May 20, 1952 G. J. E. HOWARD 2,597,799

MEANS FOR CONTROLLING THE OUTPUT OF VARIABLE DISPLACEMENT PUMPS

Filed March 14, 1949 3 Sheets-Sheet 1

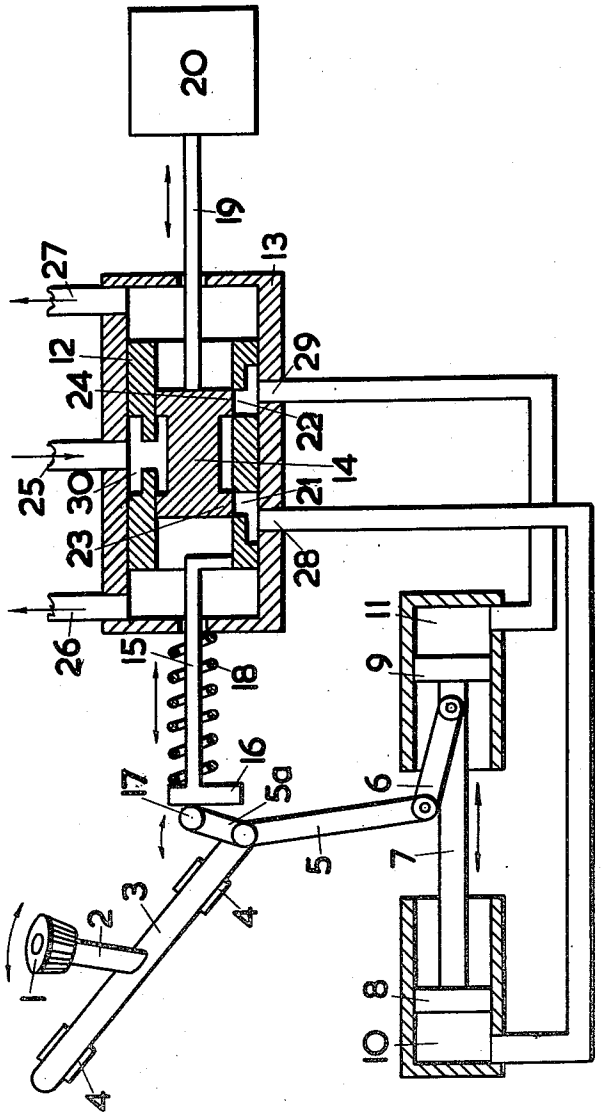


FIG.1

INVENTOR

Geoffrey John Eliot Howard

By Mewburn & Patterson

ATTORNEYS

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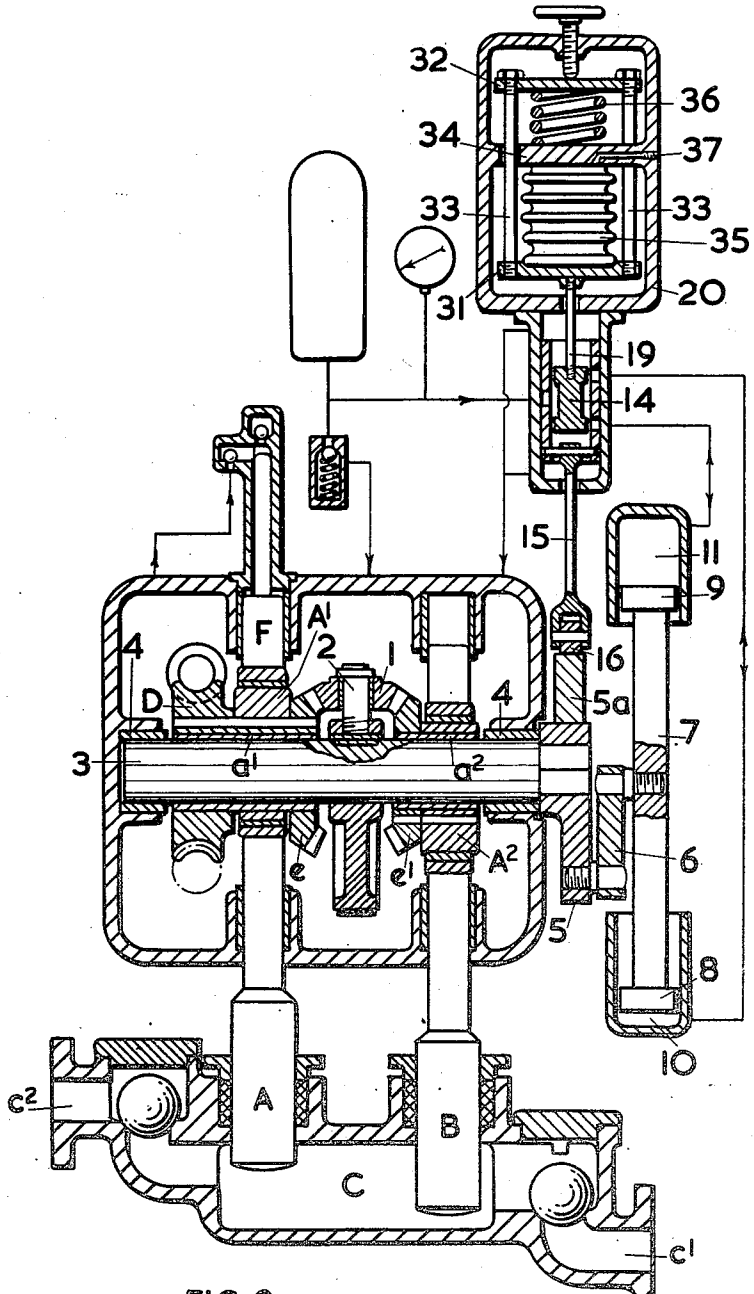


FIG. 2

INVENTOR.

BY Geoffrey John Elliot Howard

Harris & Pattenden

ATTORNEYS

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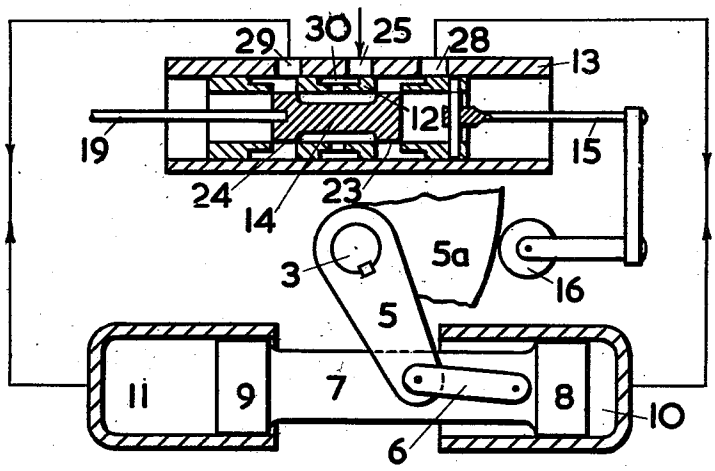


FIG. 3

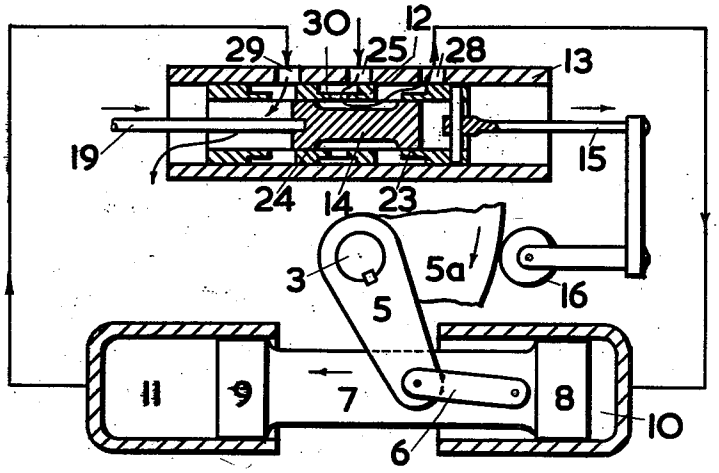


FIG. 4

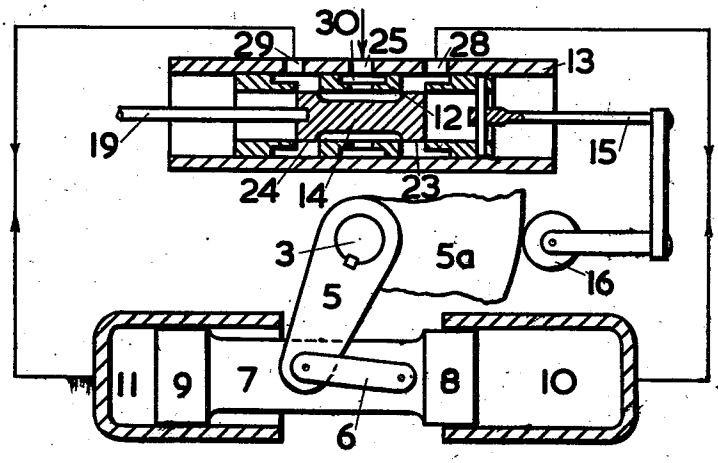


FIG. 5

INVENTOR
Geoffrey John Eliot Howard
BY Harrison Patterson
ATTORNEYS

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UNITED STATES PATENT OFFICE

2,597,799

MEANS FOR CONTROLLING THE OUTPUT OF VARIABLE DISPLACEMENT PUMPS

Geoffrey John Eliot Howard, Eccles, England, assignor to Harold Moore & Partners (Engineers) Limited, Whyteleafe, England, a company of Great Britain

Application March 14, 1949, Serial No. 81,272

2 Claims. (Cl. 103—37)

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This invention relates to reciprocating piston or plunger pumps of the kind wherein two pistons are driven through differential or other gearing arranged so that the piston phase relationship can be varied for the purpose of varying the capacity of the pump and is an improvement in the pump of the said kind described in the specification of U. S. Patent No. 2,166,873 (H. Moore and H. E. Charlton).

In the aforesaid specification the variation in output is obtained by rotating the central bevel wheel of a differential gear about the axis of the other two bevel wheels of the gear.

According to the present invention the rotation of the aforesaid central bevel wheel or of the spindle carrying the wheel of the epicyclic gear is controlled by a controlling instrument in such a manner that the output of the pump is determined by the impulse received from the instrument.

The invention is illustrated in the accompanying drawings, in which

Fig. 1 is a diagram illustrating the invention.

Fig. 2 is a section through the pump and the controlling means.

Figs. 3, 4 and 5 are detail sectional views showing diagrammatically positions of the pistons and valves of the controlling mechanism.

The pump shown in Fig. 2 is of a known type in which two plungers A and B are reciprocated in a pump chamber C having a liquid inlet c^1 and outlet c^2. The pump plungers are driven to and fro by eccentrics A^1 and A^2. The eccentric A^1 is fixed on a sleeve a^1 which sleeve is driven by the gearing D and the eccentric A^2 is mounted on a sleeve a^2 which receives its motion from the bevel wheel e secured on the sleeve a^1 through the bevel wheel 1 and the bevel wheel e^1 secured on the sleeve a^2. The sleeves a^1 and a^2 are loosely mounted on a shaft 3 mounted in bearings in the gear casing and the bevel wheel 1 is rotatably mounted on a short shaft 2 secured to and projecting at right angles to the shaft 3. Relative displacement of the eccentrics A^1 and A^2 is obtained by an angular movement of the shaft 3 which causes a rotation of the bevel wheel e^1 in relation to the bevel wheel e and a consequent displacement of the eccentrics.

It is to be understood that the mechanism so far described is known and does not form part per se of the present invention.

In the mechanism already known, the shaft 3 has been rotated to move the bevel wheel 1 about the axis of the shaft 3 manually, but in accordance with the present invention, the shaft 3 is rotated from means controlled by impulses from a measuring instrument.

A crank arm 5 is keyed at one end to the end of the shaft 3 and its other end is connected by means of a pin to a link 6 which is itself connected to a piston rod 7 fitted with a piston 8 and 9 at each extremity, each piston working in a separate cylinder 10 and 11 respectively. Oil under pressure is supplied to the cylinders 10 and 11 from a pump F (see Fig. 2) situated in the main pump gear case. The supply of oil is controlled by means of a sleeve valve 12 working in a casing 13 and having a central bore to receive a pilot valve 14. The sleeve valve 12 is connected by means of a rod 15 to a follower 16 which is pressed by a spring 18 against a crank 5a which rotates with the crank arm 5.

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Movement of the piston rod 7 will cause the crank arm 5 to rotate the shaft 3 about its axis thereby causing the central bevel wheel 1 to rotate about the axis of the shaft 3. The rotation of the shaft 3 will also cause the crank 5a to move the sleeve valve 12 through the follower 16 and rod 15.

The pilot valve 14 is connected by a rod 19 either directly or through the intermediary of a bell crank lever, one arm of which may be adjustable, to the actuating member of the controlling unit of a controlling instrument 20, and the whole mechanism is so arranged that the total movement of the pilot valve 14 imparted by the controlling instrument is the same as that of the sleeve valve 12 imparted by the follower 16 corresponding to a change in output of the pump from zero to maximum.

The controlling instrument 20 comprises two plates 31 and 32 respectively, connected together by rods 33 which can slide through apertures in a fixed partition 34. The rod 19 is fixed to the plate 31 between which and the partition 34 an expandable bellows 35 is arranged. A spring 36 is arranged between the partition 34 and the other plate 32. A passage 37 through the partition 34 connects with the interior of the bellows, and this passage may be connected to a controlling instrument, impulses of which vary the pressure within the bellows 35 and so move the pilot valve 14 in one direction or the other.

The valve casing 13 has a central inlet port 25 connected to the oil pump and two exhaust ports 26 and 27 one at each end thereof. It also has two ports 28 and 29 connected respectively to the cylinders 10 and 11.

The sleeve valve contains two ports 21 and 22 which can be put into communication with the cylinders 10 and 11 in which the pistons 8 and 9 on the ends of the piston rod 7 work by means of the ports 28 and 29 in the valve casing 13 and these ports 21 and 22 control the supply of oil to the cylinders 10 and 11.

The sleeve valve has a third port 30 connecting with the inlet port 25 in the casing 13, the port 30 being sufficiently long that the port 25 is not covered whatever the position of the sleeve valve 12 may be.

The pilot valve 14 has two lands 23 and 24 so arranged that when the pilot valve is in the centre of the sleeve valve 12 i. e. the position shown in the drawing the two lands cover the two ports 28 and 29 therein. Oil under pressure is fed to the space between the two lands 23 and 24 of the pilot valve 14 through the ports 25 and 30 in the valve casing 13 and the sleeve valve 12 respectively and the ports 26 and 27 in the ends of the valve casing are connected by pipes to the sump from which the oil pressure pump F obtains its supply.

It will be apparent that when the pilot valve 14 is in the position with the lands covering the two ports 21 and 22 in the sleeve valve 12, movement of oil to or from the two cylinders 10 and 11 is prevented and the pistons 8 and 9 therein are locked in position whereby the shaft 3 is prevented from rotating and the central bevel wheel 1 is fixed in position.

Suppose now that an impulse from the measuring instrument 20 moves the rod 19 connected to the pilot valve 14 and thereby the latter a certain distance to the left corresponding to a definite change in output required from the pump the ports 22 and 21 in the sleeve valve 12 will be uncovered and the port 29 in the valve casing will be put into communication with the sump through the port 22 and the open end of the valve 12 and the oil pressure in the cylinder 11 will be released. The port 21 in the sleeve valve 12 will also be put into communication with the pressure oil supply through the centre of the pilot valve 14 and the ports 30 and 25 and thus oil pressure will be applied to the cylinder 10 and cause the pistons 8 and 9 to move to the right. This movement will rotate the shaft 3 in an anticlockwise direction through the piston rod 7, link 6 and crank 5 thus causing the output of the pump to alter owing to the rotation of the central bevel wheel 1 about the axis of the shaft 3.

At the same time the end 17 of the crank 5a will also rotate in an anticlockwise direction about the axis of the shaft 3 and thus allow the spring 18 to move the follower 16 to the left and this in turn moves the sleeve valve 12 to the left through the follower rod 16.

This movement will continue until the sleeve valve 12 has moved into such a position that the ports 21 and 22 are again covered by the lands 23 and 24 of the pilot valve 14 when the system becomes hydraulically locked and movement ceases.

From the above description it will be understood that no matter in what position the pilot valve 14 may be, the shaft 3 will always rotate until the sleeve valve 12 has its ports 21 and 22 covered by the lands 23 and 24 of the pilot valve.

As the distance moved by the follower 16 from the zero position is arranged to be proportional to the output of the pump it will be seen that the sleeve valve 12 and thus the follower always comes to rest at a position indicated by the instrument 20 through the pilot valve 14.

Thus the ouput of the pump will always be proportional to the amount of movement imparted to the pilot valve 14 by the bellows 35 of the controlling unit.

As both ends of the pilot valve 14 and the sleeve valve 12 are in communication with the sump of the pump F it follows that both these valves are balanced and that the amount of effort required to move them is small and that the sensitivity of the apparatus is thereby increased.

I claim:

1. In a reciprocating piston pump of the kind in which two pistons are moved to and fro by eccentrics one of which is positively driven and the other driven therefrom through a differential gear comprising a pair of bevel wheels and a cooperating central bevel wheel, and arranged so that the piston phase relationship is variable to vary the capacity of the pump by rotation of the central bevel wheel about the axis of the pair of bevel wheels of the gear, the combination of a shaft carrying the said central bevel wheel, a second shaft to which the first shaft is affixed and which is co-axial with the axes of the pair of bevel wheels and arranged at right angles to the first shaft, of two cylinders and a piston in each cylinder, a common piston rod for the two pistons, means connecting the piston rod to said second shaft for converting a longitudinal movement of said rod into a rotary movement of the second shaft, a valve controlling the supply of fluid to the aforesaid cylinders to operate the pistons, and a controlling instrument operative to produce impulses to actuate the valve whereby the rotation of the central bevel wheel is actuated by and consequently the outlet of the pump is controlled by the aforesaid impulses.

2. In a reciprocating piston pump of the kind in which two pistons are moved to and fro by eccentrics one of which is positively driven and the other driven therefrom through a differential gear comprising a pair of bevel wheels and a cooperating central bevel wheel, and arranged so that the piston phase relationship is variable to vary the capacity of the pump by rotation of the central bevel wheel about the axis of the pair of bevel wheels of the gear, the combination of a shaft carrying the said central bevel wheel, a second shaft to which the first shaft is affixed and which is co-axial with the axes of the said pair of bevel wheels at right angles to the first shaft, two cylinders and a piston in each cylinder, a common piston rod for the two pistons, a crank arm connecting said second shaft with the pistons whereby a longitudinal movement of said rod is converted into a rotary movement of the second shaft, a sleeve valve having a central bore and ports for controlling the supply of fluid to the aforesaid cylinders to operate the pistons therein, a spring controlled rod carried by the sleeve valve and abutting against the crank arm, a pilot valve slidably mounted in the central bore of the sleeve valve, and a controlling instrument connected to the pilot valve and operative to produce impulses to actuate the pilot valve and through the sleeve valve control the supply of fluid to the cylinders in which the pistons operating the first shaft are located.

GEOFFREY JOHN ELIOT HOWARD.

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