Feb. 28, 1967 R. W. PAYNE 3,306,376

DRY CHEMICAL INJECTOR

Filed Aug. 14, 1964 2 Sheets-Sheet 1

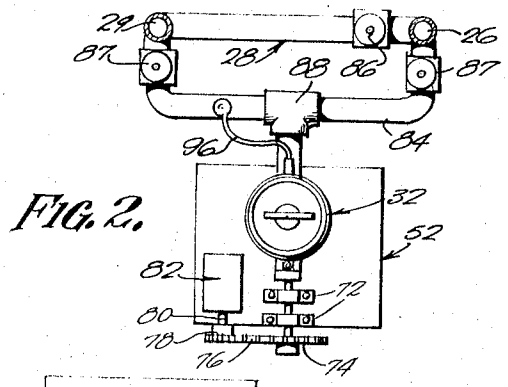

FIG. 2.

FIG. 1.

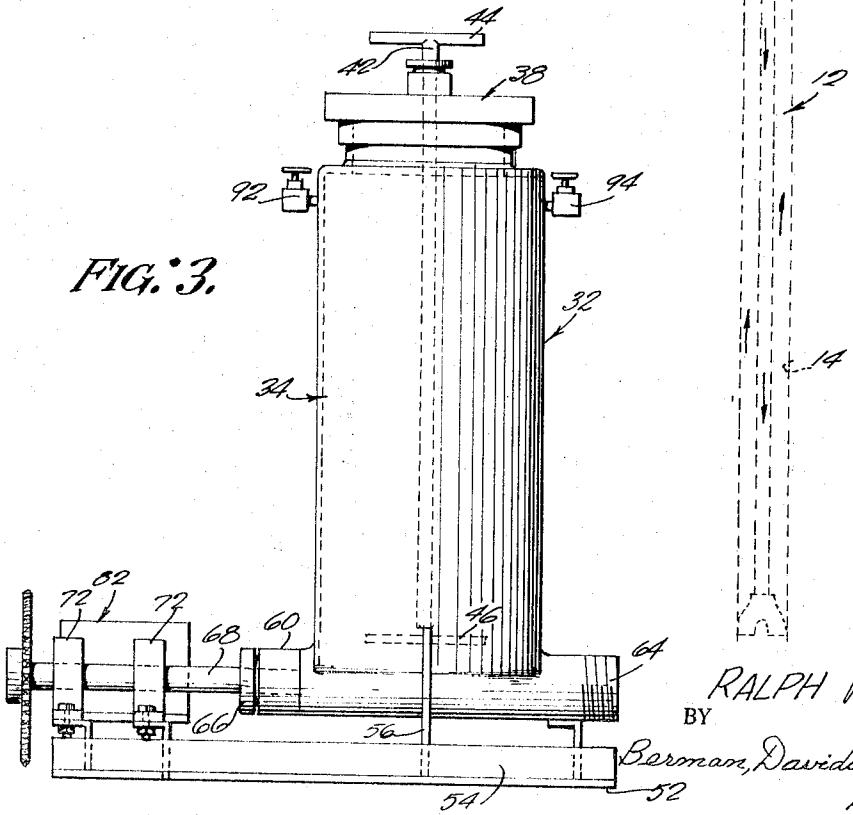

FIG. 3.

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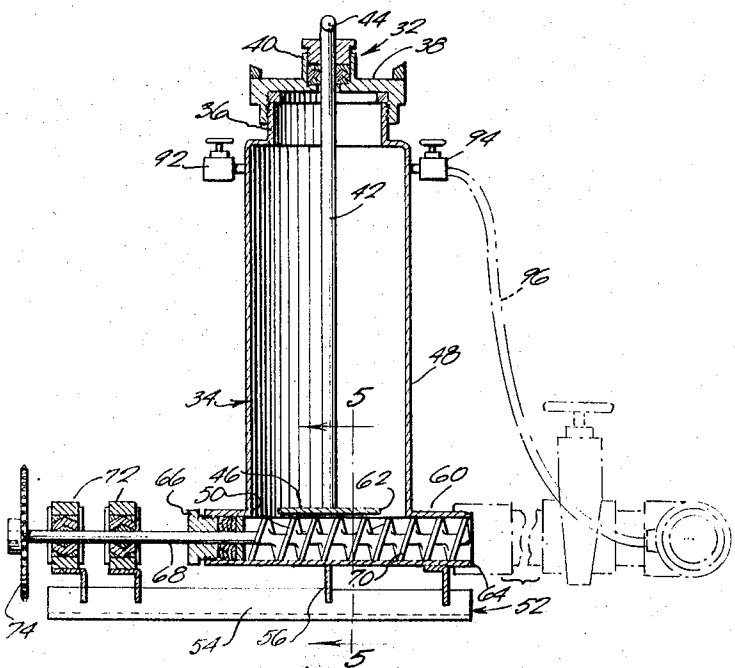

FIG. 4.

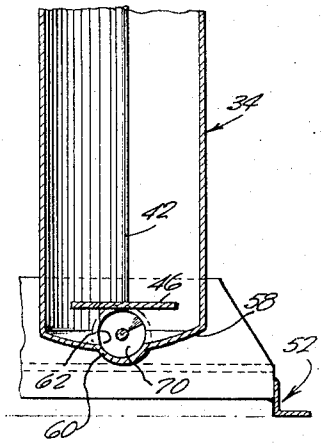

FIG. 5.

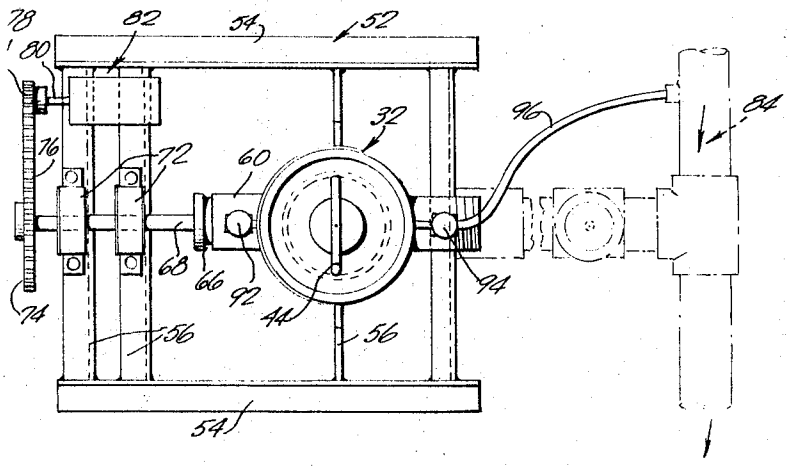

FIG. 6.

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DRY CHEMICAL INJECTOR

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6 Claims. (Cl. 175—206)

This invention relates to a dry chemical injector for oil and gas wells.

It has been the practice in drilling oil and gas wells to force air or gas down into the well bores for the purpose of circulating upwardly and removing cuttings from the well bores. This air or gas flow has also been used to carry dry chemicals, in powder or flake form, such as metallic soaps containing such as aluminum, calcium, zinc, or lithium stearate, down through the drill string, for purposes, such as:

(a) In the event of entry of water into the well bore, from porous formation, preventing gumming and balling up of formation cuttings and serving as anti setting agents, and so as to coat the cuttings, so as to enable the air or gas streams to clear the well bore;

(b) To lubricate bearings and drill bits and to reduce torque in the rotary drill string, using graphite in powder or flake form;

(c) Speed up the drying of a wet bore, using silica gel;

(d) To reduce torque in a drill string resulting from a crooked well bore or a weeping formation or formations, using combinations of the above mentioned chemicals.

The injecting means, whether using air or gas, thus far used, has been crude, inefficient, and in the case of use of gas, dangerous and difficult to handle.

The primary object of the present invention is the provision of an efficient, safe, economical chemical injector of the kind indicated above, wherein the flow of chemicals is accurately metered, within a readily controlled range of flow.

Another object of the invention is the provision of an injector of the character indicated above, which involves a substantially closed system, wherein an air motor driven auger is employed to move the dry chemicals from a hopper to the drill string, in such a manner that the chemicals are fed into the air or gas stream, by controlled rates of rotation of the auger, there being no differential of air or gas pressure, at either end of the auger, the speed of rotation of the auger being accurately controllable within a specified range of, for example, 2 to 35 R.P.M.

In the drawings:

FIGURE 1 is a schematic side elevation showing an injector assembly of the present invention connected to an air or gas hose which is connected to the upper end of the drive of a drill string, which extends down into a well bore;

FIGURE 2 is a schematic top plan view of FIGURE 1, on a reduced scale;

FIGURE 3 is a side elevation, on an enlarged scale, of the injector;

FIGURE 4 is a vertical transverse central section taken through FIGURE 3, and showing, in phantom lines, members connected thereto;

FIGURE 5 is a central vertical transverse section taken through FIGURE 4 on the line 5—5; and

FIGURE 6 is a top plan view of FIGURE 4.

Referring in detail to the drawings, there is shown (in FIGURE 1) a well head **10**, above the ground G, on the upper end of a well casing **12**, which extends downwardly into a well bore **14**. A drill string **16** extends concentrically down through the casing **12** and extends up above the well head **10**, and through a drive member **18**, supported on a table **20**. An air or gas discharge

pipe **22** leads laterally from the head **10** for discharging from the casing **12**, cuttings from the well bore, present in the discharged air or gas.

An air or gas hose **24** is connected, at one end, to the upper end of the drill string **16**, and is connected, at its other end, to the upper end of a vertical arm **26** of a flow pipe **28** through which air or gas is forced, from a suitable source, such as a compressor **30**, in the direction of the arrows, in FIGURES 1 and 6, through a pipe **29**.

An injector **32** is interposed in the flow pipe **28**, between the compressor **30** and the vertical arm **26** thereof. The injector **32** comprises a vertically elongated cylinder or hopper **34**, having a reduced diameter upper portion **36**, the open upper end of the portion **36** being closed and sealed by a cap type head **38**. The head **38** incorporates a central packing gland **40**, through which works a rod **42** having a horizontal handle bar **44**, on its upper end. The rod **42** extends down through the cylinder **34** and has fixed, on its lower end, a horizontal circular baffle plate **46**, which is smaller in diameter than the inside diameter of the cylinder. The baffle plate **46** defines, with the side wall **48** of the cylinder, an annular controlled discharge channel **50**, for comminuted chemical material contained in the cylinder **34**, and which is to be controllably discharged into the flow pipe **28**.

The cylinder **34** is upstanding on a ground-support frame **52**, having parallel spaced side members **54**, and cross members **56**, the frame being substantially wider than the cylinder, as shown in FIGURE 6.

The cylinder **34** has a concave-convex bottom wall **58**, seen in FIGURE 5, which is mutilated and extended to form a horizontal transverse centrally located auger tube **60**, which extends beyond opposite sides of the cylinder **24**, and opens, at its top, as indicated at **62**, in FIGURE 4, to the lower part of the cylinder, so as to receive chemical material, via the channel **50**.

The output or discharge end of the auger tube **60** is open, as indicated at **64**, but its other end is closed by an adjustable packing gland **66**, through which turns an elongated, reduced diameter auger shaft **68**, the latter extending from the adjacent end of an auger screw **70** which works closely in the tube **60**.

Fixedly supported on cross members of the frame **52**, is a pair of longitudinally spaced bearings **72**, through which the auger shaft **68** extends. The shaft **68** terminates in a relatively large diameter sprocket wheel **74**, over which is trained a chain **76** which is trained also over a smaller diameter sprocket wheel **78**, on the drive shaft **80**, of a motor **82**, preferably an air-driven motor, mounted on the frame **52**. When the motor **82** is in operation, the auger screw **70** is rotated in a direction, and at a desired speed, to convey chemical material from the cylinder **34**, and the open end of the tube **60**, into a bypass pipe **84**.

The bypass pipe **84** is connected, at its ends, to spaced points along the flow pipe **28**, at opposite sides of an adjustable flow valve **86**, which is incorporated in the flow pipe **28**. Adjustable valves **87** are incorporated in the bypass pipe **84**, where the ends thereof join the flow pipe **28**. The connection of the auger tube **60** with the bypass pipe **84** is effected through a fitting **88**. The valves **86** and **87** are adapted to be adjusted to determine the desired flow of chemical material from the cylinder **34** and air or gas in which the material is entrained, whereby a controlled and variable flow of air or gas and chemical material into the drill string **16** is obtained.

The cylinder **34** is provided, adjacent to its upper end, on one side with an adjustable relief valve **92**, and, on its other side with an adjustable air control valve **94**. The air control valve **94** is connected by a hose **96**, with

the bypass pipe 84, at a location, as shown in FIGURE 2, which is upstream, relative to the direction of the flow of the flow of the air or gas coming from the compressor 30. This arrangement has the desired effect of equalizing air or gas pressure, within the cylinder 34 and the flow pipe 28.

The baffle plate 46 is adapted to be elevated or depressed, relative to the auger screw 70, for the purpose of adjusting the discharge of chemical material from the injector cylinder 34 into the auger tube 60, by manipulating the handle 44.

In operation, the injector assembly being in operation, the chemical bearing air or gas passes down through the drill string 16 to the lower end of the drill string, from which it passes outwardly and upwardly, between the string and the well bore, and treats the sidewall of the well bore and the cuttings present in the bore, as hereinbefore outlined; and then passes upwardly to the well head 10 and to a place of disposal, through he pipe 22.

What is claimed is:

1. In combination with a well bore, a well head having a discharge pipe, a table overlying the well head and carrying a drive, a drill string extending operatively through the drive and down through the well head into the well bore; of a compressor having an output side, a flow pipe connected to said output side and connected to the upper end of the drill string, an injector for comminuted chemical material comprising a closed cylinder adapted to hold such material, a conveyor associated with and open to the cylinder to receive material therefrom, a bypass pipe connected to the flow pipe at points spaced along the flow pipe, said conveyor opening into the bypass pipe.

2. The combination of claim 1, wherein an air pressure equalizing pipe is connected to the upper part of the injector cylinder and to the bypass pipe.

3. The combination of claim 1, wherein an air pressure equalizing pipe is connected to the upper part of the injector cylinder and to the bypass pipe at the upstream side of the connection of the conveyor to the bypass pipe.

4. The combination of claim 1, wherein an air pressure equalizing pipe is connected to the upper part of the injector cylinder and to the bypass pipe at the upstream side of the connection of the conveyor to the bypass pipe, said cylinder having a bottom wall formed as a horizontal auger tube having a closed end and an open end, said open end being connected to the bypass pipe, said auger tube being open at its top to the interior of the cylinder, an auger screw turning in said tube and having a shaft extending through the closed end of the auger tube, means operatively connected to the auger screw shaft.

5. A device of the character described, comprising a closed hopper, an auger conveyor at the lower part of the hopper and in material-receiving relation to the hopper, said conveyor comprising an auger tube having a closed end and an open end, an air pressure flow pipe into which material and air from the hopper is adapted to be discharged, said pipe containing air flowing in one direction only, connecting means providing communication between the open end of the auger tube and the air flow pipe, said hopper having thereon an adjustable air intake valve communicating with the interior thereof, and an adjustable air outlet valve communicating with the interior thereof, and means providing communication between the air outlet valve and said air pressure flow pipe at the upstream side of the point at which the auger tube is connected to the air flow pipe.

6. A device according to claim 5, wherein a vertically adjustable baffle plate is supported within the lower part of the hopper, said baffle plate having a peripheral edge spaced from the side wall of the hopper so as to provide a controlled discharge channel for air and material passing the baffle plate to the conveyor tube.

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