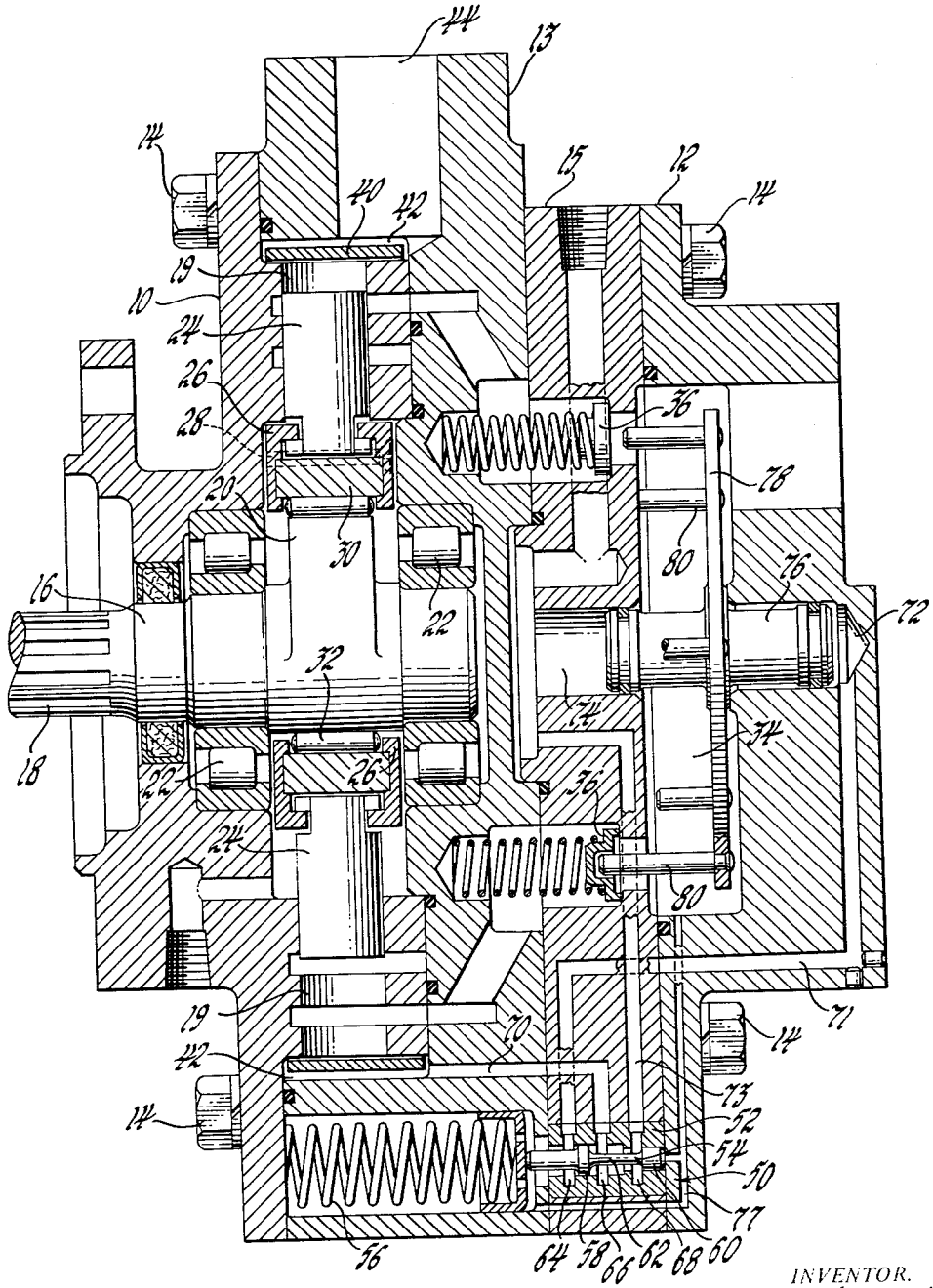
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PUMP CONTROL

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PUMP CONTROL

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This invention relates to a multi-piston pump and more particularly concerns a radial piston pump incorporating means whereby at a predetermined discharge pressure one or more of the pumping cylinders is cut out or inactivated.

The invention has as its principal object to provide means for the purpose indicated characterized in operation in that a further increase in discharge pressure, with one of the cylinders already inactivated, is marked by the cutting out of one or more additional cylinders, the exact number depending on the magnitude of the increased pressure.

Another object of the invention is to provide such means which under a condition of decreasing discharge pressure operates similarly but oppositely, i.e., on a further decrease in the discharge pressure, with a previously inactivated cylinder restored to operation, an additional number of inactivated cylinders are successively restored to operation as determined by the extent of the further decrease in the discharge pressure.

An additional object is to provide means as described adapted for actuation by fluid pressure.

Still other objects and features of the invention will become apparent from the following description of a preferred embodiment thereof. The description will proceed with the aid of the accompanying drawing wherein some of the parts appear in section and some are shown in elevation.

As will be seen from the drawing, the pump casing or housing is comprised of cover members **10** and **12**, these being secured by bolts **14** to intermediate members **13** and **15**, respectively. The pump is driven by a shaft **16** splined at **18** and having a cam enlargement **20**. Within the pump housing, the shaft turns in roller bearings **22** of any suitable design.

Housing member **13** is formed to provide a plurality of cylinders **19** adapted to accommodate pistons **24**, each of which is connected via retainer rings **26**, interconnected by pins **28**, to a race member **30** spaced from the cam portion **20** of the drive shaft **16** by roller bearings **32**. As shown, these roller bearings are kept confined between the cam portion of the shaft and the race by the retainers **26**.

With the arrangement as shown and described, it should be clear that rotation of the drive shaft **16** is marked by reciprocation of the pistons **24** in the corresponding cylinders **19**.

Cover member **12** will be seen formed to provide an inlet cavity **34**. Between such cavity and each cylinder **19** is a check valve **36** which opens on the suction stroke of the piston. For the discharge valving there is provided a flexible band **40** encircling the cylinder bank with a slight clearance. In operation, such band is held tightly against the outer ends of the intaking cylinders by the pressure of the fluid passing from the discharging cylinders, such action proceeding with rotary movement of the band which is consequently largely self-cleaning.

Outward of the band **40** is an annular discharge chamber **42** common to all of the cylinders and communicating with the discharge port **44**.

For the purposes of the present invention, the pump incorporates a valve, generally denoted by the numeral **50**, comprising a housing portion **52** and a plunger **54**, the latter being loaded by a spring **56**. The plunger **54**

includes a pair of lands **58**, **60** interconnected via a stem portion **62**.

The housing **52** of valve **50** will be noted as provided with three annular channels **64**, **66**, **68**. Channel **66** communicates with the discharge chamber **42** via a passage **70**, which channels **64** and **68** communicate via passages **71** and **73** with chambers **72** and **74**, respectively, at the opposite ends of a cut-out piston **76**. Such piston has an integral flange **78** provided with a series of pins **80**, the number of pins conforming with the number of pumping cylinders. These pins vary in length in a stepwise fashion and each is disposed in juxtaposition to one of the check valves **36**.

A passage **77** communicating with the chamber housing the spring **56** and the bore of the valve housing **52** is simply a bleed passage.

To describe the operation of the pump, let it be taken that the same has been operating normally with all of the pumping cylinders working. Assuming now lessening of the demand on the pump, the pressure in the discharge chamber **42** will, of course, increase. When such pressure has attained a predetermined value, plunger **54** or valve **50** will be forced leftward against the resistance of spring **56** to interconnect passages **70** and **71**, with the result that the developing pressure in chamber **72** will force the cut-out piston **76** leftward. This action is accompanied by engagement of the longest pin **80** with the corresponding check valve **36** so that the corresponding cylinder **19** becomes open to the intake cavity **34**. Thus, on the discharge stroke of the particular piston, the fluid which was withdrawn from the cavity on the suction stroke of the piston is returned thereto instead of being forced past the band **40** into the discharge chamber **42**. In the event of a further increase in the discharge pressure, cut-out piston **76** will be forced further leftward, since the increased pressure is reflected in the chamber **72**, to open up an additional number of the check valves **36** as necessary to maintain the pump discharging pressure constant.

When demand is once again made on the pump, the resulting decrease in the discharge pressure, reflected between the lands **58** and **60** of valve **50**, allows spring **56** to shift the plunger **54** rightward to its shown position causing rightward movement of the cut-out piston **76** by reason of passage **73** and progressive restoration of the pumping cylinders to operation.

What I claim is:

1. In a pump including a housing confining a plurality of radially arranged cylinders and a corresponding number of pistons in said cylinders, said housing having therein an inlet cavity communicating with said cylinders via circumferentially arranged individual inlet passages, each of said passages having a check valve therein normally closing the passage during the discharge stroke of the piston in the corresponding cylinder, the combination of an axially displaceable piston having flange carrying pins of varying length adapted to engage said check valves, said piston being responsive to and actuated by the pressure of the discharge fluid, movement thereof being accompanied by sequential opening of said valves.

2. In a pump including a housing confining a plurality of radially arranged cylinders and a corresponding number of pistons in said cylinders, said housing having therein an inlet cavity communicating with said cylinders via circumferentially arranged individual inlet passages, each of said passages having a valve therein normally closing the passage during the discharge stroke of the piston in the corresponding cylinder, the combination of stepped means circumferentially arranged in correspondence with the arrangement of said passages and said valves and axially displaceable by fluid pres-

sure, said means comprising two reaction surfaces each confined in a separate chamber in said housing, and control means in said housing whereby discharge fluid under a first predetermined pressure is admitted to one of said chambers to axially displace said stepped means toward said valves to open one or more of the same and whereby discharge fluid at a second predetermined pressure is admitted to the other of said chambers to axially displace said stepped means in the opposite direction.

3. The combination of claim 2 where said stepped means takes the form of a piston the ends of which provide the opposed reaction surfaces, said piston having a flange carrying pins adapted to engage said valves, said pins being of varying length to provide the stepping.

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