March 31, 1942. M. B. BOOTH 2,277,661

ROTARY FLUID PRESSURE MOTOR, PUMP, AND THE LIKE

Filed Jan. 19, 1939

Fig. 1.

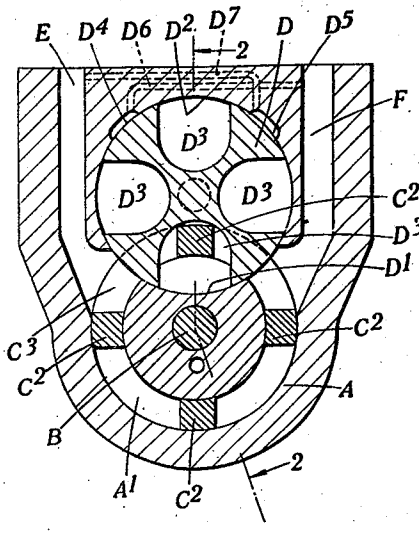


Fig. 2.

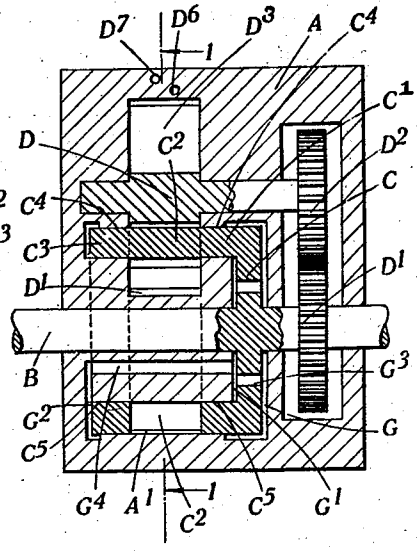


Fig. 3.

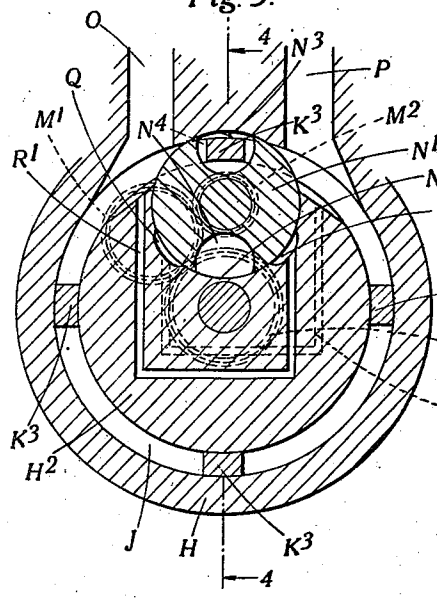
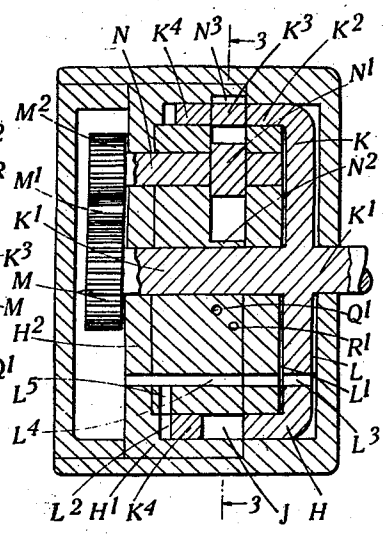


Fig. 4.



Inventor

MELVILLE BERTRAM BOOTH

by

Louis L. Amato

his Attorney

Patented Mar. 31, 1942 2,277,661

UNITED STATES PATENT OFFICE

2,277,661

ROTARY FLUID PRESSURE MOTOR, PUMP, AND THE LIKE

Melville Bertram Booth, Allesley, England, assignor to The Keelavite Company Limited, Coventry, England, a company of Great Britain

Application January 19, 1939, Serial No. 251,669
In Great Britain June 4, 1937

6 Claims. (Cl. 103—125)

This invention relates to rotary fluid pressure motors, pumps and the like adapted to be operated by or to operate upon a fluid, whether gaseous or liquid, hereinafter termed the working fluid, and whether employed primarily to act on or to be acted upon by the working fluid or employed as or incorporated in devices such as transmission devices or fluid motors.

For brevity such motors or pumps will hereinafter be referred to as rotary engines.

This application is a continuation in part of my copending application Serial No. 210,503, now issued as Patent No. 2,258,504, of October 7, 1941.

The invention is concerned with rotary engines of the kind comprising a casing in which is provided an annular blade chamber, a rotor having blades which extend across the blade chamber so as to make a sealing fit with the inner and outer circumferential walls of the blade chamber relatively to which the rotor rotates about the axis of the blade chamber, a rotary abutment supported in bearings in a part rigid with the inner or outer circumferential wall of the blade chamber and extending across the blade chamber between inlet and outlet ports and having a circumferential surface which is circular in cross-sections at right angles to its axis of rotation and makes a sealing fit at all times with abutment recesses of part-circular cross-section respectively in the inner and outer circumferential walls of the blade chamber, one or more blade-receiving recesses or openings being provided in the periphery of the abutment, each of which during rotation of the abutment comes into position to receive a blade and permit it to pass the abutment as the blade during its rotation comes to the part of the blade chamber across which the abutment extends.

The object of the invention is to provide an improved rotary engine of the above kind in which unbalanced forces due to fluid pressure acting on the moving parts thereof will tend to be reduced or eliminated.

To this end the rotor of a rotary engine of the kind referred to comprises an axially extending flange from which extend axially two or more blades the ends of which remote from the flange are united by a ring, the inner and outer circumferential surfaces of the flange and ring making a fluid seal with sealing surfaces on the casing.

Conveniently the sealing surfaces are constituted by extensions of the inner and outer circumferential surfaces of the blade chamber. In any case the area of each inner sealing surface is preferably approximately equal to that of the adjacent outer sealing surface.

With such a construction it will be seen that for any inward radial force acting on any point on the outer circumferential surface of the flange or ring due to fluid pressure in the adjacent part of the blade chamber, there will be a corresponding counterbalancing outward radial force acting on the adjacent inner surface of the flange or ring. Thus, however pressures may vary at different parts of the circumference of the blade chamber, radial forces due to such pressures acting on the flange and ring will tend to counterbalance one another whereby radial thrusts on the rotor tend to be eliminated under all conditions of working.

It will also be seen that axial forces acting on the face of the flange which is exposed at one end of the blade chamber will be counterbalanced by axial forces acting on the face of the ring at the other end of the blade chamber so that axial balance will also tend to be obtained. In order still further to ensure as great a degree of axial balance as possible, communicating passages are preferably provided between the spaces in which lie the faces of the flange and ring remote from the blade chamber so that axial forces acting on these faces are automatically balanced.

Again, where, as is generally preferred, the flange extends from a disc-like rotor, communicating passages are preferably provided between the spaces on opposite sides of the disc-like rotor and between these spaces and the space in which lies the face of the ring remote from the blade chamber.

In order to counterbalance radial forces acting on the abutment, the abutment recess in that wall of the blade chamber in which the abutment is supported may be provided with a pressure recess opposite the point on the abutment which is exposed to the high pressure part of the blade chamber, the pressure recess receiving fluid pressure directly or indirectly from such high pressure part and preferably having an area exposed to the abutment equal to the area of the abutment which is exposed to the high pressure part of the blade chamber. If desired, the abutment recess referred to above may also have a second similar pressure recess opposite the point on the abutment which is exposed to the low pressure part of the blade chamber and receives fluid pressure from such low pressure part.

The invention may be carried into practice in

various ways but two constructions according to the invention are diagrammatically illustrated by way of example in the accompanying drawing, in which

Figure 1 is a cross-section in a plane at right angles to the axes of rotation of the rotor and abutment of one construction according to the invention, the cross-section being on the line 1—1 of Figure 2,

Figure 2 is a section on the line 2—2 of Figure 1,

Figure 3 is a similar view to Figure 1 of an alternative construction according to the invention, and

Figure 4 is a section on the line 4—4 of Figure 3.

In the construction illustrated in Figures 1 and 2, the pump or motor comprises a casing A in which is formed an annular blade chamber A^1. Mounted to rotate within the casing on a shaft B is a rotor comprising a disc C having an axially extending flange C^1 from which project axially four blades C^2 the ends of which remote from the flange C^1 are united by and preferably formed integral with a ring C^3. A single rotary abutment D which is driven by gearing D^1, D^2 from the shaft of the rotor extends across the blade chamber A^1 between inlet and outlet ports E, F, this abutment being supported in bearings in the outer wall of the blade chamber and engaging part-cylindrical abutment recesses D^1, D^2 in the inner and outer circumferential walls of the blade chamber, as shown. The abutment D has four blade-receiving recesses D^3 therein each of which is adapted to come into position to receive one of the blades C^2 and thus permit it to pass the abutment as the blade during its rotation in the blade chamber comes to the abutment.

It will be seen that the faces of the flange C^1 and the ring C^3 adjacent to the blade chamber constitute the ends of the chamber. The annular recess the centre part of which constitutes the blade chamber A^1 thus has parts beyond each end of the blade chamber and constituted in effect by extensions of the inner and outer circumferential surfaces of the blade chamber which make an approximately fluid-tight seal respectively with the inner and outer circumferential surfaces of the flange C^1 and the ring C^3. Each of these parts is so formed that the total area of the outer circumferential surface which engages the outer circumferential surface C^4 of the flange C^1 or ring C^3 is approximately equal to the total area of the adjacent inner circumferential surface C^5 which engages the inner circumferential surface of the flange or ring. In this way a reduction or elimination of unbalanced radial forces acting on the rotor tends to be obtained. Again, the spaces or fluid pressure balancing chambers G, G^1 and G^2 are all in communication with one another through passages G^3, G^4 so that the rotor is not subject to unbalanced end thrusts.

Formed in the face of the abutment recess D^3 are two pressure recesses D^4, D^5 respectively lying opposite to and communicating respectively through passages D^6, D^7 with the outlet and inlet ports F and E so as to be subject to the pressures therein. Thus, the fluid pressures in these recesses D^4, D^5 counterbalance the radial forces exerted on the abutment by the fluid pressures in the parts of the blade chamber to which the abutment is exposed.

In the alternative construction illustrated in Figures 3 and 4, the engine comprises a casing H in which is rigidly secured a member H^1 having rigidly secured thereto a member H^2 so constructed and arranged that the member H^2 constitutes the inner circumferential wall of an annular recess the outer circumferential wall of which is constituted partly by the member H^1 and partly by the casing H. The intermediate part of this annular recess constitutes an annular blade chamber J. Mounted to rotate within the casing H is a rotor comprising a disc K mounted on a driving shaft K^1 and provided with an axially extending flange K^2 from the end of which project four blades K^3 united at their ends by a ring K^4 so that the faces of the ring K^4 and the flange K^3 adjacent to the blade chamber J constitute the ends of the chamber. The inner and outer circumferential surfaces of the flange K^2 and ring K^4 thus make approximately fluid-tight seals with extensions of the inner and outer circumferential surfaces of the blade chamber so that radial forces on the rotor tend to counterbalance one another, as in the construction shown in Figures 1 and 2. The spaces L, L^1 and L^2 all communicate with one another through passages L^3, L^4, L^5 so as also to tend to prevent unbalanced axial forces acting on the rotor.

The rotor shaft K^1 is connected through gearing M, M^1, M^2 to the shaft N of a rotary abutment N^1 supported in the inner circumferential wall of the blade chamber and engaging part-cylindrical abutment recesses N^2, N^3 in this wall and in the outer circumferential wall of the blade chamber between inlet and outlet ports O, P, as shown, this abutment having two blade-receiving recesses N^4 adapted to come into position to permit the blades to pass the abutment. In this construction it will be seen that the abutment must be rotated at twice rotor speed.

Formed in the abutment recess N^2 are two pressure recesses Q, R respectively opposite the parts of the abutment exposed to the high and low pressure parts of the blade chamber. The recess Q communicates through a passage Q^1 with the high pressure part of the blade chamber while the recess R communicates through a passage R^1 with the low pressure part of the blade chamber so that the fluid pressures in these recesses exert radial forces on the abutment tending to counterbalance the radial forces exerted thereon by the fluid pressures in the blade chamber.

What I claim as my invention and desire to secure by Letters Patent is:

1. A rotary engine including in combination a casing containing an annular blade chamber provided with inlet and outlet means including at least one inlet port and one outlet port spaced apart along said blade chamber, a rotor comprising an axially extending annular flange, said flange having circumferentially inner and outer cylindrical sealing surfaces, blades extending axially from the edge of such flange across the blade chamber and making a sealing fit with the inner and outer circumferential walls of the blade chamber relatively to which the rotor rotates about the axis of the blade chamber, and a ring uniting the ends of the blades remote from the flange and having unbroken circumferentially inner and outer cylindrical sealing surfaces, sealing surfaces in the casing making an effective fluid seal with said sealing surfaces of the ring and flange, fluid pressure balancing chambers at the axially remote ends of said sealing surfaces communicating with each other and containing fluid under substantially the same pressure there-

by subjecting said sealing surfaces to substantially the same fluid pressure at their axially remote ends and tending to resist leakage from the blade chamber along said sealing surfaces, and a rotary abutment device for said blade chamber located between said inlet and outlet ports and having means to provide for passage of a blade while maintaining at all times a seal at that part of the blade chamber.

2. A rotary engine including the combination of elements set forth in claim 1, in which the area of each inner sealing surface is approximately equal to that of its adjacent outer sealing surface.

3. A rotary engine including in combination a casing containing an annular blade chamber provided with inlet and outlet ports, a rotor comprising an axially extending annular flange, said flange having circumferentially inner and outer cylindrical sealing surfaces, blades extending axially from such flange across the blade chamber so as to make a sealing fit with the inner and outer circumferential walls of the blade chamber relatively to which the rotor rotates about the axis of the blade chamber, and a ring open at its interior uniting the ends of the blades remote from the flange and having circumferentially inner and outer cylindrical sealing surfaces extending in an axial direction from one side of the ring to the other, sealing surfaces at the inside of the casing making an effective fluid seal with said inner and outer surfaces of the ring and flange, fluid pressure balancing chambers at the axially remote ends of said sealing surfaces communicating with each other and containing fluid under substantially the same pressure thereby subjecting said sealing surfaces to substantially the same fluid pressure at their axially remote ends and tending to resist leakage from the blade chamber along said sealing surfaces, and a rotary abutment supported in bearings in a part rigid with one of the circumferential walls of the blade chamber and extending across the blade chamber between said inlet and outlet ports and having a circumferential surface which is circular in cross-sections at right angles to its axis of rotation and makes a sealing fit at all times with abutment recesses of part-circular cross-section respectively in the inner and outer circumferential walls of the blade chamber, one or more blade-receiving recesses being provided in the periphery of the abutment each of which during rotation of the abutment comes into position to receive a blade and permit it to pass the abutment as the blade during its rotation comes to the part of the blade chamber across which the abutment extends, communicating passages being provided between the aforesaid pressure balancing chambers, said pressure balancing chambers extending across the faces of the flange and ring remote from the blade chamber so that axial pressures acting on these faces automatically counterbalace one another.

4. A rotary engine including in combination a casing containing an annular blade chamber provided with inlet and outlet ports, a rotor within the casing comprising a disc, an axially extending annular flange projecting from one face of the disc towards the blade chamber, said flange having circumferentially inner and outer cylindrical sealing surfaces, blades extending axially across the blade chamber from the end of the flange remote from the disc and making a sealing fit with the inner and outer circumferential walls of the blade chamber relatively to which the rotor rotates about the axis of the blade chamber, and a ring uniting the ends of the blades remote from the flange and having circumferentially inner and outer cylindrical sealing surfaces extending axially from one edge of the ring to the other, sealing surfaces at the inside of the casing making an effective fluid seal with said inner and outer sealing surfaces of the ring and flange, fluid pressure balancing chambers at the axially remote ends of said sealing surfaces communicating with each other and containing fluid under substantially the same pressure thereby subjecting said sealing surfaces to substantially the same fluid pressure at their axially remote ends and tending to resist leakage from the blade chamber along said sealing surfaces, and a rotary abutment device for said blade chamber located between said inlet and outlet ports and having means to provide for passage of the blade while maintaining at all times a seal at that part of the blade chamber.

5. A rotary engine including the combination of elements set forth in claim 4, in which the area of each inner sealing surface is approximately equal to that of its adjacent outer sealing surface.

6. A rotary engine including in combination a casing containing an annular blade chamber provided with inlet and outlet ports, a rotor within the casing comprising a disc, an axially extending annular flange projecting from one face of the disc towards the blade chamber, blades extending axially across the blade chamber from the end of the flange remote from the disc and making a sealing fit with the inner and outer circumferential walls of the blade chamber relatively to which the rotor rotates about the axis of the blade chamber, and a ring open at its interior uniting the ends of the blades remote from the flange, the flange and ring having circumferentially inner and outer cylindrical sealing surfaces, sealing surfaces on the casing constituted by extensions of the inner and outer circumferential surfaces of the blade chamber and making a fluid seal with the sealing surfaces of the flange and ring, fluid pressure balancing chambers extending across the axially remote sides of the rotor disc and ring, a fluid pressure balancing chamber extending across the side of said disc adjacent said flange, passages connecting said pressure chambers, and a rotary abutment device for said blade chamber located between said inlet and outlet ports and having means to provide for passage of a blade while maintaining at all times a seal at that part of the blade chamber.

MELVILLE BERTRAM BOOTH.