

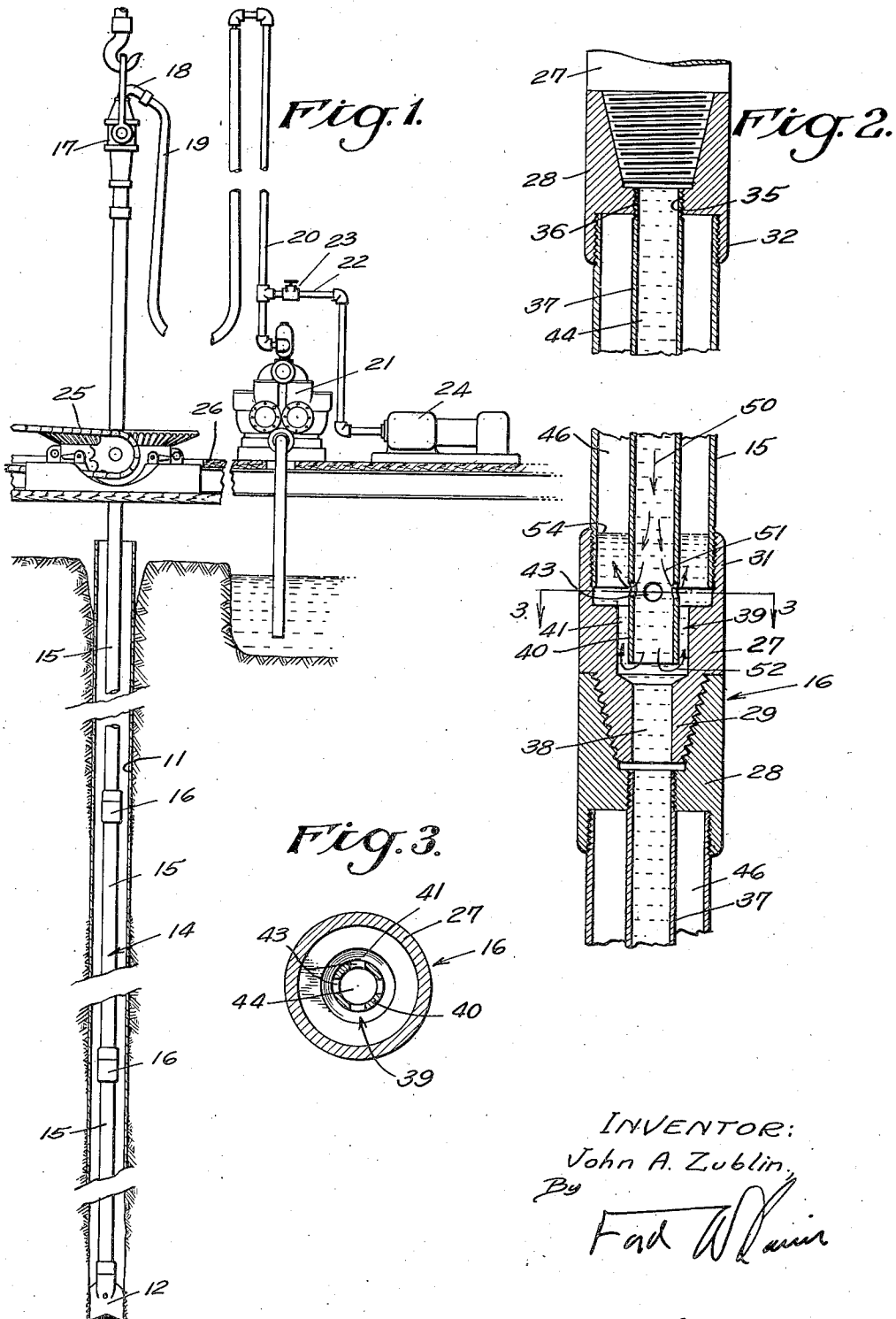
April 21, 1931.

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1,801,788

WEIGHT RELIEF AND FLUID CONTROL ON DRILL PIPE

Filed April 22, 1929



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Application filed April 22, 1929. Serial No. 357,010.

My invention relates to a column or a drill pipe such as used in the oil-producing industry, having means for rendering the column buoyant in order to reduce the weight which must be supported by the upper end of the column, and for the reducing pump pulsation.

In order that the advantages of my invention may be readily understood I shall briefly refer to the well-drilling industry, in which my invention is useful. According to present practice, the drill pipe is extended into the well, there being a bit at the lower end of the drill pipe and there being rotating means such as a rotary machine engaging the drill pipe where the drill pipe extends through the floor of the derrick. A swivel head is connected to the upper end of the drill pipe by which the drill pipe is supported and by which rotary mud is pumped into the well through the drill pipe. This rotary mud passes through openings in the bit and passes upward through the well around the drill pipe, carrying the cuttings to the surface of the ground, preventing caveins, and floating the drill pipe away from the wall of the well.

It is common practice to drill wells over six thousand feet deep. In view of the enormous torque which must be transmitted through the drill pipe to the bit it is necessary to make the walls of the drill pipe heavy enough to withstand such torque. According to the ordinary method of drilling, a portion of the weight of the drill pipe is supported by the bit in order that there may be a cutting action. The remaining portion of the weight of the drill pipe is carried by the swivel head of the derrick. Because of the great weight of the drill pipe which must be largely supported by the swivel head there is a tendency for the drill pipe to separate at the tool joints. There is also a possibility that the elastic limit of the pipe may be exceeded. For example we may assume that the length of pipe is of such a weight that the elastic limit of the metal is reached. If the bit sticks in the well it is necessary to lift upward on the upper end of the drill pipe to free it. Since the drill pipe is already at

its elastic limit the additional force to raise the drill pipe exceeds the elastic limit thereof and results in a breakage. As wells are drilled deeper this tendency to separate increases.

It is an object of my invention to provide a drill pipe which is partly or fully floating so that it is not necessary to support most of the weight of the drill pipe from the upper end thereof. The advantage of a construction embodying this object is that the tendency for the drill pipe to pull apart will be relieved to the extent that there will be no danger of such a separation occurring.

As pointed out heretofore it is ordinary practice to circulate mud through the well. At a depth of about six thousand feet the pressure per square inch of the rotary mud is around three thousand pounds. So long as the pressure within the drill pipe and outside the drill pipe is in balance there is no preponderance of forces tending to collapse or disrupt the drill pipe. If, however, it is attempted to form gas chambers in the drill pipe in order to obtain buoyancy it is necessary for the gas chambers to contain a gas under a pressure of substantially the same pounds per square inch as the external rotary mud. Unless there is this balance of pressure, there will be collapsing forces on the drill pipe.

It is an object of my invention to provide a drill pipe having gas chambers or flotation chambers in which the pressure is substantially the same as the external pressure on the drill pipe.

The pressure of the rotary mud increases in a ratio directly proportionate to the increase in depth of the well; therefore it will be seen that at the lower end of the drill pipe the pressure in the gas chambers must be greater than the pressure in the gas chambers near the upper end of the well, in order that a balance with the external pressure of the rotary mud may be obtained.

It is an object of my invention to provide a drill pipe in which the gas chamber pressure is automatically maintained substantially the same as the external pressure at a corresponding level.

It is necessary upon commencing drilling operations with the drill pipe of my invention to fill the gas chambers with gas and it is further necessary to maintain these gas chambers filled with compressed gas.

It is one of the objects of my present invention to provide a method of supplying gas to the gas chambers and of maintaining the desired quantity of gas in the various gas chambers during the operation of the drill pipe.

When the rotary mud is under high pressure every reciprocation of the pump plunger causes a rather severe vibration or pulsations. This is due to the fact that the rotary mud is an inelastic fluid. It is these pulsations that usually cause a breakage of the flexible hose of the apparatus. It sometimes happens that the openings in the bit through which the rotary mud passes will become clogged, and the pressure in the drill pipe will instantaneously build up to such a point that the rotary hose will be burst.

It is an object of my invention to provide the drill pipe with one or more chambers filled or partly filled with a compressible fluid which acts as a shock absorber or pulsation absorber.

When this feature of my invention is embodied in the drill pipe there will be no severe pulsations and when the openings in the bit are clogged, pressure will not instantaneously build up to a pressure greater than the rotary hose can handle but will gradually build up. As the pressure builds up the pump will operate slower, this acting as a signal to warn the operator that something is wrong. This will enable the operator to shut down the pump before the rotary pump has burst or any other damage has occurred.

Another of my objects is to provide a novel tool joint for drill pipe which facilitates the use of an inner tube which forms the gas chambers.

Other objects of my invention reside in the details of construction of the preferred form of my invention. In the following description which presents the preferred form of my invention these various other objects will be made manifest.

Referring to the drawings in which my invention is illustrated:

Fig. 1 is a utility view showing the drill pipe of my invention and showing the apparatus necessary for the performance of the method of my invention.

Fig. 2 is a section through a portion of drill pipe which incorporates the features of my invention.

Fig. 3 is a section taken on the line 3—3 of Fig. 2.

Referring to the drawing in detail, the numeral 11 represents a well which is being drilled by means of a bit 12 secured to the lower end of a drill pipe 14 which incor-

porates the features of my invention. This drill pipe 14 consists of lengths of pipe 15 secured together by tool joints 16. Connected to the upper end of the drill pipe 14 is a swivel head 17, by means of which a portion of the weight of the drill pipe may be supported. The swivel head 17 has a gooseneck 18 to which a flexible hose 19 is secured. The flexible hose 19 is connected to a stand pipe 20 which is also connected to a slush pump 21. A branch pipe 22 having a valve 23 is connected to the stand pipe 20, this branch pipe 22 being also connected to a gas supply means, such as an air compressor 24.

The drill pipe 14 is rotated by means of a rotary machine 25 supported on the floor of a derrick 26.

In Figs. 2 and 3 in which the details of the drill pipe 14 are illustrated, the tool joint 16 consists of a primary part 27 and a secondary part 28. The primary part has a threaded pin 29 which is screwed into a threaded socket or box of the secondary part. The upper end of the primary part is provided with an internally threaded flange 31 into which the lower end of a length of pipe 15 is screwed, and the secondary part 28 has a lower internally threaded flange 32 into which the upper end of a length of pipe 15 is screwed.

The secondary part 28 has a threaded opening 35 connecting to the box thereof and threaded into this opening 35 is an upper threaded end 36 of a tube 37. The primary part 27 is provided with a passage 38, the upper end 39 of which is slightly enlarged to receive a lower end 40 of the tube 37. The external diameter of the tube 37 is smaller than the diameter of the enlargement 39 and therefore an annular space 41 is formed around the lower end of the tube 37. A plurality of openings 43 are formed in the lower end of the tube 37, as shown.

The tube 37 provides a passage 44 which cooperates with the passage 38 to provide a continuous passage from the swivel head 17 to the bit 12. Through this passage rotary mud passes from the surface of the ground to the bottom of the well. In each length of pipe 15 surrounding the tube 37 therein is an annular gas chamber 46. The upper end of the gas chamber 46 is sealed by reason of the upper end of the tube 37 screwing into the threaded opening 35. The lower end of the gas chamber 46, however, is in communication with the passage 44 by reason of the openings 43 and the annular space 41.

In the drill pipe 14 incorporating the invention just described every section of the drill pipe may be formed as shown in Fig. 2. It may be satisfactory, however, to construct the drill pipe so that only certain sections are provided with the gas chambers 46, according to the needs of a particular condition and according to the weight of the drill pipe which is being used. It may be laid

down as a rule, however, that sufficient gas chambers 46 should be provided in order to relieve the weight which must be supported by the swivel head 17 to the extent that there will be no danger of the joints of drill pipe being separated.

After the drill pipe has been installed in the well as illustrated in Fig. 1, the slush pump 21 is set into operation, in order to force rotary mud through the drill pipe to the bit 12. The air compressor 23 is also set into operation and the valve in the branch pipe 22 is opened and a quantity of compressed gas is passed into the stream of rotary mud flowing through the stand pipe 20. This rotary mud having the compressed gas mixed therewith passes downward through the passage of the drill pipe. Due to the difference in specific gravities of the rotary mud and the compressed gas there is always a tendency for the compressed gas to rise relative to the rotary mud. The rotary mud and compressed gas pass downward through the passage as indicated by arrows 50 in Fig. 2.

The gas bubbles have a tendency of passing through the openings 43 and through the annular space 41 and into the gas chamber 46, as indicated by arrows 51 and 52. The gas, therefore, is caused to fill the gas chamber 46, the rotary mud assuming a level substantially as indicated at 54 in Fig. 2. As previously pointed out the rotary mud passes from the bit 12 and upward through the well around the drill pipe 14 to the surface of the ground. When the operator observes that bubbles of compressed gas are rising in the well around the drill pipe 14 he will know that the gas chambers 46 have been filled with gas. The operator will then close the valve in the branch line 22 and shut down the compressor 24. The gas chambers may also be filled by operating the air compressor 24 without the slush pump 21. The gas is forced downward through the drill pipe, filling all of the gas chambers 46. When the gas chambers 46 have been filled, the gas will pass from the openings in the bit 12 and upward through the well around the drill pipe. The operator will then know that the chambers are filled and he will then put the slush pump 21 into operation. It is desirable at certain intervals to again start up the compressor 24 and open the valve in the branch pipe 22 so that if leakages have occurred in any of the chambers 46 they may be refilled with compressed gas.

Due to the difference in the specific weight of the compressed gas and the rotary mud, buoyancy is provided, which will float or support a portion of the weight of the drill pipe, thus relieving the weight at the swivel head 17. This is effective in reducing the tendency for the sections of the drill pipe to be separated.

Due to the fact that the gas chambers 46

of the drill pipe 14 are in communication with the passage through the drill pipe 14 the gas in the gas chambers will be maintained at the same pressure as the rotary mud in the passage at that level. The pounds pressure per square inch of the rotary mud in the passage is the same as the pounds pressure per square inch of the rotary mud around the drill pipe. Therefore, the pressures in the passage and the chambers 46 and surrounding the drill pipe will be the same. In other words, these pressures are in balance so that there are no forces tending to collapse or disrupt either the length of pipe 15 or the tube 37 which forms a part of each section of the drill pipe 14.

As pointed out in the objects of this invention the gas chambers act as shock absorbing means and absorb the pulsations of the slush pump 21. This prevents severe vibrations and severe strains from being imposed on the parts of the apparatus and eliminates knocking in the slush pump. Should the openings in the bit 12 become clogged the pressure of the rotary mud will be gradually raised. This is due to the fact that the bodies of gas in the gas chambers 46 will gradually be compressed to a greater extent. As the pressure increases the slush pump will labor harder and the operator will know that something has occurred which is increasing the pressure in the rotary mud system. The slush pump may be shut down before the rotary hose has been burst. This not only avoids damage being done to the apparatus but prevents any injury to workmen on the derrick floor.

I claim as my invention:

1. A method of rendering buoyant a column having a passage and a chamber connected at its lower end to said passage, said method consisting in: passing a rotary mud and a gas through said passage, said gas flowing into and being trapped in said chamber, and said rotary mud passing through said passage.

2. In apparatus for drilling wells, the combination of: a drill pipe adapted to be extended into a well; a pump for delivering an incompressible fluid under pressure to said drill pipe; means for pumping a gas into said drill pipe; and means embodied in said drill pipe for absorbing the pulsations of said pump.

3. In apparatus for drilling wells, the combination of: a drill pipe adapted to be extended into a well; a pump for delivering an incompressible fluid under pressure to said drill pipe; means for pumping a gas into said drill pipe; and walls forming a compressible gas chamber in said drill pipe, said compressible gas chamber containing a compressible gas adapted to absorb the pulsations of said pump.

4. In well drilling apparatus, the com-

combination of: a drill pipe having walls forming air chambers and a fluid passage, said air chambers communicating with said fluid passage at points below their upper ends; means
5 for forcing a drilling fluid through said fluid passage; and a pump for forcing a gas into said fluid passage.

5. In well drilling apparatus, the combination of: a drill pipe having walls forming air chambers and a fluid passage, said
10 air chambers communicating with said fluid passage at points below their upper ends; a swivel at the upper end of said drill pipe; a tubular member connected with said swivel
15 for the introduction of fluids into said drill pipe; a liquid pump connected to said tubular member; and a gas pump connected to said tubular member.

In testimony whereof, I have hereunto set
20 my hand at Los Angeles, California, this 16th day of April, 1929.

JOHN A. ZUBLIN.

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