Mar. 27, 1923. 1,449,537

A. G. L. NEIGHBOUR ET AL

MEANS FOR PUMPING FLUIDS

Original Filed Apr. 22, 1918

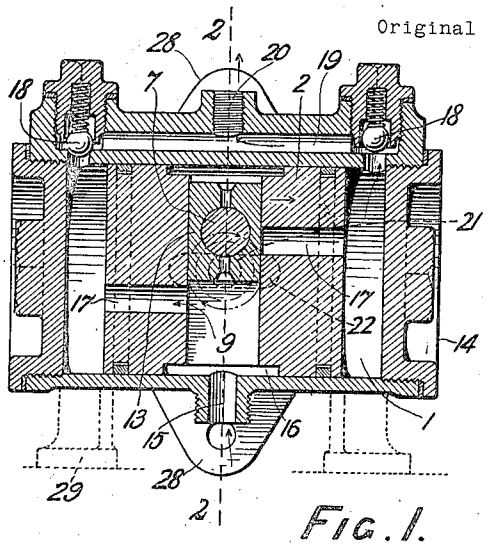


FIG. 1.

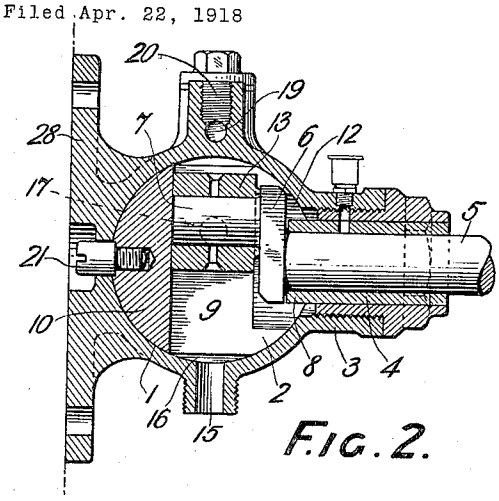


FIG. 2.

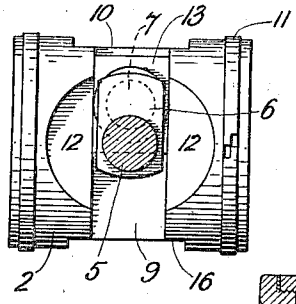


FIG. 3.

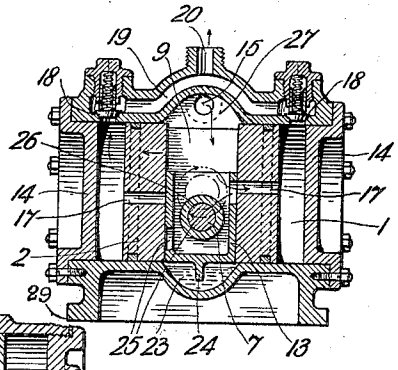


FIG. 4.

FIG. 7.

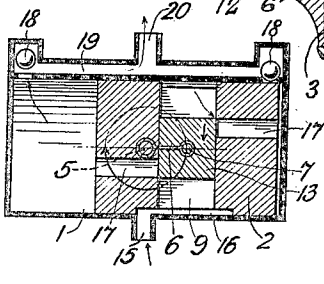


FIG. 5.

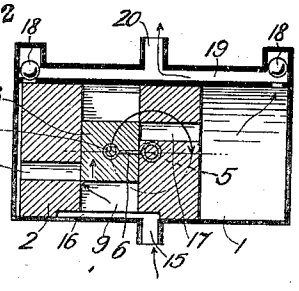


FIG. 6.

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UNITED STATES PATENT OFFICE.

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MEANS FOR PUMPING FLUIDS.

Application filed April 22, 1918, Serial No. 229,939. Renewed September 12, 1921. Serial No. 500,455.

To all whom it may concern:

Be it known that we, ARTHUR GEORGE LLOYD NEIGHBOUR and HARRY CECIL WYNNE NEIGHBOUR, subjects of the King of Great Britain, residing at Brighton, in the State of Victoria, Commonwealth of Australia, have invented new and useful Improvements in Means for Pumping Fluids, of which the following is a specification.

This invention relates to improvements in means for pumping fluids such as water, oil or air, and more particularly has reference to an improved pump which is highly efficient and very reliable and durable in operation, and extremely simple, compact and light in construction and consequently economical in manufacture.

The invention is particularly well adapted to the construction of small air compressors and vacuum pumps.

Air compressors constructed in accordance with the invention are well adapted for inflating the tires of motor vehicles, and are very suitable for supplying compressed air for the brakes of electrically driven railway trains and tramway cars and for starting large internal combustion engines. Vacuum pumps made in accordance with the invention are capable of use in connection with vacuum cleaners and milking machines, for the latter very simple, durable and efficient pumps are required.

The invention is, moreover, very suitable for forcing oil under pressure to the bearings of high speed machinery, such for example as high speed steam and internal combustion engines and steam turbines.

Furthermore, the invention can be applied to the construction of pumps for water and other liquids and the absence of suction valves renders its use desirable for pumps for molasses, heavy oils, and similar dense liquids in which the valves do not give satisfaction.

In order that the invention may be readily understood, reference will now be had to the accompanying explanatory drawings, wherein:—

Figure 1 is a view in longitudinal section of a small air compressor designed for intermittent working constructed and arranged in accordance with the invention.

Figure 2 is a view intransverse section taken on the line 2—2, Figure 1 of the air compressor shewn therein.

Figure 3 is a detached view partly in side elevation and partly in section to a pump piston, and parts which co-act therewith constructed in accordance with the invention.

Figure 4 is a view in longitudinal section of an air compressor vacuum pump comprising the essential features of the invention and constructed for general purposes.

Figures 5 and 6 are diagrammatical views illustrating the cycle of operations during one revolution of the crank-shaft of a compressor or pump embodying the essential features of the invention.

Figure 7 is a sectional view taken substantially through the center of Figure 2 and looking at the top.

In these drawings like characters of reference denote similar or corresponding parts in the different views and the numeral 1 designates a pump or compressor cylinder containing a piston 2 adapted to reciprocate therein. At the middle point of the length of said cylinder 1 and formed integrally therewith is a laterally projecting boss 3. This centrally disposed boss 3 has its axis perpendicular to and intersecting that of the cylinder 1 and forms the housing for the bearing 4 in which is rotatably mounted the operating crank-shaft 5.

The bearing 4 can be fixed in the housing or boss 3 as by screwing as shewn in Figure 2, or it can be made a neat fit in said boss 3 and secured in position by studs or set-screws which are passed through a flange on the outer end of said bearing 4 into lugs formed on the sides of the boss 3, or said bearing 4 can be fixed in the boss 3 in any approved way.

The crank-shaft 5 is provided with a crank-arm 6 and crank-pin 7, which are preferably made integrally with said crank-shaft 5 from a single piece of metal as shewn in Figure 2. In order that the crank 6 and crank-pin 7 may be well supported the inner end 8 of the bearing 4 is extended into the cylinder 1 as shewn in Figure 2 thereby considerably reducing the overhang of said crank-pin.

A transverse centrally-disposed rectangu-

lar slot 9 is cut, as by milling partly through the piston 2 at the middle point of its length, leaving a portion 10 of segmental section connecting together the opposite ends of said piston 2, and said piston 2 can be fitted with rings 11 or other approved packing means.

Recesses 12 formed in the piston 2 on each side of the centrally-disposed slot 9 provide the necessary room or clearance to enable the crank-arm 6 to revolve within the cylinder 1 and permit said bearing 4 to be extended therein thereby securing the advantages in construction and arrangement above set forth and enabling the pump to be made exceedingly compact.

A sliding block or die 13 is mounted upon the crank-pin 7 and this block or die 13 is slidably and accurately fitted in the centrally-disposed slot 9. As the crank-pin 7 revolves the block or die 13 is carried round in a circular path and at the same time reciprocates transversely in the centrally-disposed slot 9.

This arrangement is an adaptation of the well known slotted cross-head motion but arranged so that the operating parts are contained in a very small space, and it is to be understood that no claim is made broadly for said slotted cross-head motion. In the ordinary form of slotted cross-head motion the movement of the block or die in the direction of the longitudinal axis of the reciprocating member which produces the reciprocation of said member is alone made use of, and the movement of said block or die transversely in the reciprocating member has hitherto been regarded as lost motion and has served no useful purpose.

A salient feature of the present invention is the means whereby said block or die 13 in addition to causing reciprocation of the piston 2 by its longitudinal motion in the direction of the axis of cylinder 1 also by its transverse motion forms the means whereby fluid is admitted alternately to each end of cylinder 1, said block or die 13 in fact forms a mechanically operated inlet slide valve adapted at the right times to open and admit fluid to the working portions of the cylinder 1 and close when the fluid is to be expelled therefrom.

The working portions of the cylinder 1 lie between the ends of the piston 2 and the ends of the said cylinder 1, the latter being closed by suitable covers or caps 14 which can be attached to said cylinder 1 as by screwing as shewn in Figure 1, or said covers 14 can be flanged and secured to the cylinder 1 by studs or set screws as shewn in Figure 4.

The slot 9 and recesses 12 in the piston 2 form a central chamber which is always kept in communication with the source of fluid supply by means of a centrally-disposed inlet orifice 15 formed through the wall of the cylinder 1 at any convenient part of said cylinder 1 situated in the plane passing transversely through the middle point thereof.

The piston 2 can be provided with longitudinal slots 16 which extend on both sides of the end of the slot 9 and ensures that said central chamber is always connected with the inlet orifice 15 in all positions of said piston 2 as shewn in Figures 5 and 6.

Suction or admission ports 17 formed longitudinally in the piston 2 connect each end thereof with the rectangular slot 9 therein, and these suction ports 17 which can be circular, rectangular or other preferred section are adapted to be simultaneously opened and closed positively and alternately at each end of the stroke of the piston 2 by the block or die 13 as it reciprocates in said slot 9.

Eduction or discharge valves 18 of any well known construction commonly used in pumps and compressors are fitted at any convenient point of the ends of the cylinder 1 and these eduction valves 18 preferably discharge into a chamber 19 formed along the outside of said cylinder 1 and provided with an outlet orifice 20.

The mode of action or cycle of operations may be readily followed from Figures 5 and 6 of the drawings. In Figure 5 the piston is shewn at the right end of the cylinder 1 and is about to commence to move towards the left end of said cylinder 1 which for clearness in explanation is assumed to be full of fluid.

The block 13 is moving downwardly in the slot 9 and is just about to open the port 17 at the right end of the piston 2 and close the port 17 at the left end thereof. During the lower half of the revolution of the crank-pin 7, the block 13 covers the latter port 17 and is tightly pressed against the left side of the slot 9 thereby preventing leakage, and the fluid is discharged from the left working chamber of the cylinder 1 through the outlet valve 18 into the chamber 19 whence it passes through the discharge orifice 20.

Meanwhile fluid has been entering the cylinder 1 through the inlet orifice 15 into the central chamber aforesaid, and passing through the port 17 in the right end of the piston 2 into the right working chamber of the cylinder 1, and when the piston 2 reaches the left end of the said cylinder 1, as shewn in Figure 6 the right working chamber thereof will be filled with fluid.

The block 13 now moves upwardly and opens the left port 17 in the piston 2 and simultaneously closes the right port 17 therein, and during the return stroke of the piston 2 the fluid in the right working chamber of said cylinder 1 is similarly discharged through the outlet valve 18, and the left working chamber of said cylinder 1 is re-

filled with fluid, and when the piston 2 reaches the right end of cylinder 1 the cycle of operations is repeated.

In Figures 1 and 4 of the drawings the piston 2 is shewn at mid-stroke and the entrance of fluid into the working chambers of the cylinder 1 and discharge of fluid therefrom is clearly illustrated and indicated by arrows shewn therein.

At the end of the stroke of the piston 2 the transverse motion of the block 13 is a maximum and results in very rapid opening and shutting of the said ports 17, thereby enabling the admission and discharge of fluid to and from the working chamber of the cylinder 1 to be accurately timed. Moreover, owing to the rapid transverse motion of the block 13 the ports 17 in the opposite ends of the piston 2 are respectively fully closed and fully opened before the latter commences its stroke.

The working chamber of the cylinder 1 about to be discharged is rapidly shut off from the source of fluid supply, and the opposite chamber of said cylinder 1 which is about to be filled, is with equal rapidity connected therewith. Owing to the port 17 being fully opened on the commencement of the suction stroke of the piston 2 no vacuum is formed in said chamber and the fluid enters freely and uninterruptedly thereto. The said chamber is thereby completely filled with fluid at the end of the suction stroke of the piston 2.

Furthermore, the entering fluid has not the resistance to overcome due to passing through automatic inlet valves and such inlet valves, and the parts which co-operate with them such as cages, springs, and covers are eliminated, resulting in a reduction of the cost of manufacture.

When the pump is intended for intermittent use the block or die 13 can be constructed so as to project beyond the ends of the centrally-disposed slot 9 when the piston 2 is at mid-stroke as shewn in Figures 1, 2 and 3, thereby enabling the cylinder to be made of simple and compact construction.

When a block 13 of short length is used as shewn in Figures 1, 2 and 3, one end of the said block 13 at mid-stroke of the piston 2 is adjacent to the axis of the cylinder 1, and said piston 2 when in said mid-stroke position might turn axially in the cylinder 1, resulting in damage to the pump.

Axial rotation of the piston 2 may be prevented by making the bore of the cylinder 1 considerably greater than the stroke thereof, thereby enabling a longer block 13 to be used than is shewn in Figure 1, which can extend when in mid-stroke position for some distance on the opposite side of the axis of the cylinder 1 to the crank-pin 7. In the case of the small pump shewn in Figure 1 in which it is not desirable to unduly increase the bore of the cylinder 1, a screw or pin 21 is fixed radially in the segmental portion 10 of the piston 2 at the middle point thereof, and this pin is adapted to reciprocate in a centrally-disposed longitudinal slot 22 shewn by broken lines in Figure 1. This pin 21 effectively prevents any possibility of axial rotaton of the piston 2, and further prevents any binding of the block 13 on the crank pin 7.

When a vacuum pump or air compressor for general use is required and which may have to work for long periods without attention the block 13 is made of considerable length as shewn in Figure 4 and in its mid-stroke positions said block 13 extends beyond the centrally-disposed slot 9 in the piston 2, and said block 13 at its lower mid-stroke position dips into a recess 23 formed in the bottom of the cylinder 1 and adapted to form an oil bath. Said block 13 can itself dip into the oil bath 23, or it can be provided with a splasher 24 adapted to pass through and throw up the oil in said bath 23.

In order to prevent an excessive amount of oil passing into the working chambers of the cylinder 1 the block 13 is made hollow as shewn in Figure 4 and is provided with holes 25 which moves into alignment with the ports 17 at the correct times to admit fluid thereto. A cylindrical bridge 26 is formed integrally with the block 13 and this bridge 26 extends transversely across the inside of the said block 13 and is bored internally to fit the crank-pin 7. The air enters through the orifice 15 in the side of a recess 27 formed at the top of the cylinder 1 and passes downwardly into the interior of the hollow block 13. Recesses 12 are also provided in each side of the slot 9 in the piston 2, which permit the crank arm 6 to revolve within the cylinder and the bearing 4 to be extended therein, in a similar manner as in the case of the pump hereinbefore described.

When the invention is intended to be used as a water or vacuum pump the orifice 15 is connected to the cistern containing the water or to the vessel to be exhausted, and in order to prevent air gaining access to the cylinder 1 along the crank-shaft 5 the latter can be provided with any approved form of stuffing box and packing.

A pump or compressor constructed in accordance with the invention is easily taken apart and re-assembled, and in order to assemble said pump or compressor the block 13 is inserted in the slot 9 of the piston 2 and the said piston 2 is then placed in the cylinder 1 and adjusted to its mid-stroke position. The crank-shaft 5 is then passed through the boss 3 which is made of sufficient diameter to admit the crank-arm 6, and the crank-pin 7 is pushed into the hole in the block 13, and finally the bearing 4 is placed upon the crank-shaft 5 and secured in position.

The pump can be provided with a flange

28 for attachment to a wall or dash-board of a motor car or it can be provided with feet 29. Moreover, for special purposes it can be made single acting, only one port 17 being made in the piston 2, and an eduction valve 18 being provided only at the corresponding end of the said cylinder 1.

At the end of the compression stroke of the piston when the piston 2 is momentarily arrested the clearance space contains air at high pressure, and this air as soon as the block 13 uncovers the inlet port 17 escapes and the pressure in the clearance space falls to atmospheric pressure. The piston 2 commences its stroke with the air in the clearance space at atmospheric pressure.

In the case of a pump having automatic suction valves the high pressure air expands to and below atmospheric pressure before the suction valve opens, the piston in consequence moving some distance before the valve opens resulting in a loss of efficiency.

What we do claim is:

1. In a fluid pump or compressor, the combination of a cylindrical piston chamber of the same diameter for the entire length thereof, a piston to reciprocate in the cylinder having a transverse slot, an inlet port in the wall of the piston chamber in communication with the piston slot, a block slidably fitting in said slot and adapted to reciprocate therein during the reciprocation of the piston, a port extending longitudinally through the piston from the slot to the end to connect the inlet of the piston chamber with the piston chamber at one end of and through the piston, and said block arranged to connect the piston port with the inlet to the piston chamber as the piston moves in one direction and shut off said piston port from the piston chamber as the piston moves in the opposite direction, and a valve controlled outlet port from the piston chamber for the purposes specified.

2. In a fluid pump or compressor, the combination of a cylinder having an inlet port, a piston to reciprocate in the cylinder and separate the cylinder into a pair of chambers one at each end of the piston, said piston having a slot extending transversely therethrough with which the inlet port of the cylinder communicates, outlet ports from said chambers; spring influenced valve closing into and opening outward from the chambers to control said ports, ports through opposite ends of the piston to connect the chambers with the piston slot and cylinder inlet, and a block slidably mounted in the piston slot adapted to be reciprocated during the reciprocation of the piston and arranged to alternately connect the piston ports with the piston slot and thereby the inlet port to the cylinder for the purpose specified.

3. In a fluid pump or compressor, the combination of a cylinder, a piston to reciprocate in said cylinder and separating the cylinder into a pair of chambers one at each end of the piston said piston having a slot extending transversely therethrough, an inlet port to said cylinder at all times in communication with the piston slot, an outlet port from each chamber controlled by a check valve opening outward from and closing into the chambers; a pair of ports extending longitudinally through the opposite ends of the piston, one at each side of the longitudinal axis of the piston, to connect the chambers with the cylinder inlet through the piston slot, a block slidably mounted in the piston slot and reciprocable therein during the reciprocation of the piston and arranged to alternately connect the piston ports and thereby the chambers with the cylinder inlet through the piston slot, and a crank shaft journaled in the cylinder and carrying said block upon the crank pin.

4. In a fluid pump or compressor, the combination of a cylinder the bore of which is of the same diameter for the entire length thereof and having valved outlets from opposite ends, a piston reciprocably fitting in said cylinder and separating the cylinder into two chambers, one at each end of the piston, a transverse slot in the piston; an inlet port to the cylinder in communication with the piston slot, a boss integral with the cylinder to extend laterally therefrom, a bearing in the boss one end of which bearing projects into the cylinder and piston slot, a shaft rotatably mounted in the bearing having a crank-arm and a crank-pin extending into the piston slot, a block mounted on said crank-pin and slidably fitting in the piston slot to reciprocate in said slot as the piston is reciprocated, and admission ports in the piston extending from said piston slot through the piston to communicate with the chambers at opposite ends of the cylinder and controlled by the movement of the block for the purpose specified.

5. In a fluid pump or compressor, the combination of a cylinder, a piston fitting the cylinder, a transverse slot in the piston, a hollow valve-block slidably fitting said slot, recesses in the upper and lower sides of the cylinder, an inlet orifice in the upper recess admission holes in said hollow valve-block, and admission holes in said piston extending from said transverse slot to the ends of said piston.

6. In a fluid pump or compressor, the combination of a cylinder, a piston fitting the cylinder, a transverse slot in said piston, a hollow valve-block slidably fitting said slot, a bridge transversely across the inside of said valve-block, a hole through said bridge accommodating a crank-pin and an oil splasher on the lower end of said valve-block.

7. In a fluid pump or compressor, the combination of a cylinder having valved outlet ports from opposite ends, a piston to reciprocate in the cylinder and separate the cylinder into two chambers one at each end of the piston, said piston having a slot extending transversely therethrough, an inlet in the cylinder leading to the piston slot, a block slidably mounted in the piston slot and reciprocable therein during the reciprocation of the piston, ports extending longitudinally through the piston from the piston slot to the cylinder chambers at opposite ends of the piston arranged to be alternately shut off and connected to the piston slot and cylinder by the movement of the block during the reciprocation of the piston, and said piston ports and the block being arranged so as to uncover the ports previously to the commencement of the return stroke of the piston, for the purpose specified.

8. A fluid pump or compressor comprising a closed cylinder, a piston fitting the cylinder, a lateral boss formed integrally with the cylinder, a bearing fitting said boss, a crank-shaft rotatably mounted in the bearing, a crank-arm and crank-pin within the cylinder, a transverse slot in the piston, recesses in the piston on each side of said slot, a valve-block on the crank-pin slidably fitting said slot, an inlet orifice in the cylinder in communication with said slot, admission ports in the piston extending from the slot to the ends of said piston, and discharge valves at the opposite ends of the cylinder.

9. A fluid pump or compressor comprising a closed cylinder, a piston fitting the cylinder, a centrally-disposed lateral boss formed integrally with the cylinder, a bearing fitting the lateral boss and extending into the cylinder, a crank-shaft rotatably mounted in said bearing, a crank-arm and crank-pin formed integrally with the crank-shaft and contained within the cylinder, a centrally-disposed transverse rectangular slot in the piston at the middle point of said piston, recesses in the piston on each side of the transverse slot, a valve-block mounted on the crank-pin and slidably fitting said slot, a centrally-disposed inlet orifice in the cylinder in communication with the slot, admission ports in the piston extending from the slot to the ends of said piston, discharge valves at the opposite ends of the cylinder, a delivery chamber formed integrally along the outside of the cylinder, and a discharge orifice in the delivery chamber.

10. In a fluid pump or compressor, the combination of a cylindrical piston chamber having fluid inlet and outlet ports and a laterally extending boss, a piston fitting in said chamber having a transverse slot cut through the side thereof, recesses at opposite sides of the slot of less depth than the slot, a block slidable in said slot, a shaft journaled in the cylinder boss having a crank and pin, the pin being arranged to engage in the piston slot and upon which the block is mounted, and the crank arranged to engage and operate in the piston recesses, for the purpose specified.

11. In a fluid pump or compressor, the combination of a cylindrical piston chamber having fluid inlet and outlet ports, and an opening in the side midway between the ends and in line with the axis of the cylinder, a piston fitting the piston chamber having a transverse slot between the ends of the piston and recesses at opposite sides of the slot, a bearing in the cylinder opening extending into the recessed portion of the piston, a crank shaft journaled in said bearing with the crank arranged to operate in the recessed portion of the piston and the pin to engage in the piston slot, and a block loosely mounted on the said crank pin in the piston slot to connect the piston thereto.

12. In a pump or the like, the combination of a cylinder, a piston to reciprocate in said cylinder and separating the cylinder into a pair of chambers one at each end of the piston, said piston having a transverse slot, an inlet port to the cylinder at all times in communication with the piston slot, an outlet port from each chamber at opposite ends of the piston, ports through opposite ends of the piston to connect the chambers with the piston slot and cylinder inlet, a crank shaft journaled in the cylinder with the crank pin extending into the piston slot, and a block mounted on the crank pin engaging in the piston slot to operatively connect the piston and crank shaft and operable to control the opening and closing of the piston ports.

13. A pump or compressor having a cylinder, a piston in the cylinder, a transversely disposed guide-way in the piston, an operative shaft, a cranked member formed on the operative shaft and located in said piston, a bearing support formed integrally with said cylinder and of a size to permit the passage therethrough of said cranked member, openings extending longitudinally of the piston and the guide-way to permit of the entrance of said crank member, and a bearing in said support extending into the slotted opening in said piston.

In testimony whereof we affix our signatures in presence of two witnesses.

ARTHUR G. L. NEIGHBOUR.
HARRY C. W. NEIGHBOUR.

Witnesses:
A. J. CALLINAN,
JAMES H. ANDERSON.