July 12, 1960 O. W. LE GATE 2,944,789

AUTOMATIC CONTROLS FOR WELL DRILLS

Filed Sept. 28, 1959

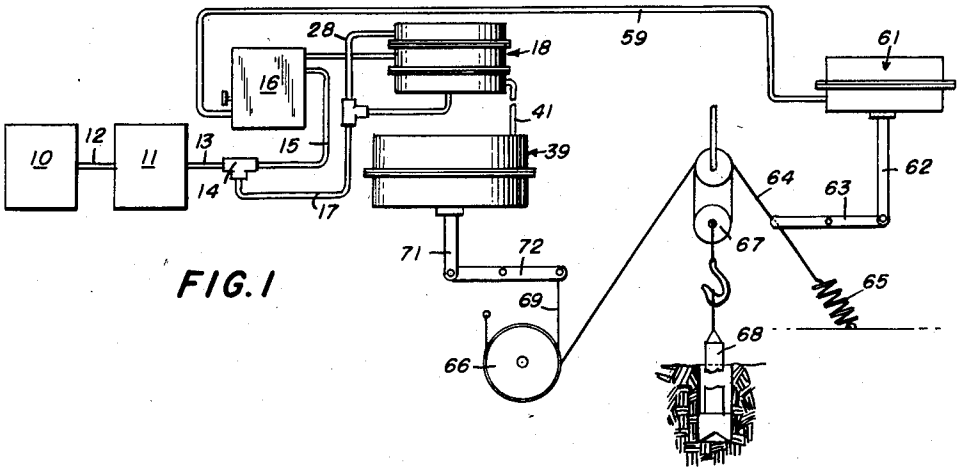


FIG. 1

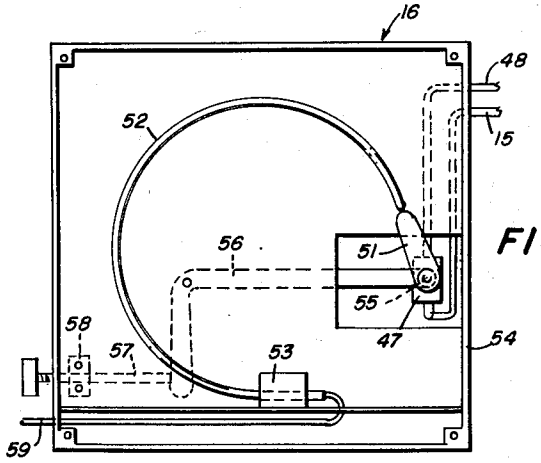


FIG. 2

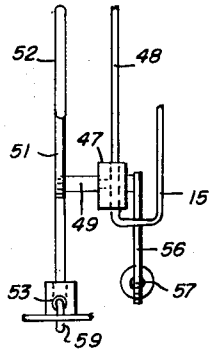


FIG. 3

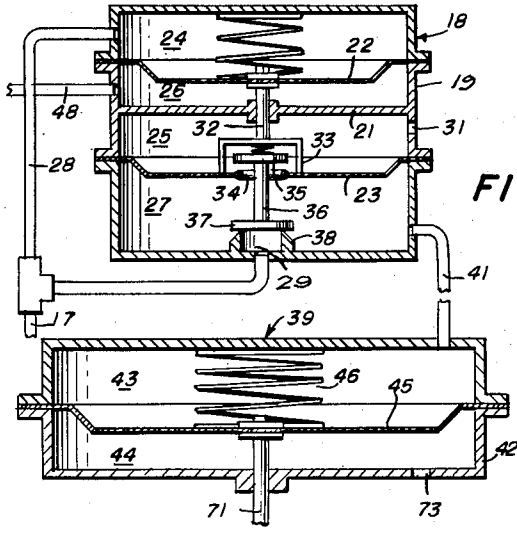


FIG. 4

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United States Patent Office 2,944,789 Patented July 12, 1960

2,944,789

AUTOMATIC CONTROLS FOR WELL DRILLS

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Filed Sept. 28, 1959, Ser. No. 842,819

2 Claims. (Cl. 254—173)

The present invention relates to automatic controls for well drills, and more particularly to vacuum-operated mechanism for controlling the advance of a rotary drilling tool into the ground. The control is responsive to the weight of the suspended drill pipe and is designed to insure, within desired limits, optimum pressure on the drill bit as it is lowered.

As the operation of drilling a well proceeds, the weight of the drill string or pipe becomes progressively greater, and, if not properly suspended and lowered, the pressure of the drill string on the drill bit will either be too great, resulting in rapid deterioration thereof, or too light to perform efficient drilling. It is, therefore, an object of this invention so to control the feed of the drill bit that undue pressure thereon is avoided and, at the same time, the pressure imposed on the tool will be sufficient to promote ideal drilling conditions.

Another object of the invention is to provide vacuum-actuated brake releasing means for the conventional cable drum, these releasing means being responsive to a novel form of control valve which in turn is responsive to the weight imposed on the feed cable.

Other objects will be apparent from the following description when taken with the accompanying drawings in which

Fig. 1 is a diagrammatic view of the assembled components of the invention;

Fig. 2 is an elevation of a control valve and actuator therefor forming part of the apparatus;

Fig. 3 is a fragmentary side view of the mechanism shown in Fig. 2; and

Fig. 4 is an elevation, partly in section, of the vacuum-operated brake actuator.

Referring to Fig. 1 of the drawings, it will be seen that a vacuum pump **10** is in communication with a vacuum reservoir **11** through conduit **12**, suitable controls (not shown) being associated therewith to maintain a desired degree of vacuum in the reservoir. Pipe **13** terminates in a T-coupling **14** to which is connected pipe **15** leading to control valve **16** and pipe **17** leading to vacuum-actuated relay motor **18**. The relay motor comprises a housing **19** having a dividing wall **21** to form upper and lower chambers. Each of these chambers is likewise divided by diaphragms **22, 23** into upper chambers **24, 25** and lower chambers **26, 27**. Pipe **28** connects vacuum line **17** with chamber **24** above the upper diaphragm **22**. Line **17** also leads to a port **29** at the bottom of housing **19**. Chamber **25** communicates with atmosphere through opening **31**. Connected to diaphragm **22** is a stem **32** having a cage **33** secured to its lower end, the cage in turn being fastened to diaphragm **23**. Thus, it will be seen, the diaphragms are constrained to move together. Diaphragm **23** is provided with an opening **34**, the periphery of which forms a seat for valve head **35**. A second stem **36** connects valve head **35** with another valve head **37** adapted to cooperate with valve seat **38** above port **29**. Chamber **26** communicates with control valve **16** and chamber **27** is connected to

a brake actuator **39** through conduit **41**. The brake actuator comprises a housing **42** divided into chambers **43, 44** by diaphragm **45**, the latter being normally held in brake-applying position by spring **46**.

Referring to Figs. 2 and 3, the control valve **16** includes a coupling **47** having connected thereto pipe **15** communicating with reservoir **11** and conduit **48** leading to the underside of top diaphragm **22** of the relay motor. Coupling **47** is provided with a branch passage **49**, the open end of which is normally closed by leaf **51** secured to the terminal end of Bourdon tube **52** mounted in bracket **53** in the casing **54**. Leaf **51** is provided with an aperture **55** normally out of register with the open end of branch **49** so that, as long as this branch is not open to the atmosphere, both upper and lower chambers **24, 26** of the relay are in communication with reservoir **11**. The position of coupling **47** may be adjusted by means of bell-crank **56** on which the coupling is mounted, adjustment thereof being effected by screw **57** threaded in fixed nut **58** in the casing **54**, the screw abutting one arm of the bell-crank.

Bourdon tube **52** connects through conduit **59** with a weight-responsive fluid motor **61**, this motor having a diaphragm or piston operatively connected by rod **62** and lever **63** to the dead end of cable **64**. The cable is secured to a fixed portion of the derrick by a resilient connection such as spring **65** or the like. A suitable length of cable is wound on drum **66** and, by means of block **67** secured to the derrick, the cable suspends the drill string **68**. Brake **69** normally prevents the drum from rotating, but, when it is released, the weight of the drill string unwinds the cable until the brake is again applied. As long as the pressure on the drill bit is maintained within desired limits, the advance of the tool will be gradual. But if for any reason this pressure falls below these limits, the pull of the weight of the drill string will actuate the weight indicator or motor **61**. Movement of the diaphragm or piston in this motor will then be transmitted through a suitable fluid to Bourdon tube **52** and leaf valve **51**. Opening **55** will then register with conduit **49** permitting air at atmospheric pressure to enter the lower chamber **26** of relay **18**. Since the upper chamber **24** of the relay is in communication with the source of vacuum, diaphragm **22** will rise and elevate diaphragm **23** to a position where valve head **35** will be engaged by valve seat **34** closing chamber **27** to atmospheric pressure. Further upward movement of diaphragm **23** raises both valve heads **35** and **37**. When valve **37** is lifted from seat **38**, the pressure in chamber **27** is lowered and, at the same time, chamber **43** in the brake actuating motor is placed in communication with the source of vacuum through conduit **41**. Diaphragm **45** will then move connecting rod **71** upwardly and, through lever **72**, will release brake **68** to permit the cable to unwind from drum **66**. When the drill bit again encounters resistance, the pull of the weight of the drill string will be reduced and motor **61** will be reversed, thus returning leaf valve **51** to a position in which the branch conduit will be closed. Relay **18** will then be returned to its normal position with the pressures on opposite sides of the diaphragm being equalized. In this latter position of the relay diaphragms are lowered to seat valve **37** and unseat valve **35**. A suitable air drain aperture **73** in the wall of lower chamber **44** is provided to permit the brake actuating diaphragm to return to brake applying position.

From the foregoing description it will be understood that controlled feed of the drill bit may be regulated within desired limits and that regulation is readily effected by adjustment of the control valve. The application and release of the cable drum brake is effectively controlled

by vacuum-actuated apparatus responsive to the weight of the drill string.

While a preferred embodiment of the invention has been illustrated and described, it is intended that modifications thereof are contemplated and may be employed without departing from the essential arrangement of component parts of the apparatus as expressed in the appended claims.

What is claimed is:

1. Automatic control apparatus for regulating the feed of a drilling string and associated tool comprising a drum, a cable wound on said drum and suspending said tool, a brake for said drum, a source of vacuum, vacuum-actuated means communicating with said source for releasing said brake to unwind said cable, a relay valve for controlling the degree of vacuum applied to said brake releasing means, a balanced vacuum-operated motor adapted to actuate said relay valve, and other valve means responsive to the weight of said drill string for modifying the pressures in said motor whereby said motor moves said valve to actuate said brake releasing means.

2. Automatic control apparatus as claimed in claim 1 in which said other valve means comprises an apertured leaf having a portion normally closing said source of vacuum to atmosphere and movable to a position to open said source to atmosphere.

References Cited in the file of this patent

UNITED STATES PATENTS

1,867,078	Kazenmaier	July 12, 1932
1,932,649	Trachsel	Oct. 31, 1933
2,455,917	Crake	Dec. 14, 1948