J. B. KENDALL.

FLUID MOTOR.

APPLICATION FILED NOV. 29, 1916.

Patented Apr. 8, 1919.

1,299,477.

3 SHEETS—SHEET 1.

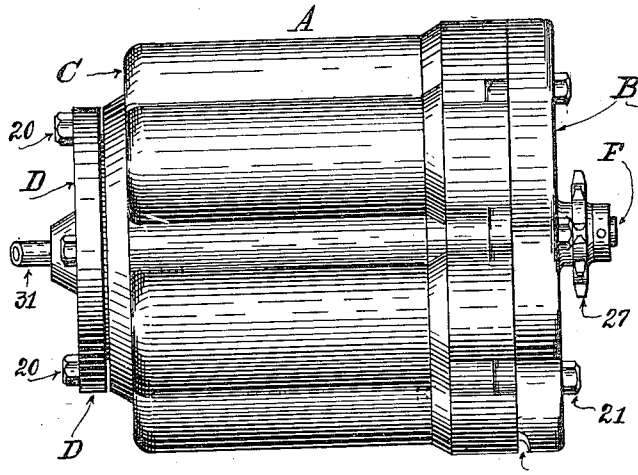


FIG. 1.

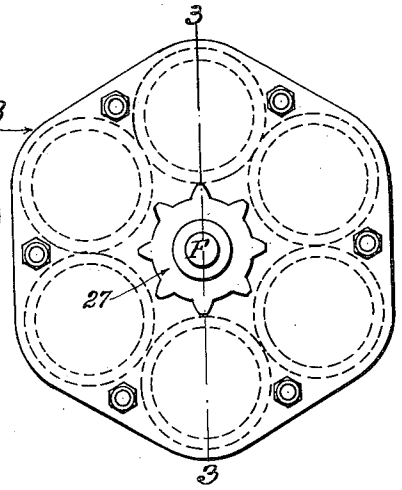


FIG. 2.

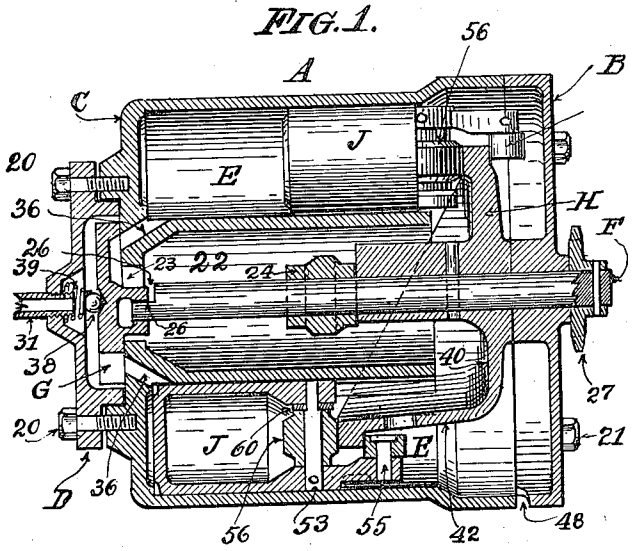


FIG. 3.

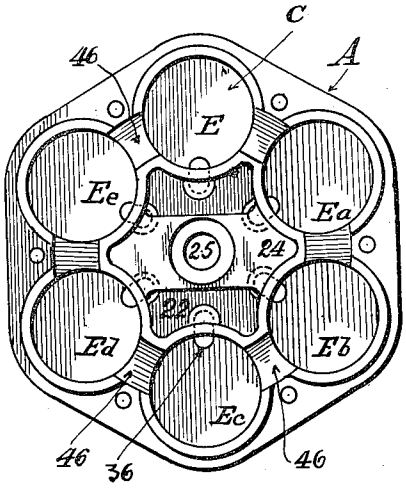


FIG. 4.

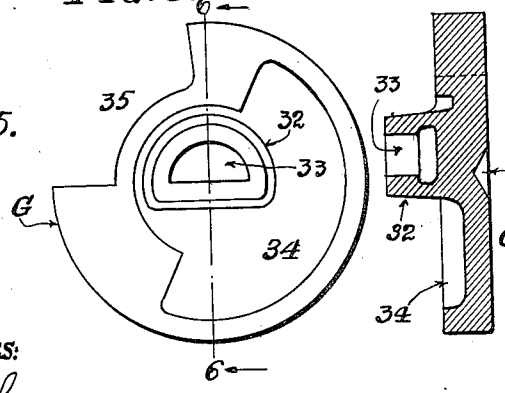


FIG. 5.

FIG. 6.

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FLUID-MOTOR.

1,299,477. Specification of Letters Patent. Patented Apr. 8, 1919.

Application filed November 29, 1916. Serial No. 134,046.

To all whom it may concern:

Be it known that I, JAMES B. KENDALL, a citizen of the United States, and a resident of the city of Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Fluid-Motors; and I do hereby declare that the following description of my said invention, taken in connection with the accompanying sheet of drawing, forms a full, clear, and exact specification, which will enable others skilled in the art to which it appertains to make and use the same.

My invention relates generally to improvements in a fluid motor and it consists, essentially, in the novel and peculiar combination of parts and details of construction, as hereinafter first fully set forth and described and then pointed out in the claims.

The object of my present invention is the production of an efficient, serviceable, light and comparatively inexpensive fluid motor, which though especially designed as an engine starter for automobile, launch and similar engines, is well adapted for employment in many arts where a motor of this description can be successfully used, such, for instance, as driving a drill and other small machinery requiring a rotating motor.

To attain these results I construct this motor essentially as shown in the drawings already referred to, which drawings form a part of this specification and illustrate my invention quite fully. In these drawings, Figure 1 is a side elevation of this improved motor. Fig. 2 is an end elevation of the same. Fig. 3 is a longitudinal sectional elevation on line 3—3 of Fig. 2, showing one of the pistons in elevation. Fig. 4 is an end elevation of the engine casing, the cover, the pistons and the swash plate being removed. Fig. 5 is a plan view of the rotating valve removed, said view being drawn to a scale slightly larger than that of Figs. 1 to 4 inclusive. Fig. 6 is a sectional view of this valve drawn on line 6—6 of Fig. 5. Fig. 7 is a sectional view of the casing, the parts located therein being removed. Fig. 8 is a rear end view of the engine casing, the valve chest and the valve being removed. Fig. 9 is a rear elevation of the casing cover removed. Fig. 10 is a sectional view of the same drawn on the indirect line 10—10 of Fig. 9. Fig. 11 is an end elevation of the same. Fig. 12 is a plan view of one of the trunk pistons detached, Fig. 13 is a side view of the same, and Fig. 14 is an end view thereof. Fig. 15 is a sectional view of the driving disk or swash plate. Fig. 16 is a plan of the swash plate. Fig. 17 is a front elevation of the valve chest removed, and Fig. 18 is a sectional view on line 18—18 of Fig. 17.

The principal member of this motor is the casing A, which casing is open at one end, and this end is closed by a cover B; the other end of this casing being closed by an integrally formed bottom C, and to this end there is removably secured, by bolts 20, a valve chest D, the cover B being bolted to the casing A by bolts 21.

In the casing A and concentric to its axial line, there are arranged a series of cylinders E^a, E^b, E^c, etc., there being shown in Figs. 2 and 4, six of these cylinders. These cylinders form, preferably, an integral part of said casing; and defined by the inner portions of these cylinders there is a chamber 22 to which further reference will be hereinafter had.

In the bottom C there is a central aperture 23; and in the cover B there is a coinciding aperture 24′, which latter aperture serves as a bearing for the engine shaft F, said shaft being longitudinally disposed in the casing and reaching to the bottom thereof. Crossing the chamber 22 and preferably formed integrally with the casing, there is a transverse bar 24 which has centrally a journal bearing 25, Figs. 4 and 7, for said shaft F. The inner end of this shaft is flattened as shown at 26, while to the outer end of this shaft there is secured a driving element 27, such as a sprocket wheel, pulley or the like.

The valve chest D, shown detached in Figs. 17 and 18, is recessed on its inner side, as at 28, and in this recess there is a second, smaller, recess 29, while centrally this valve chest is apertured, as at 30, which aperture is internally screw-threaded to receive the fluid supply pipe 31. In the recess 28 of the valve chest there is located a rotatable, disk-shaped distribution valve G, shown in detail in Figs. 5 and 6. This valve has centrally a boss 32, which is centrally recessed with a depression 33, of a contour coinciding with the flattened portion 26 of the shaft F and thereby rotatably connected to said shaft. This valve G has in its face a recess 34, of

substantially semi-circular contour, and it has an excision or cut-away portion 35, the object of which will further on appear.

In the bottom C of the casing A, and concentric to its axial line, there are arranged a series of inlet passages or ports 36, which correspond in number to that of the cylinders E, and which connect these cylinders to the valve chest, this portion of the device being best shown in Figs. 7 and 8.

In order to keep this valve G upon its seat in the bottom of the casing, there is preferably provided in the center of the back of the valve a counter sink 37, and in this counter sink there is located a thrust element 38, which might be a ball, and acting upon this thrust member there is a tensioned spring 39 which keeps the valve to its seat.

Upon the shaft F and within the casing A and the cover B there is located a driven member H, which for the purpose of this description I shall term the "swash plate" owing to its similiarity to that well known mechanical movement technically known by that term for converting reciprocating movement into a rotative one, although in my present construction this element H is not a plate strictly speaking, but a hollow cylinder, the one terminal or margin of which is angular to the axis thereof. This swash-plate, shown in detail in Figs. 15 and 16 on an increased scale, comprises a bottom or web member 40, having centrally a long hub 41, bored at 47, to be pinned or otherwise secured to the shaft F. This bottom 40 has a rim 42, the margin of which, 43, is angularly disposed to the axis of the shaft and this marginal edge performs the function of a swash-plate, as already mentioned.

In each of the cylinders E there is located a trunk piston J, shown in detail in Figs. 12, 13 and 14; and since these trunk pistons are all alike I shall describe them in the singular number. This trunk piston being, as is well known, a tubular body, has, however, no connecting rod connected therewith but instead it has a forwardly extending arm 50, and diametrically opposite this arm 50, a shorter arm 51, both arms being punctured at 52 to receive a pivot bolt 53, Fig. 3, while the arm 50 is punctured at its extremity by a hole 54 for the reception of a pivot-stud 55. Upon the pivot bolt 53 there is rotatably mounted a roller 56, which normally bears upon the marginal edge 43 of the swash plate, while a roller 57 rotatably mounted on the pivot stud 55 engages the shouldered back 59 of the swash plate to positively connect the piston to the swash plate. In order to stiffen the bottom 40 of the swash plate, there are provided strengthening ribs 58, and in order to balance this swash plate the lower half of the bottom and that of the hub 41 are made thicker than the upper halves thereof; and if I find it necessary to do so, I may provide holes 44 in the rim 42 for the purpose of balancing this swash plate, or I may accomplish the desired object by the proper number of holes 44 without thickening the bottom, the object being to make the swash plate as light as possible consistent with the duties which it has to perform.

And, since it is one of my objects to use this motor as a portable one and make it as light as possible, the cover B is made quite thin; but it is strengthened by stiffening ribs 45, as illustrated in Figs. 9 and 10.

In order to permit rotation of the swash plate in the casing, it is made in the shape of a hollow cylinder provided with a bottom, as described, so that the rim only of the swash plates enters the cylinders and these cylinders are, therefore, provided with the slots 46, Figs. 4 and 7, in which the rim 42 of the swash plates rotates.

To prevent rotation of the pistons in the cylinders, I provide each piston with a guide plate 60, shown in detail in Figs. 19 and 20. These plates 60 have their ends 61 downwardly deflected, and centrally they are provided with apertures to engage the pivotal bolts 53, as indicated in Fig. 3. The downwardly deflected portions 61 engage the marginal edges of the slots 46 in the cylinders and thus prevent rotation of the trunk pistons in an efficient yet very simple manner. I have heretofore stated that the margin 43 of the swash plate is inclined to the axis of rotation thereof, but it is to be understood that the face of this margin 43 is at every point of its circumference at right angles to said axis of rotation; so that the rollers 56 on the pistons J bear correctly and truly upon this face, as is clearly illustrated in Fig. 3.

I shall now proceed to describe the operation of this motor.

Fluid matter, preferably compressed air under high pressure, is admitted to the valve chest D through the inlet pipe 31 and the valve G, by the cut out portion 35 therein, permits this air to enter two and sometimes three of the cylinders through the respective ports 36, and forcing the trunk pistons J outwardly to cause the rotation of the swash plate H by the rollers 56 pressing upon the marginal edge 43 of said plate H. The three remaining pistons J are, of necessity, on their return stroke, and air in these cylinders passes through the remaining three ports 36 and through the cavity or recess 34 in the valve G, and through a central opening 23, Figs. 3 and 7, in the bottom of the casing A, into the interior chamber 22 and finally escapes from the casing A through a notch 48 in the rim of the cover B.

The valve G rotates with the shaft F, and thereby successively uncovers all the inlet

ports 36, one after the other, and thus governs and causes the rotation of said shaft effected by the trunk pistons pressing on the marginal edges of the swash plate.

Attention is now directed to the extreme simplicity of this motor and the comparative ease of manufacturing the same thus: the casing with its cylinders, its interior chamber, the cross bar in said chamber are an integrally formed casting of which all parts are round and thus easily machined, the pistons are all alike and hence mass-production is attained, and the remaining parts, viz., the valve chest, the casing cover, the valve and the swash plate, are all of simple construction and easily produced, so that this motor can be manufactured at a reasonably low figure.

I have heretofore described with considerable minuteness the preferred embodiment of my invention, but I desire it to be understood that minor details of construction may be varied and parts omitted without departing from the scope of my invention.

Having thus fully described my invention, I claim as new, and desire to secure to myself by Letters Patent of the United States:—

1. In a multi-cylinder motor, a casing, a series of cylinders in said casing, each of said cylinders being longitudinally slotted at its free end, a longitudinally disposed central shaft in said casing, a swash plate fixedly secured to said shaft, said swash plate being a cup-shaped body the rim of which has its marginal edge inclined to the axis of said shaft, said rim being constructed to rotate in said longitudinal slots, pistons in said cylinders, there being on said pistons arms, rollers rotatably mounted on said arms, said rollers being constructed to act upon said marginal edge of the swash plate to effect its revolution, and means on said pistons constructed to prevent rotation of said pistons, said means comprising plates secured to said arms, said plates being constructed to reciprocate in the said slots in the cylinders.

2. In a multi-cylinder motor, a casing, said casing comprising a series of integrally connected cylinders, one end of said cylinders being open, the other end being closed by a bottom plate formed integrally with said cylinders, the open ends of said cylinders terminating in an enlarged chamber, said cylinders forming between them a longitudinal central chamber, a cup-shaped cover for said enlarged chamber, a centrally disposed shaft in said longitudinal, central chamber, the longitudinal axial lines of said cylinders being coincident to the axial line of said shaft, said cylinders being concentric to said shaft, a swash plate fixedly mounted on said shaft, said swash plate being a cup-shaped body comprising a bottom and a rim, the outer margin of said rim being inclined to the axial line of said shaft, said outer margin having a shoulder, a piston in each of said cylinders, means on each piston constructed to engage the outer marginal edge of said swash plate and other means on said pistons to engage the shoulder on said swash plate.

3. In a multi-cylinder motor, a casing, said casing comprising a series of cylinders located equi-distant around a common center, a plate at one end of said cylinders, said plate forming the bottoms for all of said cylinders, a rim in front of said cylinders to afford an enlarged chamber at the open end of said cylinders, a cross bar connecting two opposed cylinders approximately medially of their length, said cylinders, said bottom plate, and said cross bar being integrally formed in a single piece of casting, a cup-shaped head to close said enlarged chamber, a cup-shaped part secured to the outer surface of said bottom plate, there being in said cup-shaped head, said cross bar, and said cup-shaped part bearings, a shaft rotatably mounted in said bearings, a swash plate fixed to said shaft to rotate in said enlarged chamber, a piston in each of said cylinders, means connecting said pistons to said swash plate, an annular recess in the outer surface of said bottom plate, a valve disk rotatably mounted in said cup-shaped part, and passages leading from said annular recess to said cylinders, said passages being successively opened and closed by the rotation of said disk valve.

4. In a multi-cylinder motor, a casing, said casing comprising a multiplicity of cylinders located equi-distant around a common center, a plate at one end of said cylinders said plate forming a bottom for all of the cylinders, a rim in front of said cylinders to afford an enlarged chamber at the open end of said cylinders, a cross bar connecting two opposed cylinders approximately medially of their length, said cylinders, said bottom plate, and said cross bar being integrally formed in a single piece of casting, a cup-shaped head to close said enlarged chamber, a cup-shaped element secured to the outer surface of said bottom plate, there being in said cup-shaped head, said cross bar, and said cup-shaped element bearings, a shaft rotatably mounted in said bearings, a swash-plate fixed to said shaft to rotate in said enlarged chamber, a piston in each of said cylinders, means connecting said pistons to said swash plate to effect the rotation of said swash plate and said shaft, an annular recess in the outer surface of said bottom plate, a valve disk rotatably mounted in said cup-shaped element, and passages leading from said annular recess to said cylinders, said passages being successively opened and closed by the rotation of said disk valve, said disk valve comprising a plate, said plate having a portion of its margin cut away, and

said plate having one of its faces recessed, the recessed face being in rotative contact with said bottom plate.

5. A multi-cylinder motor, comprising a casing, said casing comprising a multiplicity of integrally formed and connected cylinders, said cylinders being open at one end, there being at the other ends of said cylinders a plate, said plate forming a closure for the other ends of said cylinders, said cylinders and said plate being integrally formed in a single piece of casting, an annular recess in the outer surface of said plate, passages leading from said recess to said cylinders, a centrally located, longitudinal, shaft, means for rotating said shaft, a disk valve movably connected to said shaft and rotatably mounted in said recess and bearing upon the back of said plate, said disk valve comprising a hub and a disk, there being a cut-out in said disk and in the face of said disk adjacent said hub a recess, and spring-actuated means for forcing said disk valve upon its seat.

In testimony that I claim the foregoing as my invention I have hereunto set my hand.

JAMES BLAINE KENDALL.