March 18, 1924. 1,487,405

S. G. SKINNER

SUCTION MOTOR FOR WINDSHIELD CLEANERS

Filed Oct. 24, 1921 2 Sheets-Sheet 1

Fig. 1.

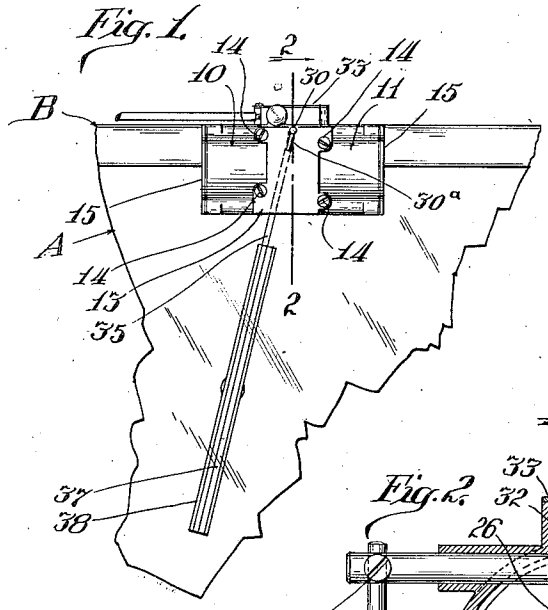


Fig. 4.

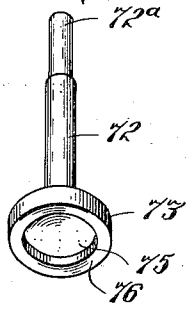


Fig. 2.

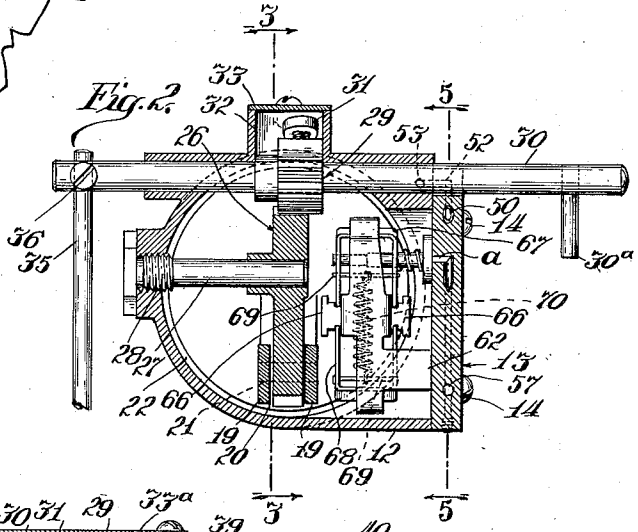
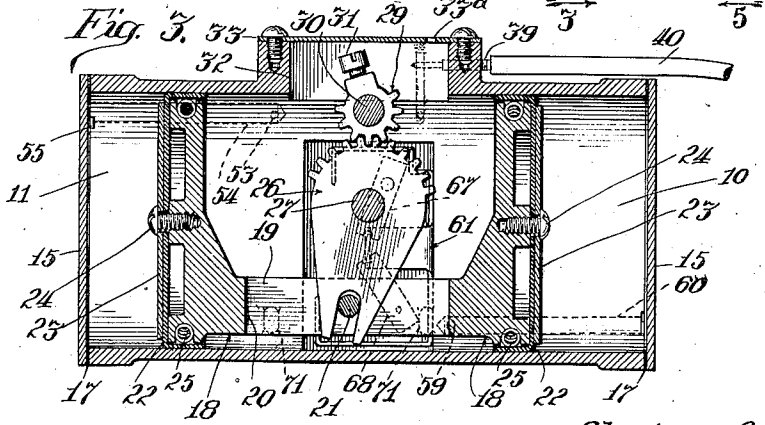


Fig. 3.



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Fig. 6.

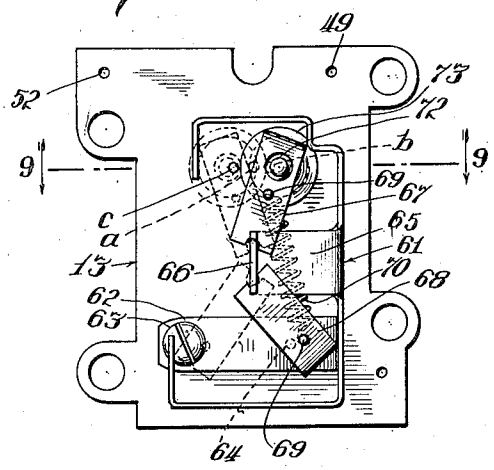


Fig. 7.

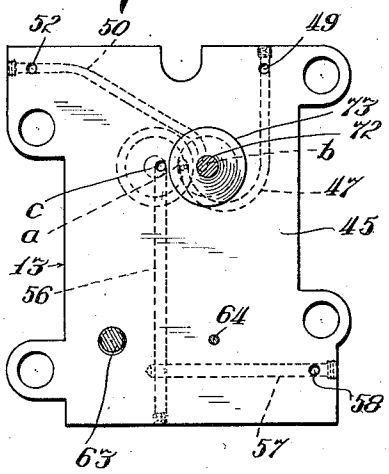


Fig. 9.

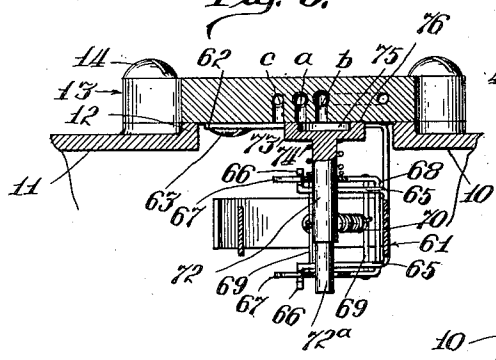


Fig. 5.

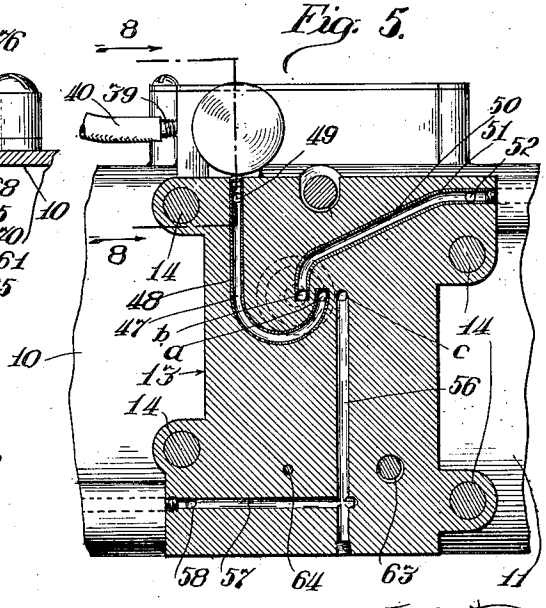
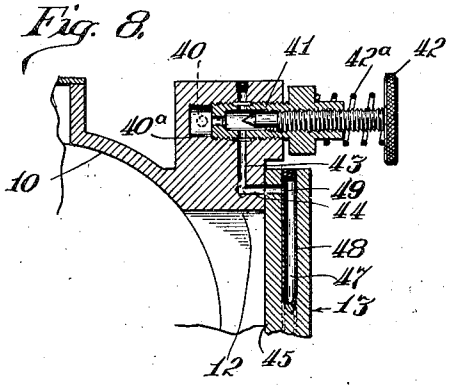


Fig. 8.



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Patented Mar. 18, 1924. 1,487,405

UNITED STATES PATENT OFFICE.

STEPHEN G. SKINNER, OF WILMETTE, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE FOLBERTH AUTO SPECIALTY COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

SUCTION MOTOR FOR WINDSHIELD CLEANERS.

Application filed October 24, 1921. Serial No. 509,850.

To all whom it may concern:

Be it known that I, STEPHEN G. SKINNER, a citizen of the United States, and resident of Wilmette, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Suction Motors for Windshield Cleaners, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a suction motor that is particularly adapted to form part of an automotive vehicle wind-shield cleaner. For the operation of my device I prefer to utilize suction created by the internal combustion engine of the vehicle with which the cleaner is associated—for instance, the suction created in the intake manifold of the engine.

One of the salient features of my present invention is the provision of novel means for properly effecting and controlling the alternate applications of suction and atmospheric pressure to the opposite ends or sides of that element of the motor which is actuated by variations in pressure upon such ends or sides.

As a description of the device of my invention will best be understood when read in connection with illustrative drawings, I shall proceed at once to a detailed description of the accompanying drawings, in which—

Figure 1 is a rear elevational view, on reduced scale, illustrating how the cleaner embodying the motor of my invention is applied to the wind-shield of an automotive vehicle;

Figure 2 is a transverse section taken on the line 2—2 of Figure 1;

Figure 3 is a longitudinal section of the motor taken on line 3—3 of Figure 2;

Figure 4 is an isolated view in perspective of the device which controls the variations in pressure exerted upon the opposite sides of the reciprocating piston structure of the motor;

Figure 5 is a fragmentary view, partly in vertical section, taken on line 5—5 of Figure 2, it being the purpose of this view to illustrate the location of the several passages in the plate over which the device of Figure 4 moves in a manner presently to be explained;

Figure 6 is a detail view illustrating how the device of Figure 4, under the influence of snap-over mechanism, co-operates with the plate to which reference has been made in the preceding description of Figure 5;

Figure 7 is an elevational view of the inner face of said plate, the snap-over mechanism being removed and the passages in said plate being indicated by dotted lines;

Figure 8 is a fragmentary sectional view taken on the line 8—8 of Figure 5; and

Figure 9 is a fragmentary sectional view taken on the line 9—9 of Figure 6.

Similar characters of reference refer to similar parts throughout the several views.

Referring to the drawings, at A I have illustrated a glass wind-shield which is provided with the usual metal frame work B. The frame work B is provided with spaced apertures which receive the oscillating shaft of the cleaning device and the bolts or screws wherewith the cylinder structure of the motor of the cleaning device is secured upon the frame work. A suitable arrangement for mounting the cleaning device upon the frame work of the wind-shield is illustrated in my Patent No. 1,395,604 dated November 1, 1921, said patent having issued on my co-pending application Serial No. 444,718, filed February 14, 1921.

The cylinder structure comprises a casting—preferably a die casting—which is conformed to provide the opposed cylinders 10 and 11 and the offset portion 12, which is located intermediate the cylinders and which houses the mechanism for alternately connecting the cylinders 10 and 11 with the source of suction. The offset portion of the housing is provided with an opening which is closed by a removable side plate 13, the details of which are most clearly illustrated in Figs. 5, 6 and 7. Plate 13 is held in position by a plurality of screws 14—14. The heads of the cylinders 10 and 11 are preferably in the form of metal stampings 15—15 which are held in position by suitable screws (not shown) which engage in the ends of the cylinder structure. Paper or other suitable gaskets 17—17 effectively prevent air leakage at the cylinder heads.

The piston structure comprises pistons

18—18, which are disposed and adapted to reciprocate within the cylinder structure. The pistons 18 are preferably formed integral with the connecting piece 19 which is disposed below the common axis of the pistons and cylinders. Connecting piece 19 is provided with a longitudinal slot 20 and a cross pin 21, the purpose of which will presently be made clear. Each piston is provided with a cup leather 22 held in position by a stamping 23 and a screw 24, as shown. Snug fits between the cup leathers and the cylinder walls are assured by helical springs 25 which are disposed in annular grooves in the pistons. The springs tend to move out of the grooves and press against the inner faces of the cup leathers in a wellknown manner.

The cross pin 21 of the piston structure co-operates with the slotted lower end of the gear sector 26, which is journaled upon a stub shaft 27. Stub shaft 27 threads into the cylinder casting as indicated at 28. The teeth of the sector 26 co-operate with the gear sector 29, which is fixed upon a shaft 30 by means of a set screw 31. The set screw and certain other parts of the apparatus, which are presently to be mentioned, are accessible through an opening 32 in the upper part of the cylinder casting, this opening being normally closed by a plate 33. Shaft 30 is journaled in the cylinder casting, projects forwardly from the casting and extends freely through an aperture in the wind-shield frame B. The rear end of shaft 30 is preferably provided with a handle 30^a by means of which shaft 30 may be rocked manually.

At its forward end, the shaft 30 is provided with an aperture which receives the upper end of a cleaner arm 35. The cleaner arm is preferably formed of relatively stiff wire and is fixed to the shaft 30 by set screw 36. Pivoted to the lower end of the cleaner arm is the cleaner device, which consists of the usual rubber squeegee 37 carried in a suitable frame 38.

From the description thus far it will be understood that when the piston structure reciprocates within the cylinders, the squeegee 37 will be caused to move across the front face of the wind-shield in the arc of a circle having the axis of the shaft 30 as its center.

I shall now describe the means whereby the suction of the intake manifold is utilized to effect the reciprocation of the piston structure. Projecting laterally from the upper portion of the cylinder casting is a nipple 39 over which is slipped one end of a rubber tube 40, the other end of said rubber tube having suitable connection to the source of suction—for instance, the intake manifold of the engine. The nipple 39 communicates with the bore 40^a which in turn communicates with the interior of needle valve housing 41, said valve housing being threaded into a horizontal bore in the cylinder casting, as illustrated in Fig. 8. The flow of air through the valve housing may be shut off entirely or regulated as desired by needle valve 42. A spring 42^a holds the needle valve in any desired adjustment. The needle valve housing communicates with a vertical bore 43 (in the cylinder structure), the bore 43 in turn communicating with a horizontal bore 44 (Fig. 8).

Now let us refer to the removable side plate 13, the details of which are illustrated in Figs. 5, 6 and 7. This plate is provided with a plane inner surface 45. Formed in the surface 45 are three ports, *a*, *b*, and *c*, the ports *b* and *c* being located closely adjacent to but on opposite sides of port *a*. Port *a* communicates with a curved passage 47, this passage being illustrated as provided with a brass lining 48. Plate 13 is preferably die cast and the brass tube or lining 48 is utilized for a purpose which will be apparent to persons familar with die casting operations. Passage 47 communicates with a horizontal bore 49 which registers with the horizontal suction bore 44 (Fig. 8) to which I have previously alluded. Port *c* communicates with an upwardly inclined passage 50 which, similarly to the passage 47, is provided with a brass liner 51.

The brass liners 48 and 51 of passages 47 and 50, respectively, are provided to facilitate the formation of such passages in the die casting operation. Since such passages are curved, these cannot conveniently be formed by removable cores. Neither can they conveniently be formed by drilling after the die casting operation. Hence the brass liners are properly positioned with respect to the dies prior to the casting operation and the metal of which the side plate is formed is cast around the liners so that the passages will be present after the die casting operation has been completed. The upper end of passage 50 (Fig. 5) communicates with a horizontal bore 52 which registers with a horizontal bore 53 in the cylinder structure (Fig. 2). Bore 53 communicates with a longitudinal bore 54 in the cylinder structure, said bore 54 in turn communicating with the interior of cylinder 11 through a slot or notch 55, said slot or notch being formed in the end of cylinder 11 and extending from bore 54 to the inner surface of said cylinder. The port *c* communicates with the vertical bore 56 in plate 13, said vertical bore in turn communicating with the horizontal bore 57 (Figs. 5 and 7). Bore 57 is intersected by a second bore 58 which registers with a bore 59 in the cylinder structure, said last-mentioned bore in turn communicating with the longitudinal

bore 60 in the wall of cylinder 10. Bore 60 communicates with cylinder 10 in exactly the same way that the corresponding bore 54 communicates with the cylinder 11.

The methods to be employed in forming the several bores and passages to which I have made reference and the manner in which to block the bores wherever necessary will be readily understood by persons familiar with the manufacture of devices of the general class to which my invention relates.

In the operation of the motor of my invention, communication is established between ports *a* and *b* when suction is to be created in cylinder 11, port *c* in this case being exposed to atmospheric pressure. When suction is to be created in cylinder 10, communication is established between ports *a* and *c*, port *b* in this instance being exposed to atmospheric pressure. I may state that the space between the pistons is always under atmospheric pressure by reason of leakage under plate 33 and around shaft 30. However, for clearness, I have illustrated an atmospheric port 33ª in plate 33.

I shall now describe the snap-over mechanism and explain how such mechanism co-operates with the device of Fig. 4 to control the ports *a*, *b* and *c*.

The snap-over mechanism comprises a frame 61 having an arm 62 which is secured to the inner surface of plate 13 by a screw 63 and a pin 64. The frame 61 is provided with parallel arms 65—65, each of which is provided with a laterally turned extremity 66. The portions 66—66 are notched at their upper and lower edges to receive the slotted ends of the U-shaped members 67 and 68. Cross pins 69—69, carried by members 67 and 68, are connected by a tension spring 70. The frame is conformed to lie around the free ends of each of the members 67 and 68 to limit the movement thereof. Arm 68 is the "slow motion" arm and is actuated at the piston structure by lugs, to which specific reference will presently be made. Arm 67 is the "quick motion" arm and is actuated by spring 70 in a well-known manner.

Projecting laterally from the connecting piece 19 of the piston structure are two lugs 71—71 which effect the operation of the snap-over mechanism by their co-operation with the "slow motion" arm 68 thereof.

The parallel portions of the "quick motion" arm 67 of the snap-over mechanism are provided with two aligned apertures which receive the stem 72 of the suction port controlling device, this device being illustrated in detail in Fig. 4. The controlling device comprises a head 73 which is normally urged into contact with the plane inner surface of plate 13 by a light spring 74. It will be noted that a recess 75 is formed in the portion of the head which lies against the plane inner surface of plate 13. This recess is of such size that when the "quick motion" arm 67 of the snap-over mechanism is in one of two positions which it assumes under the influence of spring 70, communication between ports *a* and *b* is afforded through said recess, and when the said "quick motion" arm is in the other position which it assumes under the influence of said spring, communication is established between ports *a* and *c*. Thus, it will be understood, that the said recess 75 remains in registry with suction port *a* at all times, its registry with ports *b* or *c* being determined by the position of the member 67 of the snap-over mechanism.

It should be noted that the annular face 76 of the suction port controlling device (Fig. 4) has a snug sliding fit with the plane inner surface of plate 13, this snug fit being maintained by spring 74. Thus is air leakage between the head 73 and the plate 13 prevented.

I previously alluded to the apertures in the parallel portions of the "quick motion" arm in which the stem 72 of the suction port controlling device slides. I would direct attention to the fact that the free end of the stem is reduced in diameter, as indicated at 72ª and has a comparatively loose fit in the aperture through which it projects. This loose fit is clearly illustrated in Figs. 6 and 9. The suction port controlling device is, therefore, always free to assume any position, under the influence of spring 74, wherein the annular face 76 fits snugly against the plane inner surface of the plate 13.

By virtue of the arrangement and construction of parts hereinbefore described, suction is applied to cylinder 11 whenever the snap-over mechanism occupies the position indicated by full lines in Fig. 6. When the snap-over mechanism occupies the position indicated by dotted lines in Fig. 6, suction is applied to cylinder 10. Moreover, whenever the snap-over mechanism occupies the position illustrated in full lines in Fig. 6, atmospheric pressure is permitted to exist in cylinder 10, and, similarly, when the snap-over mechanism occupies the position indicated by dotted lines in Fig. 6, atmospheric pressure is permitted to exist in cylinder 11.

Now let us assume that the piston structure and the parts operated thereby are in the several positions shown in Figs. 2, 3 and 6, and that the needle valve 42 has been opened to establish communication between the intake manifold and the motor of the wind-shield cleaner. In this case, suction will be applied to cylinder 11 by reason of the fact that the recess 75 of the suction

port controlling device is in registry with ports *a* and *b* (Fig. 7). Under these circumstances, the port *c* is exposed and atmospheric pressure will exist in cylinder 10. The piston structure will, therefore, move to the left (Fig. 3), or, in other words, toward the head of cylinder 11. As the piston structure moves toward the head of cylinder 11, one of the lugs 71 for operating the snap-over mechanism engages the "slow motion" member 68 of the snap-over mechanism and moves the same toward the dotted line position indicated in Fig. 6. As soon as the arm 68 is moved to such a position that the axis of spring 70 lies to the left (Fig. 6) of the axis of the member 67, the said member 67 is snapped to the dotted line position illustrated in Fig. 6. When the arm 67 is snapped over, as thus explained, the recess 75 of the valve port controlling device remains in registry with port *a*, but comes into registry with port *c*, the port *b* being now exposed to atmospheric pressure. Suction is, therefore, removed from cylinder 11 and is applied to cylinder 10, atmospheric pressure being permitted to exist in cylinder 11 when suction is applied to cylinder 10. This operation is repeated at the end of each stroke of the piston structure. With the valve 42 open, the cleaner device continues to operate so long as the engine with which it is connected is in operation and is developing sufficient suction to operate the motor of the cleaning device.

At this time I wish to call attention to the fact that the device (Fig. 4) which controls communication between the ports *a* and the ports *b* and *c* is self-seating. Moreover, by reason of the snug sliding contact between said controlling device and the inner surface of plate 13, the seal between these parts improves with use. I find it desirable to form the controlling device of steel. The plate 13 is conveniently formed of one of the wellknown alloys suitable for die casting purposes.

Having thus described my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. A motor of the class described, comprising a housing, a piston structure adapted to reciprocate therein, said piston structure comprising a pair of separated but rigidly connected pistons, an opening in said housing at a point between said pistons, a detachable plate normally closing said opening, a snap-over mechanism mounted on said plate and insertable and removable therewith, said snap-over mechanism comprising slow and fast motion arms, and a spring for actuating the fast motion arm when the slow motion arm passes center in moving from one to the other of the extremities of its movement, a main suction port in said plate, a pair of secondary suction ports in said plate on opposite sides of the primary suction port, means for connecting the primary suction port with a source of suction, passages in said plate communicating with said secondary suction ports, and conduits affording communication between said passages and the interior of the housing at opposite ends of the piston structure, a suction port controlling device carried by the quick motion arm of the snap-over mechanism, said controlling device comprising an end recess which at all times overlies the primary suction port, and which alternately overlies the secondary suction ports as the aforesaid quick motion arm operates, spring means acting between the quick motion arm and the controlling device, and at all times holding the recessed end of the latter in sliding engagement with said plate, and means on the piston structure for operating the slow motion arm of the snap-over mechanism.

2. In a motor of the class described, a housing, a movable element adapted to operate within the housing, said movable element being operated by subjecting its opposite sides to different fluid pressures, an opening in said housing, a detachable plate for closing said opening, said plate being provided with a plane inner surface, said plate being provided with a primary suction port and two secondary suction ports, passages in the plate communicating with said ports, a valve controlled suction conduit communicating with the primary suction port passage, conduits registering with the secondary suction port passages and terminating within the housing on opposite sides of the movable element, a suction port controlling device carried by and adapted to reciprocate relative to the quick motion arm of the snap-over mechanism, spring means normally urging the controlling device into engagement with the aforesaid plane surface, and a recess in that end of the controlling device which engages the plate, said recess at all times overlying the primary suction port and adapted alternately to overlie the secondary suction ports.

3. In a motor of the class described, a housing comprising a portion having a flat surface, a primary and two secondary suction ports formed in said surface, the secondary suction ports being disposed on opposite sides of the primary suction port, a snap-over mechanism comprising a quick motion arm movable in a plane parallel to said surface, a self-seating port controlling device reciprocably and rotatably mounted in said quick motion arm, spring means acting between said quick motion arm and the controlling device, and normally holding the latter firmly in sliding engagement with said surface, that end of the controlling device which lies against said surface being provided with a blind recess which at all times

overlies the primary suction port, and which alternately overlies the secondary suction ports.

4. In a motor of the class described, a housing comprising a portion having a flat metal surface, a primary and two secondary suction ports formed in said surface, the secondary suction ports being disposed on opposite sides of the primary suction port, a snap-over mechanism comprising a quick motion arm movable in a plane parallel to said surface, a self-seating port controlling device reciprocably and rotatably mounted in said quick motion arm, spring means acting between said quick motion arm and the controlling device and normally holding the latter firmly in sliding engagement with said surface, that end of the controlling device which lies against said surface being provided with a blind recess bounded by an annular metal surface which bears against the flat metal surface of the aforesaid housing portion, said blind recess at all times overlying the primary suction port and alternately overlying the secondary suction ports.

5. In a motor of the class described, a housing, a pair of spaced pistons adapted to reciprocate within the housing, means connecting said pistons, an opening in the housing between said pistons, a removable side plate closing said opening, a primary suction port and two secondary suction ports formed in said side plate, means for connecting said secondary suction ports with a source of suction, communicating passages in said side plate and said housing for connecting said secondary suction ports with the interior of the housing at opposite ends of the piston structure, suction port controlling means and snap-over mechanism therefor both carried by said side plate and insertable and removable therewith and protuberances carried by the piston connecting means, said protuberances being spaced apart and lying on opposite sides of the snap-over mechanism, but having no mechanical connection therewith, said protuberances adapted to move said snap-over mechanism first in one direction and then in the other as the pistons reciprocate.

In witness whereof, I hereunto subscribe my name this 18 day of October, 1921.

STEPHEN G. SKINNER.

Witnesses:
ALBIN C. AHLBERG,
EDNA V. GUSTAFSON.