294,155

5 Claims. (Cl. 166—75)

This invention relates to an apparatus for simultaneously running multiple strings of pipe in a well. More particularly, it relates to distributing the total weight of all such strings and their associated equipment among the various strings so that each carries approximately its own weight.

Multiple tubing strings have been run simultaneously in wells in the past. It has been the practice in such operations to clamp all the strings to one main tubing and allow the latter to support the entire weight of all equipment lowered into the well. This has been the practice in the past since in most installations only one tubing string has been of large diameter, the others being relatively small and therefore adding only a small amount to the weight of the principal string of tubing. It has also been the practice because multiple tubing strings have been run, usually in shallow wells where the weights of tubing strings are small. In some installations, however, such as the one in which a ball is pumped down one tubing and up another, the two conduits are generally of equal diameter. If the installation is run to a considerable depth, that is, around 7000 to 8000 feet, the combined weights of the strings of pipe, together with the tubing clamps, is too much to be supported by one of the strings alone unless the pipe is made of special, more expensive steel.

Recently, difficulty has been encountered due to the action of corrosion in weakening the supporting string, and due to the added pull necessary to unseat stuck packers, pumps and other bottom hole equipment. The problems, however, of seating the pipe after running, or unseating before pulling the equipment are not nearly so serious as the problems encountered in running and pulling the tubing or other pipe since considerable time may be taken in the final seating and the initial unseating operations to avoid excessive strain on any one string of tubing. During running and pulling operations, on the other hand, the weight is transferred from the elevators to the slips many times, and a single failure to balance the loads carried by the various strings can result in stripping clamps from the strings or in breaking a tubing section or joint.

It is an object of this invention to provide apparatus for running multiple strings of pipe in a well, wherein the weight is distributed among the strings. Another object is to provide apparatus for automatically adjusting to a pre-selected value, the proportion of the total load carried by the various strings of pipe in simultaneously running multiple strings in a well. A more particular object is to provide apparatus for equalizing the loads carried by two strings of pipe of approximately the same diameter while running these dual strings simultaneously in a well.

In general, I accomplish the objects of my invention by providing a separate, vertically movable support for each of the strings of pipe together with a proportioner attached to the supports to adjust the vertical positions of the supports automatically until the loads carried by the supports reach the desired proportions of the total

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weight. In the case of tubing strings of the same diameter, the proportioner becomes an evenor or equalizer which adjusts the loads carried by the strings to approximately equal values.

For purposes of this invention, a proportioner may be defined as a mechanism which distributes automatically preselected percentages of a load among various supports. An equalizer or evenor is a proportioner which distributes a load substantially equally among supports.

The drawings consist of 9 figures as follows:

Figures 1 to 3 inclusive, are three views of an embodiment of my invention applied to handling two tubing strings of equal diameter.

Figures 4 to 6 inclusive, are three views of the same embodiment as in Figures 1 to 3 applied to handling tubing strings of different diameters.

Figures 7 and 8 illustrate apparatus for balancing torque on tubing supports; this torque resulting from use of my invention.

Figure 9 is an illustration of an embodiment for balancing the loads on tubing strings supported by elevators.

Referring to Figures 1, 2 and 3 in more detail, dual tubing strings 1 and 2 are shown supported by sets of slips 3 and 4 respectively. These sets of slips are set in spiders 5 and 6 which are in turn supported by a hydraulic system including pairs of hydraulic pistons 7 and 8, and 9 and 10 respectively. The pistons fit into cylinders 11, 12, 13 and 14. Cylinders 11 and 12 are supported on plate 12a, and cylinders 13 and 14 are supported on plate 14a. The plates are in turn supported on the derrick floor, not shown. Each cylinder is provided with a hydraulic fluid supply line illustrated as lines 15, 16, 17 and 18. These lines are manifolded into pipes 19 and 20 which are joined together by means of a union 21. A supply line 22 is provided for increasing or decreasing the quantity of hydraulic fluid in the system. Valve 23 is normally closed to maintain the quantity of liquid in the system constant. Below each piston is a spring 24.

In operation, when sets of slips 3 and 4 are dropped into spiders 5 and 6 respectively, both sets of slips should grab the tubing at approximately the same time. Sometimes, however, one set grabs immediately while the other fails to prevent movement of the tubing for a fraction of a second. In this time, if spiders 5 and 6 were fixed in position, the entire weight of both strings would be supported momentarily, at least, by the set of slips which grabbed and by the tubing which this set of slips supports. The result would probably be stripped clamps and perhaps broken tubing.

In my invention, however, if one set of slips grabs and the other does not, the supporting spider carrying the slips which do set, will move downwardly forcing hydraulic fluid out of the cylinders below its supporting pistons. This fluid flows through main flow lines 19 and 20 and through connection 21 into the cylinders below the pistons supporting the spider and slips surrounding the other string of tubing. Thus, no great weight is placed on the supporting spider carrying the slips which grab until the other pair of slips also seizes its string of tubing and imposes weight on the supporting pistons to stop the flow of hydraulic fluid from one set of cylinders to the other. Flow of fluid will continue, however, until the pressures below both sets of pistons are identical. If the areas of both sets of pistons are the same, then the weights supported by both sets of slips must be the same, and consequently, the load carried by one string of tubing is the same as that carried by the other string. It will be apparent that the apparatus acts automatically as an evenor or equalizer to adjust the loads on the two strings of tubing to the same values. Springs 24 below the pistons serve to move the two supporting spiders to approximately the same level when

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the weights of the two strings are removed from these spiders. The springs support an insignificant amount of the tubing weight, thus not disturbing the equalizing of the tubing loads.

In Figures 4, 5 and 6, the apparatus is similar to that illustrated in Figures 1, 2 and 3 except that tubing strings 31 and 32 are of different sizes. Being of different sizes, they are of different strengths and should therefore bear different proportions of the total weight of both strings. This object is accomplished by supporting the smaller string of tubing 31 on hydraulic pistons 33 and 34 which have a total cross-sectional area smaller than the total cross-sectional area of pistons 35 and 36 supporting the larger tubing 32. Thus, the entire force on the small tubing is less than the entire force on the large tubing by an amount proportional to the areas of the pistons. By making the ratio of the areas equal to the approximate ratio of weights of the two strings, each string of tubing is automatically caused to support its own weight plus its proportionate share of clamps, pumps, packers and the like. The operation of this equipment is identical to that shown in Figures 1, 2 and 3.

In Figures 7 and 8, it will be noted that the center of the tubing 41 is offset from a line running between the centers of the supporting pistons 42 and 43. Therefore, the weight of the tubing 41 exerts a torque on supporting spider 44. In order to avoid transmitting this torque to the pistons, so that the latter can move smoothly in a vertical direction, arm 45 is provided on spider 44 and to this arm there is applied a downward force sufficient to balance the torque caused by the weight of the tubing. The counterbalancing torque is applied by means of piston rod 46 and piston 47 in hydraulic cylinder 48. Hydraulic fluid is supplied to cylinder 48 through line 49 which is connected to the hydraulic systems of the principal pistons 42 and 43.

In operation, as the weight of the tubing increases upon being run into the well, the pressure of the hydraulic fluid below pistons 42 and 43 will increase. This pressure is applied through the fluid connection in line 49 to the top of piston 47 to increase automatically the counterbalancing torque on spider 44. For example, if the weight of the tubing is doubled, the pressure in the hydraulic system becomes twice as great and this pressure applied to the top of piston 47 doubles the balancing torque.

The torque balancer is necessary only when the pipe is off center with respect to a line joining the centers of the pistons. Space limitations usually require such an arrangement. Use of the torque balancer can, of course, be avoided in some cases by suspending the tubing or pipe directly between the pistons.

In Figure 9, traveling block 51 is supported and actuated by line 52. The block is provided with a hook 53 which engages hook 54 of pulley 55. Line 56 runs over pulley 55. One end of line 56 supports elevator 57 and the other end supports elevator 58. These elevators engage collars on tubing strings 59 and 60.

In operation, when it is desired to lift the tubing strings, elevators 57 and 58 are latched around tubing strings 59 and 60 and traveling block 51 is actuated by means of line 52. As the elevators are lifted, elevator 58 first strikes the collar on tubing 60. Thereupon, this elevator stops while elevator 57 continues to rise. No appreciable force is exerted on tubing string 60 until elevator 57 engages the collar on tubing string 59. Thus, a load is applied to both strings of tubing simultaneously and any unbalanced load on the strings is automatically adjusted through the action of line 56 over pulley 55. It will be noted that the apparatus shown in Fig. 9 results in equal loads being applied to both strings of tubing.

Although specific illustrations of proportions and

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eveners or equalizers have been given, other embodiments of my invention will be apparent to those skilled in the art. The scope of my invention should be limited therefore, only by the claims.

I claim:

1. Apparatus for simultaneously running and supporting multiple strings of pipe in a well comprising at least two individual, vertically-movable supports each adapted to support one of said strings, a hydraulic system including hydraulically actuated pistons for carrying and moving each of said supports, the ratio of the area of the pistons moving a support, to the total area of all pistons, being equal to the desired fraction of the total load to be carried by that support, and an unobstructed fluid connection joining together all said hydraulic systems whereby the load carried by each support is automatically adjusted to said desired fraction of the total load.

2. Apparatus for simultaneously running and supporting multiple strings of pipe of approximately the same diameters in a well comprising an individual vertically movable support for each of said strings, a hydraulic system including hydraulically actuated pistons for carrying and moving each of said supports, the areas of the pistons moving each support being equal to the areas of the pistons moving each other support, and an unobstructed fluid connection joining together all said hydraulic systems whereby the loads carried by the supports are equalized.

3. Apparatus for simultaneously running and supporting dual strings of pipe in a well comprising an individual, vertically movable support for each of said strings, a hydraulic system including hydraulically actuated pistons for carrying and moving each of said supports, the ratio of areas of the pistons moving the supports being equal to the desired ratio of string loads to be carried by the respective supports, and an unobstructed fluid connection between said hydraulic systems whereby the ratio of loads carried by the supports is automatically adjusted to said desired ratio.

4. Apparatus for simultaneously running and supporting dual strings of pipe of substantially the same diameters in a well comprising a separate, vertically movable support for each of said strings, two hydraulic systems including hydraulically actuated pistons of substantially equal areas for carrying and moving said supports, and an unobstructed fluid connection between said hydraulic systems whereby the loads carried by the supports are equalized.

5. Apparatus for simultaneously running and supporting dual strings of pipe of substantially the same diameters in a well comprising a separate, vertically movable support for each of said strings, a hydraulic system including hydraulically actuated pistons for carrying and moving said supports, each of said strings of pipe being off center with respect to said pistons carrying said supports, auxiliary hydraulic systems including at least one hydraulically actuated piston for counterbalancing the torque on the support due to said off center relationship, and an unobstructed fluid connection joining together all hydraulic systems whereby the force exerted by each piston is automatically adjusted with respect to that exerted by each other piston.

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