

Aug. 4, 1942.

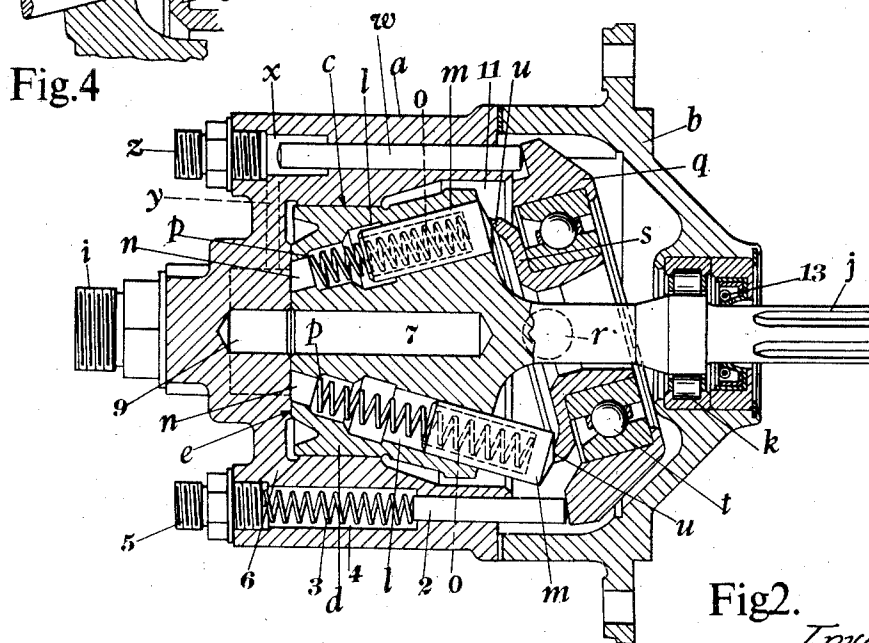
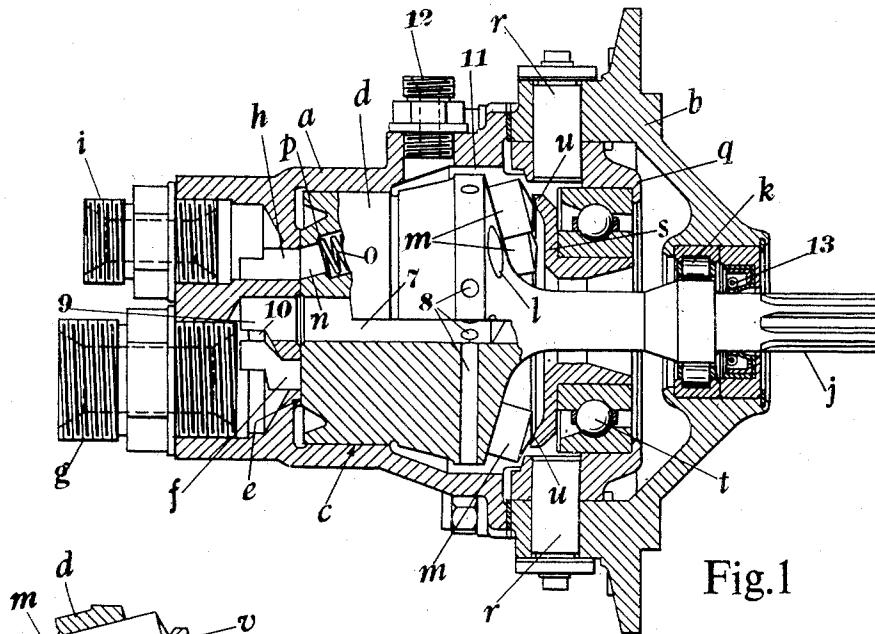
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2,292,125

ROTARY FLUID PUMP

Filed June 23, 1941

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

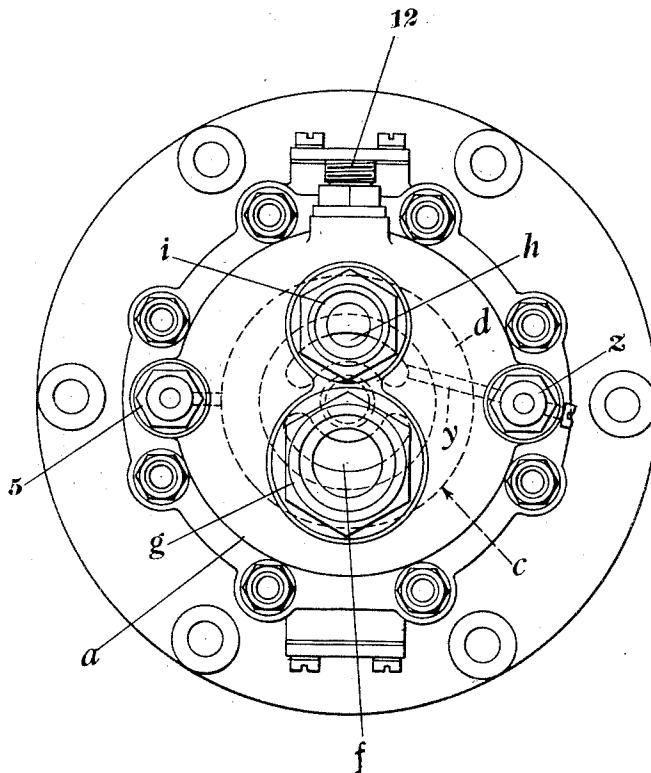


Fig.3

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UNITED STATES PATENT OFFICE

2,292,125

ROTARY FLUID PUMP

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Application June 23, 1941, Serial No. 399,344
In Great Britain August 30, 1940

1 Claim. (CL 103—162)

This invention has for its object to provide an improved rotary fluid pump of the type comprising a hollow body part, a rotary cylinder block mounted in the body part and having a plurality of bores formed around its axis, plungers slidable in the bores, and an abutment co-operating with the outer ends of the plungers, one end face of the cylinder block being arranged in contact with a complementary face in the body part having fluid inlet and outlet ports, and the cylinder bores having open inner ends which during the rotation of the block move over the said ports.

The invention comprises a pump of the aforesaid type in which the bores in the cylinder block are inclined to the axis of rotation of the block so that the inner ends of the bores are situated nearer the said axis than the outer ends, the amount of the inclination being such as will allow the outward movements of the plungers and the inflow of liquid to be assisted by centrifugal action.

The invention also comprises a pump as specified in the preceding paragraph, and in which any or all of the following features are also employed, namely, bores having their open inner ends of smaller diameter than the portions occupied by the plungers, helical compression springs accommodated within the plungers and bores, an abutment adapted to minimise the imposition of non-axial forces on the plungers, and means for automatically controlling the pump output, as hereinafter described and claimed.

In the accompanying sheets of explanatory drawings, Figure 1 is a sectional side elevation, Figure 2 a sectional plan and Figure 3 an end elevation illustrating a pump constructed in accordance with the invention. Figure 4 is a detail view illustrating a modification in the shape of the portion of the abutment acting on the outer ends of the plungers.

Referring to the drawings, the body part comprises a main portion *a* and an end cover *b*. Within the part *a* is formed a cylindrical bearing surface *c* for supporting the rotary cylinder block *d*, and an end face *e* against which the adjacent end of the cylinder block can abut. This end face *e* is formed with an arcuate inlet port *f* communicating with an inlet pipe connection *g*, and with an arcuate outlet port *h* communicating with an outlet pipe connection *i*. The cylinder block *d* is formed on or secured to one end of a driving shaft *j* supported by a bearing *k* in the end cover *b*.

Within the cylinder block is formed a plu-

5 rality of bores *l* in which are inserted reciprocatory plungers *m*. The bores are inclined to the axis of rotation of the cylinder block so that their open inner ends *n* which co-operate with the inlet and outlet ports *f*, *h*, are nearer the said axis than the opposite ends through which extend the outer ends of the plungers. The purpose of this inclination is two-fold. In the first place it enables the open inner ends of the bores and the inlet and outlet ports to be arranged conveniently near to the axis of rotation of the cylinder block, and the outer ends of the plungers to be arranged sufficiently far away from the said axis to allow the required maximum length of stroke to be obtained without excessive obliquity of the abutment to be hereinafter described. In the second place it enables both the inflow of liquid to the bores and the outward movements of the plungers to be assisted by centrifugal action. A convenient inclination is about 15° to the axis of rotation of the cylinder block.

The open end of each bore adjacent to the end face *e* in the body part is made of smaller diameter than the main portion occupied by the plunger. The purpose of this is to enable the fluid pressure in the bores to assist in holding the end face of the cylinder block against the end face *e* of the body part.

Also each plunger *m* is made hollow for the greater part of its length, and within each plunger and bore is arranged a helical compression spring *o*. One end of each spring abuts against the closed end of its plunger, and the other end abuts against a shoulder *p* in the bore. The purpose of the springs is to impart outward movements to the plungers. They also serve to hold the end face of the cylinder block in contact with the end face *e* in the body part. By arranging the springs within the bores and plungers an advantage is obtained in that long springs can be used, and the excessive projection of the outer ends of the plungers beyond the cylinder block, which occurs when externally arranged springs are used is avoided.

The abutment with which the outer ends of the plungers co-operate comprises an outer ring *q* carried on the end cover *b* by a pair of diametrically disposed trunnions *r*, and an annular plate *s* rotatably supported in the ring *q* by a ball or other bearing *t*. It is desirable that the force set up between each outer end of the plunger and the plate *s* shall be directed as nearly as possible along the axis of the plunger. In other words it is desirable that any unavoidable component of this force at right angles to the plunger

axis shall be as small as possible. To satisfy this condition the face *u* of the portion of the plate *s* which makes contact with the outer ends of the plungers is (in the example shown in Figures 1 and 2) made of conical concave form and is such that when the plate is in a position at right angles to the axis of rotation of the cylinder block the said face is at right angles to the axes of the plungers. Also the outer end of each plunger is made to a conical or rounded form. Alternatively the modification shown in Figure 4 may be used. Here the face *v* of the portion of the plate *s* which makes contact with the adjacent ends of the plungers is of a convex involute form. This shape also obviates the imposition of an unbalanced moment on the abutment.

The output of the pump is varied by varying the strokes of the plungers, and this is effected by pivotal movement (by any convenient means) of the abutment about the axis of the trunnions *r*. For effecting the said pivotal movement automatically in response to the fluid pressure in the delivery side of the pump, a plunger *w* is mounted in a bore situated at one side of the body part *a* parallel with the axis of the cylinder block. Pressure fluid is admitted to a chamber *x* containing the inner end of this plunger along a passage *y* communicating with the outlet port *h*. This chamber may also communicate with a connection *z* for a pipe leading to a pressure gauge. At the opposite side of the body part *a* is arranged another plunger 2 which is acted on by a spring 3 contained in a chamber 4. This chamber may be provided with a connection 5 for a pipe through which lubricating oil can be supplied to the contiguous end and peripheral surfaces of the cylinder block and body part, the chamber being in communication with the said surfaces through a passage 6.

The plungers *w* and 2 act on diametrically opposite parts of the outer ring *q* of the abutment, as shown in Figure 2. The spring 3 acting through the plunger 2 tends to move the abutment into its position of maximum obliquity. In this condition maximum reciprocatory movements are imparted to the plungers when the cylinder block is rotated. When the fluid pressure acting on the plunger *w* is able to counteract the pressure of the spring 3, the plunger *w* moves the abutment in the opposite direction thereby reducing the obliquity of the abutment and correspondingly reducing the strokes of the plungers and the pump output, this condition reaching its limit when the obliquity of the abutment is nil.

The pump shown in Figures 1 to 3 also has combined with a centrifugal pump for supplying fluid under pressure to any associated governing or other apparatus. Within the cylinder block is formed an axial bore 7 communicating at one end with a plurality of radial passages 8, and at the other end with an axial bore 9 in the body part, the bore 9 being in communication with the pump inlet port *f* through a passage 10. Liquid flowing through the chan-

nels 10, 9, 7, 8 is expelled from the cylinder block by centrifugal action into the chamber 11 formed by the end cover *b* and the adjacent portion of the body part *a*, and is thence conducted through a pipe attached to the connection 12 to the mechanism to be actuated. This mechanism may be for example a governor for controlling a mechanism supplied with pressure-fluid from the main part of the pump. Leakage of fluid from the chamber 11 around the driving shaft *j* is prevented by a packing 13.

A pump as above described (with or without the additional centrifugal pump) is applicable to a variety of uses, such as the supplying of pressure fluid to mechanism to be actuated by the fluid, or the supplying of liquid fuel to engines or burners. The pump may also be used as a motor for converting into mechanical work the energy of fluid supplied to it under pressure, and it is to be understood therefore that the term pump as used herein is intended to include both a means for supplying and a means for utilising the energy of fluid. Moreover whilst the pump is primarily intended to operate with a liquid medium, it may be used for dealing with a gaseous medium.

The invention is not limited to the example above described as subordinate constructional details may be varied to suit different requirements.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

A rotary pump of the type specified, comprising in combination a hollow body part, a rotary cylinder block mounted in the body part and having an end face in contact with a complementary face in the body part, the latter face having fluid inlet and outlet ports, and the cylinder block having formed around its axis a plurality of inclined bores having open inner ends which during rotation of the cylinder block move over the said ports, and which are situated nearer to the axis of the cylinder block than the outer ends of the bores, hollow plungers slidable in the bores, the open inner ends of the bores being of smaller diameter than the portions of the bores occupied by the plungers, and the inclination of the bores relatively to the axis of the cylinder block being such as will allow outward movement of the plungers and the inflow of fluid to be assisted by centrifugal force, helical compression springs arranged within the plungers and bores, and an abutment having an inner part which is rotatable relatively to an outer supporting part and against which the outer ends of the plungers abut under the action of the springs, the said inner part of the abutment and the outer ends of the plungers being adapted to minimise the imposition of non-axial forces on the plungers, and the said cylinder block and body part being formed with intercommunicating bores which also communicate with the said inlet port, and which enable the said block to serve also as a centrifugal pump.

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