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E. BOBARD
PISTON PUMP

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2 Sheets-Sheet 1

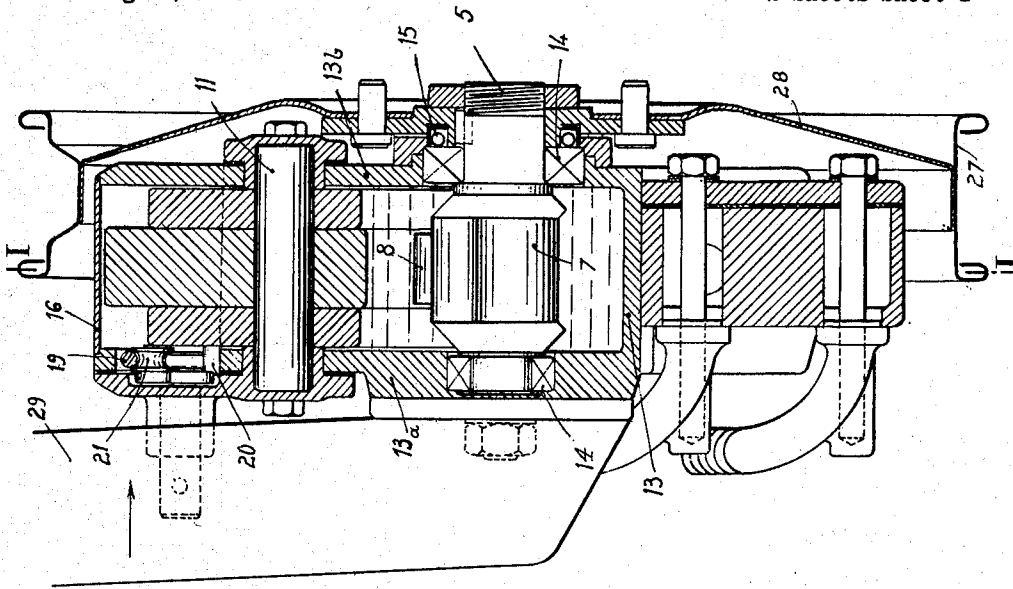


Fig. 2

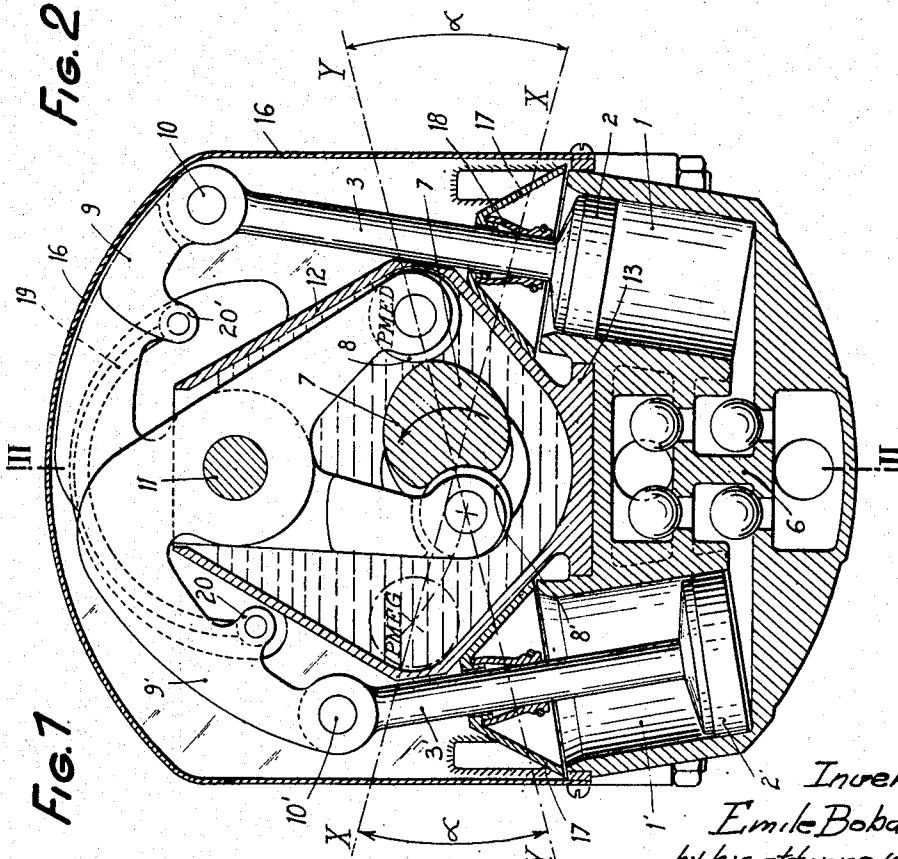


Fig. 1

Inventor
Emile Bobard
by his attorneys
Howson and Howson

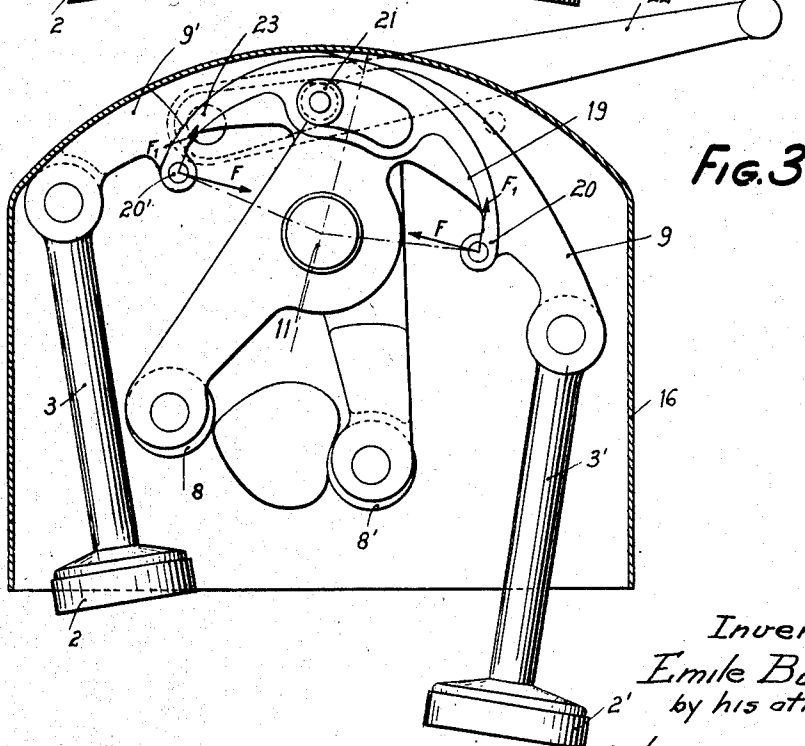
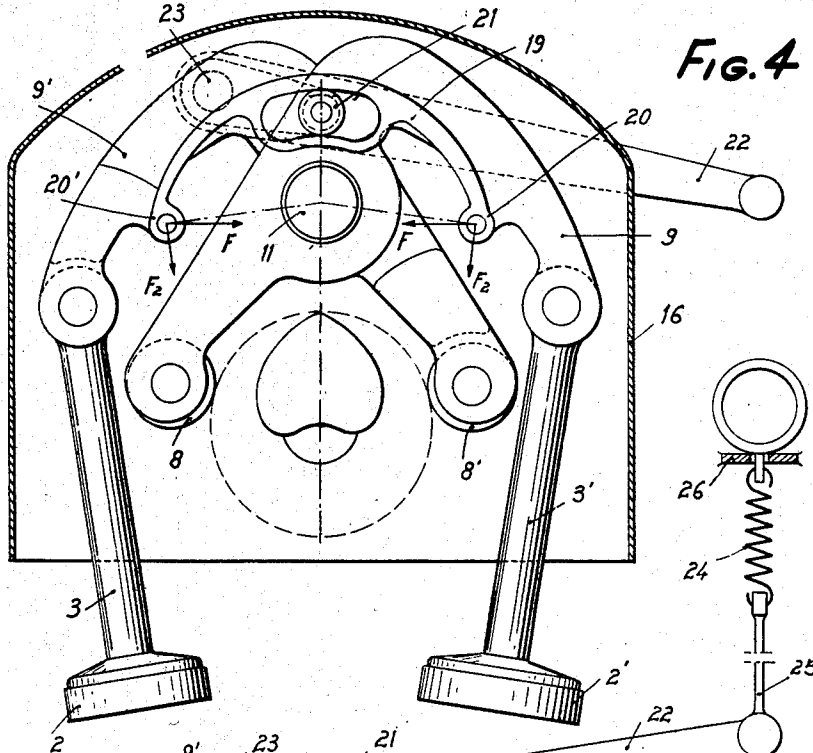
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Inventor
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by his attorneys
Howson and Howson

UNITED STATES PATENT OFFICE

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PISTON PUMP

Emile Bobard, Beaune, France

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My invention has for its object improvements in piston pumps operated by a rotary shaft with a view to reducing their weight and their bulk and to allow for instance their mounting inside the rim of a pneumatic tire, the rotation of said wheel providing in this case for the driving of the pump.

The accompanying drawing illustrates in two examples the principle of my invention.

Figs. 1 and 2 are cross-sections respectively through line I—I of Fig. 2 and through line II—II of Fig. 1 of the pump considered as a whole.

Figs. 3 and 4 show another form of the invention with the disconnecting mechanism in two different operating positions, as seen in the direction of the arrow of Fig. 2.

The pump illustrated in Figs. 1 and 2 includes chiefly two cylinders 1 and 1' inside which may reciprocate two pistons 2 and 2' carried by the two rods 3 and 3'. According to the invention, the reciprocating movement of these pistons is controlled by a shaft 5 arranged inside the group of members formed by the cylinders 1 and 1', the flap valve box 6, the piston rods 3 and 3', and the levers 9—9' serving for the control of said rods. To this purpose the shaft 5 carries a cam 7 with which cooperate the rollers 8 and 8' carried by the levers 9 and 9' pivotally secured at 10 and 10' to the rods 3 and 3' of the pistons. These levers are bent for the reason disclosed hereinafter and are pivotally secured to a common pivot 11.

It is apparent from the drawing that the rotation of the shaft 5 and of the cam 7 rigid therewith has for its action to make the two levers 9 and 9' rock round the pivot 11 so as to provide the rising and sinking movement of the pistons 2 and 2'. The outline of the cam 7 is defined in the example illustrated in a manner such as will produce for each revolution a suction stroke and a delivery stroke for each piston.

To ensure a regular output, the outline of the cam is designed so as to ensure a displacement of the pistons which is proportional to the angle of rotation of the shaft, taking into account the corrections which it is necessary to bring thereto for the reasons disclosed hereinafter.

The pump illustrated is designed so as to allow the operation of the cam and co-operating members inside an oil bath while ensuring the protection of the mechanical system against outer elements and against the fortuitous projection of liquid forced into the cylinder.

To this end the shaft 5 rotates inside an oil bath contained in a casing 12 whose peripheral

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wall is of substantially U-shaped cross section. Parallel walls 13a and 13b close the sides of the casing. The lower surface of the casing is secured to the pump body i. e. the valve box and the two cylinders. Inside this oil bath are immersed the cam 7, its two bearings 14, the two rollers 8 and 8' rolling over the cam and the three bearings of the rocking levers pivoting round the common pivot 11. It will be observed that the bent shape of the levers 9 and 9' mentioned pre-

cedingly has been provided so as to allow said levers to project above the casing 12 the opening of which is reduced to a minimum while allowing the pivot 11 to be immersed in oil.

A fluid-tight packing 15 is arranged at the outlet of the cam shaft. To ensure a protection of the driving member and of the oil bath against any extraneous object, the upper part of the casing is entirely closed by a protecting cover 16 enclosing fluid-tightly all the members controlling the pump.

In order to protect the said mechanism against liquid projected from between the piston and the wall of the cylinder, chiefly in the case of wear of the piston, there are provided auxiliary hoods 17 adapted to stop the projection of liquid in the direction of the axis of the cylinder and through which the piston rods are adapted to slide. A yielding fluid-tight arrangement 18 may moreover be provided between said rods and the hoods 17.

It has been stated that the outline of the cam is designed so as to ensure a pump output which is proportional to the angle of rotation of the shaft. However, with the mounting illustrated, two dead points appear respectively on the outside and inside of each roller along two different diameters X, Y forming with one another an angle α . Consequently as the cam is supposed to rotate in the direction of the arrow, the passage from the outer dead point of one of the rollers, say the right hand roller PMED to the outer dead point of the left hand roller PMEG corresponds to a rotation $180^\circ - \alpha$ while the passage in the opposite direction corresponds to a rotation $180^\circ + \alpha$ i. e. the delivery stroke of one of the pistons 2' corresponds to a rotation through $180^\circ - \alpha$ while the delivery stroke of the other piston 2' corresponds to a rotation of $180^\circ + \alpha$. Consequently even if the delivery stroke of one of the pistons begins as soon as the delivery stroke of the other is at an end and even if the stroke of the piston is at every moment proportional to the amplitude of the rotation of the cam, the output of the pump will not be regular; the two

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cylinders will feed the same amount of liquid during periods of different durations.

In order to remove this drawback it is possible to correct the difference in the speed of operation of the pistons 2 and 2' through a difference reversely proportional thereto of the corresponding cylinder volumes; this may be obtained either as illustrated in Fig. 1 by a difference in the cross-section of the cylinders 1 and 1' or else by a difference in the stroke of the pistons obtained through a difference in length of the lever arms or else by a combination of these two means.

According to my invention, there exists between the two balance beams or levers 9—9' a connection which may be broken and which is such that the rocking of one of the levers in the delivery direction round its pivoting axis produces a rocking of the other through the same amount in the direction of suction or reversely. The cam having a constant diameter, it is not necessary in theory to provide a spring for urging the balance beams or levers into contact with it. The disconnection may then be ensured by breaking the connection or more precisely by transforming their mutual operative connection into a rigid connection whereby the two balance beams are set in a position of maximum opening outside the field of action of the cams.

In the form illustrated in Figs. 3 and 4 said connection is ensured through a semi-circular link 19 secured to the two levers 9 and 9' at 20 and 20' respectively, said link cooperating with a roller 21 carried by a lever 22 which is adapted to rock around a stationary pivot 23 so as to raise and lower said roller.

When said roller occupies the position shown in Fig. 3 for which the link 19 is centrally located with reference to the rocking pivot 11, said link transmits from one balance beam or lever to the other the rocking motion round said pivot 11 and the two rollers 8 and 8' constantly follow the outline of the cam. On the contrary when the roller 21 is lowered as in Fig. 4 this results in a lowering of the semi-circular link 19 and in bringing the levers 9 and 9' into a position which is symmetrically opposed for the two levers and outside the field of action of the cam. The two balance beams remain rigidly held in their spaced position until the roller 21 is raised and again set in its central position with reference to the pivot 11.

It will be noticed that the disengagement is operated without any effort of the cam but by a mere lowering of the roller 21; the engagement may be controlled from a distance through a sheathed cable for instance.

In practice, however, it is necessary to take into account the irregularities in the machinery and the wear of the cam and to provide for a certain elasticity in the connection between the two levers. In the case where, as illustrated, the roller 21 is controlled by a lever 22 rocking round a stationary point 23, said elasticity is ensured by means of a spring 24 inserted in the control cable 25 engaging a stationary lug 26. But it is still simpler to use an arcuate link 19 made of spring steel which urges constantly towards one another the pivots 20 and 20' (through which it is secured to the levers) i. e. in the direction of the arrow F. Consequently the beams will have a tendency to move in the direction of the arrow F—1 and to urge the rollers against the cam for the connecting position of Fig. 3 in which a line through the pivots 20—20' passes above the axis of pivot 11. On the contrary in Fig. 4 where the line through pivots 20—20' passes below the axis

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of pivot 11 the rollers move in the direction of the arrow F—2 so as to be held outside the field of action of the cam.

As apparent the above described piston pump assumes a general shape which is substantially circular and is particularly well suited for the mounting end to end of the driving shafts and even for the housing of the entire pump inside the rim of a pneumatic tire. In the drawing I have shown at 27 the rim of the wheel and at 28 its solid disc. The shaft 5 of said pump is then in one with the shaft of the wheel 27—28 while the stationary casing of the pump is carried by an arm 29 rigid with the frame of the vehicle.

What I claim is:

1. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, levers controlling the pistons, a common pivot for the piston control levers, rollers carried at the outer ends of the levers, a cam mounted on the driving shaft and adapted to control the angular position of said levers through said rollers, means for constantly urging said rollers against the cam elastically, a valve box between the cylinders.

2. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, levers controlling the pistons, a common pivot for the piston control levers a cam mounted on the driving shaft and adapted to control the angular position of said levers, a valve box between the cylinders and a container filled with oil inside which the levers and driving shaft are immersed, the levers being bent to an extent such as will allow the common pivot to be immersed in the oil bath inside the container, the lever arms on the piston side extending out of the oil container.

3. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, levers controlling the pistons, a common pivot for the piston driving levers, rollers carried at the outer ends of the levers, a cam mounted on the driving shaft and adapted to control the angular position of said levers through said rollers, means for constantly urging said rollers against the cam elastically, a valve box between the cylinders, the inner and outer dead points of the rollers lying on a line to one side of the axis of the shaft, and the cylinder volume displaced by the pistons differing from one piston to the other for compensating the result of the unequal operation of the levers.

4. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, levers controlling the pistons, a common pivot for the piston control levers, rollers carried at the outer ends of the levers, a cam mounted on the driving shaft and adapted to control the angular position of said levers through said rollers, means for inter-engaging the levers and urging them to either side of the cam and means for controlling the position of said last means for disengaging as desired the levers and rollers thereon with reference to the cam, and a valve box between the cylinders.

5. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, levers controlling the pistons, a common pivot for the piston control levers, rollers carried at the outer ends of the levers, a cam mounted on the driving shaft and adapted to control the angular position of said levers through said rollers an arcuate link pivotally secured to each lever through the corresponding end, means

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for making said link move between a central position with reference to the pivot between the levers for which the levers are in co-operating position with reference to the cam and an eccentric position for which the levers are moved away from said cam, a valve box between the cylinders.

6. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, levers controlling the pistons, a common pivot for the piston control levers, rollers carried at the outer ends of the levers, a cam mounted on the driving shaft and adapted to control the angular position of said levers through said rollers, a resilient arcuate link pivotally secured at its ends to said levers, means for moving said link between a central position and an eccentric position with reference to said common pivot, said levers cooperating with said cam in said central position of the link, and said levers being in inoperative relation to said cam in said eccentric position of the link, the elasticity of said link urging towards one another its points of connection with the levers and urging said levers into their operative or inoperative position according to the position assumed by said link-moving means, a valve box between the cylinders.

7. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, levers controlling the pistons, a common pivot for the piston control levers, rollers carried at the outer ends of the levers, a cam mounted on the driving shaft and adapted to control the angular position of said levers through said rollers, an arcuate link pivotally secured to each lever through its corresponding end, a roller engaging said link, and means for controlling the position of said roller with reference to said common lever pivot between the levers and thereby the operativeness of the levers with reference to the cam, a valve box between the cylinders and a casing enclosing the different above-mentioned elements.

8. In combination with a vehicle wheel, a wheel shaft, a support, a pump comprising pump cylinders, pistons adapted to reciprocate therein, levers controlling the pistons, a common pivot for the piston control levers, rollers carried at the outer ends of the levers, a cam mounted on the wheel shaft and adapted to operate said levers means for moving said link between a central position and an eccentric position with reference to said common pivot, said levers cooperating with said cam in said central position of the link, and said levers being in inoperative relation to said cam in said eccentric position of the link, a valve box located between said cylinders, and a casing enclosing the cylinders, pistons, and valve box secured to said support.

9. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, valve means connected with said cylinders, levers controlling said pistons, a common pivot for the piston control levers, a cam mounted on the driving shaft and adapted to control the angular position of said levers, resilient means for constantly urging said levers toward said cam, the angular travel of said cam on the delivery stroke of one piston being greater than its

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angular travel on the delivery stroke of the other piston, and the areas of said cylinders and strokes of said pistons being constructed and arranged to compensate for said unequal travel and to equalize delivery from said pumps.

10. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, valve means connected with said cylinders, levers controlling said pistons, a common pivot for the piston control levers, a cam mounted on the driving shaft and adapted to control the angular position of said levers, means interengaging said levers and urging them oppositely toward the sides of the cam, and means for controlling the position of said interengaging means for moving as desired the levers into or out of operative relationship to the cam.

11. A pump comprising a rotary driving shaft, pump cylinders, pistons reciprocating therein, levers controlling the pistons, a common pivot for the piston control levers located within the compass of said levers and their connections to said pistons, a cam mounted on the driving shaft and adapted to control the angular position of the levers, resilient means for constantly urging said levers toward said cam, and a valve box located between said cylinders and associated therewith.

12. Pump structure as claimed in claim 11 having a container filled with oil within which said levers and common shaft and driving shaft are immersed with portions of said levers extending out of said both.

13. A pump comprising a rotary driving shaft, pump cylinders, pistons adapted to reciprocate therein, piston rods and levers associated with said shaft and pistons, a valve box located between the cylinders forming with said cylinders and the rods of said pistons a U-shaped whole, and means for the conversion of the rotary movement into reciprocating movement, said converting means being disposed between the two branches of said U, and a casing comprising two lateral parallel walls and a lower wall to which are secured the cylinders and the valve box, a container filed with oil inside said casing and within which said levers and driving shaft are immersed.

14. A pump as claimed in claim 13 having a cover adapted to cap the casing for protecting the piston rods, levers, shaft and container against any detrimental outer action.

15. A pump as claimed in claim 14 having an auxiliary hood capping the cylinders for preventing any projection of the liquid out of the cylinders.

EMILE BOBARD.

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