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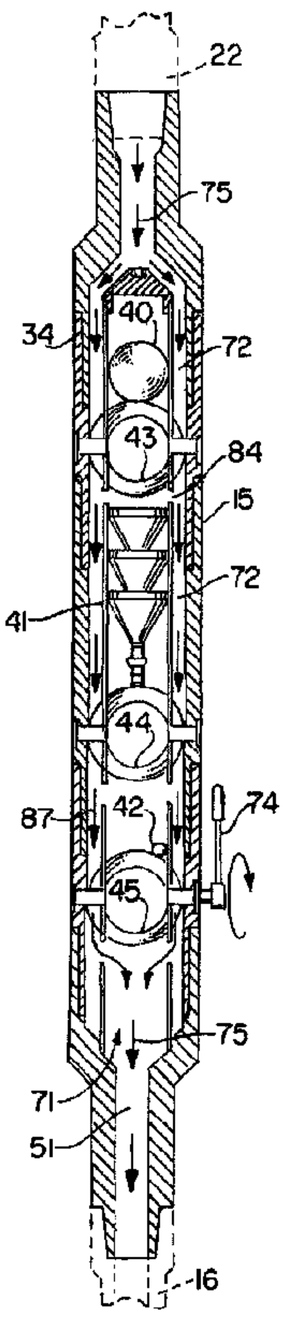

(57) Abrégé/Abstract:
An improved method and apparatus for dropping a ball, plug or dart during oil and gas well operations (e.g., cementing operations) employs a specially configured valving member with curved and flat portions that alternatively direct fluid flow through a bore or opening in the valving member via an inner channel or around the periphery of the valving member in an outer channel. In one embodiment, the ball(s), dart(s) or plug(s) are contained in a sliding sleeve that shifts position responsive to valve rotation.

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(54) Title: METHOD AND APPARATUS FOR DROPPING A PUMP DOWN PLUG OR BALL

(57) Abstract: An improved method and apparatus for dropping a ball, plug or dart during oil and gas well operations (e.g., cementing operations) employs a specially configured valving member with curved and flat portions that alternatively direct fluid flow through a bore or opening in the valving member via an inner channel or around the periphery of the valving member in an outer channel. In one embodiment, the ball(s), dart(s) or plug(s) are contained in a sliding sleeve that shifts position responsive to valve rotation.

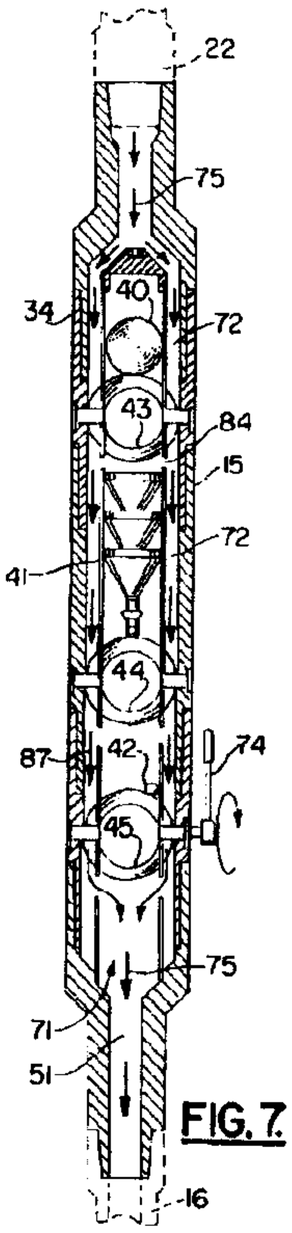

FIG. 7.

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METHOD AND APPARATUS FOR DROPPING A PUMP DOWN PLUG OR BALL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method and apparatus that is of particular utility in cementing operations associated with oil and gas well exploration and production.

More specifically the present invention provides an improvement to cementing operations and related operations employing a plug or ball dropping head.

2. General Background of the Invention

Patents have issued that relate generally to the concept of using a plug, dart or a ball that is dispensed or dropped into the well or "down hole" during oil and gas well drilling and production operations, especially when conducting cementing operations.

The following possibly relevant patents are listed numerically. The order of such listing does not have any significance.

TABLE

PATENT NO.	TITLE	ISSUE DATE
3,828,852	Apparatus for Cementing Well Bore Casing	08-1974
4,427,065	Cementing Plug Container and Method of Use Thereof	01-1984
4,624,312	Remote Cementing Plug Launching System	11-1986
4,671,353	Apparatus for Releasing a Cementing Plug	06-1987
4,722,389	Well Bore Servicing Arrangement	02-1988
4,782,894	Cementing Plug Container with Remote Control System	11-1988
4,854,383	Manifold Arrangement for use with a Top Drive Power Unit	08-1989
4,995,457	Lift-Through Head and Swivel	02-1991
5,095,988	Plug Injection Method and Apparatus	03-1992
5,236,035	Swivel Cementing Head with Manifold Assembly	08-1993
5,293,933	Swivel Cementing Head with Manifold Assembly Having Remove Control Valves and Plug Release Plungers	03-1994
5,435,390	Remote Control for a Plug-Dropping Head	07-1995
5,758,726	Ball Drop Head With Rotating Rings	06-1998
5,833,002	Remote Control Plug-Dropping Head	11-1998
5,856,790	Remote Control for a Plug-Dropping Head	01-1999
5,960,881	Downhole Surge Pressure Reduction System and Method of Use	10-1999
6,142,226	Hydraulic Setting Tool	11-2000
6,182,752	Multi-Port Cementing Head	02-2001
6,390,200	Drop Ball Sub and System of Use	05-2002
6,575,238	Ball and Plug Dropping Head	06-2003

6,672,384	Plug-Dropping Container for Releasing a Plug Into a Wellbore	01-2004
6,904,970	Cementing Manifold Assembly	06-2005
7,066,249	Plug-Dropping Container for Releasing a Plug into a Wellbore	01-2004

BRIEF SUMMARY OF THE INVENTION

The present invention provides an improved method and apparatus for use in cementing and like operations, employing a plug or ball dropping head of improved configuration.

One embodiment of the present invention provides a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet, a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, one or more fluid flow channels that enable fluid to bypass the valving members when a valving member is in the closed position, at least one of the valving members having a cross section that, in the closed position, does not valve fluid flow in the main flow channel, wherein fluid flow in the main channel flows around the valving member when it is in the closed position and through the valving member when it is in the open position, a sliding sleeve above each valving member that is configured to support a ball or plug when the valve below the sleeve is closed, wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore, and wherein each sleeve has an upper end that does not form a seal with any valve. Preferably, at least one valve has a pair of opposed, generally flat surfaces. Preferably, at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches (16.5 cm). Preferably, at least one valving member in the closed position has a generally cylindrically shaped cross section. Preferably, at least one valving member in the closed position has a generally rectangular shaped cross section. Preferably, the body has a working tension of two million pounds

(907,200 kg). Preferably, the body has an internal working pressure of 15,000 psi (10,546,050 kg/m^2). Preferably, the body has a working torque of 50,000 foot pounds (6912.75 kg-m), and more preferably the body has a working torque of 50,000 foot pounds (6912.75 kg-m) in either of two rotational directions. Preferably, there are multiple valving members that enable fluid flow around the valving member when the valving member is closed. Preferably, fluid can flow around the valving member when the valving member is closed.

Another embodiment of the present invention provides a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet, vertically sliding sleeves dividing the main flow channel into an inner channel and an outer channel, a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, the outer channel enabling fluid to bypass a valving member when a valving member is in the closed position, at least one of the valving members having a cross section that, in the open position, does not valve fluid flow in the main flow channel, wherein fluid flow flows around the valving member via the outer channel when it is in the closed position and through the valving member and inner channel when the valve is in the open position, wherein each valving member is configured to support a ball or plug when closed, and wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore. Preferably, at least one valve has a pair of opposed, generally flat surfaces. Preferably, at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches (16.5 cm). Preferably, at least one valving member in the closed position has a generally cylindrically shaped cross section. Preferably, at least one valving member in the closed position has a generally rectangular shaped cross section. Preferably, the body has a working tension of two million pounds (907,200 kg). Preferably, the body has an internal working pressure of 15,000 psi (10,546,050 kg/m^2). Preferably, the body has a working torque of 50,000 foot pounds (6912.75 kg-m), and more preferably the body has a working torque of 50,000 foot

pounds (6912.75 kg-m) in either of two rotational directions. Preferably, there are multiple valving members that enable fluid flow around the valving member when the valving member is closed.

Another embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet, a plurality of vertically sliding sleeves that divide the main channel into inner and outer channels, a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, the outer channel enabling fluid to bypass the valving members when a valving member is in the closed position, at least one of the valving members having a curved surface that closes the inner but not the outer channel in a closed position and wherein in the open position the valving member opening generally aligns with the inner channel, wherein fluid flow in the main channel flows around the valving member when it is in the closed position and through the valving member when it is in the open position, wherein each valving member is configured to support a ball or plug when closed, and wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore.

Another embodiment of the present invention providing a method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet and a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, enabling fluid to bypass the valving members when a valving member is in the closed position, preventing fluid flow in the main flow channel when a valving member is in a closed position, enabling fluid flow in the main channel around the valving member when the valving member is in the closed position and through the valving member when the valving member is in the open position, supporting a ball or plug with a valving member when the valving member is

closed, and permitting a ball or plug to pass through a valving member when the valving member is in the closed position. Preferably, at least one valve has a pair of opposed, generally flat surfaces. Preferably, at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches (16.5 cm). Preferably, at least one valving member in the closed position has a generally cylindrically shaped cross section. Preferably, at least one valving member in the closed position has a generally rectangular shaped cross section. Preferably, the body has a working tension of two million pounds (907,200 kg). Preferably, the body has an internal working pressure of 15,000 psi (10,546,050 kg/m^2). Preferably, the body has a working torque of 50,000 foot pounds (6912.75 kg-m) and more preferably the body has a working torque of 50,000 foot pounds (6912.75 kg-m) in either of two rotational directions.

Another embodiment of the present invention providing a method of dropping one or more balls or plugs into a well tubing, comprising providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a flow channel that connects the inlet and the outlet, a plurality of sleeves that divide the flow channel into an inner channel and an outer channel, a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, enabling fluid to bypass the valving members via the outer channel when a valving member is in the closed position, flowing fluid in the outer channel and around a valving member when a valving member is in the closed position and through the valving member via the inner channel when the valving member is in the open position, supporting a ball or plug with a valving member when closed, and permitting a ball or plug to pass a valving member when open.

A further embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising, a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, the housing having an inner surface surrounding an outer bypass channel and an inner flow channel, wherein each said channel connects to the inlet and the outlet, a plurality of valving members spaced between the inlet and the outlet, each valving

member having an inner valve with a flow bore, and being movable between open and closed positions, each valving member having an outer valve that is in an open position when the inner valve is closed and in a closed position when the inner valve is open, said outer valve presenting a curved surface to the housing inner surface when the inner valve is open, each outer valve not valving flow in the bypass channel when the inner flow channel is closed, canisters in the housing that separate said inner and bypass fluid flow channels, said bypass channel enabling fluid to bypass the inner valve and the inner flow channel when the outer valve is in the open position and the inner valve is in the closed position, wherein the inner valve does not valve fluid flow in the bypass flow channel when the inner valve is in the closed position, wherein fluid flow flows around the inner valve and in between the canisters and the housing inner surface when it is in the closed position and through the inner valve when it is in the open position, each canister being a sliding sleeve above each inner valve that is configured to support a ball or plug when the inner valve below the sleeve is closed, and wherein in the open position each inner valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the inner valve flow bore.

An embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, the housing having an inner surface surrounding a main flow channel that connects the inlet and the outlet, vertically sliding sleeves dividing the main flow channel into an inner channel and an outer bypass channel a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, the outer channel enabling fluid to bypass a valving member when a valving member is in the closed position, at least one of the valving members having a cross section that, in the open position, does not valve fluid flow in the main flow channel, wherein fluid flow flows around the valving member via the outer bypass channel when the valving member is in the closed position and through the valving member and inner channel when the valving member is in the open position wherein each valving member is configured to support a ball or plug when closed wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball

nor plug is in the valve flow bore and one or more bypass valve plates, each attached to and rotating with a valving member, each bypass valve plate valving flow in the outer bypass channel but not the inner channel, each bypass valve plate having at least one curved portion that tracks the inner surface of the housing, and wherein each valve plate has a thickness that occupies only a part of the outer bypass channel when the valving member is rotated to a closed position.

Another embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, the housing having an inner surface surrounding a main flow channel that connects the inlet and the outlet, a plurality of vertically sliding sleeves that divide the main channel into inner and outer channels, a plurality of valving members spaced between the inlet and the outlet, each valving member having a valve flow bore, and each valving member being movable between open and closed positions, the outer channel enabling fluid to bypass the valving members when a valving member is in the closed position at least one of the valving members having a curved surface that closes the inner but not the outer channel in a closed position and wherein in the open position the valving member opening generally aligns with the inner channel wherein fluid flow in the main channel flows around the valving member and sleeves when the valving member is in the closed position and through the valving member when the valving member is in the open position wherein each valving member is configured to support a ball or plug when the valving member is in the closed position wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore, and plates mounted to the valving members and positioned to valve flow in the outer channel, each plate occupying a position that enables flow in the outer channel when the valving member to which it is attached is in the closed position.

In a further embodiment of the present invention providing a method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet and a plurality of

valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, the main channel having an inner section and an outer bypass section enabling fluid to bypass the valving members via the bypass section when a valving member is in the closed position preventing fluid flow in the inner section of the main flow channel when a valving member is in a closed position enabling fluid flow in the inner section when the valving member is in the open position supporting a ball or plug with a valving member when the valving member is in the closed position permitting a ball or plug to pass through a valving member when the valving member is in the open position and valving flow in the outer section with plates that are attached to and that rotate with the valving members, said plates enabling flow in the outer section when the valving member is in the closed position.

Another embodiment of the present invention providing a method of dropping one or more balls or plugs into a well tubing, comprising providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a housing inner surface that surrounds a flow channel that connects the inlet and the outlet, a plurality of sleeves that divide the flow channel into an inner channel and an outer channel, a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions enabling fluid to bypass the valving members via the outer channel when a valving member is in the closed position flowing fluid in the outer channel and around a valving member when a valving member is in the closed position and through the valving member via the inner channel when the valving member is in the open position wherein substantial fluid flow is stopped in the outer channel when a valving member is in the open position by rotating plates with the valving members to close the outer channel, said plates attached to and rotating with the valving members supporting a ball or plug with a valving member when closed and permitting a ball or plug to pass a valving member when open.

An embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls, darts or plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet and a mating inside surface the housing having an inner surface surrounding an outer bypass

channel and an inner flow channel, wherein each said channel connects to the inlet and the outlet a plurality of valving members spaced between the inlet and the outlet, each valving member having an inner valve with a flow bore, and being movable between open and closed positions, each valving member having an outer valve that is in an open position when the inner valve is closed and in a closed position when the inner valve is open, said outer valve presenting a mating surface to the housing inner surface when the inner valve is open, each outer valve not valving flow in the bypass channel when the inner flow channel is closed canisters in the housing that separate said inner and bypass secondary fluid flow channels, said bypass channel enabling fluid to bypass the inner valve and the inner flow channel when the outer valve is in the open position and the inner valve is in the closed position wherein the inner valve does not valve fluid flow in the bypass flow channel when the inner valve is in the closed position wherein fluid flow flows around the inner valve and in between the canisters and the housing inner surface when it is in the closed position and through the inner valve when it is in the open position each canister being a sliding sleeve above each inner valve that is configured to support a ball, dart or plug when the inner valve below the sleeve is closed wherein in the open position each inner valve flow bore permits a ball, dart or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball, dart nor plug is in the inner valve flow bore and one or more members attached to and rotating with the valving member that close the secondary channel when the valving member opens the main channel, said member having a mating edge that tracks said mating inside surface.

A further embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls, darts or plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet and a mating inside surface the housing having an inner surface surrounding a main flow channel that connects the inlet and the outlet, vertically sliding sleeves dividing the main flow channel into an inner channel and an outer bypass channel a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions the outer channel enabling fluid to bypass a valving member when a valving member is in the closed position at least one of the valving members having a cross section that, in the open position, does not valve fluid flow in the main flow channel wherein fluid flow flows

around the valving member via the outer bypass channel when the valving member is in the closed position and through the valving member and inner channel when the valving member is in the open position) wherein each valving member is configured to support a ball or plug when closed wherein in the open position each valve flow bore permits a ball, dart or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore and one or more bypass valve plates, each attached to and rotating with a valving member, each bypass valve plate valving flow in the outer bypass channel but not the inner channel, each bypass valve plate having at least one mating portion that tracks the inner surface of the housing, and wherein each valve plate has a thickness that occupies only a part of the outer bypass channel when the valving member is rotated to a closed position.

Another embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls, darts or plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet the housing having an inner surface surrounding a main flow channel that connects the inlet and the outlet a plurality of vertically sliding sleeves that divide the main channel into inner and outer channels a plurality of valving members spaced between the inlet and the outlet, each valving member having a valve flow bore, and each valving member being movable between open and closed positions the outer channel enabling fluid to bypass the valving members when a valving member is in the closed position at least one of the valving members having a mating surface that closes the inner but not the outer channel in a closed position and wherein in the open position the valving member opening generally aligns with the inner channel wherein fluid flow in the main channel flows around the valving member and sleeves when the valving member is in the closed position and through the valving member when the valving member is in the open position wherein each valving member is configured to support a ball, dart or plug when the valving member is in the closed position wherein in the open position each valve flow bore permits a ball, dart or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore and plates mounted to the valving members and positioned to valve flow in the outer channel, each plate occupying a position that enables flow in the outer channel when the valving member to which it is attached is in the closed position.

Another embodiment of the present invention providing a method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet and a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, the main channel having an inner section and an outer bypass section enabling fluid to bypass the valving members via the bypass section when a valving member is in the closed position preventing fluid flow in the inner section of the main flow channel when a valving member is in a closed position enabling fluid flow in the inner section when the valving member is in the open position supporting a ball, dart or plug with a valving member when the valving member is in the closed position permitting a ball, dart or plug to pass through a valving member when the valving member is in the open position and valving flow in the outer section with plates that are attached to and that rotate with the valving members, said plates enabling flow in the outer section when the valving member is in the closed position.

An embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet a main flow channel that connects the inlet and the outlet a plurality of inner valving members spaced between the inlet and the outlet, each valving member having an inner valve flow bore, and being movable upon a valve stem between open and closed positions one or more bypass fluid flow channels that enable fluid to bypass the inner valving members when a said inner valving member is in the closed position at least one of the inner valving members having a cross section that, in the closed position, does not valve fluid flow in the main flow channel wherein fluid flow in the main channel flows around the inner valving member via the bypass fluid flow channel when it is in the closed position and through the inner valving member when it is in the open position wherein in the open position each inner valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore one or more outer valving members mounted on the valve stem and that

each occupy a position in the bypass channel i) wherein the outer valving member opens the bypass channel when the inner valving member is in the closed position and wherein the outer valving member closes the bypass channel when the inner valving member is in the open position.

A further embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet a main flow channel that connects the inlet and the outlet, and including an inner channel and an outer channel a plurality of valving members spaced between the inlet and the outlet, each valving member having a valve stem, a valve inner part with a flow bore, a valve outer part, and being movable between open and closed positions the outer channel enabling fluid to bypass a valving member inner part when a valving member inner part is in the closed position at least one of the valving members having said inner part with a cross section that, in the open position, does not valve fluid flow in the main flow channel wherein fluid flow flows around the valving member inner part via the outer channel when said inner part is in the closed position and through the valving member inner part and the inner channel when the valve inner part is in the open position wherein each valving member inner part is configured to support a ball or plug when closed wherein in the open position each inner part flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the inner part flow bore the valve outer part movable between first and second positions, the first position enabling flow via the outer channel when the inner channel is closed by the inner part and the second position closing the outer channel when the inner channel is open.

Another embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet a main flow channel that connects the inlet and the outlet a plurality of vertically sliding sleeves that divide the main channel into inner and outer channels a plurality of valving members spaced between the inlet and the outlet, each valving member having an inner part with a flow bore, and being movable between open and closed positions the outer channel

enabling fluid to bypass the valving members when a valving member inner part is in the closed position at least one of the valving members having a curved surface that closes the inner but not the outer channel in a closed position and wherein in the open position the valving member opening generally aligns with the inner channel wherein fluid flow in the main channel flows around the valving member inner part when it is in the closed position and through the valving member inner part when it is in the open position wherein each valving member inner part is configured to support a ball or plug when closed) wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore and one or more of the valving members having an outer part that closes the outer channel when the inner part opens the inner channel.

A further embodiment of the present invention providing a method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, an inner flow channel that connects the inlet and the outlet and a plurality of inner valving members spaced between the inlet and the outlet, each inner valving member having a flow bore, and being movable between open and closed positions enabling fluid to bypass the inner valving members via an outer channel when a said inner valving member is in the closed position preventing fluid flow in the inner flow channel when a said inner valving member is in a closed position enabling fluid flow around a said inner valving member via the outer channel when the inner valving member is in the closed position and through the said inner valving member when the inner valving member is in the open position supporting a ball or plug with a said inner valving member when the said inner valving member is closed permitting a ball or plug to pass through a said inner valving member when the valving member is in the open position and closing the outer channel with an outer valving member when the inner channel is opened with an inner valving member.

An embodiment of the present invention providing a method of dropping one or more balls or plugs into a well tubing, comprising providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, an inner flow channel that connects the inlet and the outlet, an outer flow channel, a plurality of sleeves that separate the inner channel

from the outer channel, a plurality of inner valving members spaced between the inlet and the outlet, each inner valving member having a flow bore, and being movable between open and closed positions enabling fluid to bypass the inner valving members via the outer flow channel when an inner valving member is in the closed position flowing fluid in the outer channel and around an inner valving member when an inner valving member is in the closed position and through a said inner valving member via the inner channel when the inner valving member is in the open position supporting a ball or plug with a said inner valving member when the said inner valving member is closed and permitting a ball or plug to pass a said inner valving member when it is open.

Another embodiment of the present invention providing a ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet a main flow channel that connects the inlet and the outlet a plurality of valving members spaced between the inlet and the outlet, each valving member having a valve inner part with a flow bore, a valve outer part, and a valve stem, wherein each said inner part rotates on said stem with a said outer part between first and second positions one or more bypass fluid flow channels that enable fluid to bypass a said valve inner part when a said inner part is in the closed position wherein at least one of the valve inner parts does not stop fluid flow in the main flow channel in said first position wherein fluid flows around the said inner part via the bypass fluid flow channel when the said inner part is in the second position wherein in the first position the main flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the main flow channel the valving member outer part occupying a position in the bypass channel and wherein the valve outer part closes the bypass channel in the first position and opens the bypass channel in the second position.

An embodiment of the present invention providing a method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet and a plurality of valving members spaced between the inlet and the outlet, each valving member having an inner part with a flow bore, a valve stem, and an outer part, said inner and outer valve parts

being movable upon said stem between first and second positions providing a bypass channel and enabling fluid to bypass the valve inner part via the bypass channel when the valve inner part is in the first position preventing fluid flow in the main flow channel when the valving member inner part is in the first position enabling fluid flow through the valving member inner part when the valving member inner part is in the second position supporting a ball or plug with a valving member when the valving member inner part is in the first position permitting a ball or plug to pass through the valving member inner part when the valving member inner part is in the second position and wherein the valve outer part closes the bypass channel in the first position and opens the bypass channel in the second position.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

For a further understanding of the nature, objects, and advantages of the present invention, reference should be had to the following detailed description, read in conjunction with the following drawings, wherein like reference numerals denote like elements and wherein:

Figures IA, IB, 1C are partial sectional elevation views of the preferred embodiment of the apparatus of the present invention wherein line A-A of figure IA matches line A-A of figure IB, and line B-B of figure IB matches line B-B of figure 1C;

Figure 2 is a partial, sectional, elevation view of the preferred embodiment of the apparatus of the present invention;

Figure 3 is a partial, sectional, elevation view of the preferred embodiment of the apparatus of the present invention;

Figure 4 is a sectional view taken long lines 4-4 of figure 2;

Figure 5 is a sectional view taken along lines 5-5 of figure 3;

Figure 6 is a partial perspective view of the preferred embodiment of the apparatus of the present invention;

Figure 7 is a sectional elevation view of the preferred embodiment of the apparatus of the present invention and illustrating a method step of the present invention;

Figure 8 is a sectional elevation view of the preferred embodiment of the apparatus of the present invention and illustrating a method step of the present invention;

Figure 9 is an elevation view of the preferred embodiment of the apparatus of the present invention and illustrating the method of the present invention;

Figure 10 is a sectional elevation view illustrating part of the method of the present invention and wherein line A-A of figure 10 matches line A-A of figure 9;

Figure 11 is a sectional elevation view illustrating part of the method of the present invention and wherein line A-A of figure 11 matches line A-A of figure 9;

Figure 12 is a sectional elevation view illustrating part of the method of the present invention;

Figure 13 is a sectional elevation view illustrating part of the method of the present invention;

Figure 14 is a sectional elevation view illustrating part of the method of the present invention and wherein line A-A of figure 14 matches line A-A of figure 9;

Figure 15 is a sectional elevation view illustrating part of the method of the present invention and wherein line A-A of figure 15 matches line A-A of figure 9;

Figure 16 is a sectional elevation view illustrating part of the method of the present invention;

Figure 17 is a partial perspective view of the preferred embodiment of the apparatus of the present invention;

Figure 18 is a partial view of the preferred embodiment of the apparatus of the present invention and showing a ball valving member;

Figure 19 is a partial side view of the preferred embodiment of the apparatus of the present invention and showing an alternate construction for the ball valving member;

Figure 20 is a partial view of the preferred embodiment of the apparatus of the present invention and showing a ball valving member;

Figure 21 is a partial side view of the preferred embodiment of the apparatus of the present invention and showing an alternate construction for the ball valving member;

Figure 22 is a sectional view of the preferred embodiment of the apparatus of the present invention showing an alternate sleeve arrangement;

Figure 23 is a sectional view of the preferred embodiment of the apparatus of the present invention showing an alternate sleeve arrangement;

Figure 24 is a fragmentary view of the preferred embodiment of the apparatus of the present invention;

Figure 25 is a fragmentary view of the preferred embodiment of the apparatus of the present invention; and

Figure 26 is a fragmentary view of the preferred embodiment of the apparatus of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 9 shows generally an oil well drilling structure 10 that can provide a platform 11 such as a marine platform as shown. Such platforms are well known. Platform 11 supports a derrick 12 that can be equipped with a lifting device 21 that supports a top drive unit 13. Such a derrick 12 and top drive unit 13 are well known. A top drive unit can be seen for example in US Patent Nos. 4,854,383 and 4,722,389.

A flow line 14 can be used for providing a selected fluid such as a fluidized cement or fluidized setable material to be pumped into the well during operations which are known in the industry and are sometimes referred to as cementing operations. Such cementing operations are discussed for example in prior US Patent Nos. 3,828,852; 4,427,065; 4,671,353; 4,782,894; 4,995,457; 5,236,035; 5,293,933; and 6,182,752.

A tubular member 22 can be used to support plug dropping head 15 at a position below top drive unit 13 as shown in figure 9. String 16 is attached to the lower end portion of plug dropping head 15.

In figure 9, the platform 11 can be any oil and gas well drilling platform such as a marine platform shown in a body of water 18 that provides a seabed or mud line 17 and water surface 19. Such a platform 11 provides a platform deck 20 that affords space for well personnel to operate and for the storage of necessary equipment and supplies that are needed for the well drilling operation.

A well bore 23 extends below mud line 17. In figures 10 and 11, the well bore 23 can be surrounded with a surface casing 24. The surface casing 24 can be surrounded with cement/concrete 25 that is positioned in between a surrounding formation 26 and the surface casing 24. Similarly, a liner or production casing 32 extends below surface casing 24. The production casing 32 has a lower end portion that can be fitted with a casing shoe 27 and float valve 28 as shown in figures 10-16. Casing shoe 27 has passageway 30. Float valve 28 has passageway 29.

The present invention provides an improved method and apparatus for dropping balls, plugs, darts or the like as a part of a cementing operation. Such cementing operations are in general known and are employed for example when installing a liner such as liner 32. In the drawings, arrows 75 indicate generally the flow path of fluid (e.g. cement, fluidized material or the like) through the tool body 34. In that regard, the present invention provides an improved ball or plug or dart dropping head 15 that is shown in figures 1-8 and 10-17. In figures 1A, 1B, 1C and 2-8, ball/plug dropping head 15 has an upper end portion 31 and a lower end portion 33. Ball/plug dropping head 15 provides a tool body 34 that can be of multiple sections that are connected together, such as with threaded connections. In figures 1A-1C, the tool body 34 includes sections 35, 36, 37, 38, 39. The section 35 is an upper section. The section 39 is a lower section.

Ball/plug dropping head 15 can be pre-loaded with a number of different items to be dropped as part of a cementing operation. For example, in figures 1A, 1B, 1C there are a number of items that are contained in ball/plug dropping head 15. These include an upper, larger diameter ball dart 40, 41 and smaller diameter ball 42. In figures 18-26, an alternate embodiment is shown which enables very small diameter balls, sometimes referred to as "frac-balls" 102 (which can have a diameter of between about 1/2 and 5/8 inches (about 1.25-1.59 cm) to be dispensed into the well below toll body 34.

The tool body 34 supports a plurality of valving members at opposed openings 90. The valving members can include first valving member 43 which is an upper valving

member. The valving members can include a second valving member 44 which is in between the first valving member 43 and a lower or third valving member 45. Valving member 43 attaches to tool body 34 at upper opening positions 61, 62. Valving member 44 attaches to tool body 34 at middle opening positions 63, 64. Valving member 45 attaches to tool body 43 at lower opening positions 65, 66.

Threaded connections 46, 47, 48, 49 can be used for connecting the various body sections 35, 36, 37, 38, 39 together end to end as shown in figures 1A, 1B, 1C. Tool body 34 upper end 31 is provided with an internally threaded portion 50 for forming a connection with tubular member 22 that depends from top drive unit 13 as shown in figure 9. A flow bore 51 extends between upper end 31 and lower end 33 of tool body 34.

Sleeve sections 52 are secured to tool body 34 within bore 15 as shown in figures 1A, 1B, 1C. Sleeves 52 can be generally centered within bore 51 as shown in figures 1A, 1B, 1C using spacers 67 that extend along radial lines from the sections 35-39.

Each valving member 43, 44, 45 is movable between open and closed positions. In figures 1A, 1B, 1C each of the valving members 43, 44, 45 is in a closed position. In that closed position, each valving member 43, 44, 45 prevents downward movement of a plug, ball 40, 42, or dart 41 as shown. In figure 1A, the closed position of valving member 43 prevents downward movement of larger diameter ball 40. Similarly, in figure 1B, a closed position of valving member 44 prevents a downward movement of dart 41. In figure 1B, a closed position of valving member 45 prevents a downward movement of smaller diameter ball 42. In each instance, the ball, dart or plug rests upon the outer curved surface 68 of valving member 43, 44 or 45 as shown in the drawings.

Each valving member 43, 44, 45 provides a pair of opposed generally flat surfaces 69, 70 (see figures 3, 6, 17). Figure 17 shows in more detail the connection that is formed between each of the valving members 43, 44, 45 and the tool body 34. The tool body 34 provides opposed openings 90 that are receptive the generally cylindrically shaped valve stems 54, 55 that are provided on the flat sections or flat surfaces 69, 70 of each valving member 43, 44, 45. For example, in figures 6 and 17, the flat surface 69 provides valve stem 54. Openings 90 are receptive of the parts shown in exploded view in figure 17 that enable a connection to be formed between the valving member 43, 44 or 45 and the tool body 34. For the stem 55, fastener 91 engages an internally threaded

opening of stem 55. Bushing 92 is positioned within opening 90 and the outer surface of stem 55 registers within the central bore 95 of bushing 92. Bushing 92 is externally threaded at 93 for engaging a correspondingly internally threaded portion of tool body 34 at opening 90. O-rings 60 can be used to interface between stem 55 and bushing 92. A slightly different configuration is provided for attaching stem 54 to tool body 34. Sleeve 94 occupies a position that surrounds stem 54. Sleeve 54 fits inside of bore 95 of bushing 92. The externally threaded portion 93 of bushing 92 engages correspondingly shaped threads of opening 90. Pins 99 form a connection between the stem 54 at openings 98 and the sleeve 94. Fastener 96 forms a connection between bushing 92 and an internally threaded opening 97 of stem 54. As assembled, this configuration can be seen in figure 1A for example. The flat surfaces 69, 70 enable fluid to flow in bore 51 in a position radially outwardly or externally of sleeve or sleeve section 52 by passing between the tool body sections 35, 36, 37, 38, 39 and sleeve 52. Thus, bore 51 is divided into two flow channels. These two flow channels 71, 72 include a central flow channel 71 within sleeves 52 that is generally cylindrically shaped and that aligns generally with the channel 53 of each valving member 43, 44, 45. The second flow channel is an annular outer flow channel 72 that is positioned in between a sleeve 52 and the tool body sections 35, 36, 37, 38, 39. The channels 71, 72 can be concentric. The outer channel 72 is open when the valving members 43, 44, 45 are in the closed positions of figures 1A, 1B and 1C, wherein central flow channel 71 is closed. When the valving members 43, 44, 45 are rotated to a closed position, fins 73 become transversely positioned with respect to the flow path of fluid flowing in channel 72 thus closing outer flow channel 72 (see figure 5). This occurs when a valving member 43, 44, 45 is opened for releasing a ball 40 or 42 or for releasing dart 41. Figure 4 illustrates a closed position (figure 4) of the valving member 45 just before releasing smaller diameter ball 42. Fins 73 are generally aligned with bore 15 and with flow channels 71, 72 when flow in channel 72 is desired (figure 4). In figure 4, valving member 45 is closed and outer flow channel 72 is open.

In figures 2-3, 5 and 7-8, a tool 74 has been used to rotate valving member 45 to an open position that aligns its channel 53 with central flow channel 71 enabling smaller diameter ball 42 to fall downwardly via central flow channel 71 (figure 8). In figure 5, outer flow channel 72 has been closed by fins 73 that have now rotated about 90 degrees from the open position of figure 4 to the closed position. Fins 73 close channel 72 in

figure 5. It should be understood that tool 74 can also be used to rotate valving member 44 from an open position of figure 1B to a closed position such as is shown in figure 5 when it is desired that dart 41 should drop. Similarly, tool 74 can be used to rotate upper valving member 43 from the closed position of figure 1A to an open position such as is shown in figure 5 when it is desired to drop larger diameter ball 40.

Figures 7-16 illustrate further the method and apparatus of the present invention. In figure 8, lower or third valving member 45 has been opened as shown in figure 5 releasing smaller diameter ball 42. In figure 8, smaller diameter ball 42 is shown dropping wherein it is in phantom lines, its path indicated schematically by arrows 75.

Figure 10 shows a pair of commercially available, known plugs 76, 77. These plugs 76, 77 include upper plug 76 and lower plug 77. Each of the plugs 76, 77 can be provided with a flow passage 79, 81 respectively that enables fluid to circulate through it before ball 42 forms a seal upon the flow passage 81. Smaller diameter ball 42 has seated upon the lower plug 77 in figure 10 so that it can now be pumped downwardly, pushing cement 80 ahead of it. In figure 11, arrows 78 schematically illustrate the downward movement of lower plug 77 when urged downwardly by a pumped substance such as a pumpable cement or like material 80. Each of the plugs 76, 77 can be provided with a flow passage 79, 81 respectively that enables fluid to circulate through it before ball 42 forms a seal upon the flow passage 81 (see figure 11). When plug 77 reaches float valve 28, pressure can be increased to push ball 42 through plug 77, float valve 28 and casing shoe 27 so that the cement flows (see arrows 100, figure 11) into the space 101 between formation 26 and casing 32.

In figure 12, second valving member 44 is opened releasing dart 41. Dart 41 can be used to push the cement 80 downwardly in the direction of arrows 82. A completion fluid or other fluid 83 can be used to pump dart 41 downwardly, pushing cement 80 ahead of it. Once valves 44 and 45 are opened, fluid 83 can flow through openings 84 provided in sleeves 52 below the opened valving member (see figure 7) as illustrated in figures 7 and 12. Thus, as each valving member 43 or 44 or 45 is opened, fluid moves through the openings 84 into central flow channel 71.

When valve 44 is opened, dart 41 can be pumped downwardly to engage upper plug 76, registering upon it and closing its flow passage 79, pushing it downwardly as illustrated in figures 14 and 15. Upper plug 79 and dart 41 are pumped downwardly

using fluid 83 as illustrated in figures 14 and 15. In figure 16, first valving member 43 is opened so that larger diameter ball 40 can move downwardly, pushing any remaining cement 80 downwardly.

The ball 40 can be deformable, so that it can enter the smaller diameter section 86 at the lower end portion of tool body 34. During this process, cement or like mixture 80 is forced downwardly through float collar 28 and casing shoe 27 into the space that is in between production casing 32 and formation 26. This operation helps stabilize production casing 32 and prevents erosion of the surrounding formation 26 during drilling operations.

During drilling operations, a drill bit is lowered on a drill string using derrick 12, wherein the drill bit simply drills through the production casing 32 as it expands the well downwardly in search of oil.

Figures 18-26 show an alternate embodiment of the apparatus of the present invention, designated generally by the numeral 110 in figures 22-23. In figures 18-26, the flow openings 84 in sleeves 52 of ball/plug dropping head 110 of figures 1-17 have been eliminated. Instead, sliding sleeves 111 are provided that move up or down responsive to movement of a selected valving member 112, 113. It should be understood that the same tool body 34 can be used with the embodiment of figures 18-26, connected in the same manner shown in figures 1-17 to tubular member 22 and string 16. In figures 18-26, valving members 112, 113 replace the valving members 43, 44, 45 of figures 1-17. In figures 18-26, sleeves 111 replace sleeves 52. While two valving members 112, 113 are shown in figures 22, 23, it should be understood that three such valving members (and a corresponding sleeve 111) could be employed, each valving member 112, 113 replacing a valving member 43, 44, 45 of figures 1-17.

In figures 18-26, tool body 34 has upper and lower end portions 31, 33. As with the preferred embodiment of figures 1-17, a flow bore 51 provides a central flow channel 71 and outer flow channel 72. Each valving member 112, 113 provides a valve opening 114. Each valving member 112, 113 provides a flat surface 115 (see figure 20). Each valving member 112, 113 provides a pair of opposed curved surfaces 116 as shown in figure 20 and a pair of opposed flat surfaces 117, each having a stem 119 or 120.

An internal, generally cylindrically shaped surface 118 surrounds valve opening 114 as shown in figure 20. Each valving member 112, 113 provides opposed stems 119,

120. Each valving member 112, 113 rotates between opened and closed positions by rotating upon stems 119, 120. Each of the stems 119, 120 is mounted in a stem opening 90 of tool body 34 at positions 61, 62 and 63, 64 as shown in figure 22.

In figure 19, valving member 122, 123 is similar in configuration and in sizing to the valving members 43, 44, 45 of the preferred embodiment of figures 1-17, with the exception of a portion that has been removed which is indicated in phantom lines in figure 19. The milled or cut-away portion of the valving member 112, 113 is indicated schematically by the arrow 121. Reference line 122 in figure 19 indicates the final shape of valving member 112, 113 after having been milled or cut. In figures 20 and 21, a beveled edge at 123 is provided for each valving member 112, 113.

When a valving member 112, 113 is in the closed position of figure 22, flow arrows 124 indicate the flow of fluid through the tool body 34 bore 51 and more particularly in the outer channel 72 as indicated in figure 22.

In figure 23, the lower valving member 113 has been rotated to an open position as indicated schematically by the arrow 134, having been rotated with tool 74. In this position, fins 73 now block the flow of fluid in outer channel 72. Flat surface 115 now faces upwardly. In this position, the cut-away portion of valving member 113 that is indicated schematically by the arrow 121 in figure 19 now faces up. Sliding sleeve 111 drops downwardly as indicated schematically by arrows 130 when a valving member 112 or 113 is rotated to an open position (see valving member 113 in figure 23). In figure 22, a gap 129 was present in between upper valve 112 and sleeve 111 that is below the valve 112. The sleeve 111 that is in between the valves 112,113 is shown in figure 22 as being filled with very small diameter balls or "frac-balls" 102.

When valving member 113 is rotated to the open position of figure 23, the gap is now a larger gap, indicated as 135. Gap 135 (when compared to smaller gap 129) has become enlarged an amount equal to the distance 121 illustrated by arrow 121 in figure 19. The frac-balls 102 now drop through valving member 113 as illustrated by arrows 127 in figure 23. Arrows 125, 126 in figure 23 illustrate the flow of fluid downwardly through gap 135 and in central channel 71.

A sleeve 111 above a valving member 112 or 113 thus move up and down responsive to a rotation of that valving member 112 or 113. Spacers 28 can be employed that extend from each sleeve 111 radially to slidably engage tool body 34. In figures 20

and 21, each stem 119, 120 can be provided with one or more annular grooves 131 that are receptive of o-rings 60 or other sealing material. As with the preferred embodiment of figures 1-17, openings 132 in each stem 119, 120 are receptive of pins 99. Likewise, each stem 119, 120 provides internally threaded openings 133. Thus, the same connection for attaching a valving member 112, 113 to tool body 34 can be the one shown in figures 1-17.

The following is a list of parts and materials suitable for use in the present invention.

PARTS LIST

Part Number	Description
10	oil well drilling structure
11	platform
12	derrick
13	top drive unit
14	flow line
15	ball/plug dropping head
16	string
17	sea bed/mud line
18	body of water
19	water surface
20	platform deck
21	lifting device
22	tubular member
23	well bore
24	surface casing
25	cement/concrete
26	formation
27	casing shoe
28	float valve
29	passageway
30	passageway
31	upper end

32	liner/production casing
33	lower end portion
34	tool body
35	section
36	section
37	section
38	section
39	section
40	larger diameter ball
41	dart
42	smaller diameter ball
43	first valving member
44	second valving member
45	third valving member
46	threaded connection
47	threaded connection
48	threaded connection
49	threaded connection
50	threaded portion
51	flow bore
52	sleeve
53	channel
54	stem
55	stem
56	sleeve
57	sleeve
58	plug
59	plug
60	o-ring
61	opening position
62	opening position
63	opening position

64	opening position
65	opening position
66	opening position
67	spacer
68	outer curved surface
69	flat surface
70	flat surface
71	central flow channel
72	outer flow channel
73	fin
74	tool
75	arrow
76	upper plug
77	lower plug
78	arrows
79	flow passage
80	cement
81	flow passage
82	arrow
83	fluid
84	opening
85	opening
86	smaller diameter section
87	arrow - fluid flow path
88	fastener
89	internally threaded opening
90	opening
91	fastener
92	bushing
93	external threads
94	sleeve
95	passageway/bore

96	fastener
97	internally threaded opening
98	opening
99	pin
100	arrows
101	space
102	frac-ball
110	ball/plug dropping head
111	sleeve
112	valving member
113	valving member
114	valve opening
115	flat surface
116	curved surface
117	flat surface
118	internal surface
119	stem
120	stem
121	arrow
122	reference line
123	beveled edge
124	arrow
125	arrow
126	arrow
127	arrow
128	spacer
129	smaller gap
130	arrow sleeve movement
131	annular groove
132	opening
133	internally threaded opening
134	arrow

135 larger gap

All measurements disclosed herein are at standard temperature and pressure, at sea level on Earth, unless indicated otherwise. All materials used or intended to be used in a human being are biocompatible, unless indicated otherwise.

The foregoing embodiments are presented by way of example only; the scope of the present invention is to be limited only by the following claims.

CLAIMS

1. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) a main flow channel that connects the inlet and the outlet;

c) a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions;

d) one or more fluid flow channels that enable fluid to bypass the valving members when a valving member is in the closed position;

e) at least one of the valving members having a cross section that, in the closed position, does not valve fluid flow in the main flow channel;

f) wherein fluid flow in the main channel flows around the valving member when it is in the closed position and through the valving member when it is in the open position;

g) a sliding sleeve above each valving member that is configured to support a ball or plug when the valve below the sleeve is closed;

h) wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore; and

i) wherein each sleeve has an upper end that does not form a seal with any valve.

2. The ball and plug dropping head of claim 1, wherein at least one valve has a pair of opposed, generally flat surfaces.

3. The ball and plug dropping head of claim 1, wherein at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches (16.5 cm).

4. The ball and plug dropping head of claim 1, wherein at least one valving member in the closed position has a generally cylindrically shaped cross section.

5. The ball and plug dropping head of claim 1, wherein at least one valving member in the closed position has a generally rectangular shaped cross section.

6. The ball and plug dropping head of claim 1, wherein the body has a working tension of two million pounds (907,200 kg).

7. The ball and plug dropping head of claim 1, wherein the body has an internal working pressure of 15,000 psi (10,546,050 kg/m^2).

8. The ball and plug dropping head of claim 1, wherein the body has a working torque of 50,000 foot pounds (6912.75 kg-m).

9. The ball and plug dropping head of claim 8, wherein the body has a working torque of 50,000 foot pounds (6912.75 kg-m) in either of two rotational directions.

10. The ball and plug dropping head of claim 1, wherein there are multiple valving members that enable fluid flow around the valving member when the valving member is closed.

11. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) a main flow channel that connects the inlet and the outlet, vertically sliding sleeves dividing the main flow channel into an inner channel and an outer channel;

c) a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions;

d) the outer channel enabling fluid to bypass a valving member when a valving member is in the closed position;

e) at least one of the valving members having a cross section that, in the open position, does not valve fluid flow in the main flow channel;

f) wherein fluid flow flows around the valving member via the outer channel when it is in the closed position and through the valving member and inner channel when the valve is in the open position;

g) wherein each valving member is configured to support a ball or plug when closed;

h) wherein in the open position each valve flow bore permits a ball or plug

to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore.

12. The ball and plug dropping head of claim 11, wherein at least one valve has a pair of opposed, generally flat surfaces.

13. The ball and plug dropping head of claim 11, wherein at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches (16.5 cm).

14. The ball and plug dropping head of claim 11, wherein at least one valving member in the closed position has a generally cylindrically shaped cross section.

15. The ball and plug dropping head of claim 11, wherein at least one valving member in the closed position has a generally rectangular shaped cross section.

16. The ball and plug dropping head of claim 11, wherein the body has a working tension of two million pounds (907,200 kg).

17. The ball and plug dropping head of claim 11, wherein the body has an internal working pressure of 15,000 psi (10,546,050 kg/m^2).

18. The ball and plug dropping head of claim 11, wherein the body has a working torque of 50,000 foot pounds (6912.75 kg-m).

19. The ball and plug dropping head of claim 18, wherein the body has a working torque of 50,000 foot pounds (6912.75 kg-m) in either of two rotational directions.

20. The ball and plug dropping head of claim 11, wherein there are multiple valving members that enable fluid flow around the valving member when the valving member is closed.

21. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) a main flow channel that connects the inlet and the outlet;

c) a plurality of vertically sliding sleeves that divide the main channel into inner and outer channels;

d) a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed

positions;

e) the outer channel enabling fluid to bypass the valving members when a valving member is in the closed position;

f) at least one of the valving members having a curved surface that closes the inner but not the outer channel in a closed position and wherein in the open position the valving member opening generally aligns with the inner channel;

g) wherein fluid flow in the main channel flows around the valving member when it is in the closed position and through the valving member when it is in the open position;

h) wherein each valving member is configured to support a ball or plug when closed;

i) wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore.

22. A method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of:

a) providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet and a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions;

b) enabling fluid to bypass the valving members when a valving member is in the closed position;

c) preventing fluid flow in the main flow channel when a valving member is in a closed position;

d) enabling fluid flow in the main channel around the valving member when the valving member is in the closed position and through the valving member when the valving member is in the open position;

e) supporting a ball or plug with a valving member when the valving member is closed;

f) permitting a ball or plug to pass through a valving member when the valving member is in the closed position.

23. The method of claim 22, wherein at least one valving member has a pair of opposed, generally flat surfaces.

24. The method of claim 22, wherein at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches (16.5 cm).

25. The method of claim 22, wherein at least one valving member in the closed position has a generally cylindrically shaped cross section.

26. The method of claim 22, wherein at least one valving member in the closed position has a generally rectangular shaped cross section.

27. The method of claim 22, wherein the body has a working tension of two million pounds (907,200 kg).

28. The method of claim 22, wherein the body has an internal working pressure of 15,000 psi (10,546,050 kg/m^2).

29. The method of claim 22, wherein the body has a working torque of 50,000 foot pounds (6912.75 kg-m).

30. The method of claim 29, wherein the body has a working torque of 50,000 foot pounds (6912.75 kg-m) in either of two rotational directions.

31. The method of claim 22, further comprising enabling fluid to flow around the valving member when the valving member is closed.

32. A method of dropping one or more balls or plugs into a well tubing, comprising:

a) providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a flow channel that connects the inlet and the outlet, a plurality of sleeves that divide the flow channel into an inner channel and an outer channel, a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions;

b) enabling fluid to bypass the valving members via the outer channel when a valving member is in the closed position;

c) flowing fluid in the outer channel and around a valving member when a valving member is in the closed position and through the valving member via the inner channel when the valving member is in the open position;

d) supporting a ball or plug with a valving member when closed; and

e) permitting a ball or plug to pass a valving member when open.

33. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) the housing having an inner surface surrounding an outer bypass channel and an inner flow channel, wherein each said channel connects to the inlet and the outlet;

c) a plurality of valving members spaced between the inlet and the outlet, each valving member having an inner valve with a flow bore, and being movable between open and closed positions, each valving member having an outer valve that is in an open position when the inner valve is closed and in a closed position when the inner valve is open, said outer valve presenting a curved surface to the housing inner surface when the inner valve is open, each outer valve not valving flow in the bypass channel when the inner flow channel is closed;

d) canisters in the housing that separate said inner and bypass fluid flow channels, said bypass channel enabling fluid to bypass the inner valve and the inner flow channel when the outer valve is in the open position and the inner valve is in the closed position;

e) wherein the inner valve does not valve fluid flow in the bypass flow channel when the inner valve is in the closed position;

f) wherein fluid flow flows around the inner valve and in between the canisters and the housing inner surface when it is in the closed position and through the inner valve when it is in the open position;

g) each canister being a sliding sleeve above each inner valve that is configured to support a ball or plug when the inner valve below the sleeve is closed; and

h) wherein in the open position each inner valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the inner valve flow bore.

34. The ball and plug dropping head of claim 33, wherein at least one outer valve has a pair of opposed, generally flat surfaces.

35. The ball and plug dropping head of claim 33, wherein at least one inner valve has a valve opening that enables passage of a plug of a diameter of 6.5 inches.

36. The ball and plug dropping head of claim 33, wherein at least one inner valve in the closed position has a generally cylindrically shaped cross section.

37. The ball and plug dropping head of claim 33, wherein at least one inner valve in the open position has a generally rectangular shaped longitudinal cross section.

38. The ball and plug dropping head of claim 33, wherein the body has a working tension of two million pounds.

39. The ball and plug dropping head of claim 33, wherein the body has an internal working pressure of 15,000 psi.

40. The ball and plug dropping head of claim 33, wherein the body has a working torque of 50,000 foot pounds.

41. The ball and plug dropping head of claim 40, wherein the body has a working torque of 50,000 foot pounds in either of two rotational directions.

42. The ball and plug dropping head of claim 33, wherein there are multiple valving members that enable fluid flow around the inner valve when the valving member is closed.

43. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) the housing having an inner surface surrounding a main flow channel that connects the inlet and the outlet, vertically sliding sleeves dividing the main flow channel into an inner channel and an outer bypass channel;

c) a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions;

d) the outer channel enabling fluid to bypass a valving member when a valving member is in the closed position;

e) at least one of the valving members having a cross section that, in the open position, does not valve fluid flow in the main flow channel;

f) wherein fluid flow flows around the valving member via the outer bypass channel when the valving member is in the closed position and through the valving member and inner channel when the valving member is in the open position;

g) wherein each valving member is configured to support a ball or plug when closed;

h) wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore; and

i)one or more bypass valve plates, each attached to and rotating with a valving member, each bypass valve plate valving flow in the outer bypass channel but not the inner channel, each bypass valve plate having at least one curved portion that tracks the inner surface of the housing, and wherein each valve plate has a thickness that occupies only a part of the outer bypass channel when the valving member is rotated to a closed position.

44. The ball and plug dropping head of claim 43, wherein at least one bypass valve plate has a pair of opposed, generally flat surfaces.

45. The ball and plug dropping head of claim 43, wherein at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches.

46. The ball and plug dropping head of claim 43, wherein at least one valving member in the closed position has a generally cylindrically shaped cross section.

47. The ball and plug dropping head of claim 43, wherein at least one valving member in the open position has a generally rectangular shaped longitudinal cross section.

48. The ball and plug dropping head of claim 43, wherein the body has a working tension of two million pounds.

49. The ball and plug dropping head of claim 43, wherein the body has an internal working pressure of 15,000 psi.

50. The ball and plug dropping head of claim 43, wherein the body has a working torque of 50,000 foot pounds.

51. The ball and plug dropping head of claim 50, wherein the body has a working torque of 50,000 foot pounds in either of two rotational directions.

52. The ball and plug dropping head of claim 43, wherein there are multiple valving members that enable fluid flow around the valving member when the valving member is closed.

53. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) the housing having an inner surface surrounding a main flow channel that connects the inlet and the outlet;

c) a plurality of vertically sliding sleeves that divide the main channel into inner and outer channels;

d) a plurality of valving members spaced between the inlet and the outlet, each valving member having a valve flow bore, and each valving member being movable between open and closed positions;

e) the outer channel enabling fluid to bypass the valving members when a valving member is in the closed position;

f) at least one of the valving members having a curved surface that closes the inner but not the outer channel in a closed position and wherein in the open position the valving member opening generally aligns with the inner channel;

g) wherein fluid flow in the main channel flows around the valving member and sleeves when the valving member is in the closed position and through the valving member when the valving member is in the open position;

h) wherein each valving member is configured to support a ball or plug when the valving member is in the closed position;

i) wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore; and

j) plates mounted to the valving members and positioned to valve flow in the outer channel, each plate occupying a position that enables flow in the outer channel when the valving member to which it is attached is in the closed position.

54. The ball and plug dropping head of claim 53, further comprising enabling fluid to flow in the outer section and around multiple of the valving members when the valving members are closed.

55. A method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of:

a) providing a housing having an inlet at its upper end adapted to be fluidly

connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet and a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, the main channel having an inner section and an outer bypass section;

b) enabling fluid to bypass the valving members via the bypass section when a valving member is in the closed position;

c) preventing fluid flow in the inner section of the main flow channel when a valving member is in a closed position;

d) enabling fluid flow in the inner section when the valving member is in the open position;

e) supporting a ball or plug with a valving member when the valving member is in the closed position;

f) permitting a ball or plug to pass through a valving member when the valving member is in the open position; and

g) valving flow in the outer section with plates that are attached to and that rotate with the valving members, said plates enabling flow in the outer section when the valving member is in the closed position.

56. The method of claim 55, wherein at least one valving member has a pair of opposed, generally flat surfaces.

57. The method of claim 55, wherein at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches.

58. The method of claim 55, wherein at least one valving member in the closed position has a generally cylindrically shaped cross section.

59. The method of claim 55, wherein at least one valving member in the open position has a generally rectangular shaped longitudinal cross section.

60. The method of claim 55, wherein the body has a working tension of two million pounds.

61. The method of claim 55, wherein the body has an internal working pressure of 15,000 psi.

62. The method of claim 55, wherein the body has a working torque of 50,000 foot pounds.

63. The method of claim 62, wherein the body has a working torque of 50,000 foot pounds in either of two rotational directions.

64. A method of dropping one or more balls or plugs into a well tubing, comprising:

a) providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a housing inner surface that surrounds a flow channel that connects the inlet and the outlet, a plurality of sleeves that divide the flow channel into an inner channel and an outer channel, a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions;

b) enabling fluid to bypass the valving members via the outer channel when a valving member is in the closed position;

c) flowing fluid in the outer channel and around a valving member when a valving member is in the closed position and through the valving member via the inner channel when the valving member is in the open position;

d) wherein substantial fluid flow is stopped in the outer channel when a valving member is in the open position by rotating plates with the valving members to close the outer channel, said plates attached to and rotating with the valving members;

e) supporting a ball or plug with a valving member when closed; and

f) permitting a ball or plug to pass a valving member when open.

65. A ball and plug dropping head for use in sequentially dropping one or more balls, darts or plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet and a mating inside surface;

b) the housing having an inner surface surrounding an outer bypass channel and an inner flow channel, wherein each said channel connects to the inlet and the outlet;

c) a plurality of valving members spaced between the inlet and the outlet, each valving member having an inner valve with a flow bore, and being movable between open and closed positions, each valving member having an outer valve that is in an open position when the inner valve is closed and in a closed position when the inner valve is open, said outer valve presenting a mating surface to the housing inner surface when the inner valve is open, each outer valve not valving flow in the bypass channel when the inner flow channel is closed;

d) canisters in the housing that separate said inner and bypass secondary fluid flow channels, said bypass channel enabling fluid to bypass the inner valve and the inner flow channel when the outer valve is in the open position and the inner valve is in the closed position;

e) wherein the inner valve does not valve fluid flow in the bypass flow channel when the inner valve is in the closed position;

f) wherein fluid flow flows around the inner valve and in between the canisters and the housing inner surface when it is in the closed position and through the inner valve when it is in the open position;

g) each canister being a sliding sleeve above each inner valve that is configured to support a ball, dart or plug when the inner valve below the sleeve is closed;

h) wherein in the open position each inner valve flow bore permits a

ball, dart or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball, dart nor plug is in the inner valve flow bore; and

i) one or more members attached to and rotating with the valving member that close the secondary channel when the valving member opens the main channel, said member having a mating edge that tracks said mating inside surface.

66. The ball and plug dropping head of claim 65, wherein at least one outer valve has a pair of opposed, generally flat surfaces.

67. The ball and plug dropping head of claim 65, wherein at least one inner valve has a valve opening that enables passage of a plug of a diameter of 6.5 inches.

68. The ball and plug dropping head of claim 65, wherein at least one inner valve in the closed position has a generally cylindrically shaped cross section.

69. The ball and plug dropping head of claim 65, wherein at least one inner valve in the open position has a generally rectangular shaped longitudinal cross section.

70. The ball and plug dropping head of claim 65, wherein the body has a working tension of two million pounds.

71. The ball and plug dropping head of claim 65, wherein the body has an internal working pressure of 15,000 psi.

72. The ball and plug dropping head of claim 65, wherein the body has a working torque of 50,000 foot pounds.

73. The ball and plug dropping head of claim 72, wherein the body has a working torque of 50,000 foot pounds in either of two rotational directions.

74. The ball and plug dropping head of claim 65, wherein there are multiple valving members that enable fluid flow around the inner valve when the valving member is closed.

75. A ball and plug dropping head for use in sequentially dropping one or more balls, darts or plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet and a mating inside surface;

b) the housing having an inner surface surrounding a main flow channel that connects the inlet and the outlet, vertically sliding sleeves dividing the main flow channel into an inner channel and an outer bypass channel;

c) a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions;

d) the outer channel enabling fluid to bypass a valving member when a valving member is in the closed position;

e) at least one of the valving members having a cross section that, in the open position, does not valve fluid flow in the main flow channel;

f) wherein fluid flow flows around the valving member via the outer bypass channel when the valving member is in the closed position and through the valving member and inner channel when the valving member is in the open position;

g) wherein each valving member is configured to support a ball or plug when closed;

h) wherein in the open position each valve flow bore permits a ball, dart or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore; and

i) one or more bypass valve plates, each attached to and rotating with a valving member, each bypass valve plate valving flow in the outer bypass channel but not the inner channel, each bypass valve plate having at least one mating portion that tracks the inner surface of the housing, and wherein each

valve plate has a thickness that occupies only a part of the outer bypass channel when the valving member is rotated to a closed position.

76. The ball and plug dropping head of claim 75, wherein at least one bypass valve plate has a pair of opposed, generally flat surfaces.

77. The ball and plug dropping head of claim 75, wherein at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches.

78. The ball and plug dropping head of claim 75, wherein at least one valving member in the closed position has a generally cylindrically shaped cross section.

79. The ball and plug dropping head of claim 75, wherein at least one valving member in the open position has a generally rectangular shaped longitudinal cross section.

80. The ball and plug dropping head of claim 75, wherein the body has a working tension of two million pounds.

81. The ball and plug dropping head of claim 75, wherein the body has an internal working pressure of 15,000 psi.

82. The ball and plug dropping head of claim 75, wherein the body has a working torque of 50,000 foot pounds.

83. The ball and plug dropping head of claim 82, wherein the body has a working torque of 50,000 foot pounds in either of two rotational directions.

84. The ball and plug dropping head of claim 75, wherein there are multiple valving members that enable fluid flow around the valving member when the valving member is closed.

85. A ball and plug dropping head for use in sequentially dropping one or more balls, darts or plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly

connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) the housing having an inner surface surrounding a main flow channel that connects the inlet and the outlet;

c) a plurality of vertically sliding sleeves that divide the main channel into inner and outer channels;

d) a plurality of valving members spaced between the inlet and the outlet, each valving member having a valve flow bore, and each valving member being movable between open and closed positions;

e) the outer channel enabling fluid to bypass the valving members when a valving member is in the closed position;

f) at least one of the valving members having a mating surface that closes the inner but not the outer channel in a closed position and wherein in the open position the valving member opening generally aligns with the inner channel;

g) wherein fluid flow in the main channel flows around the valving member and sleeves when the valving member is in the closed position and through the valving member when the valving member is in the open position;

h) wherein each valving member is configured to support a ball, dart or plug when the valving member is in the closed position;

i) wherein in the open position each valve flow bore permits a ball, dart or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore; and

j) plates mounted to the valving members and positioned to valve flow in the outer channel, each plate occupying a position that enables flow in the outer channel when the valving member to which it is attached is in the closed

position.

86. A method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of:

a) providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet and a plurality of valving members spaced between the inlet and the outlet, each valving member having a flow bore, and being movable between open and closed positions, the main channel having an inner section and an outer bypass section;

b) enabling fluid to bypass the valving members via the bypass section when a valving member is in the closed position;

c) preventing fluid flow in the inner section of the main flow channel when a valving member is in a closed position;

d) enabling fluid flow in the inner section when the valving member is in the open position;

e) supporting a ball, dart or plug with a valving member when the valving member is in the closed position;

f) permitting a ball, dart or plug to pass through a valving member when the valving member is in the open position; and

g) valving flow in the outer section with plates that are attached to and that rotate with the valving members, said plates enabling flow in the outer section when the valving member is in the closed position.

87. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) a main flow channel that connects the inlet and the outlet;

c) a plurality of inner valving members spaced between the inlet and the outlet, each valving member having an inner valve flow bore, and being movable upon a valve stem between open and closed positions;

d) one or more bypass fluid flow channels that enable fluid to bypass the inner valving members when a said inner valving member is in the closed position;

e) at least one of the inner valving members having a cross section that, in the closed position, does not valve fluid flow in the main flow channel;

f) wherein fluid flow in the main channel flows around the inner valving member via the bypass fluid flow channel when it is in the closed position and through the inner valving member when it is in the open position;

g) wherein in the open position each inner valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore;

h) one or more outer valving members mounted on the valve stem and that each occupy a position in the bypass channel;

i) wherein the outer valving member opens the bypass channel when the inner valving member is in the closed position; and

j) wherein the outer valving member closes the bypass channel when the inner valving member is in the open position.

88. The ball and plug dropping head of claim 87, wherein at least one valve has a pair of opposed, generally flat surfaces.

89. The ball and plug dropping head of claim 87, wherein at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches.

90. The ball and plug dropping head of claim 87, wherein at least one valving member in the closed position has a generally cylindrically shaped cross section.

91. The ball and plug dropping head of claim 87, wherein at least one valving member in the closed position has a generally rectangular shaped cross section.

92. The ball and plug dropping head of claim 87, wherein the body has a working tension of two million pounds.

93. The ball and plug dropping head of claim 87, wherein the body has an internal working pressure of 15,000 psi.

94. The ball and plug dropping head of claim 87, wherein the body has a working torque of 50,000 foot pounds.

95. The ball and plug dropping head of claim 94, wherein the body has a working torque of 50,000 foot pounds in either of two rotational directions.

96. The ball and plug dropping head of claim 87, wherein there are multiple valving members that enable fluid flow around the valving member when the valving member is closed.

97. The ball and plug dropping head of claim 87, further comprising enabling fluid to flow around the inner valving member via the outer channel and the outer valving member is opened, and wherein both inner and outer valving members are mounted to and rotate with a common valve stem when the inner valving member is closed.

98. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) a main flow channel that connects the inlet and the outlet, and including an inner channel and an outer channel;

c) a plurality of valving members spaced between the inlet and the outlet, each valving member having a valve stem, a valve inner part with a flow bore, a valve outer part, and being movable between open and closed positions;

d) the outer channel enabling fluid to bypass a valving member inner part when a valving member inner part is in the closed position;

e) at least one of the valving members having said inner part with a cross section that, in the open position, does not valve fluid flow in the main flow channel;

f) wherein fluid flow flows around the valving member inner part via the outer channel when said inner part is in the closed position and through the valving member inner part and the inner channel when the valve inner part is in the open position;

g) wherein each valving member inner part is configured to support a ball or plug when closed;

h) wherein in the open position each inner part flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the inner part flow bore;

i) the valve outer part movable between first and second positions, the first position enabling flow via the outer channel when the inner channel is closed by the inner part; and

j) the second position closing the outer channel when the inner channel is open.

99. The ball and plug dropping head of claim 98, wherein at least one valve has a pair of opposed, generally flat surfaces.

100. The ball and plug dropping head of claim 98, wherein at least one valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches.

101. The ball and plug dropping head of claim 98, wherein at least one valving member in the closed position has a generally cylindrically shaped cross section.

102. The ball and plug dropping head of claim 98, wherein at least one valving member in the closed position has a generally rectangular shaped cross section.

103. The ball and plug dropping head of claim 98, wherein the body has a working tension of two million pounds.

104. The ball and plug dropping head of claim 98, wherein the body has an internal working pressure of 15,000 psi.

105. The ball and plug dropping head of claim 98, wherein the body has a working torque of 50,000 foot pounds.

106. The ball and plug dropping head of claim 105, wherein the body has a working torque of 50,000 foot pounds in either of two rotational directions.

107. The ball and plug dropping head of claim 98, wherein there are multiple valving members that enable fluid flow around the valving member when the valving member is closed.

108. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) a main flow channel that connects the inlet and the outlet;

c) a plurality of vertically sliding sleeves that divide the main channel into inner and outer channels;

d) a plurality of valving members spaced between the inlet and the outlet, each valving member having an inner part with a flow bore, and being movable between open and closed positions;

e) the outer channel enabling fluid to bypass the valving members when a valving member inner part is in the closed position;

f) at least one of the valving members having a curved surface that closes the inner but not the outer channel in a closed position and wherein in the open position the valving member opening generally aligns with the inner channel;

g) wherein fluid flow in the main channel flows around the valving member inner part when it is in the closed position and through the valving member inner part when it is in the open position;

h) wherein each valving member inner part is configured to support a ball or plug when closed;

i) wherein in the open position each valve flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the valve flow bore; and

j) one or more of the valving members having an outer part that closes the outer channel when the inner part opens the inner channel.

109. A method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of:

a) providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, an inner flow channel that connects the inlet and the outlet and a plurality of inner valving members spaced between the inlet and the outlet, each inner valving member having a flow bore, and being movable between open and closed positions;

b) enabling fluid to bypass the inner valving members via an outer channel when a said inner valving member is in the closed position;

c) preventing fluid flow in the inner flow channel when a said inner valving member is in a closed position;

d) enabling fluid flow around a said inner valving member via the outer channel when the inner valving member is in the closed position and through the said inner valving member when the inner valving member is in the open position;

e) supporting a ball or plug with a said inner valving member when the said inner valving member is closed;

f) permitting a ball or plug to pass through a said inner valving member when the valving member is in the open position; and

g) closing the outer channel with an outer valving member when the inner channel is opened with an inner valving member.

110. The method of claim 109, wherein the outer valving member has a plurality of opposed, generally flat surfaces.

111. The method of claim 109, wherein at least one inner valving member has a valve opening that enables passage of a plug of a diameter of 6.5 inches.

112. The method of claim 109, wherein at least one inner valving member in the closed position has a generally cylindrically shaped cross section.

113. The method of claim 109, wherein at least one inner valving member in the closed position has a generally rectangular shaped cross section.

114. The method of claim 109, wherein the body has a working tension of two million pounds.

115. The method of claim 109, wherein the body has an internal working pressure of 15,000 psi.

116. The method of claim 109, wherein the body has a working torque of 50,000 foot pounds.

117. The method of claim 116, wherein the body has a working torque of 50,000 foot pounds in either of two rotational directions.

118. A method of dropping one or more balls or plugs into a well tubing, comprising:

a) providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, an inner flow channel that connects the inlet and the outlet, an outer flow channel, a plurality of sleeves that separate the inner channel from the outer channel, a plurality of inner valving members spaced between the inlet and the outlet, each inner valving member having a flow bore, and being movable between open and closed positions;

b) enabling fluid to bypass the inner valving members via the outer flow channel when an inner valving member is in the closed position;

c) flowing fluid in the outer channel and around an inner valving member when an inner valving member is in the closed position and through a said inner valving member via the inner channel when the inner valving member is in the open position;

d) supporting a ball or plug with a said inner valving member when the said inner valving member is closed; and

e) permitting a ball or plug to pass a said inner valving member when it is open.

119. A ball and plug dropping head for use in sequentially dropping one or more balls and plugs into a well tubing, comprising:

a) a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet;

b) a main flow channel that connects the inlet and the outlet;

c) a plurality of valving members spaced between the inlet and the

outlet, each valving member having a valve inner part with a flow bore, a valve outer part, and a valve stem, wherein each said inner part rotates on said stem with a said outer part between first and second positions;

d) one or more bypass fluid flow channels that enable fluid to bypass a said valve inner part when a said inner part is in the closed position;

e) wherein at least one of the valve inner parts does not stop fluid flow in the main flow channel in said first position;

f) wherein fluid flows around the said inner part via the bypass fluid flow channel when the said inner part is in the second position;

g) wherein in the first position the main flow bore permits a ball or plug to pass therethrough, and circulating fluid to pass downwardly therethrough when neither a ball nor plug is in the main flow channel;

h) the valving member outer part occupying a position in the bypass channel; and

i) wherein the valve outer part closes the bypass channel in the first position and opens the bypass channel in the second position.

120. A method of sequentially dropping one or more balls, darts or plugs into an oil and gas well tubing, comprising the steps of:

a) providing a housing having an inlet at its upper end adapted to be fluidly connected in line with the lower end of a top drive, an outlet generally aligned with the inlet, a main flow channel that connects the inlet and the outlet and a plurality of valving members spaced between the inlet and the outlet, each valving member having an inner part with a flow bore, a valve stem, and an outer part, said inner and outer valve parts being movable upon said stem between first and second positions;

b) providing a bypass channel and enabling fluid to bypass the valve inner part via the bypass channel when the valve inner part is in the first position;

c) preventing fluid flow in the main flow channel when the valving member inner part is in the first position;

d) enabling fluid flow through the valving member inner part when the valving member inner part is in the second position;

e) supporting a ball or plug with a valving member when the valving member inner part is in the first position;

f) permitting a ball or plug to pass through the valving member inner part when the valving member inner part is in the second position; and

g) wherein the valve outer part closes the bypass channel in the first position and opens the bypass channel in the second position.

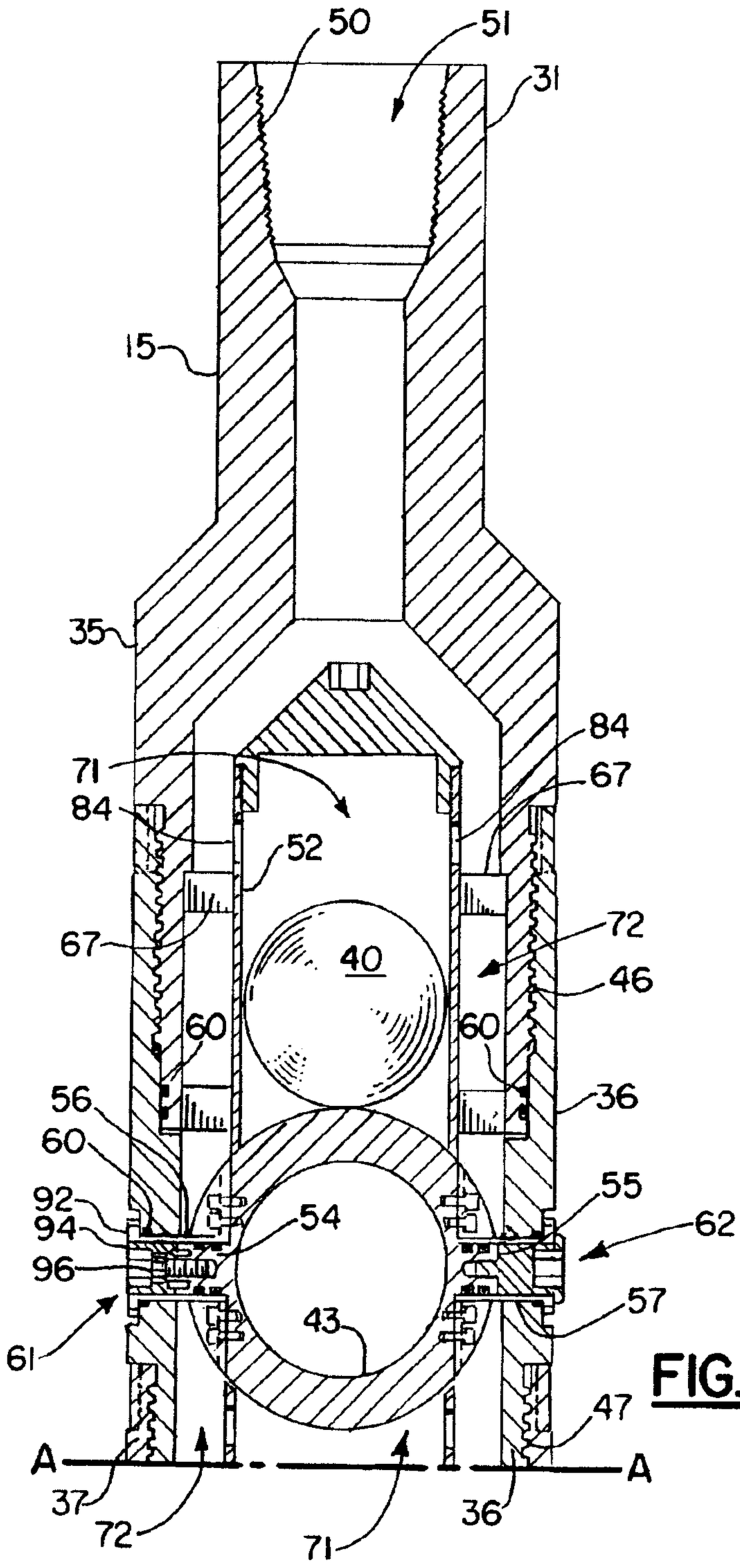
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FIG. 1A.

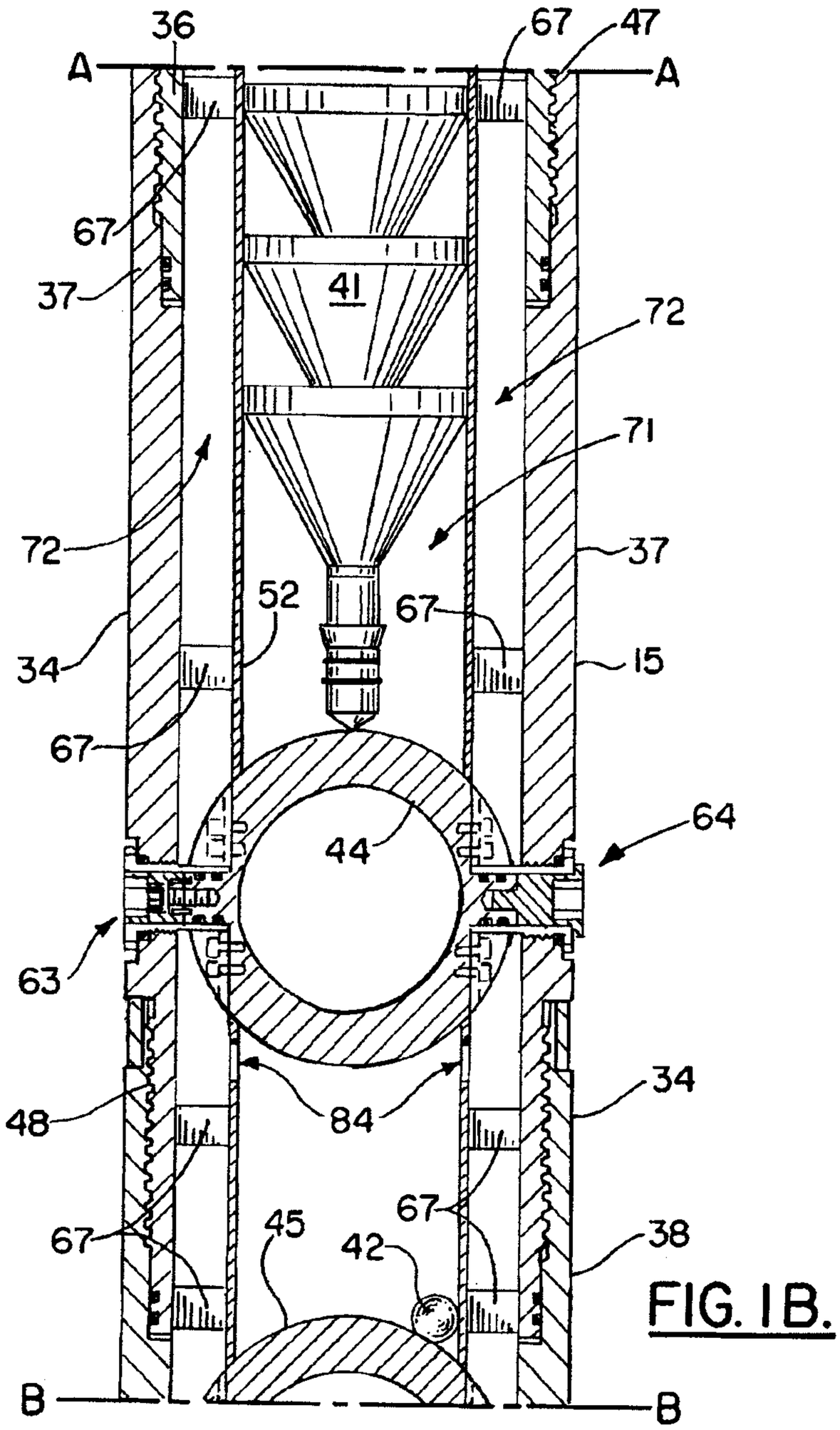
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FIG. 1B.

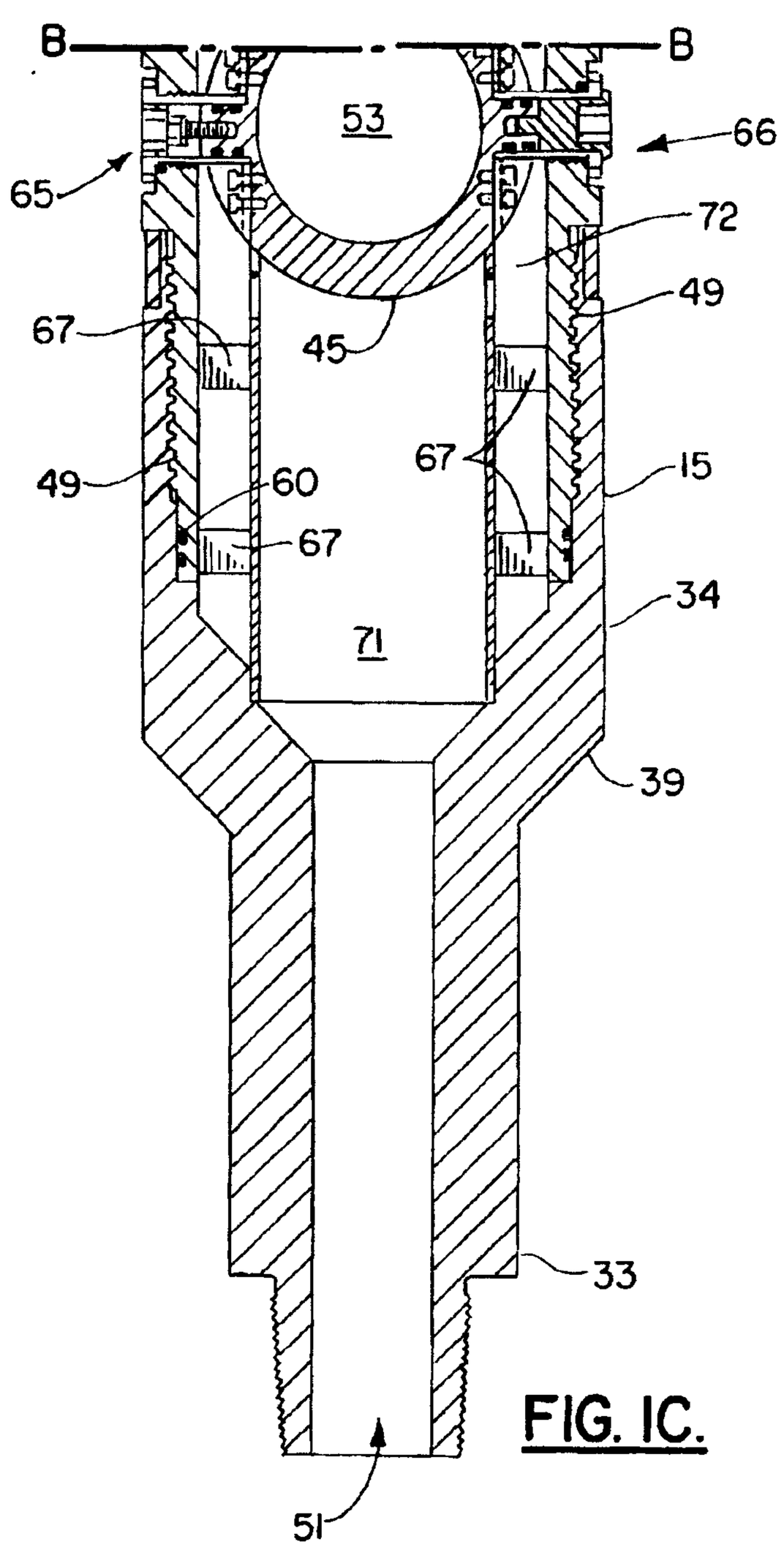

FIG. IC.

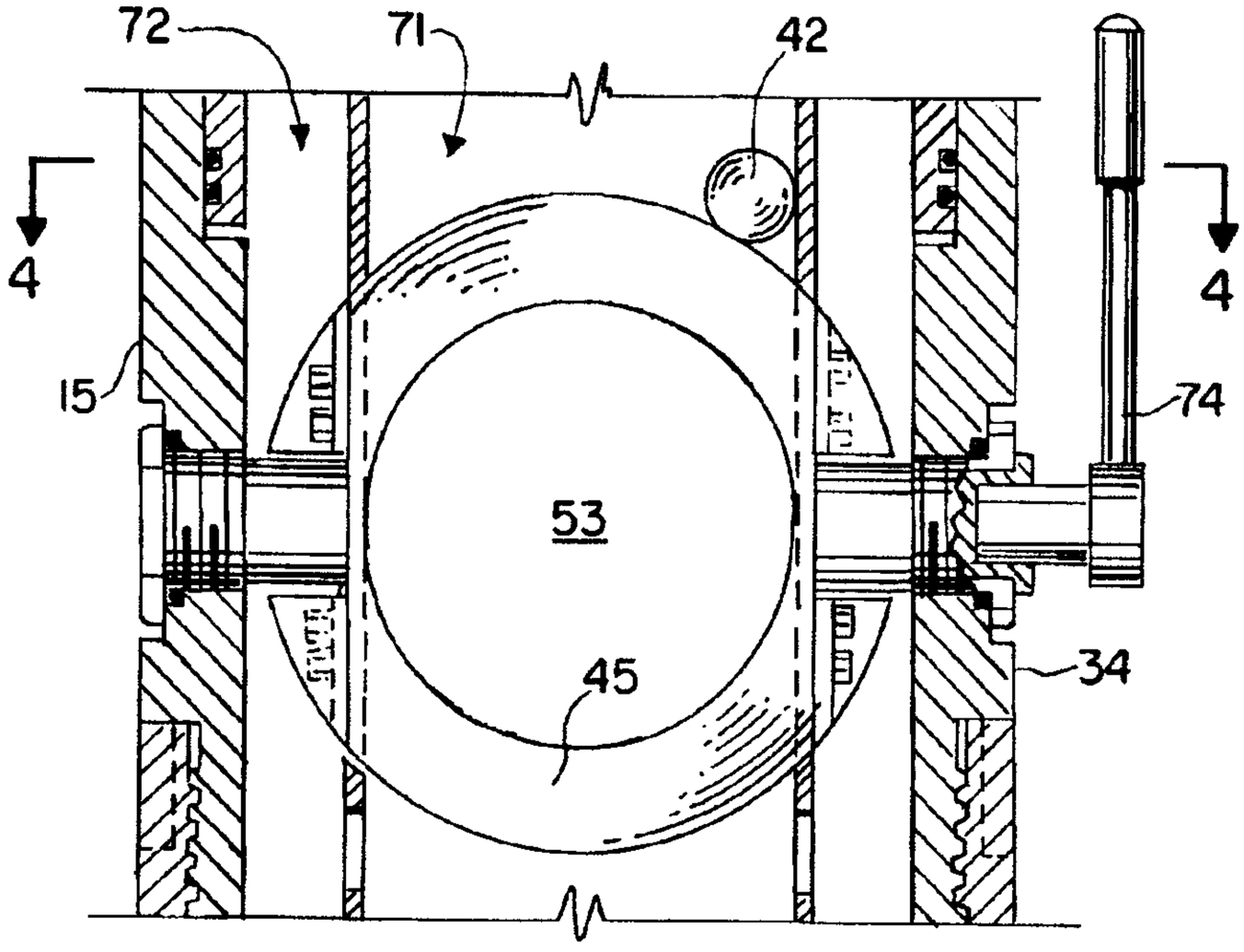

FIG. 2.

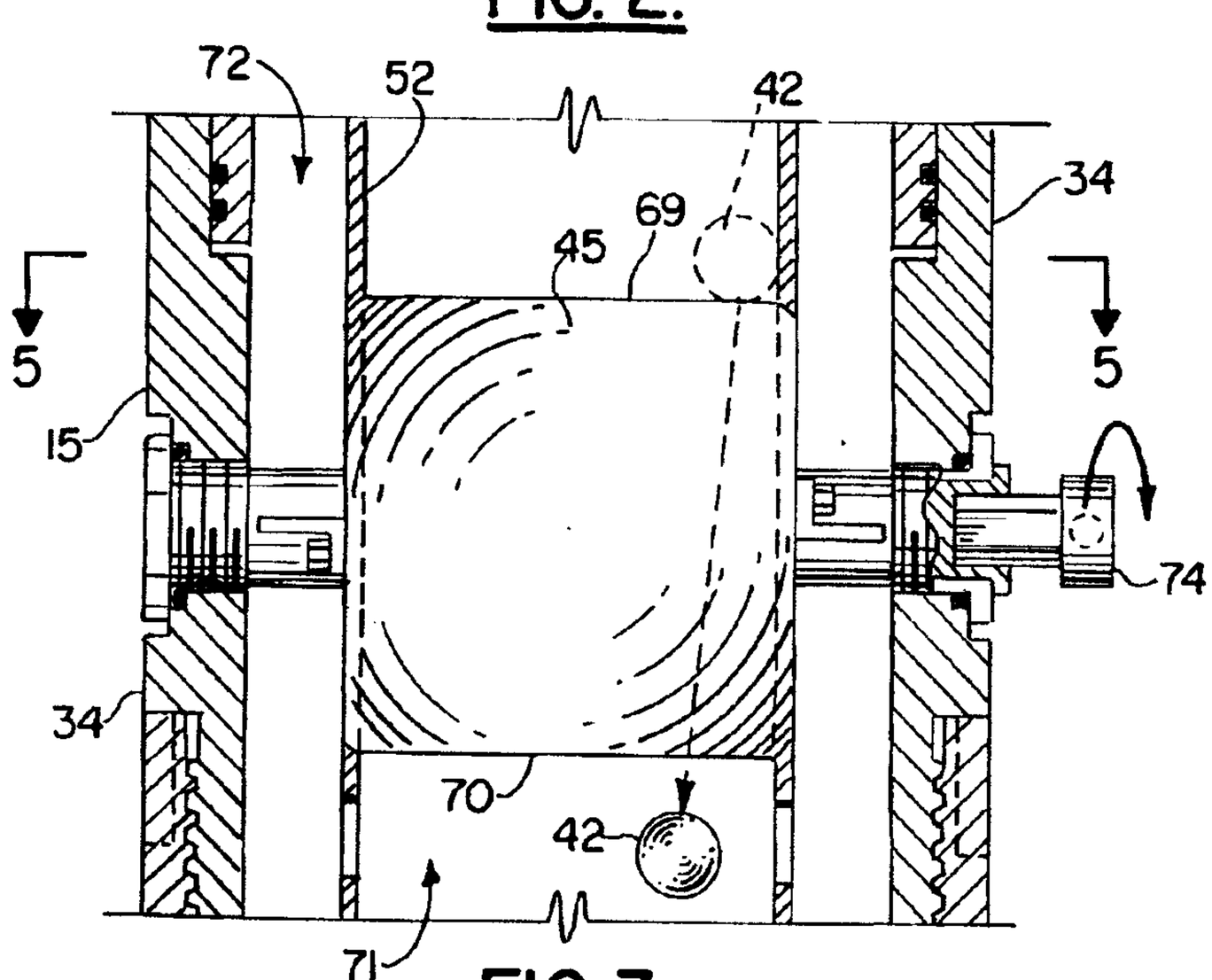

FIG. 3.

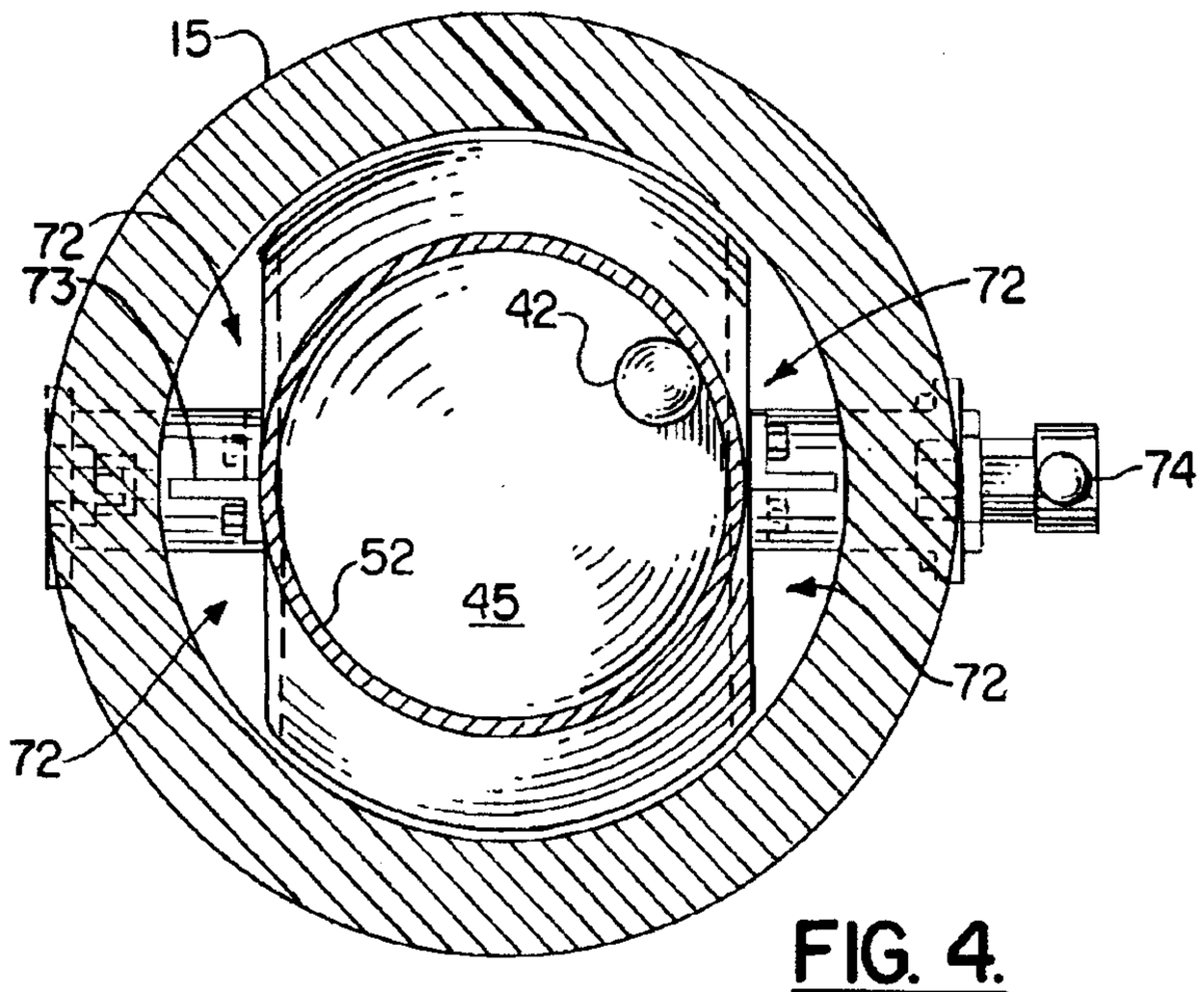

FIG. 4.

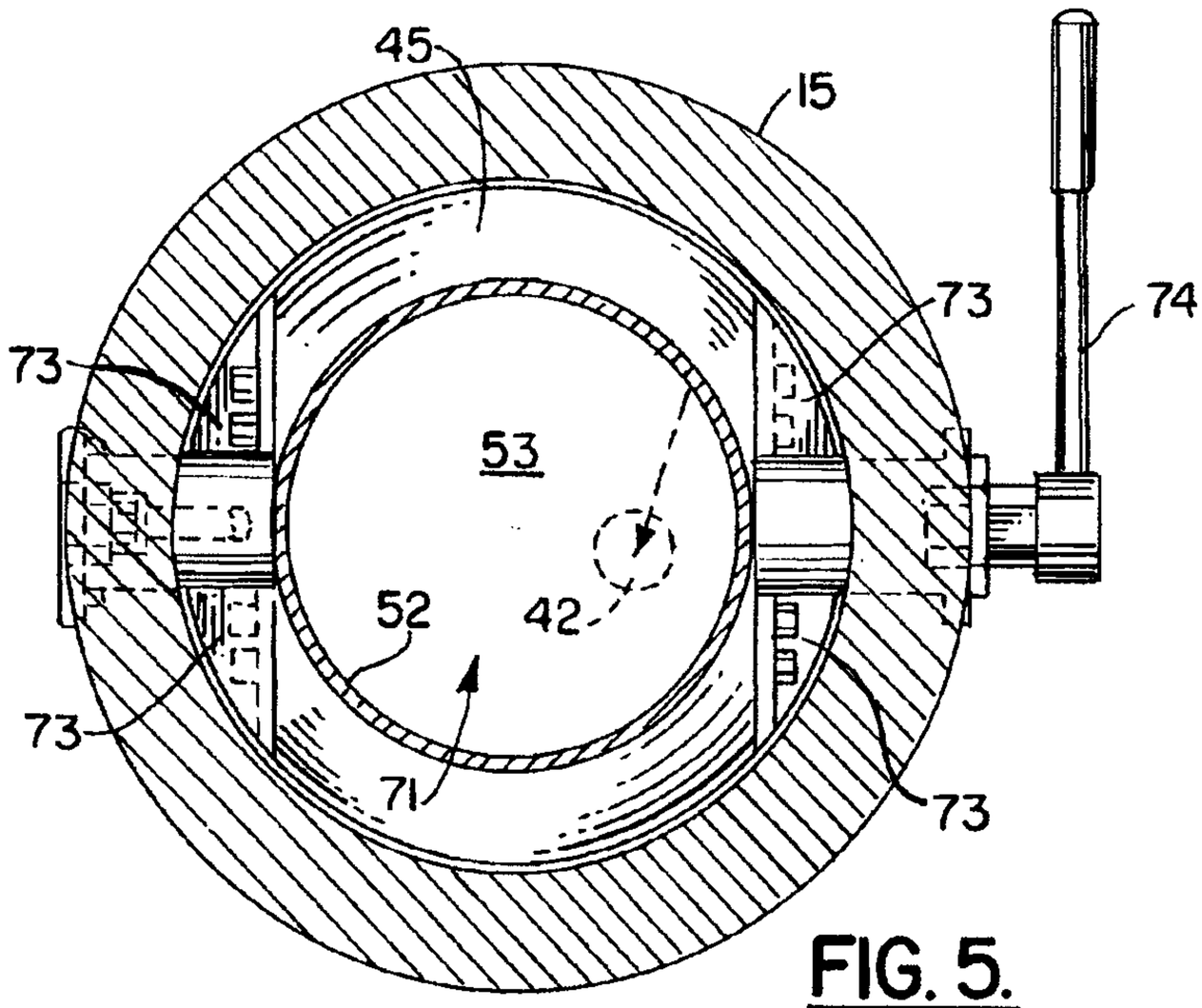

FIG. 5.

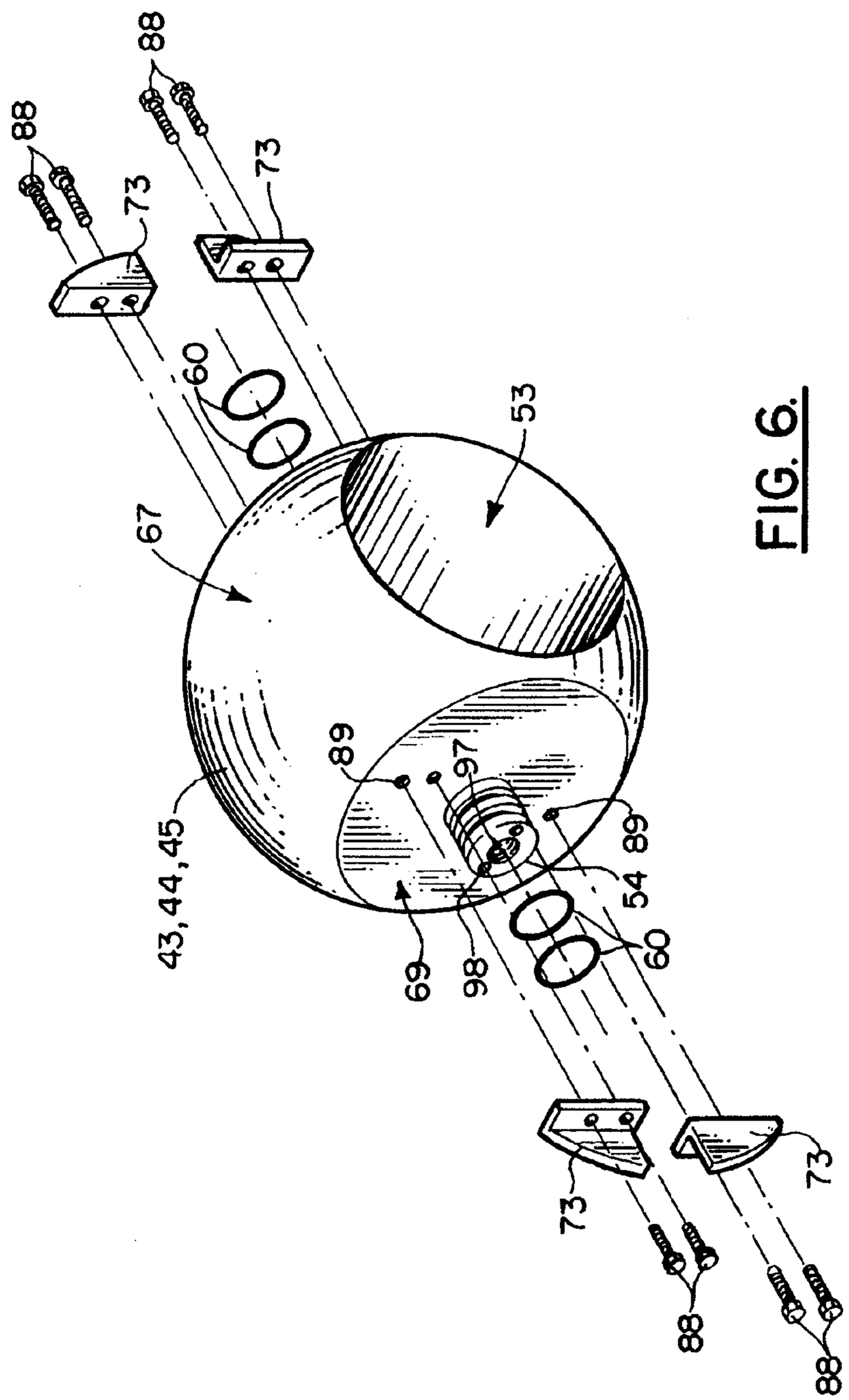

FIG. 6.

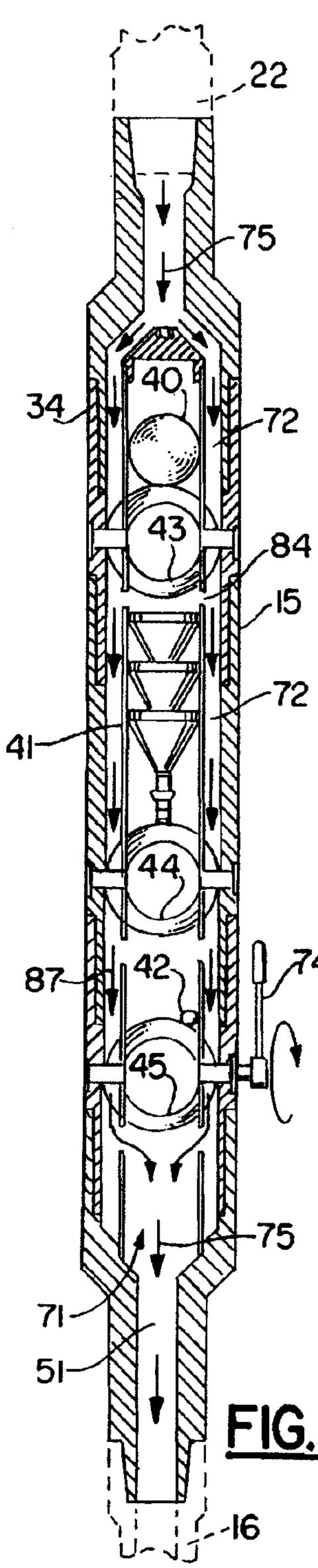
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FIG. 7.

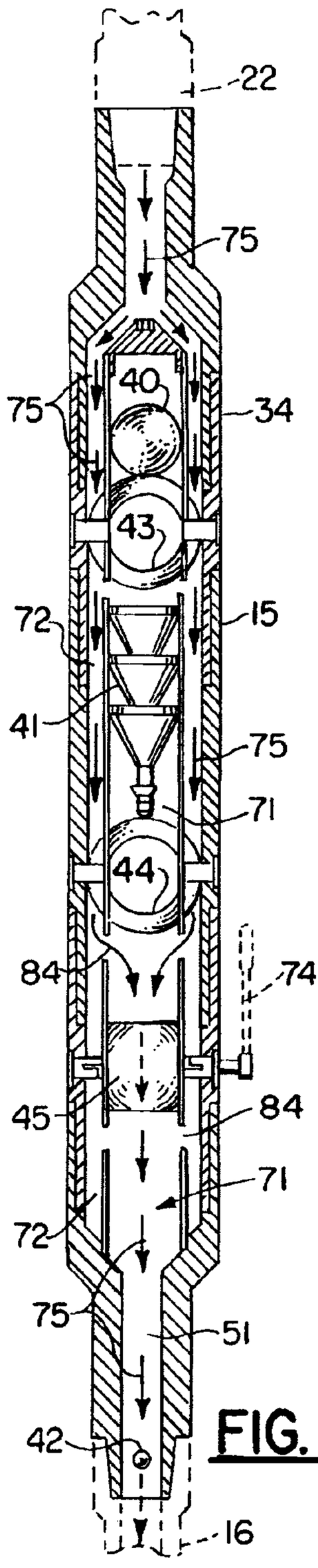
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FIG. 8.

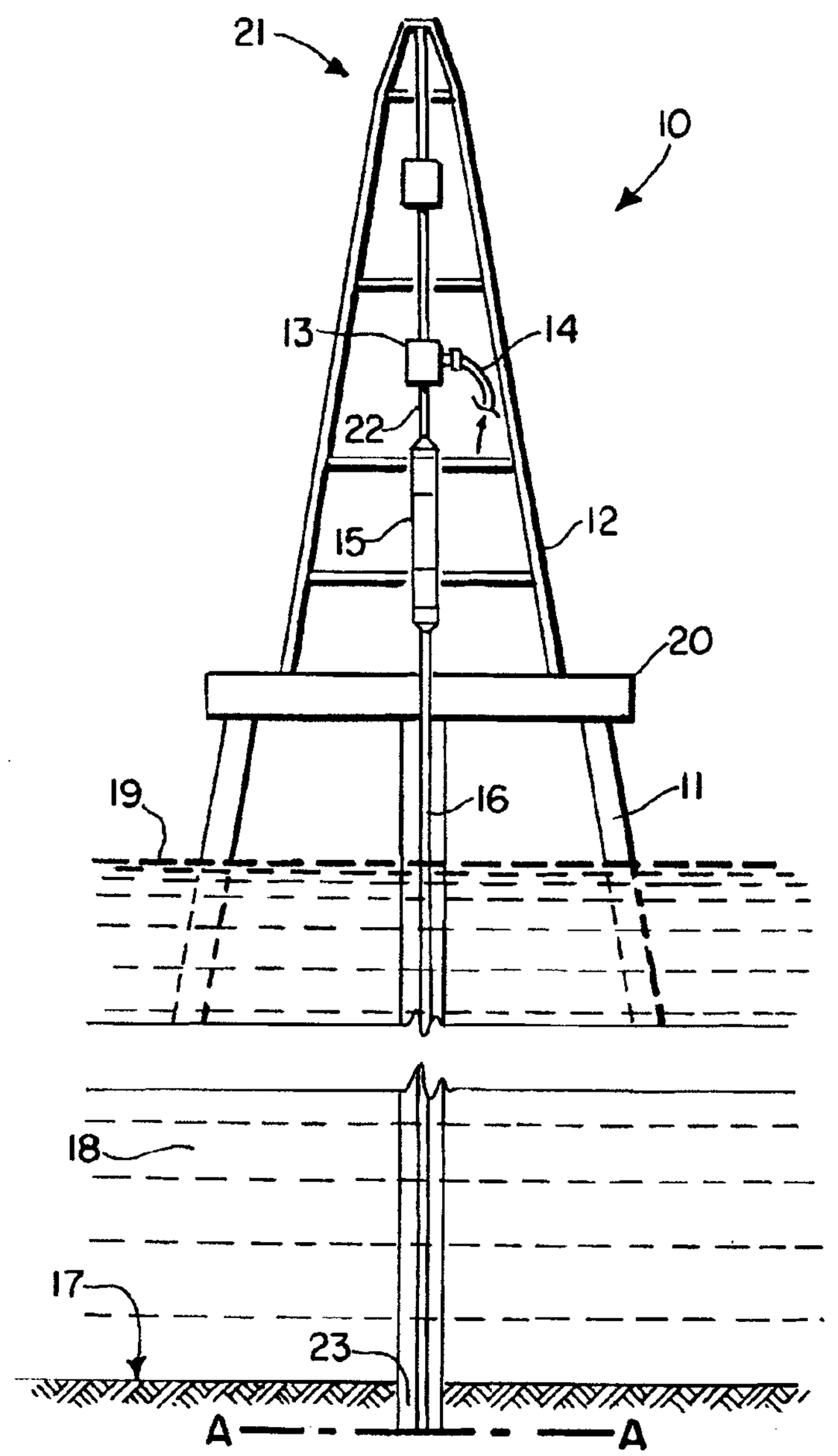

FIG. 9.

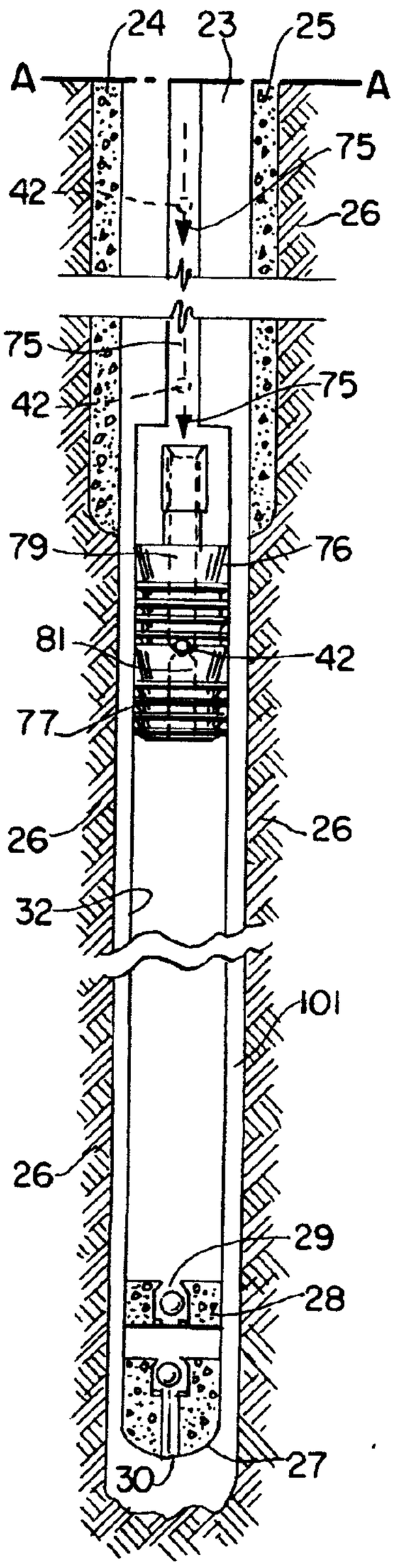
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FIG. 10.

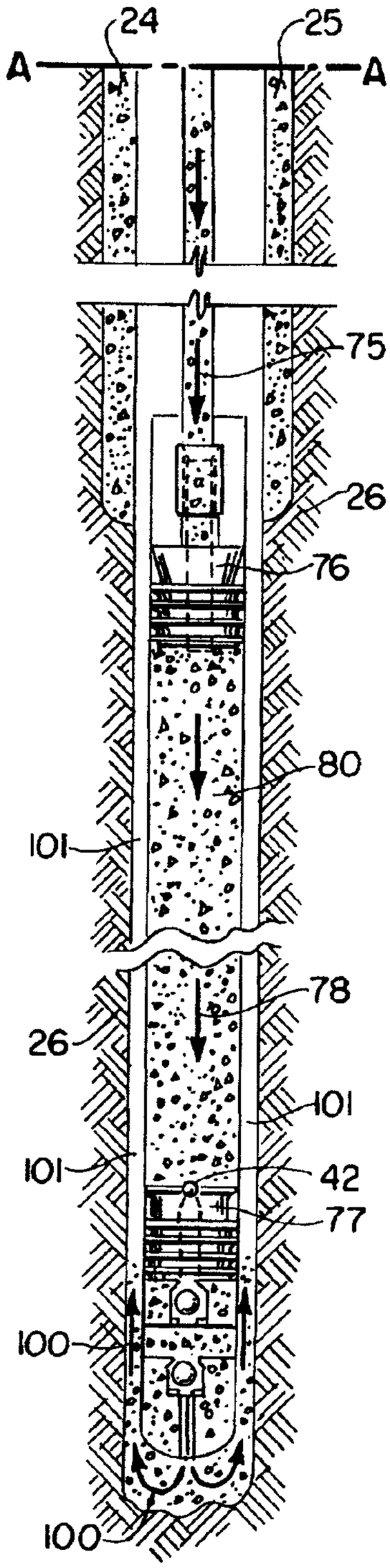
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FIG. 11.

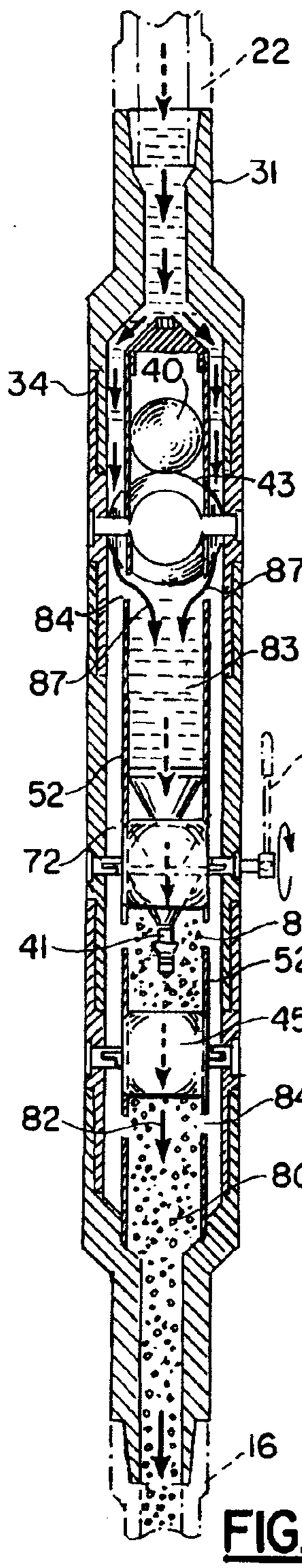
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FIG. 12.

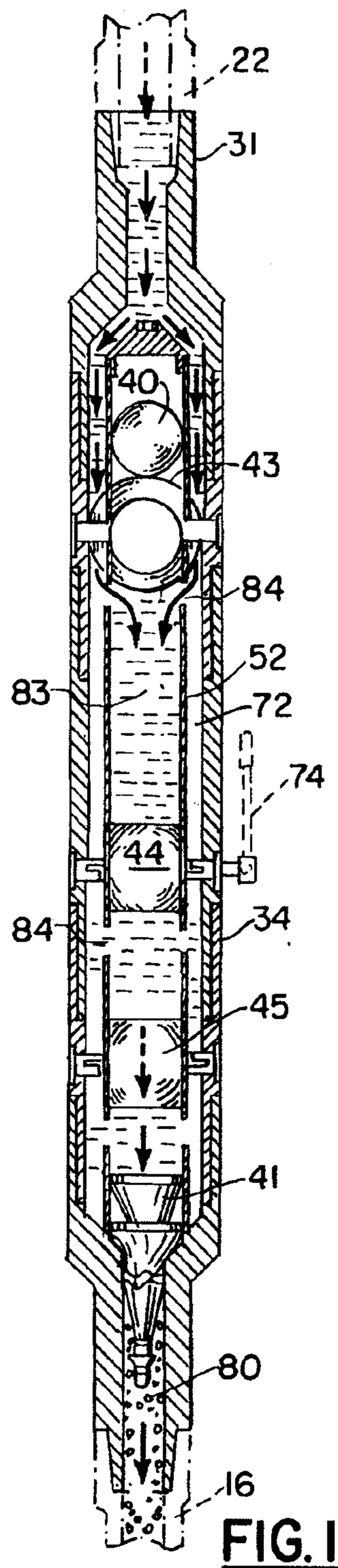
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FIG. 13.

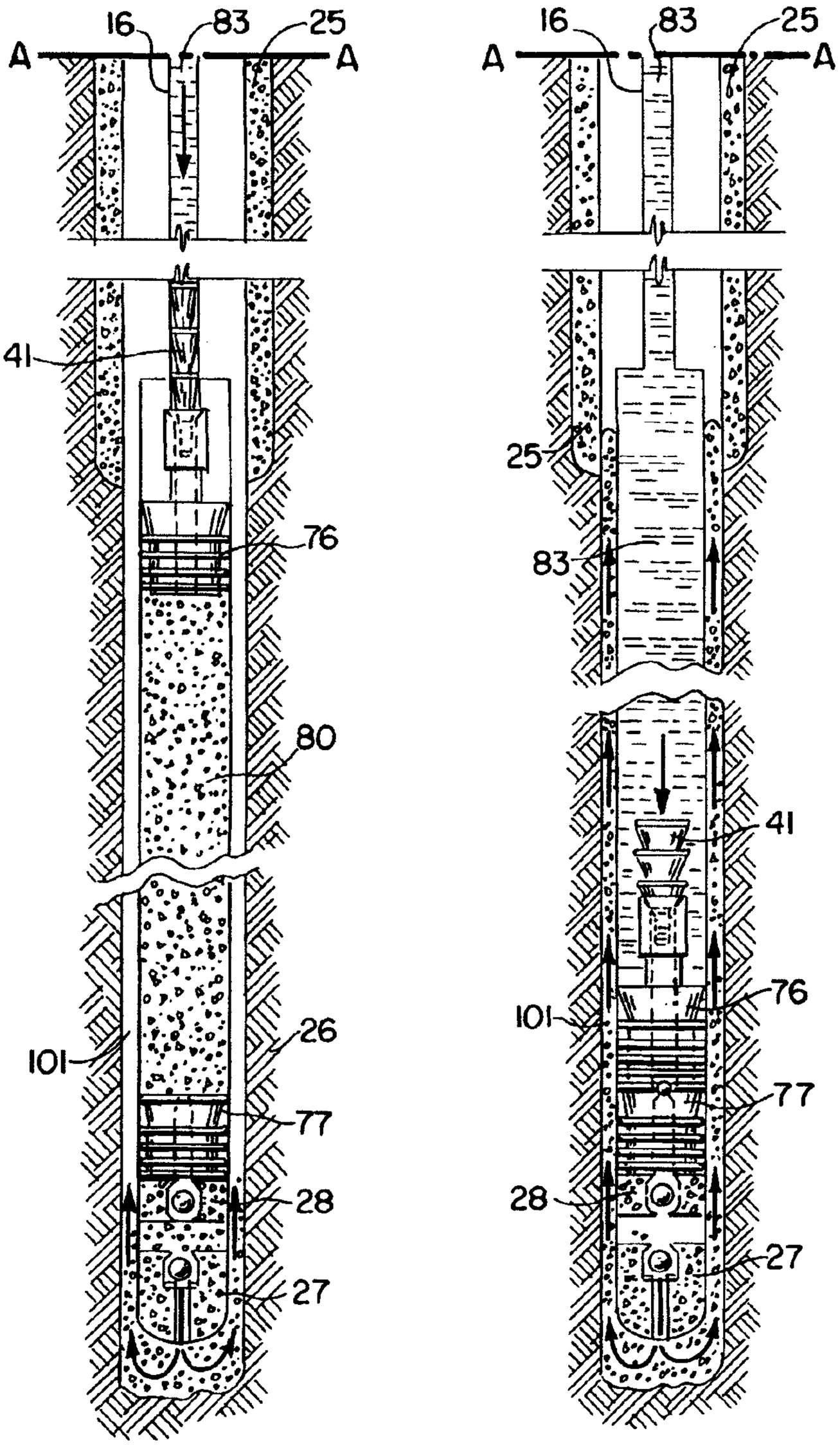
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FIG. 14.

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FIG. 15.

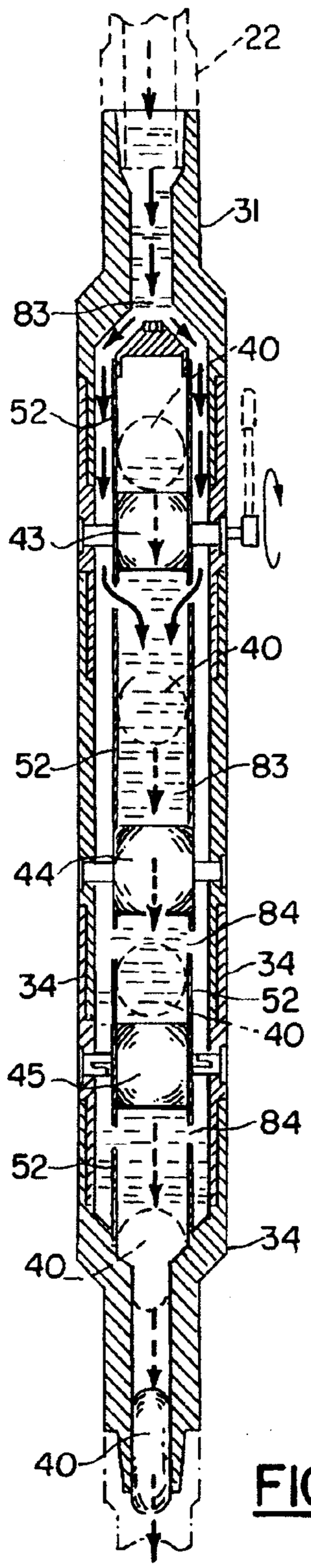

FIG. 16.

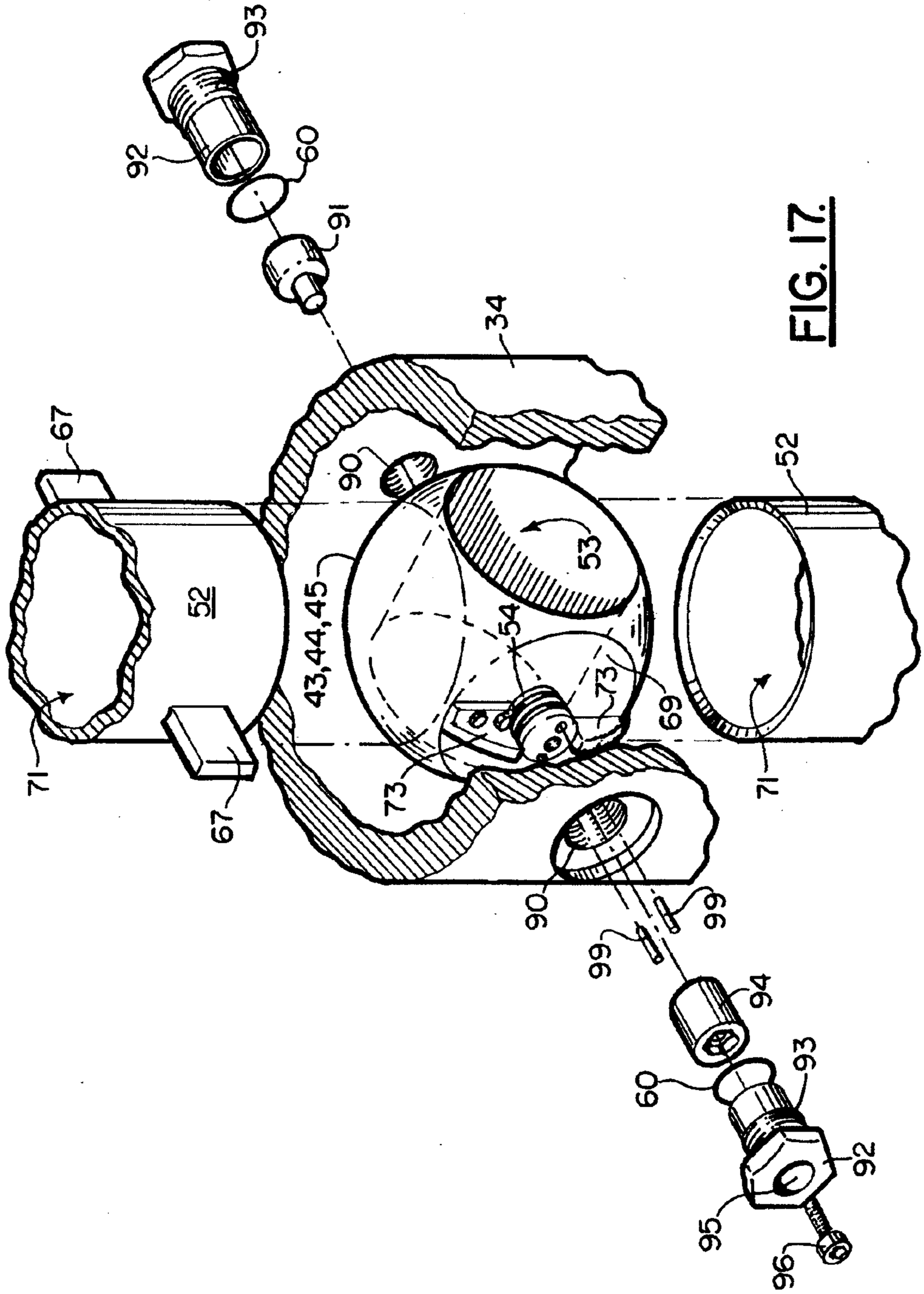
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FIG. 17.

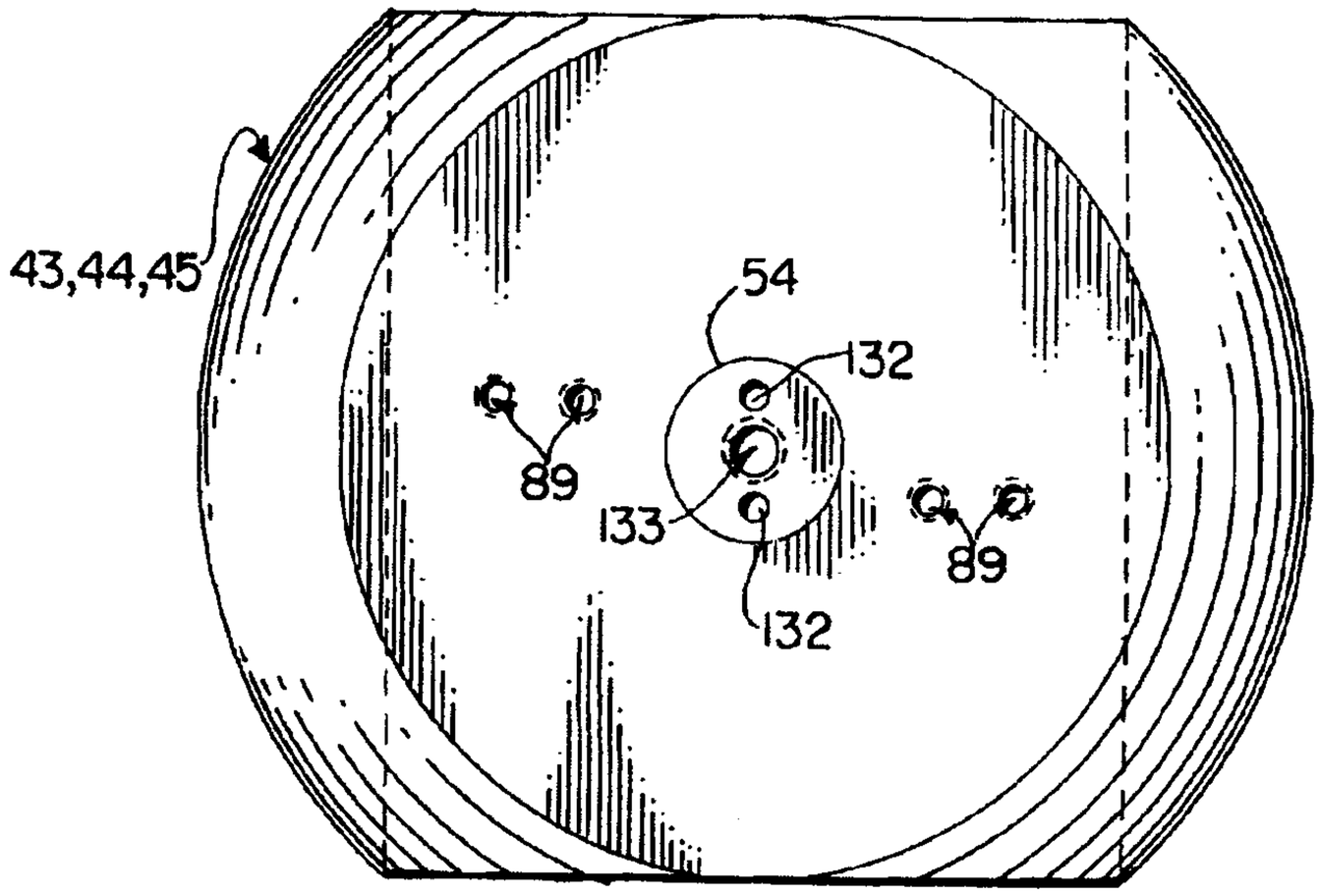
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FIG. 18.

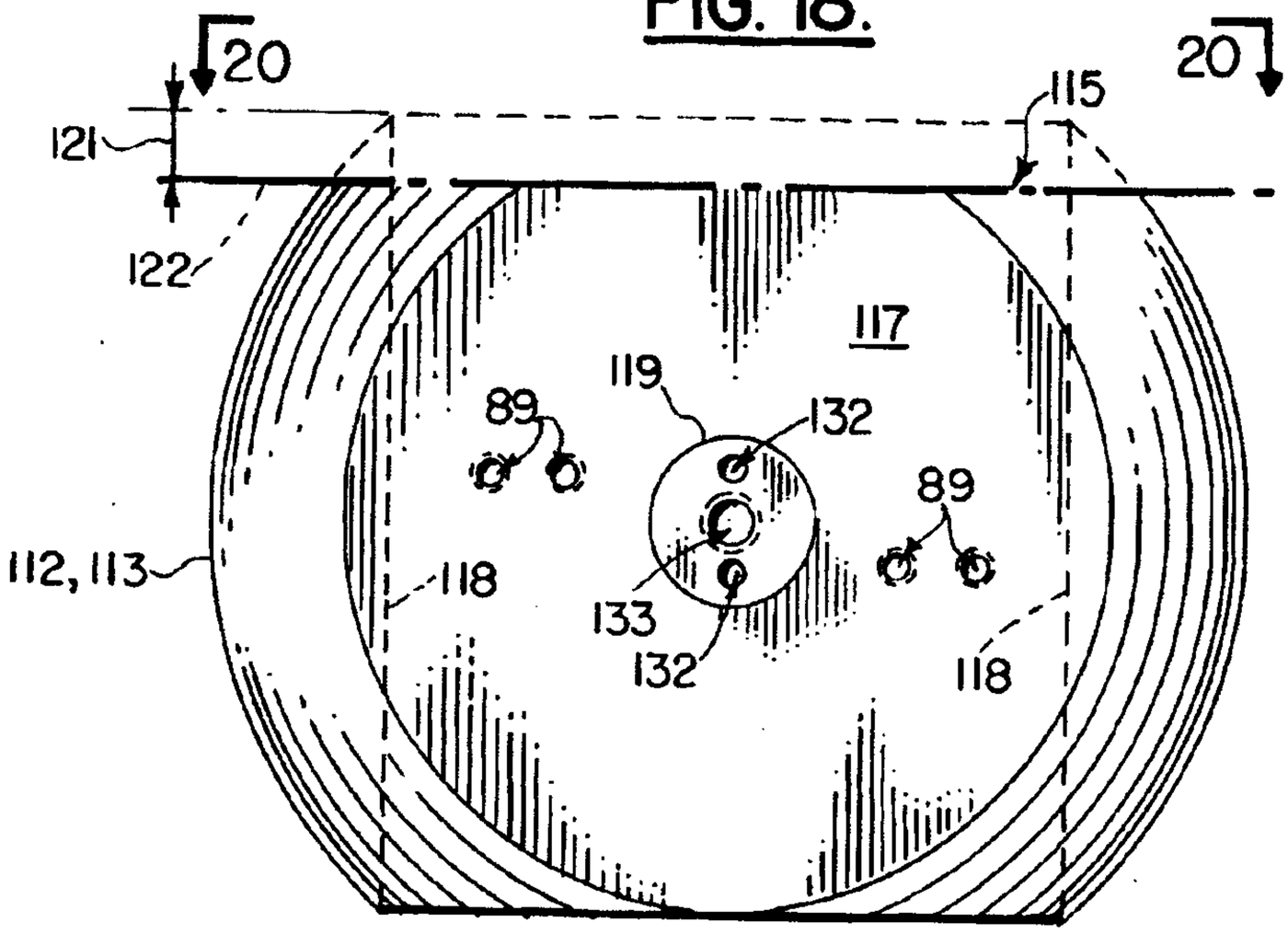
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FIG. 19.

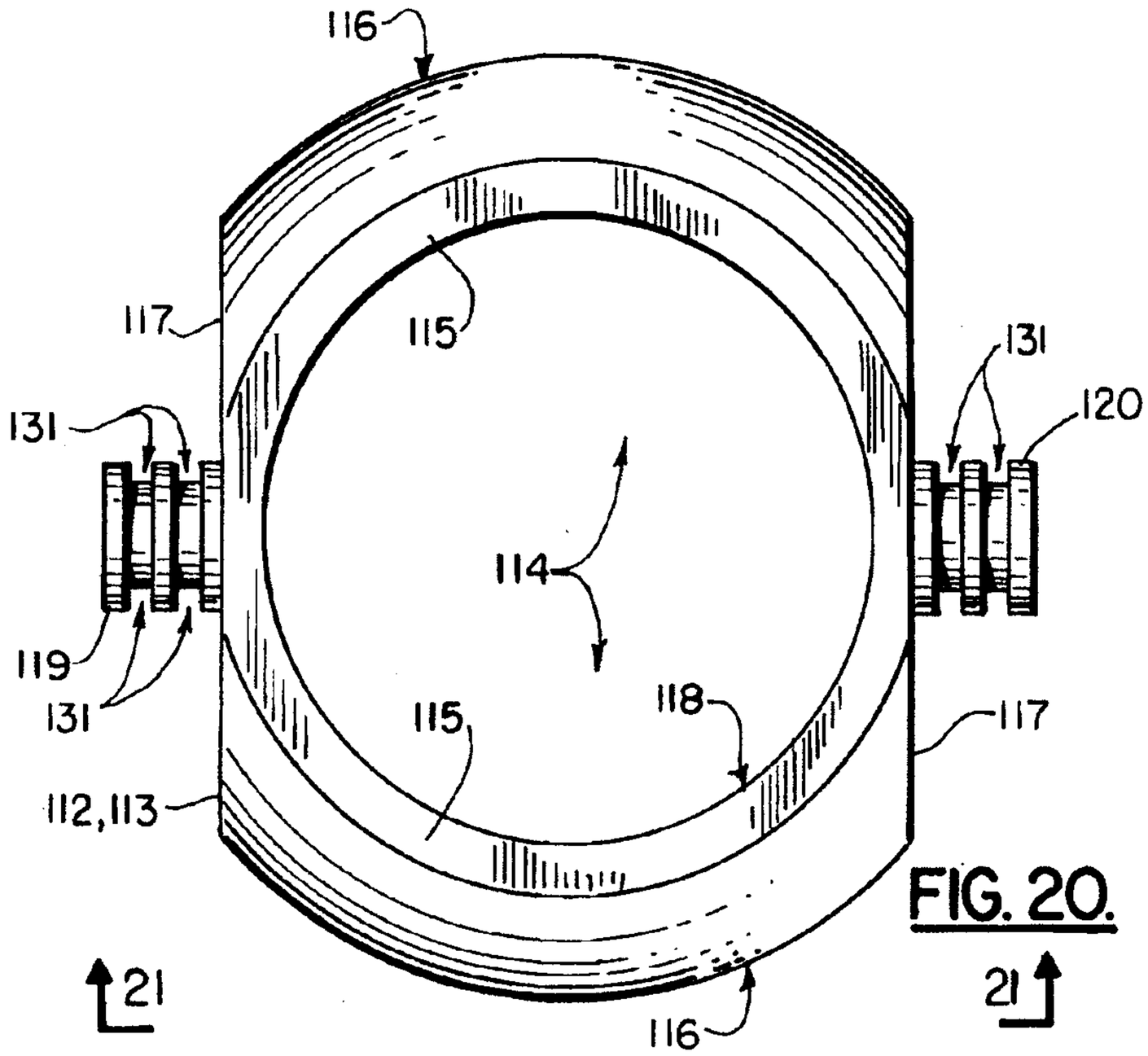
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FIG. 20.

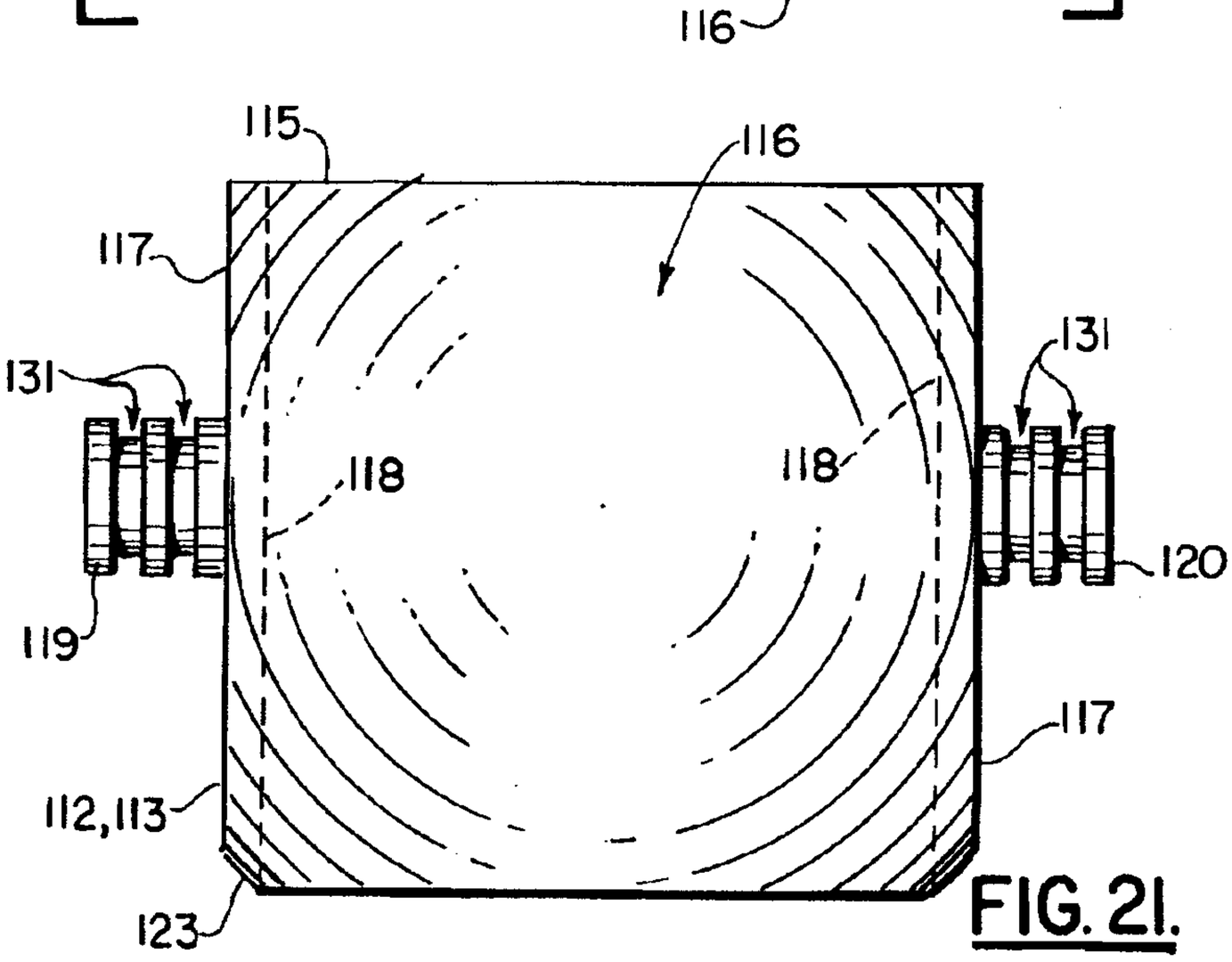
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FIG. 21.

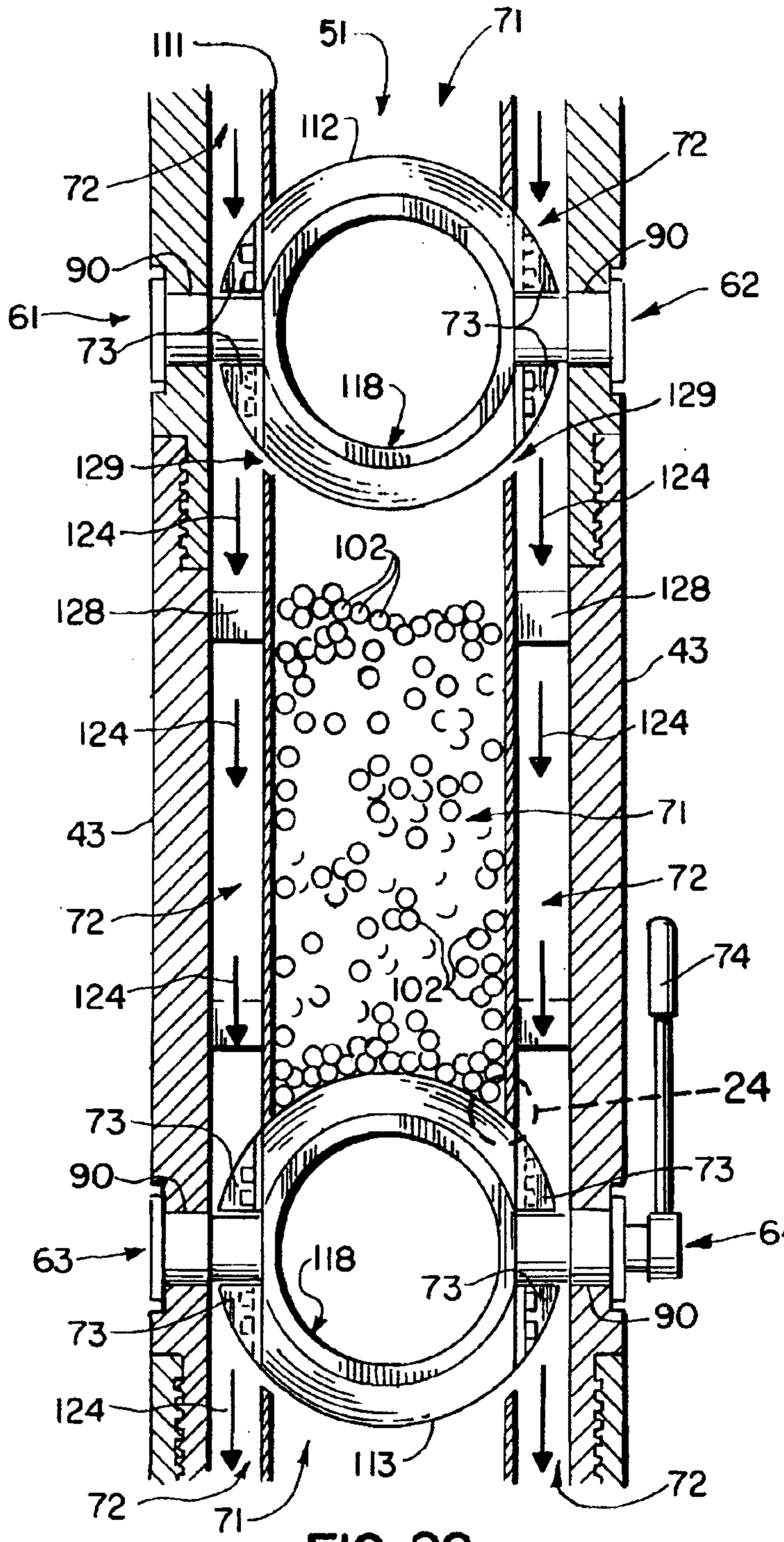
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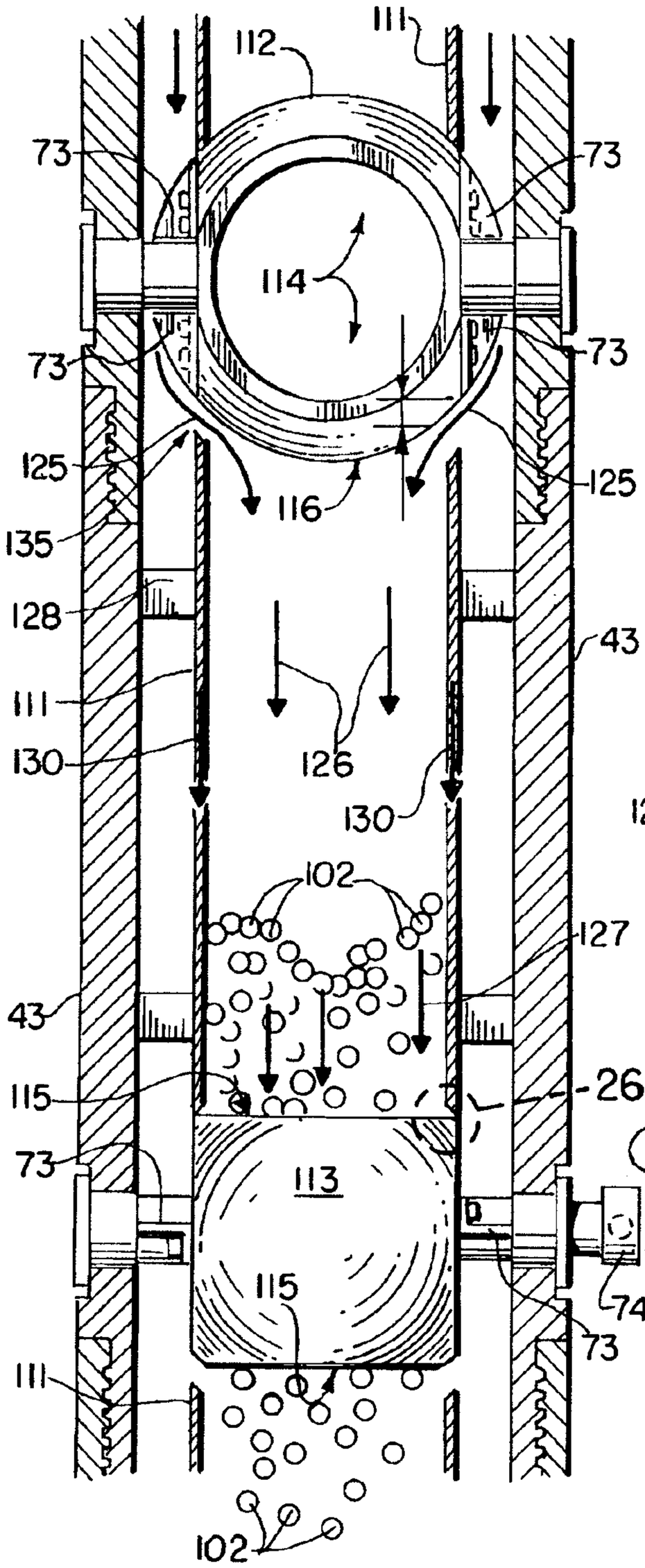
FIG. 22.



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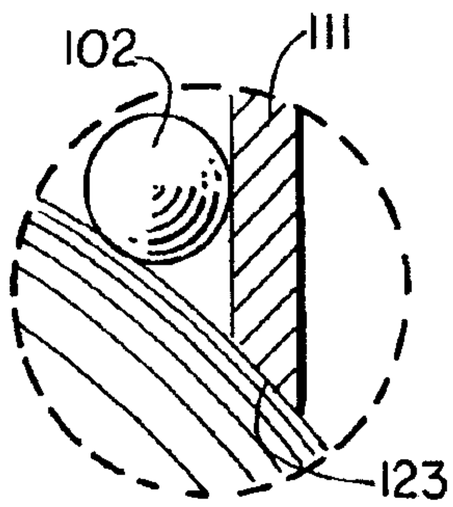
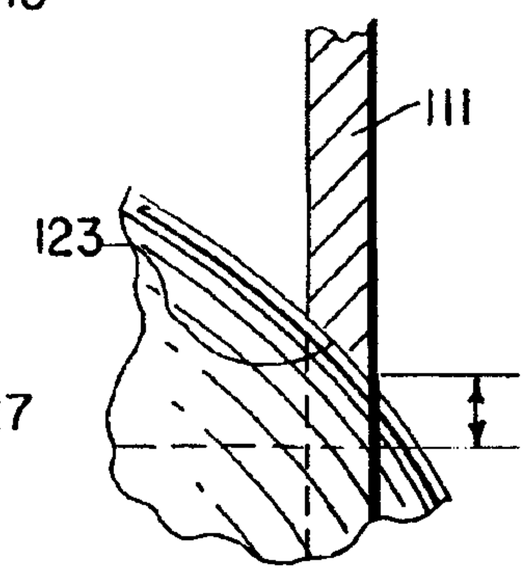


FIG. 24.



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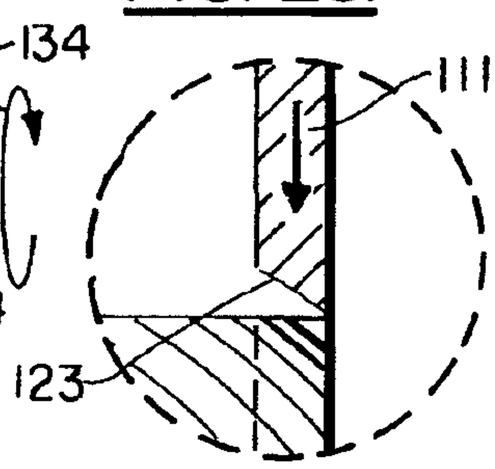
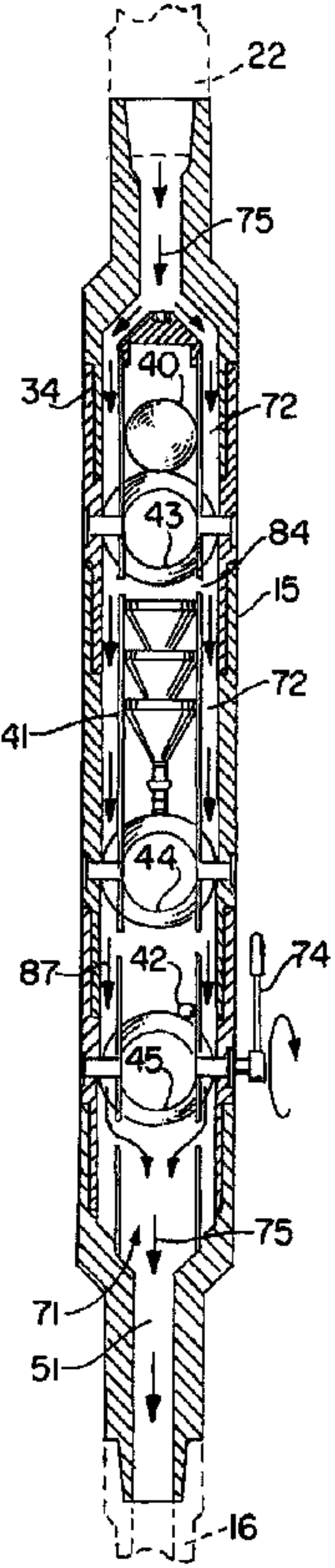


FIG. 26.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