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[54] PUMP CONTROL MECHANISM

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 866,253, Oct. 14, 1969, abandoned.

[52] **U.S. Cl.** **417/222,** 91/505

[51] **Int. Cl.** **F04b 49/00**

[58] **Field of Search** 92/13.1; 91/505, 91/506; 417/222

[56] **References Cited**

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[57] **ABSTRACT**

The invention relates to a control mechanism for a swash plate type pump wherein the cam plate can be moved to opposite inclinations relative to the axis of the rotation of the rotor. An axially movable pump stroke controlling member is connected to means for setting the member through a means permitting lost motion against the action of a spring or the like. A piston subjected to the output pressure of the pump is provided with an arm to coact with an abutment controlling member, when the pump output pressure exceeds a predetermined value with the cam plate of the pump set at one inclination to the axis of rotation. A lever connected to the piston coacts with the abutment in reducing the stroke of the pump when the pump output pressure exceeds a predetermined value with the cam plate of the pump set at the other inclination to the axis of rotation of the rotor.

3 Claims, 3 Drawing Figures

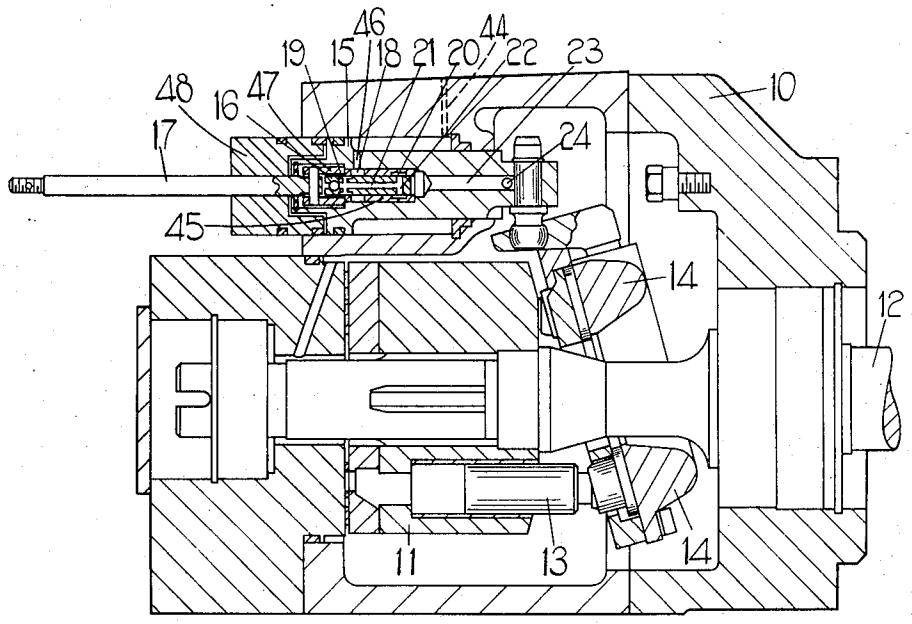


FIG. 1

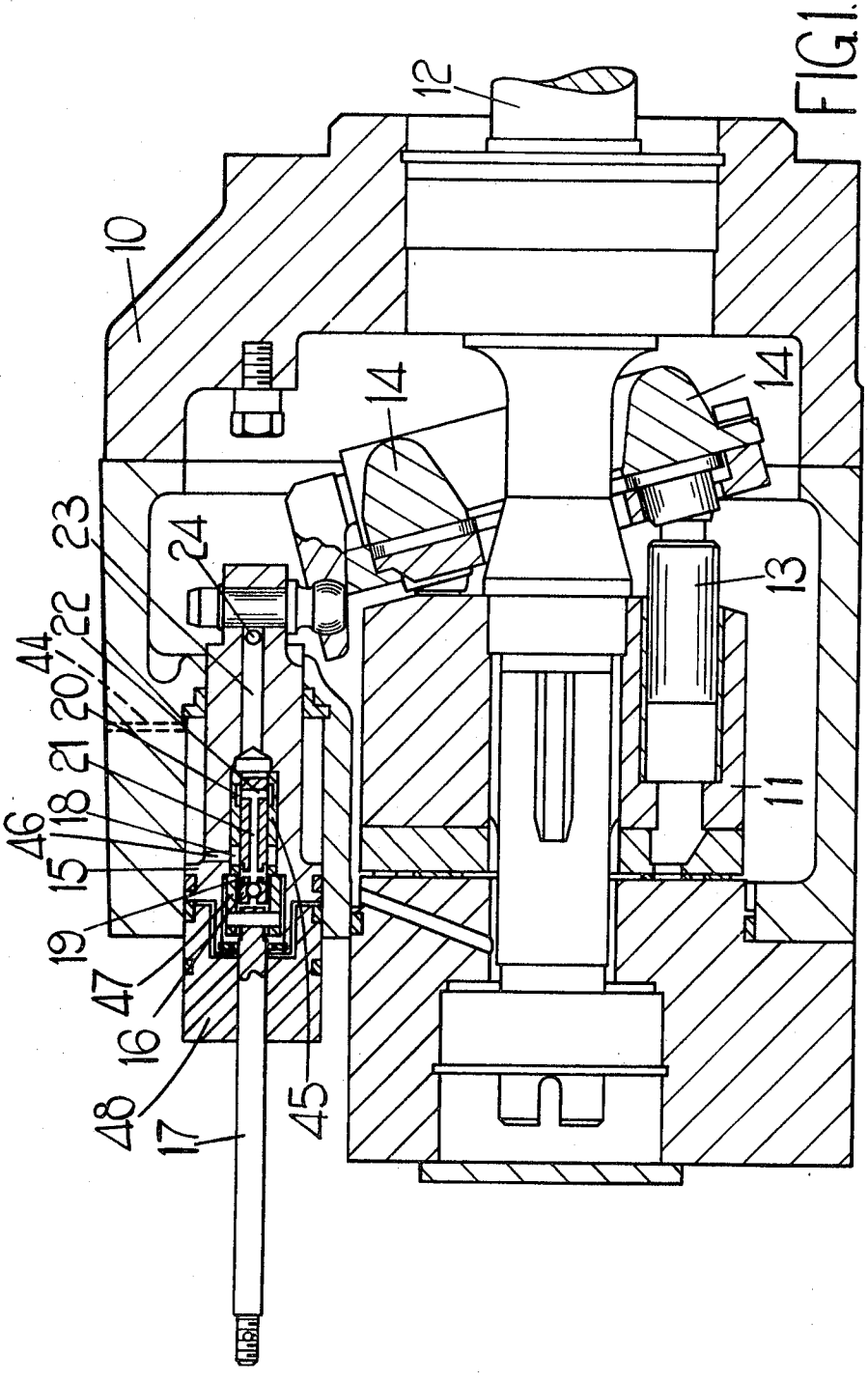
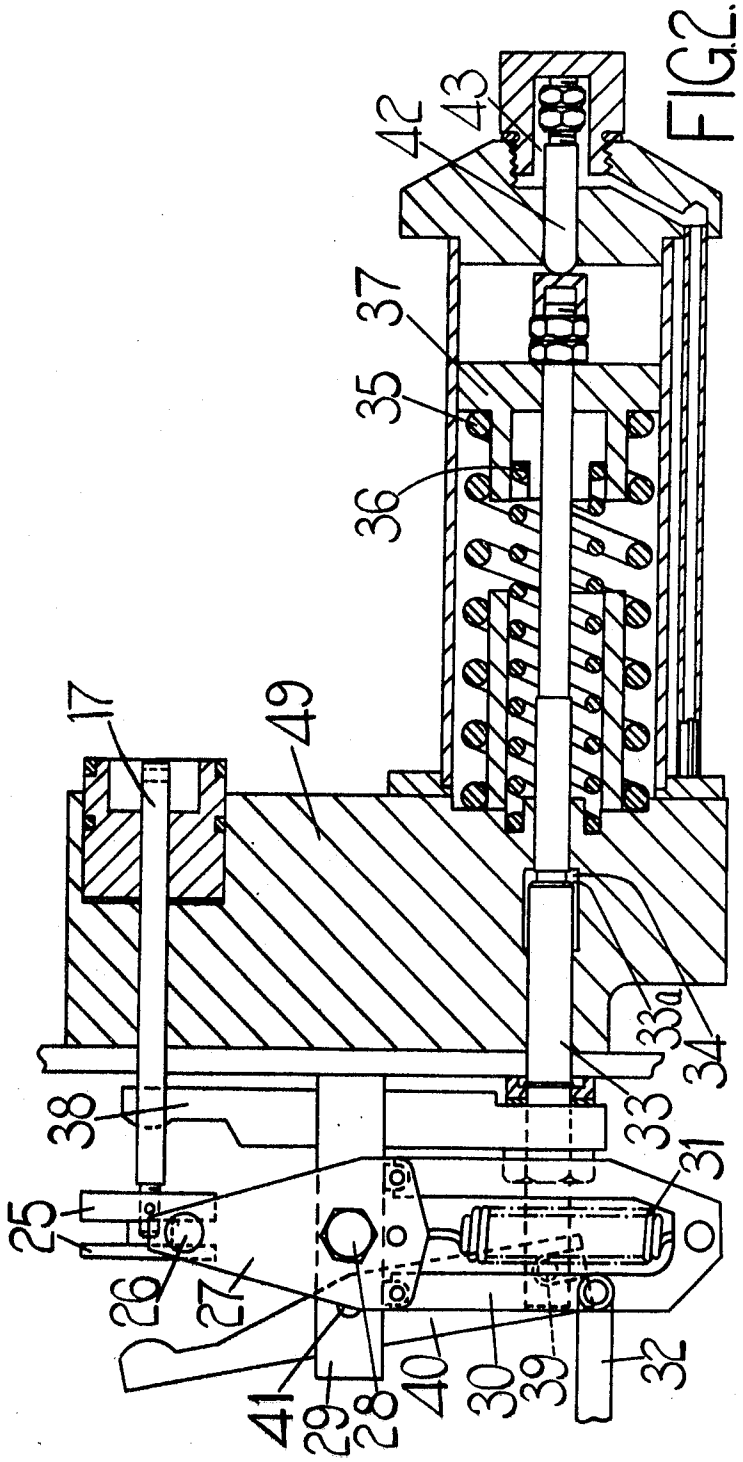


FIG.2



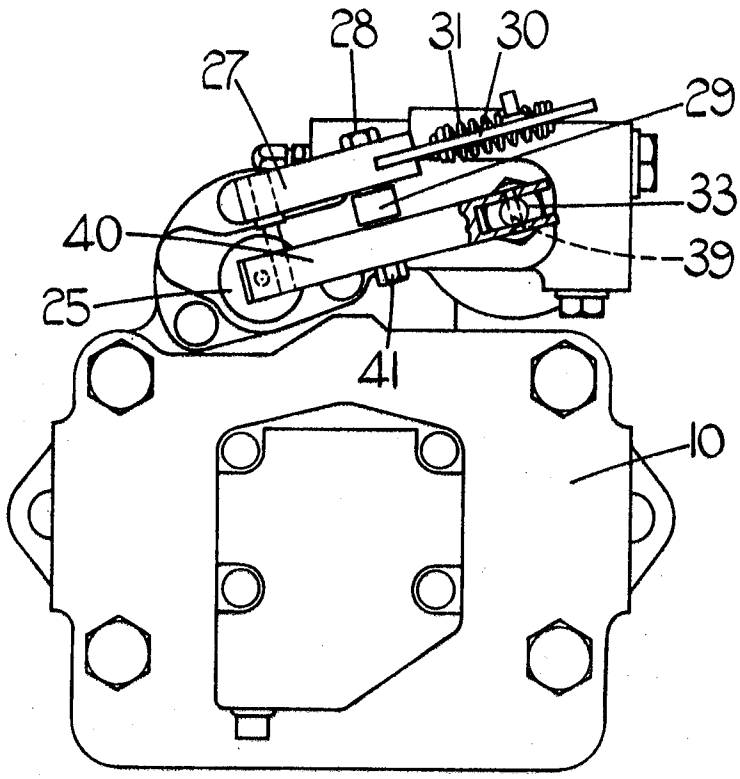


FIG.3.

PUMP CONTROL MECHANISM

This is a continuation-in-part of Ser. No. 866,253, filed Oct. 14, 1969, now abandoned.

This invention relates to mechanism for controlling the stroke of a swash-plate type pump of the kind wherein the cam plate can be moved to opposite inclinations relative to the axis of rotation of the rotor so as to provide for a reverse flow of fluid through the pump.

The object of the invention is to provide a convenient control mechanism for such a pump whereby the stroke of the pump will be varied from a predetermined value dependent on the output pressure of the pump. As the torque and hence the horsepower absorbed or developed by the pump is a function of pump displacement or stroke and the delivery pressure of the hydraulic medium the control mechanism provides a substantially constant horsepower control.

According to the invention control mechanism for a pump of the kind specified comprises in combination an axially movable pump stroke controlling member, an abutment on the member, control means for setting said member, means permitting lost motion between the control means and the member against the action of resilient means, a piston subjected to the output pressure of the pump, an arm connected to the piston to co-act with the abutment in reducing the stroke of the pump against the action of said resilient means, when the pump output pressure exceeds a predetermined pressure with the cam plate of the pump set at one inclination to the axis of rotation of the rotor, and a lever connected to the piston so as to co-act with the abutment in reducing the stroke of the pump against the action of said resilient means, when the pump output pressure exceeds sad predetermined pressure with the cam plate of the pump set at the other inclination to the axis of rotation of the rotor.

In the accompanying drawings:

FIG. 1 is a longitudinal sectional view of a known form of pump in association with which mechanism according to the invention can be used,

FIG. 2 is a longitudinal sectional view of mechanism in accordance with the invention, and

FIG. 3 is an end view of the pump seen in FIG. 1, to which the mechanism shown in FIG. 2 has been fitted, a small portion of the drawing being shown in section.

Referring first to FIG. 1 of the drawings, a known form of pump comprises a housing **10** containing a rotor **11** which can be driven by means of a shaft **12.** In the rotor **11** are formed a plurality of annularly arranged cylinders containing pistons **13** which co-act with a cam plate **14** which can be angularly adjusted by means of a servo piston **15** situated in a cylinder formed in the housing **10.** The cylinders formed in the rotor **11** communicate at their ends remote from the cam plate **14** in turn with an inlet and outlet as the rotor rotates.

The cam plate **14** can be moved to opposite inclinations relative to the axis of rotation of the rotor, so as to provide for a reverse flow of fluid through the pump. The adjustment of the angular setting of the cam plate **14** is effected by the piston **15** under the control of a spool valve **16** which is connected to a control rod **17** which can be moved axially to effect control of the piston **15** by manual or other means.

The end of the cylinder containing the piston **15** remote from the rod **17** is connected through a passage **44** and a selector valve (not shown) to whichever is at the higher pressure of the inlet and outlet of the pump.

Within the piston **15** is a fixed sleeve **45** in which the spool valve **16** is axially movable. Moreover, within the sleeve **45** are formed ports **18** which are in communication with the passage **44** through a passage **46** in the piston. When it is required to move the piston **15** to the right as viewed in FIG. **1,** the spool valve **16** is set to the position shown in which a groove **19** in the spool valve communicates with the ports **18.** The groove **19** is in communication with an axial bore **21** in the spool valve through which fluid can flow to the left-hand side of the piston **15** as viewed in FIG. **1.** Since the pressure at the left-hand side of the piston will act upon the whole area of the piston, whilst the pressure at the right-hand side of the piston **15** acts only on the relatively small annular area of the piston, the piston will move to the right until the ports **18** are removed from the groove **19.** It will be appreciated therefore, that in order to move the piston **15** continuously to the right as viewed in FIG. **1,** a continual pressure must be applied to the rod **17** to cause the spool valve to maintain its illustrated relationship to the piston. It will also be understood that such movement of the piston **15** to the right will reduce the obliquity of the cam plate **14** and thereby reduce the stroke of the pistons **13** until zero obliquity is obtained, whereupon continued movement in this direction will increase the stroke of the pistons **13** to provide increasing output in the reverse direction.

When it is required to move the piston **15** in the opposite direction, the control rod **17** is moved to the left as viewed in FIG. **1,** until an internal groove **20** in the sleeve **45** is uncovered by the right-hand end of the valve **16.** In this position, the groove **19** is out of register with the ports **18,** thus preventing communication between the two sides of the piston **15.** However, fluid can escape from the left-hand side of the piston via the groove **19,** an axial bore **21,** a passage **22** in the spool valve **16,** a groove **20,** a passage **23** and port **24** to the interior of the pump housing **10** which is maintained at a low pressure. As a result, the high pressure acting on the annular area of the piston **15** at its right-hand side will cause the piston to move to the left as viewed in the drawing, until communication between the groove **20** and the passage **23** is interrupted by the end of the spool valve **16.** As in the opposite case, in order to maintain a continued movement of the piston **15** to the left, a continuous pull must be maintained upon the rod **17.** The spool valve **16** is connected to the rod **17** by means of a collar **47** surrounding respectively the adjacent ends of the spool valve and rod and connected thereto respective by a pair of diametrical pins at right angles to one another to provide the equivalent of a limited universal connection. Moreover, the rod **17** extends through a plug **48** closing the end of the cylinder in the housing **10** containing the piston **15,** and also extending into a body **49** secured to the housing **10** (FIG. **2**).

Referring to FIG. **2,** the rod **17** carried at its outer end a pair of spaced abutment plates **25** between which is located a pin **26** extending laterally from a lever **27** pivoted at **28** upon a fixed bracket **29** on operable housing **10.** The lever **27** forms part of a means permitting lost motion between the control rod **17** and the manually or otherwise operable means for controlling the rod **17.** The other part of the means permitting lost motion comprises a bifurcated member **30** having arcuate recesses at the ends of its limbs which are held

against complementary arcuate surfaces on the lever **27** by means of a coiled tension spring **31** interconnecting the two parts. The manually or otherwise opera le setting means is diagrammatically illustrated as being connected to the member **30** by a pivotal link **32,** and it will be appreciated that if the rod **17** is moved axially when the rod **32** is fixed, the lever **27** can be moved angularly against the action of the spring **31** by permitting one of the arcuate surfaces of the lever **27** to move out of its recess on a limb of the member **30** whilst depressing member **30** as a whole.

Also slidable in the housing **10** is a stepped piston **33** which extends parallel to the rod **17.** The step **33***a* of this piston is contained in a chamber **34** which is subjected to the output pressure of the pump. The pressure acting against the step **33***a* opposes the action of a pair of coiled compression springs **35,36** acting between the housing **10** and an abutment **37** on an extension of the piston **33.**

Secured to a portion of the piston **33** outside the housing **10** is an arm **38** which is arranged to co-act with one of the abutment plates **25** in moving the rod **17** to cause a reduction in the pump stroke when the output pressure of the pump acting upon the step **33***a* exceeds a predetermined value and when the cam plate **14** of the pump is set at one inclination. The piston **33** also carries a pin **39** which is located in a slot at the lower end of a lever **40** fulcrummed at **41** on the bracket **29.** The opposite end of the lever **40** is arranged to co-act with the other abutment plate **25** in moving the rod **17** in a direction to reduce the stroke of the pump when the pressure in the chamber exceeds the predetermined pressure, with the cam plate of the pump set to the opposite inclination.

Where the prime mover driving the pump drives a second or auxiliary pump and it is desired not to overload the prime mover, there may be provided a further piston **42** which is coaxially arranged with respect to the piston **33** and is contained in a chamber **43** which is subjected to the output pressure of the second or auxiliary pump. The piston **42** is arranged to bear against the piston **33** so that the piston **33** is moved by the combined output pressures of the two pumps. Thus, when the total load on the prime mover exceeds a predetermined value, the piston **33** will be moved in a direction to reduce the stroke of the main pump.

I claim:

1. A swash plate type pump comprising in combination a body, a rotor within the body having formed therein a plurality of equi-angularly spaced cylinders, a plurality of pistons occupying the cylinders respectively, an angularly adjustable cam plate with which the pistons co-act, a servo piston for moving the cam plate between opposite inclinations relative to the axis of rotation of the rotor, a pump stroke controlling member, valve means connected to said member for controlling the position of the servo piston, an abutment on said member, a pivoted lever operatively connected to said member, a part rockable relative to the lever against the action of resilient means, control means for setting said member, said control means being operatively connected to said part, a further piston subjected to the output pressure of the pump, an arm connected to the piston to co-act with the abutment in reducing the stroke of the pump against the action of said resilient means, when the pump output pressure pressure exceeds a predetermined pressure with the cam plate of the pump set at one inclination to the axis of rotation of the rotor, and a further lever connected to the piston so as to co-act with the abutment in reducing the stroke of the pump against the action of said resilient means, when the pump output pressure exceeds said predetermined pressure when the cam plate of the pump set at the opposite inclination to the axis of rotation of the rotor.

2. A swash plate type pump as claimed in claim **1** including a spring acting upon the further piston in opposition to the fluid pressure.

3. A swash plate type pump as claimed in claim **2** in which said part is bifurcated and has arcuate recesses at the ends of its limbs engaging upon complementary arcuate surfaces on the lever, said resilient means acting to hold the recesses against said arcuate surfaces.

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