M. K. INGOLDBY.

HYDRAULIC PUMP AND MOTOR.

APPLICATION FILED NOV. 28, 1921.

1,424,823.

Patented Aug. 8, 1922.

2 SHEETS—SHEET 1.

Fig 2.

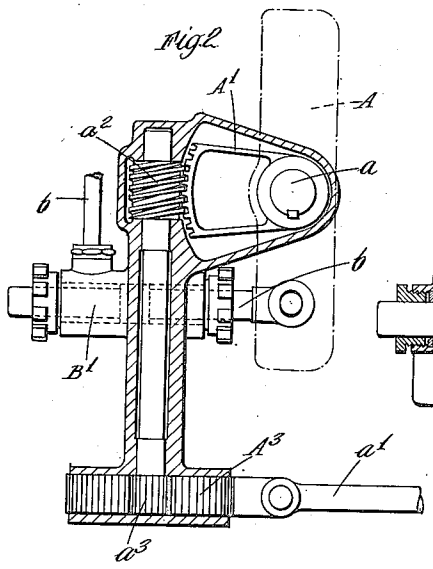


Fig 1.

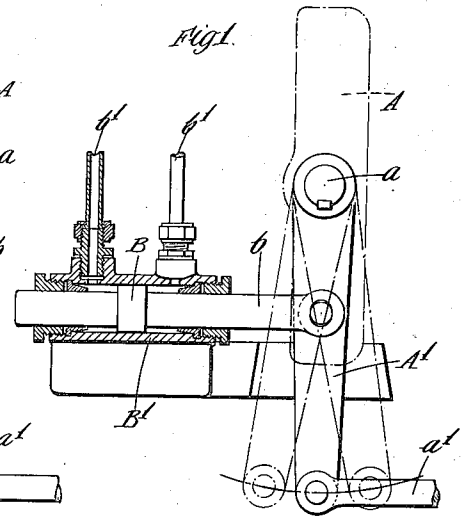
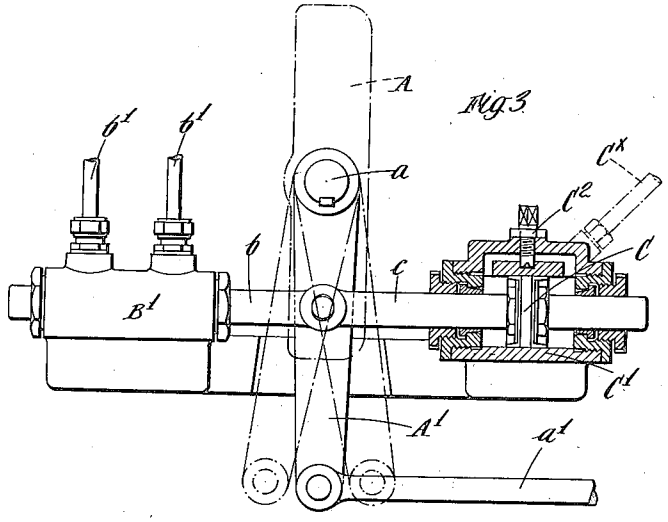


Fig 3.



Inventor
Maurice Herr Ingoldby

By
Dennis, Davis, Marvin & Edmonds
Attorneys

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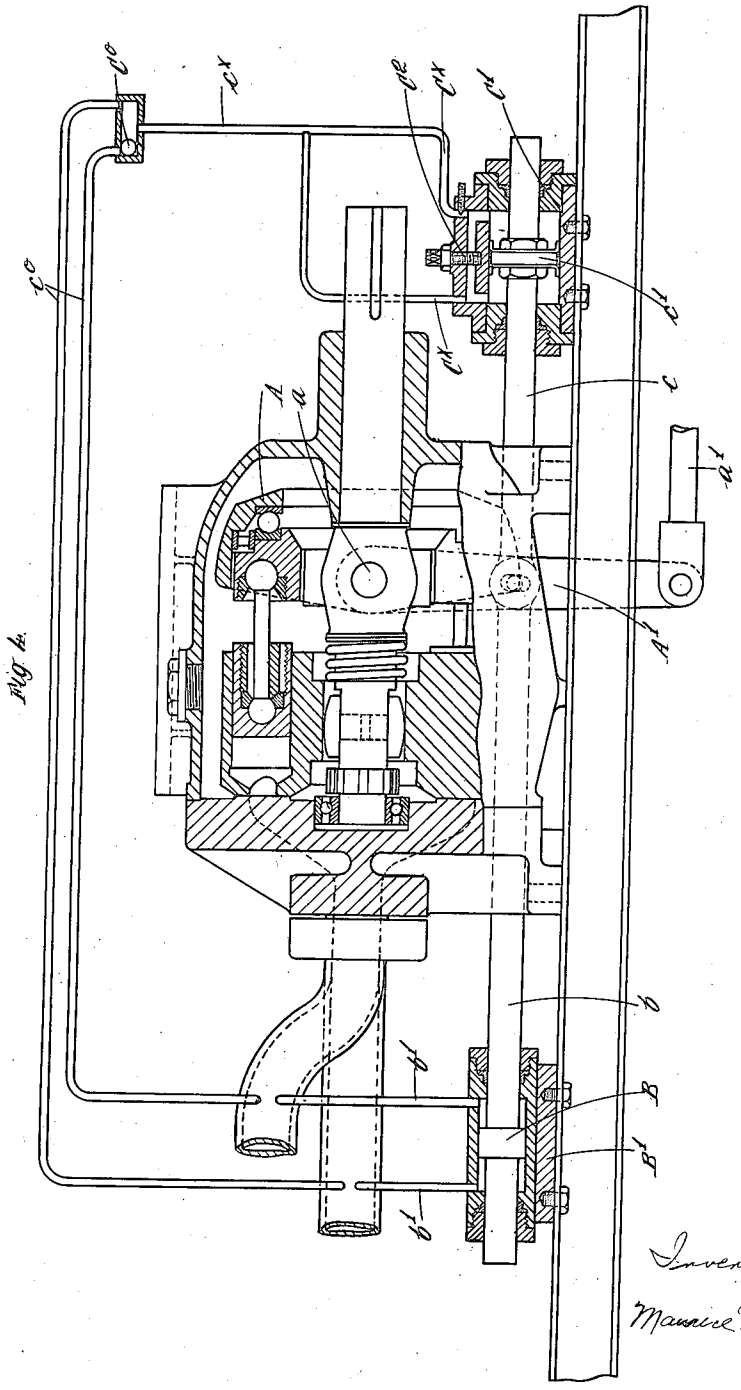


Fig 4.

Inventor:
Maurice K. Ingoldby

Penrie Davis Dawson & Edmonds

UNITED STATES PATENT OFFICE.

MAURICE KERR INGOLDBY, OF WESTMINSTER, LONDON, ENGLAND, ASSIGNOR TO THE VARIABLE SPEED GEAR, LIMITED, OF WESTMINSTER, LONDON, ENGLAND.

HYDRAULIC PUMP AND MOTOR.

1,424,823. Specification of Letters Patent. Patented Aug. 8, 1922.

Application filed November 28, 1921. Serial No. 518,186.

To all whom it may concern:

Be it known that I, MAURICE KERR INGOLDBY, a subject of the King of Great Britain, of Broadway Court, Broadway, Westminster, in the county of London, England, have invented certain new and useful Improvements in or Relating to Hydraulic Pumps and Motors, of which the following is a specification.

This invention relates to variable stroke hydraulic pumps and motors of the kind having a tiltable or other movable stroke-controlling member whose adjustment varies the stroke of the pistons of the pump or motor.

In such pumps or motors it has been found that the resultant pressure on the said stroke-controlling member set up during working offers considerable resistance to the adjustment of this member to increase the stroke in the case of a pump and to reduce the stroke in the case of a motor, such resistance preventing the easy manipulation of the control hand-lever, hand-wheel or other device when the stroke-controlling member is adjusted thereby.

According to the invention a device is provided for balancing or approximately balancing the aforesaid resistance offered to the adjustment of the stroke-controlling member, this device preferably comprising a piston or ram which operates upon a part connected to the said member and works in a cylinder placed in communication with the pressure fluid in the pump or motor system; in this manner, since the resistance to the adjustment of the stroke-controlling member is dependent upon the pressure in the system, it can be ensured that the said member is at all positions in a state of balance so that it can be easily adjusted by hand as aforesaid. In cases where the stroke-controlling member is intended to be moved to either side of its neutral or "no-stroke" position the said piston is made double-acting, one end of the cylinder being connected to the pressure system and the other to the suction or exhaust system.

When the control-hand-lever is arranged to operate upon the stroke-controlling member otherwise than through worm or other irreversible or self-locking gearing, we may employ a dash-pot or buffer device of suitable construction for the purpose of damping or eliminating the vibratory movements of the stroke-controlling member that occur during the working of the pump or motor even when this member is balanced as aforesaid. The cylinder of the said dash-pot device preferably contains fluid under pressure which, while allowing the piston to remain statically balanced, serves to more effectively damp the vibratory movements of the stroke-controlling member than is the case when the cylinder contains fluid which is normally not under pressure.

In order that the said invention may be clearly understood and readily carried into effect the same will now be described more fully with reference to the accompanying drawings, in which—

Figure 1 is a sectional side elevation shewing a constructional form of the balancing device as applied to a stroke-controlling member which is operated without the use of irreversible or self-locking gearing.

Figure 2 is a sectional side elevation shewing the balancing device of Figure 1 used in conjunction with a stroke-controlling member which is operated through the intermediary of irreversible or self-locking gearing,

Figure 3 is a sectional side elevation of a constructional form of the aforesaid dash-pot device used in conjunction with the balancing device of Figure 1.

Fig. 4 is a vertical section showing the improvement employed with a pump of the well known Williams-Janney type.

In the examples shewn A represents the tilting box which controls the stroke of the pistons of a pump or motor of the kind having a number of cylinders arranged in a rotating cylinder barrel parallel to the axis of rotation. This tilting box is angularly displaceable about the pivot a and has connected thereto an arm A′ which, in Figures 1 and 3, is operated directly by a rod a' leading to the control lever and which, in Figure 2, is in the form of a worm-wheel sector meshing with a worm a^2 operated through a pinion a^3 and a rack A^3 by a rod a' connected to the said rack.

Referring to Figure 1, B is the double-acting piston of the balancing device and B′ is the cylinder in which this piston works, the ends of this cylinder communicating with pipes b', b' one leading to the pressure

system and the other to the suction system. The rod *b* of the piston B is connected to the aforesaid arm A′ of the tilting box A and the effective area of the piston is so chosen that the pressure of the fluid acting thereon will at all positions of the tilting box operate to balance or approximately balance the resistance of the said tilting box to movement in the "stroke-increasing" direction in the case of a pump and in the "stroke-decreasing" direction in the case of a motor.

In Figure 2 the arrangement of the balancing piston and cylinder is similar to that of Figure 1 except that the piston rod *b* is connected directly to the tilting box A.

In Figure 3, C represents the piston and C′ the cylinder of the aforesaid dash-pot device which is shewn as being used in conjunction with the arrangement of balancing device shewn by Figure 1 but which can be used without the latter device. The dash-pot device is made double-acting and the degree of its retarding action can be controlled by an adjustable plug C^2 as is well understood. In the construction shown the piston C is arranged in line with the piston of the balancing device and the respective piston rods *c*, *b* are connected at the same point to the arm A′ of the tilting box. The fluid in the cylinder C′ may as aforesaid be placed under pressure preferably by connecting either or both ends of the cylinder by a pipe or pipes to a source of fluid pressure which may give a constant pressure or pressures varying in accordance with the pressure of the fluid within the pump or motor, the pipes in the latter case being connected to a suitable portion of the pressure system of the pump or motor; in Figure 4 C^x, C^x are pipes leading from a pipe c^x to the ends of the cylinder C′. This pipe communicates with a casing containing a throw-over valve C^0 and the ends of this casing communicate by pipes c^0, c^0 with the pressure and suction systems of the pump. This valve ensures that the cylinder C′ shall communicate with the pressure system when the direction of flow of the liquid pumped by the pump is reversed.

It will be understood that the aforesaid dash-pot device will not be required in the construction shewn by Figure 2 and in other constructions involving the use of irreversible or self-locking gearing as such gearing prevents any vibratory movements of the tilting box or its equivalent from being transmitted to the control lever.

Although the invention has been described in its application to a pump or motor having parallel cylinders and a tilting box, it is to be understood that it may also be used in conjunction with other types of variable stroke pumps or motors, for example one in which the cylinders are radial and the stroke of the piston is controlled by a ring adapted to be moved into various positions of eccentricity with respect to the axis of rotation of the pump or motor. The invention is also particularly intended for use with a variable speed hydraulic transmission gear composed of a pump and a motor the stroke of either or both of which is capable of adjustment.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In a variable stroke fluid pump having at least one cylinder and piston, a member controlling the stroke of the piston, and balancing means acting on said member interposed between the same and a part which remains stationary during the stroke controlling adjustments of said member, for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke increasing direction.

2. In a variable stroke fluid motor having at least one cylinder and piston, a member controlling the stroke of the piston, and balancing means acting on said member interposed between the same and a part which remains stationary during the stroke controlling adjustments of said member, for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke decreasing direction.

3. In a variable stroke fluid pump having at least one cylinder and piston, a member controlling the stroke of the piston, and a fluid operated balancing device having connections with the pump whereby said device is under the control of the pressure of the fluid in the pump, the balancing device being interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke increasing direction.

4. In a variable stroke fluid motor having at least one cylinder and piston, a member controlling the stroke of the piston, and a fluid operating balancing device having connections with the motor whereby said device is under the control of the pressure of the fluid in the motor, the balancing device being interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke decreasing direction.

5. In a variable stroke fluid pump, the combination with the member controlling the stroke, of a cylinder, a piston working in said cylinder, means for placing said cylinder in communication with the pressure system of the pump and means for connecting said piston to the stroke controlling member

for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke increasing direction.

6. In a variable stroke fluid motor, the combination with the member controlling the stroke, of a cylinder, a piston working in said cylinder, means for placing said cylinder in communication with the pressure system of the motor and means for connecting said piston to the stroke controlling member for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke decreasing direction.

7. In a variable stroke and reversible fluid pump, the combination with the member controlling and reversing the stroke, of a cylinder, a double acting piston working in said cylinder, means for placing one end of said cylinder in communication with the pressure system of the pump and the other in communication with the suction system of the pump and means for connecting said piston to the stroke controlling and reversing member for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke increasing direction.

8. In a variable stroke and reversible fluid motor, the combination with the member controlling and reversing the stroke, of a cylinder, a double acting piston working in said cylinder, means for placing one end of said cylinder in communication with the pressure system of the motor and the other in communication with the exhaust system of the motor and means for connecting said piston to the stroke controlling and reversing member for approximately balancing the resistance offered by the fluid to adjustment of said member in the stroke decreasing direction.

9. In a variable stroke fluid pump having at least one cylinder and piston, a member controlling the stroke of the piston, and a buffer device which is interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for damping the vibratory movements of said member that occur during the working of the motor.

10. In a variable stroke fluid motor having at least one cylinder and piston, a member controlling the stroke of the piston, and a buffer device which is interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for damping the vibratory movements of said member that occur during the working of the motor.

11. In a variable stroke fluid pump having at least one cylinder and piston, a member controlling the stroke of the piston, and a dash-pot device which is interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for damping the vibratory movements of the said member that occur during the working of the pump.

12. In a variable stroke fluid motor having at least one cylinder and piston, a member controlling the stroke of the piston, and a dash-pot device which is interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for damping the vibratory movements of said member that occur during the working of the motor.

13. In a variable stroke fluid pump having at least one cylinder and piston, a member controlling the stroke of the piston, and a dash-pot cylinder containing fluid under pressure and carried by a part which remains stationary during stroke controlling adjustments of said member, a piston working in said cylinder and means for connecting said piston to said member for damping the vibratory movements of said member that occur during the working of the pump.

14. In a variable stroke fluid motor having at least one cylinder and piston, a member controlling the stroke of the piston, and a dash-pot cylinder containing fluid under pressure and carried by a part which remains stationary during stroke controlling adjustments of said member, a piston working in said cylinder and means for connecting said piston to said member for damping the vibratory movements of said member that occur during the working of the motor.

15. In a variable stroke fluid pump having at least one cylinder and piston, a member controlling the stroke of the piston, and a dash-pot cylinder carried by a part which remains stationary during stroke controlling adjustments of said member, a piston working in said cylinder, means for placing said cylinder in communication with a source of fluid pressure supply, and means for connecting said piston to said member for damping the vibratory movements of said member that occur during the working of the pump.

16. In a variable stroke fluid motor having at least one cylinder and piston, a member controlling the stroke of the piston, and a dash-pot cylinder carried by a part which remains stationary during stroke controlling adjustments of said member, a piston working in said cylinder, means for placing said cylinder in communication with a source of fluid pressure supply, and means for connecting said piston to said member for damping the vibratory movements of said member that occurs during the working of the motor.

17. In a variable stroke and reversible fluid pump having at least one cylinder and piston, a member controlling and reversing the stroke of the piston, and a dash-pot cylinder carried by a part which remains sta-

tionary during stroke controlling adjustments of said member, a double-acting piston working in said cylinder, means for placing said cylinder in communication with a source of fluid pressure supply, and means for connecting said piston to said member for damping the vibratory movements of said member that occur during the working of the pump.

18. In a variable stroke and reversible fluid motor having at least one cylinder and piston, a member controlling and reversing the stroke of the piston, and a dash-pot cylinder carried by a part which remains stationary during stroke controlling adjustments of said member, a piston working in said cylinder, means for placing said cylinder in communication with a source of fluid pressure supply, and means for connecting said piston to said member for damping the vibratory movements of said member that occur during the working of the motor.

19. In a variable stroke fluid pump having at least one cylinder and piston, a member controlling the stroke of the piston, and means interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke increasing direction, and a device which is also interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for damping the vibratory movements of said member that occur during the working of the pump.

20. In a variable stroke fluid motor having at least one cylinder and piston, a member controlling the stroke of the piston, and means interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for approximately balancing the resistance offered by the fluid to the adjustment of said member in the stroke decreasing direction, and a device which is also interposed between said member and a part which remains stationary during the stroke controlling adjustments of said member, for damping the vibratory movements of said member that occur during the working of the motor.

MAURICE KERR INGOLDBY.