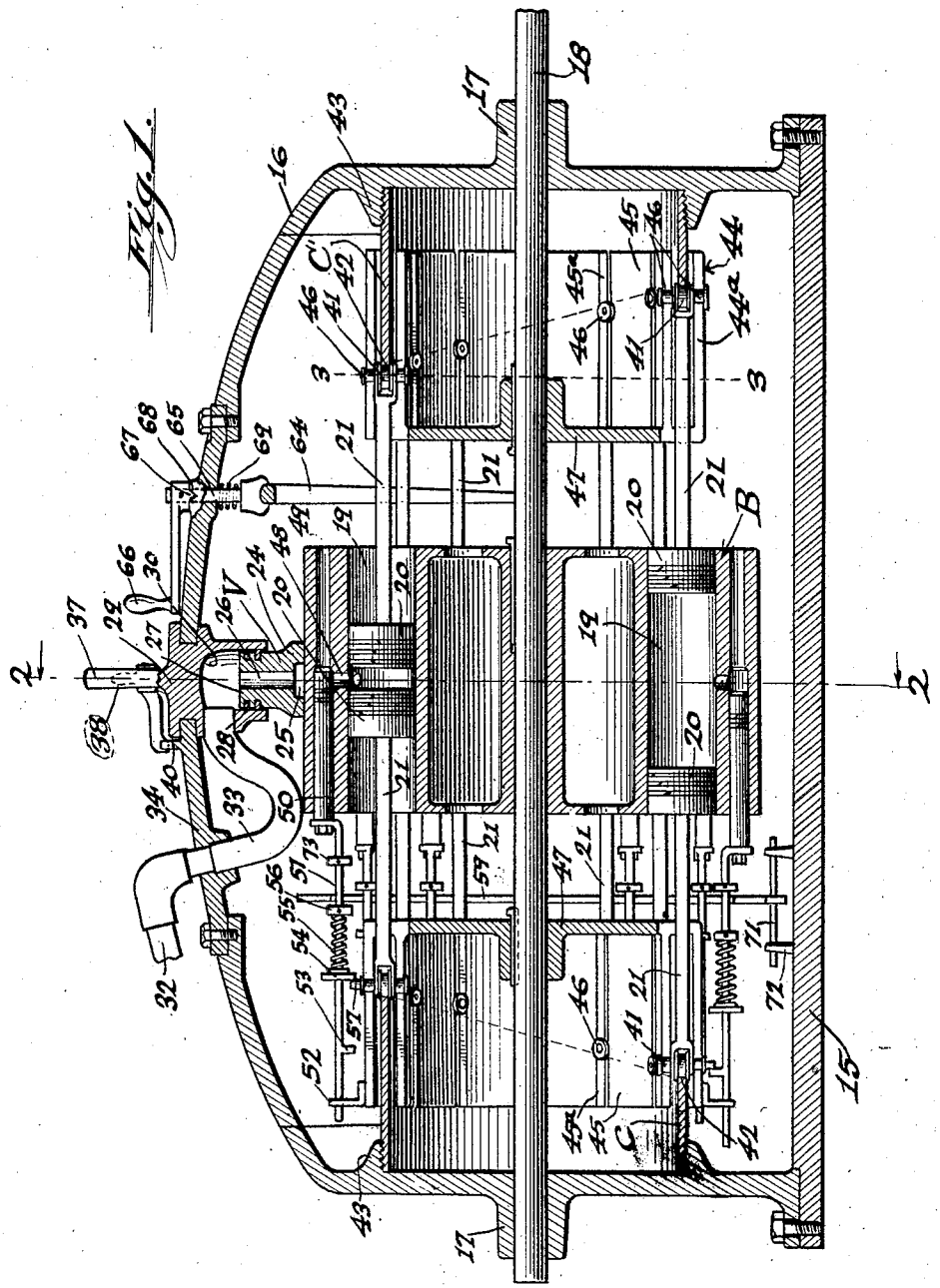
Oct. 26, 1926. 1,604,474

P. NISBET

PRIME MOVER

Filed Oct. 18, 1923 3 Sheets-Sheet 1

Fig. 1.



Inventor.
PRENTISS NISBET
By Munn & Co.
Attorneys.

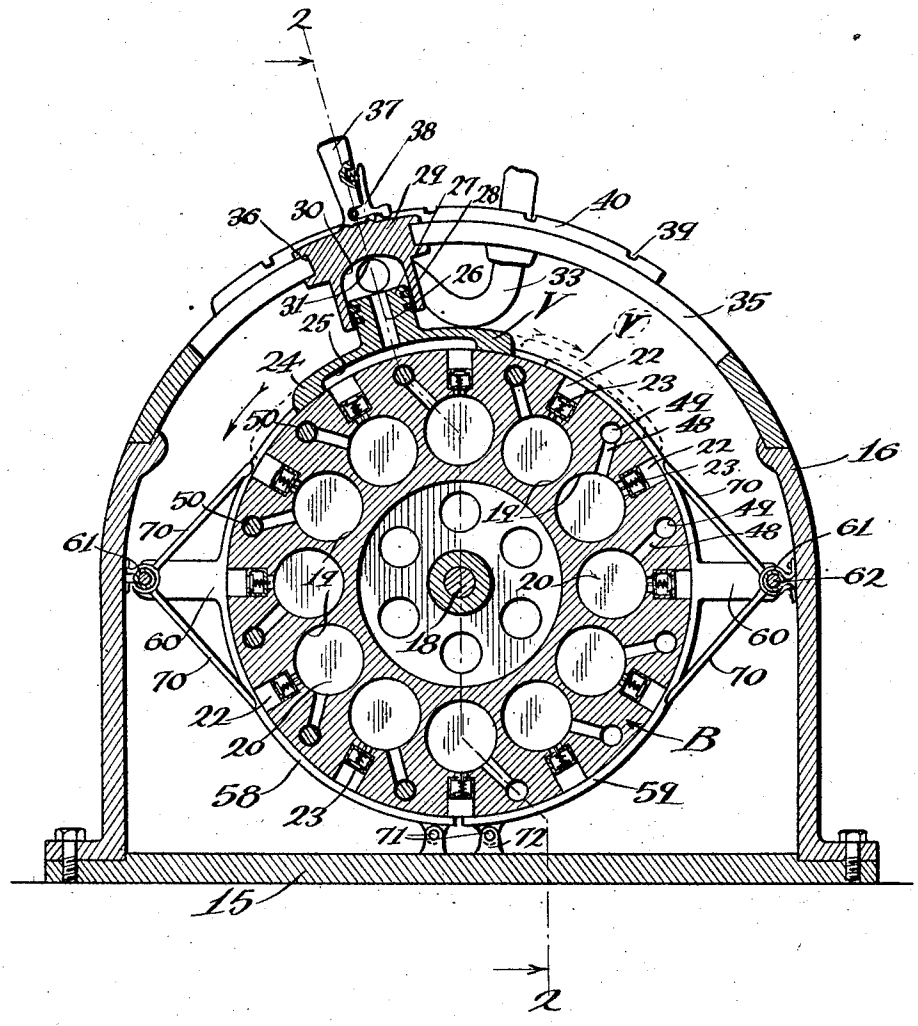
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P. NISBET

PRIME MOVER

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Fig. 2.



Inventor:
PRENTISS NISBET.
By Munn & Co.
Attorneys.

Oct. 26, 1926.

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P. NISBET

PRIME MOVER

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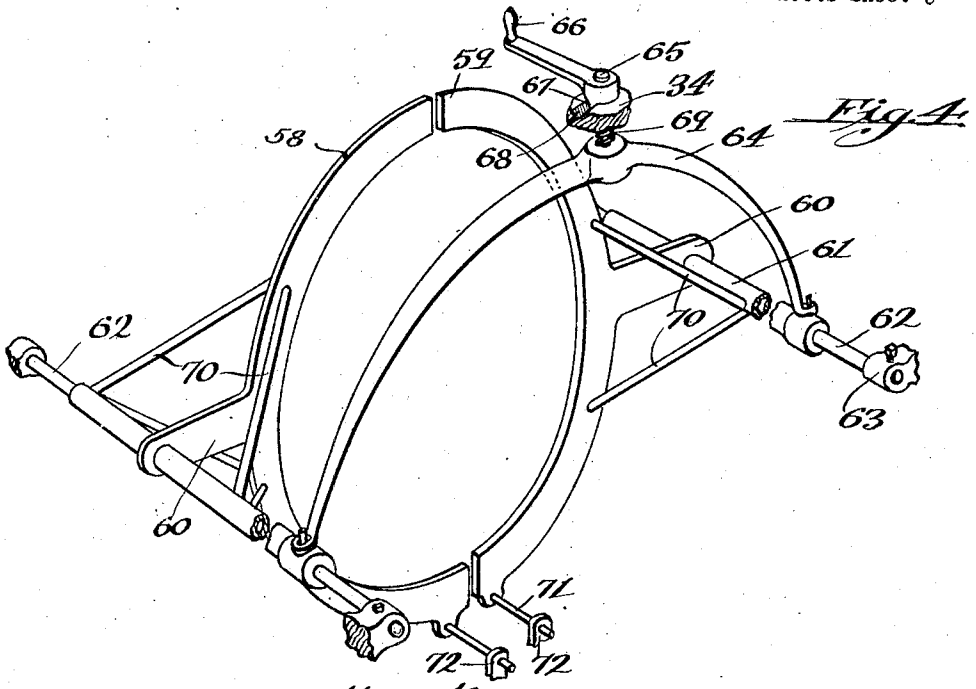


Fig. 4.

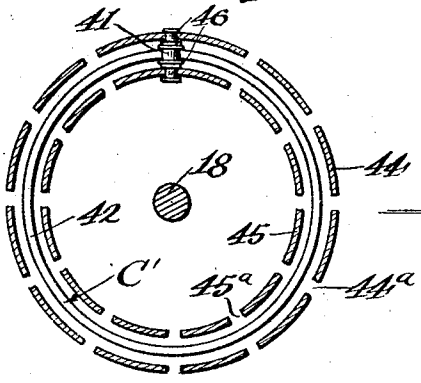


Fig. 3.

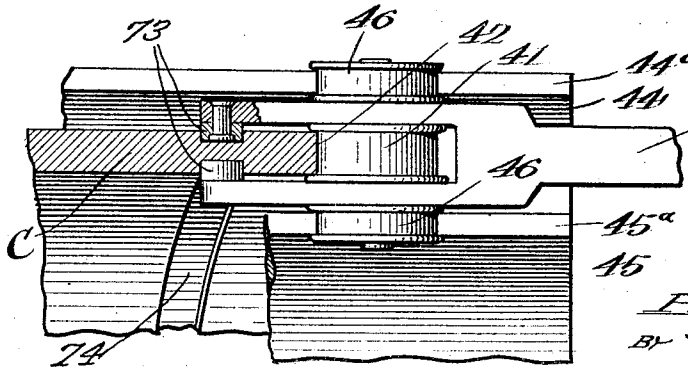


Fig. 5.

Inventor:
PRENTISS NISBET
By Munn & Co.
Attorneys.

Patented Oct. 26, 1926. 1,604,474

UNITED STATES PATENT OFFICE.

PRENTISS NISBET, OF LOS ANGELES, CALIFORNIA.

PRIME MOVER.

Application filed October 18, 1923. Serial No. 669,375.

My invention relates generally to prime movers, such as motors, engines and the like, which are operated by expansible or combustible fluids, and specifically, although not necessarily, to prime movers operated by steam.

A purpose of my invention is the provision of a steam engine which eliminates the use of crank shafts and friction producing bearings necessary in the usual reciprocating engines; insures an even wear on the cylinder walls; permits the use of any number of cylinder and piston units and in such manner as to allow an early cut-off of the propulsion fluid and a relatively large area of expansion in each cylinder; and the utilization of the expansive force of an expansible fluid to a higher degree of efficiency than is possible with engines heretofore proposed.

It is also a purpose of my invention to provide an engine including a plurality of piston and cylinder units mounted for bodily rotation about a common axis, and means by which the reciprocating movement of the pistons is converted into rotary movement to effect rotation of the piston and cylinder units and the shaft to which they are fixed.

I will describe only one form of engine embodying my invention and will then point out the novel features thereof in claims.

In the accompanying drawings—

Figure 1 is a view showing in vertical longitudinal section one form of engine embodying my invention;

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

Figure 3 is a vertical sectional view taken on the line 3—3 of Figure 1;

Figure 4 is an enlarged detail perspective view of the exhaust valve controlling mechanism;

Figure 5 is an enlarged fragmentary view, partly in section, showing a modified means for connecting the piston rod of any one of the pistons in the engine shown in the preceding views to one of the cams comprising the engine.

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

Referring specifically to the drawings, and particularly to Figures 1 and 2, my invention in its present embodiment is shown as comprising a base 15 to which is bolted or otherwise secured a housing 16 provided in its end walls with bearings 17 in which a shaft 18 is journaled. Fixed to the shaft 18 at a point centrally within the housing 16 is a cylinder block or casting designated generally at B and bored co-axially with respect to the shaft 18 at regularly spaced intervals to provide an annular series of cylinders 19. In the present instance I have shown each cylinder 19 provided with two pistons 20, although it is to be understood that one piston can be provided for each cylinder. These pistons 20 are provided with piston rods 21 which extend from the opposite ends of the cylinders for engagement with means by which the outward movement of the pistons is converted into lateral movement, as will be described hereinafter.

An expansible fluid, such as steam or the like, is adapted to be successively supplied to the cylinders 19 through admission ports 22, there being one port for each cylinder, and the ports of the several cylinders being circumferentially alined so as to successively register with a master supply valve, designated generally at V. The location of the admission ports 22 of any one cylinder 19 is such as to admit steam to the cylinder at a point between the opposed pistons 20 when the latter are in their innermost position, as shown in Figure 1. As clearly shown in Figures 1 and 2, this valve V is arranged for contact with the periphery of the block B so that during rotation of the latter the admission ports 20 will successively register with the valve and thus receive charges of steam from the latter. Each admission port 22 is provided with a check valve 23 operating to normally close the port but to be opened under the pressure of the steam admitted thereto from the valve V.

The valve V, as clearly shown in Figure 2, includes a base 24 provided with a chamber 25 which communicates with a duct 26 formed in a piston extension 27. The extension 27 is provided with packing rings 28 for effecting a steam-tight seal between the same and a head 29. The head 29 is provided with a chamber 30 in communication with the duct 26 and provided with a port 31 to which steam is supplied from a pipe 32 connected to the port through a flexible length of pipe 33.

The housing 16 includes a closure plate 34 curved and disposed concentric of the shaft 18 and provided with a slot 35 in which the head 29 of the valve V is adapted to move. The opposite sides of the head 29 are formed with grooves 36 which slidably receive the edges of the slot 35 so as to permit sliding movement of the entire valve within the plate. The head 29 is provided with an operating handle 37 carrying a spring-pressed pawl 38 which is adapted to engage within the notches 39 of a plate 40 secured to the plate 34. By means of the pawl the valve V is capable of being secured in any of the several positions which it is adapted to occupy. The movement of the valve V does not interfere with the supply of steam thereto because of the flexible pipe 33. The chamber 30 being in communication with the chamber 25, a balanced steam pressure exists so as to maintain the base of the valve in contact with the periphery of the block B but without exerting any undue pressure thereon so as not to interfere with the rotation of the block during the operation of the engine.

The outer ends of the piston rods are formed to accommodate flanged wheels or rollers 41, and these wheels bear against inclined surfaces or trackways 42 of cams C and C'. The cams C and C' are threaded or otherwise secured to annular flanges 43 formed on the inner sides of the housing 16, as clearly shown in Figure 1.

Operating in conjunction with the cams C and C' are guide cylinders 44 and 45, which are provided with slots 44^a and 45^a (Figure 3) which accommodate guide rollers 46 carried by the forked ends of the piston rods. These cylinders 44 and 45 are arranged in pairs, with the slots of the cylinders of one pair registering with each other to accommodate the guide rollers 46, as will be understood. The guide cylinders of each pair are connected to a disk 47 keyed or otherwise secured to the shaft 18 so that during rotation of the latter rotation of the cylinders will be effected. As clearly seen in Figure 1, the cylindrical cams C and C' are interposed between the cylinders of each pair.

For controlling the exhaust of the expansible fluid from the cylinders 19, exhaust ports 48 are provided in the cylinders, and each port is adapted to communicate with an exhaust duct 49 in the block B which permits the discharge of steam from one side of the block. Each exhaust port 48 and exhaust duct 49 is controlled by a piston valve 50 slidably mounted in the block to occupy an open position in which the port and duct are in communication with each other, or closed position in which the port is out of communication with the duct. The outer end of each valve 50 is provided with a rod 51 mounted for sliding movement in a bracket 52 secured to the outer cylinder 44 at the corresponding side of the block B. This rod 51 is provided with lugs 53 and 54, the latter of which is yieldably sustained upon the rod by means of a spring 55 interposed between the lug and the collar 56. The corresponding piston rod 21 is provided with a projection 57 movable between the lugs 53 and 54 and adapted to engage the latter in effecting movement of the rod 51 in one direction or the other according as the corresponding piston moves to one extreme position or the other. Under this movement of the rod 51 the valve 50 is moved to open or closed position and in a predetermined time relation with respect to the movement of the piston 20.

From the foregoing description of the actuating mechanism for any one exhaust valve 50, it will be clear that the actuating mechanism for all of the exhaust valves 50 for all of the cylinders are arranged in circumferentially spaced relation about the cam C, and that such mechanisms being mounted upon the cylinder 44 rotate with the latter and with the block B in controlling the exhaust of steam from the cylinders during the operation of the engine.

As there is only one exhaust valve for each cylinder, only one set of actuating mechanisms is necessary, and it has been found desirable to arrange the several actuating mechanisms at one side of the block B.

In order to effect the exhaust of the expansible fluid from certain cylinders and to close the exhaust valves of the other cylinders which is necessary in effecting a reversal of the engine, I provide a manually operated control mechanism comprising (Figure 4) a pair of arcuate or semi-circular arms 58 and 59 provided with extensions 60 fixed to sleeves 61 slidably mounted on rods 62 supported in brackets 63. A curved operating member 64 is connected at its ends to the sleeves 61, and this member is mounted for oscillatory movement by means of a stub shaft 65 rotatably mounted in the plate 34, as clearly shown in Figure 1. Secured to the shaft 65 is a crank 66 arranged exteriorly of the plate and having a tooth 67 which works within a recess 68 formed in the plate 34. A coiled expansible spring 69 embraces the shaft 65 below the plate 34 so as to normally urge the tooth 67 downwardly into the recess 68. The recess 68 is sufficiently large to allow of a limited lateral movement of the tooth 67 to permit of the necessary oscillatory movement of the member 64 in effecting reverse movement of the arms 58 and 59. It will be clear that by rocking the member 64 about the shaft 65 as an axis, the sleeves 61 will be moved longitudinally upon the rods 62 to cause movement of the arms 58 and 59 in opposite directions. The direction

of movement of the arms 58 and 59 is determined by the direction of movement of the member 64.

To rigidly support the members 58 and 59 brace rods 70 rigidly connect the members with the sleeves 61, and rods 71 are secured to the lower ends of the members and slide within bearings 72 supported upon the base 15.

As clearly shown in Figure 1, the arms 58 and 59 encircle the exhaust valve rods 51 and are arranged between the collars 56 and other collars 73. With the members so arranged, lateral movement thereof through manipulation of the crank 66 causes the collars 56 or 73 to be engaged, depending upon the position of the exhaust valves, so as to actuate the rods 51 in opening or closing the exhaust valves. Because of the semi-circular formation of the arms 58 and 59, one arm engages the collars for half of the exhaust valves, while the other arm will engage the collars for the other half of the exhaust valves. As the arms move in opposite directions it will be clear that one set of valves is moved to open position while the other set is closed. This operation will be better understood by considering the description of the entire operation of the engine.

The operation of the engine is as follows: The master supply valve V is shown in Figure 2 in running position when block B is rotating in the direction of the arrow. To initiate movement of the engine in the direction of the arrow, it is necessary that the valve V be shifted to the dotted line position shown in Figure 2 left side so as to charge with steam those cylinders having piston rods engaging the cams C and C′ at the left side of the crest of the cams so that outward movement of the pistons will be converted into lateral movement and in such direction as to cause rotation of the block in a counter-clockwise direction. As the pistons 20 move outwardly under the expansive action of the steam admitted to the cylinders the pressure exerted against the inclined trackways 42 is converted into lateral pressure owing to the inclination of such trackways, and as the piston rods are rigidly connected to the pistons this lateral pressure is transmitted to the cylinders, and the cylinders, being free to rotate, such lateral pressure will effect rotation of the cylinders or block.

The initial movement of the block B having been effected, the master valve V can now be returned to the position shown in Figure 2, and under the rotational movement of the block the admission ports are successively presented to the chamber 25 to be supplied with steam and thus operate their respective pistons. With the charging of each cylinder and the outward movement of the pistons a new pressure is exerted against the cams C and C′, and this pressure is converted into lateral motion for effecting rotation of the block. Each charge of steam to any one cylindter is permitted to expand owing to the progressively increasing area provided within the cylinder through the outward movement of the pistons. In this manner the expansive force of the steam is completely utilized, thus producing an engine of greatly increased efficiency.

When the pistons reach their outer extreme positions the corresponding exhaust valve 53 moves to open position by the actuating mechanism therefor being operated through the movement of the corresponding piston, thus allowing the steam to exhaust from the cylinder through the port 48 and the duct 49. When the pistons of any one cylinder reach their outer extreme position, the cylinder is in its lowermost position as shown in Figure 1, and in this position the piston rods engage the lowermost points of the trackways 42. It will be understood that by virtue of the inclination of the trackways 42, the pistons are permitted to move outwardly under the expansion of the steam charges. Upon continued rotation of the block, the cams C and C′ serve to move the pistons inwardly to normal position, and the pistons reach this normal position when their respective piston rods are at the crest or upper part of the trackways 42. With the pistons returned to normal position the corresponding cylinder is now directly beneath the supply valve V so that steam is again admitted to the cylinder to repeat the operation of the pistons.

During the upward movement of any one cylinder the return movement of the pistons operates the actuating mechanisms for the exhaust valves to return the valves to closed position so that when the cylinder reaches its uppermost position it is ready to receive and retain a charge of steam.

When it is desired to reverse the engine, it is first brought to a standstill by discontinuing the flow of steam to the valve V, whereupon the valve V is shifted from the running position shown in Figure 2 to the position shown in dash lines, thereby charging those two uppermost cylinders at the right with steam when the steam supply is again continued. Owing to the fact that the piston rods for these cylinders are engaging those portions of the inclined trackways disposed to the right of the crest of the cams, it will be clear that when the pistons are forced outwardly they will operate to initiate movement of the block in a clockwise direction, as when viewed in Figure 2. This reverse movement having been initiated, it follows that the succeeding piston and cylinder units will impart successive impulses to the block to set up a continuous rotary movement of the engine. After the engine

has been started in its reverse movement the valve V is returned to running position, which is midway between the other running position shown in Figure 2 and the position shown in dash lines.

When attempting to reverse the movement of the engine immediately following the bringing of the engine to a standstill or prior thereto, it is possible that certain of the cylinders will retain charges of steam which operate to oppose any reverse movement of the engine and in some cases to such an extent that the engine cannot be reversed. Under this condition it is necessary that these opposing cylinders be freed of their steam and those cylinders which are in communication with the atmosphere closed. This condition is brought about by the manually controlled mechanism previously described, which can be operated to move those exhaust valves which are open to closed position and those valves which are closed to open position. It will thus be seen that the cylinders charged with steam prior to reversal are exhausted and the other cylinders closed to receive the new charges of steam upon the reversal of the engine.

Referring to Figure 5, I have shown one means by which the piston rods 21 are permanently associated with the cams C and C' so as to insure the proper contact of the wheels or rollers 41 with the inclined trackways 42. In this embodiment the forked end of the piston rod 21 is provided with rollers 73 which work in annular grooves 74 formed on opposite sides of the cam C or C'. These grooves are disposed in parallelism to the inclined trackway 42, and it will be understood that during rotation of the piston rods the rollers 73 move within the grooves 74 and thereby maintain the wheel 41 in contact with the trackway.

Although I have herein shown and described only one form of prime mover or engine embodying my invention, it is to be understood that various changes and modifications may be made herein without departing from the spirit of the invention and the spirit and scope of the appended claims.

What I claim is:

1. A prime mover comprising a shaft, a plurality of coaxial cylinders fixed to the shaft and having admission ports, check valves controlling the ports, a master supply valve movable to initially supply fluid to predetermined cylinders, exhaust valves for the cylinders, actuating means for the exhaust valves operable by said pistons, and manually controlled means for the actuating means whereby predetermined valves can be opened and closed at will.

2. A prime mover comprising a shaft, a plurality of coaxial cylinders fixed to the shaft and having admission ports, check valves controlling the ports, a master supply valve movable to initially supply fluid to predetermined cylinders, exhaust valves for the cylinders, actuating means for the exhaust valves operable by said pistons, and manually controlled means for the actuating means whereby the exhaust valves can be opened to exhaust expansible fluid from the charged cylinders when desired to reverse the direction of rotation of the cylinders.

3. In a prime mover, a circular series of exhaust valves, actuating mechanisms for the valves, and manually operable means for controlling the actuating mechanisms comprising arcuate members, and means for simultaneously moving one member forwardly and the other member rearwardly.

4. In a prime mover, a circular series of exhaust valves, actuating mechanisms for the valves, and manually operable means for controlling the actuating mechanisms comprising valve engaging members, and means for simultaneously moving one member forwardly and the other member rearwardly.

5. A prime mover comprising a shaft, a plurality of co-axial cylinders fixed to the shaft and having admission ports, check valves controlling the ports, a master supply valve relatively stationary so as to successively register with said admission ports when the cylinders are rotated, pistons in the cylinders for reciprocating movement, and means for converting the movement of said pistons into lateral motion whereby rotation of the cylinders and shaft is effected.

6. A prime mover comprising a shaft, a block fixed to the shaft and having co-axial cylinders therein provided with admission ports, a master valve for supplying an expansible fluid to the ports and having engagement with the periphery of the cylinder block, and a mounting for the valve by which the pressure of the fluid is utilized to balance and maintain the valve in contact with the block and yet permit adjustment of the valve to supply fluid to predetermined ports.

7. A prime mover comprising a shaft, a block fixed to the shaft and having co-axial cylinders therein provided with admission ports, a master valve for supplying an expansible fluid to the ports and having engagement with the periphery of the cylinder block, a mounting for the valve by which the pressure of the fluid is utilized to balance and maintain the valve in contact with the block and yet permit adjustment of the valve to supply fluid to predetermined ports, and means for releasably locking the valve in adjusted position.

8. In a prime mover, a shaft, a block fixed to the shaft and having cylinders at circumferentially spaced intervals disposed in parallelism to the shaft, peripherally disposed admission ports for supplying an expansible fluid to the cylinders, check valves controlling the ports, a master supply valve

relatively stationary so as to successively register with the admission ports when the cylinder block is rotated, pistons in the cylinders for reciprocating movement having rods extending exteriorly of the cylinders and in parallelism to said shaft, a circular cam surrounding and fixed to said shaft and engaged by said rods for converting the reciprocating movement of said pistons into lateral motion, whereby rotation of the cylinder block and shaft is effected, exhaust ports for the cylinders, reciprocating exhaust valves mounted in the block, and means for reciprocating said exhaust valves comprising projections on the piston rods, rods connected to said exhaust valves and mounted for movement, and abutments on the valve rods engageable by said projection for actuating the rods to effect movement of said exhaust valves.

9. A prime mover as embodied in claim 8 wherein one of said abutments is yieldably supported for the purpose described.

10. A prime mover as embodied in claim 8 wherein collars are fixed to said valve rods, and manually operable means is provided having engagement with said collars for actuating the valve rods to move the exhaust valves to open or closed position.

PRENTISS NISBET.