E. LABERGE.

INTERNAL COMBUSTION MOTOR.

APPLICATION FILED JULY 31, 1917.

1,294,487.

Patented Feb. 18, 1919.

2 SHEETS—SHEET 1.

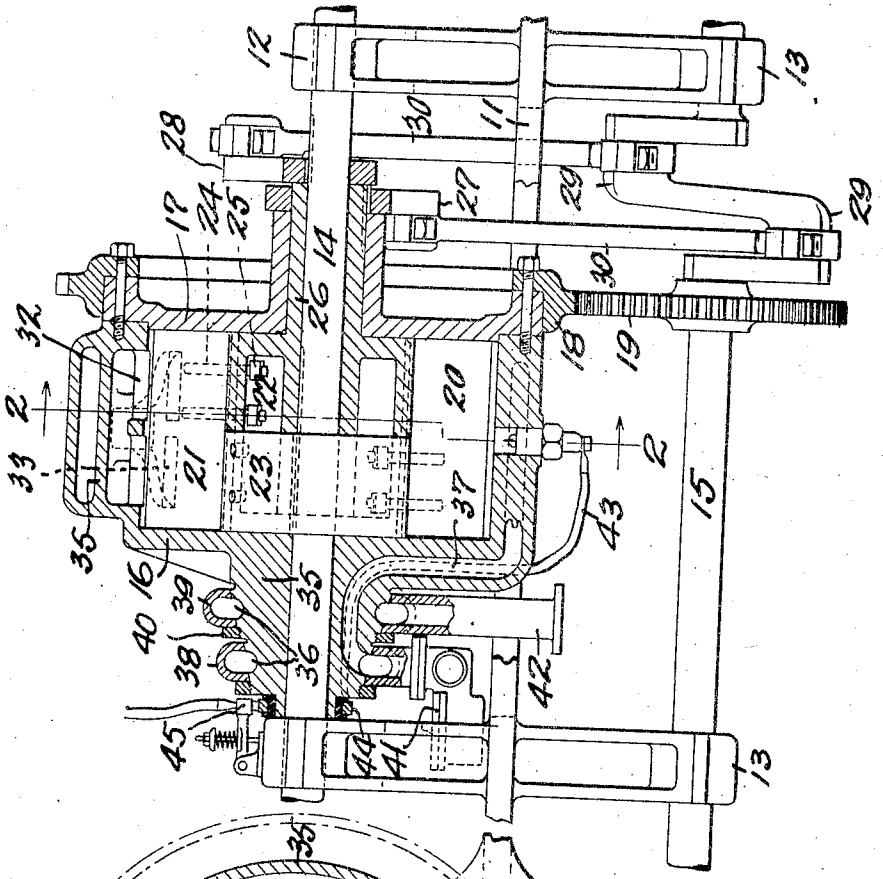


FIG. 1

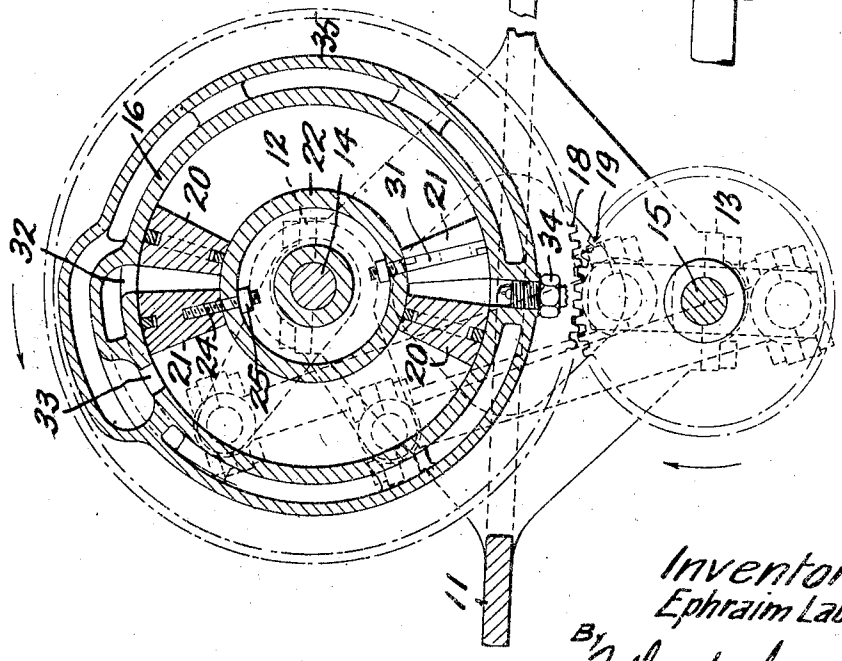


FIG. 2

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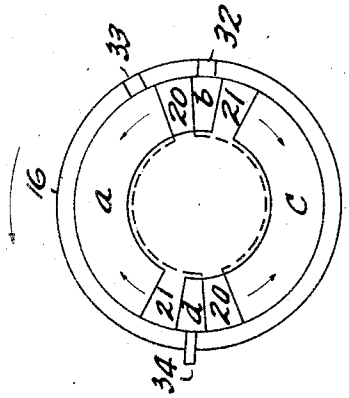


FIG. 6

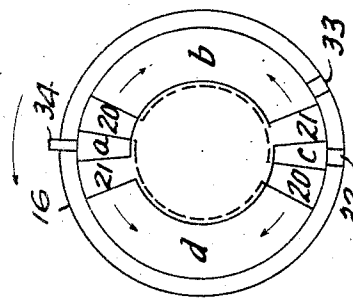


FIG. 5

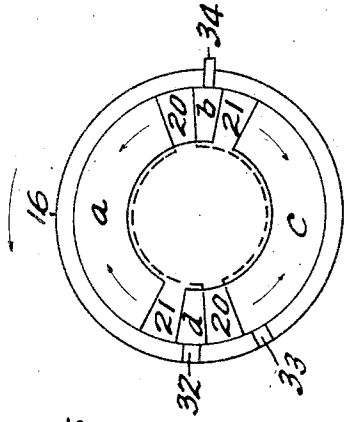


FIG. 4

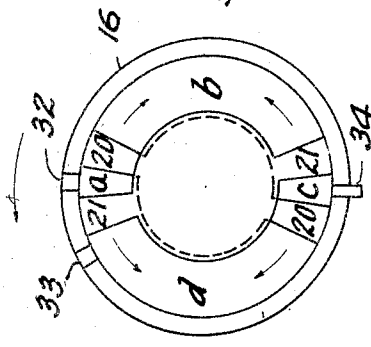


FIG. 3

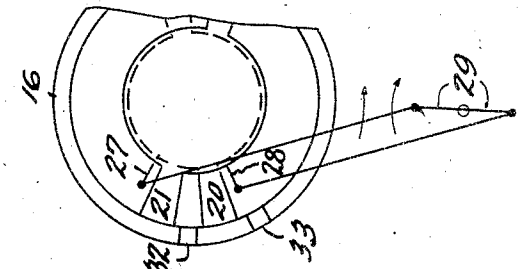


FIG. 11

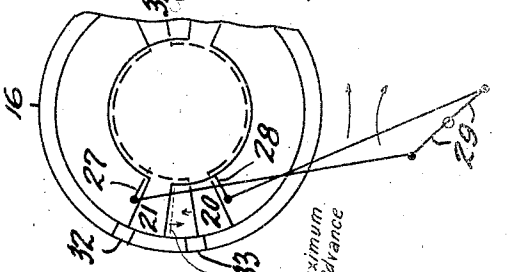


FIG. 10

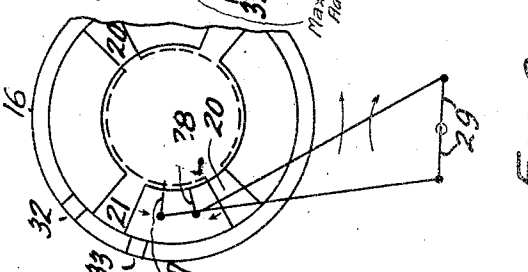


FIG. 9

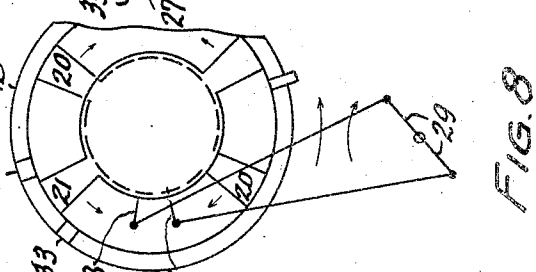


FIG. 8

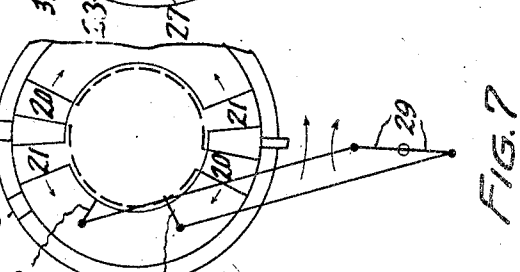


FIG. 7

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UNITED STATES PATENT OFFICE.

EPHRAIM LABERGE, OF MONTREAL, QUEBEC, CANADA.

INTERNAL-COMBUSTION MOTOR.

1,294,487. Specification of Letters Patent. Patented Feb. 18, 1919.

Application filed July 31, 1917. Serial No. 183,766.

To all whom it may concern:

Be it known that I, EPHRAIM LABERGE, a subject of the King of Great Britain, and resident of the city of Montreal, in the Province of Quebec and Dominion of Canada, have invented certain new and useful Improvements in Internal-Combustion Motors, of which the following is a full, clear, and exact description.

This invention relates to improvements in internal combustion motors, and the object of the invention is to provide a motor of extremely simple and compact design having a minimum number of parts and capable of being produced at small cost.

A further object is to provide a motor which is perfectly balanced and will therefore be free from vibration.

A still further object is to eliminate the flywheel ordinarily found in internal combustion motors, thereby reducing the weight.

Another object is to provide a device which will operate equally well either as an internal combustion motor or as an expansion motor using steam or compressed air.

The device consists essentially of a cylinder mounted on a shaft which passes axially therethrough. Two diametrically disposed pistons are provided in the cylinder, one being fixed to the shaft and the other to a sleeve revolubly mounted on the shaft. The shaft and sleeve are each provided with a crank, and these cranks are coupled by means of connecting rods to a crank shaft. The inlet and exhaust are through ports formed in the cylindrical surface, and the inlet and exhaust are controlled jointly by the movement of the pistons and the movement of the cylinder, which is geared to the crank shaft, so as to revolve on its supporting shaft.

In the drawings which illustrate the invention:—

Figure 1 is a vertical longitudinal section of the device.

Fig. 2 is a cross section on the line 2—2, Fig. 1.

Figs. 3, 4, 5 and 6 are diagrams illustrating the cycle of operation.

Figs. 7, 8, 9, 10 and 11 are diagrams illustrating the operation of each stage of the cycle.

Referring more particularly to the drawings, 11 designates a base carrying bearings 12 and 13 located respectively above and below the base. A straight shaft 14 is journaled in the upper bearings 12 and a crank shaft 15 is journaled in the lower bearings. A cylinder 16 having a cover 17 is revolubly mounted on the shaft 14, and carries a gear 18 meshing with a pinion 19 on the crank shaft, the ratio of the gears being approximately 2:1.

Radially disposed pistons 20 and 21 are mounted in pairs in the cylinder by means of hubs 22 and 23; the pistons 20 being mounted diametrically opposite on the hub 22 and the pistons 21 diametrically opposite on the hub 23. The pistons extend from end to end of the cylinder, but the hubs extend only half way so as to meet in the center. It therefore follows that the pistons are connected to their carrying hubs through only one-half of their lengths, and in the other half of their lengths overhang the other hub. This is clearly shown in Fig. 1. Each of the pistons is connected to its hub by studs 24 screwed into the piston and passing through the wall of the hub and secured by nuts 25. The hub 23 is keyed to the shaft 14, while the hub 22 is revoluble on the shaft and independently of the cylinder, and is provided with an extension 26 which passes through the cylinder cover. Cranks 27 and 28 are connected respectively to the extension 26 of the hub 22, and to the shaft 14 carrying the hub 23. The cranks 27 and 28 are coupled to the cranks 29 of the crank shaft 15 by connecting rods 30. The cranks 27 and 28 are longer than the cranks 29, the ratio being such that less than one-half revolution of the longer cranks produces a travel equal to the travel of a half revolution of the shorter cranks. Each of the pistons is provided on all its bearing surfaces with packing 31 of any suitable description.

Inlet and exhaust ports 32 and 33 are provided in the curved wall of the cylinder, and are spaced approximately the thickness of a piston apart. The ignition device 34 is provided in the curved wall of the cylinder at a point approximately diametrically opposite from the inlet port. The cylinder is provided with an outer or jacket wall 35 spaced from its inner or main wall, and this space is blocked in the neighborhood of the ignition device, and also in the neighborhood of the ports, so that the exhaust port discharges into the space on

one side of the rotative center and the inlet port connects with the space on the opposite side of the rotative center. A stepped frusto-conical projection 35ˣ is provided on the end of the cylinder remote from the cover, and has formed therein on each of its steps a groove 36. These grooves are connected by passages 37 (only one of which is shown) with the jacket space. Grooved rings 38 and 39 are revolubly mounted on the frusto-conical steps, and are each held by a nut 40 which may be adjusted to take up any wear, and thus maintain a fluid tight joint between the ring and the surface on which it bears. The ring 38 is connected with a carbureter 41 and the ring 39 with an exhaust pipe 42.

An additional passage (not shown) is provided in the closed end of the cylinder, and in the frusto-conical extension, through which the high tension cable 43 leading to the ignition device may pass. This cable leads from an insulated ring 44 mounted on the shaft, and supplied with the high tension current for ignition by a suitable brush 45.

The operation of the device is as follows:—Assuming the parts to be in the position shown in Figs. 2 and 3, it will be seen that the pistons divide the cylinder into four chambers *a*, *b*, *c* and *d*; chambers *a* and *c* being small, the former in communication with the inlet port and the latter with the ignition device; while chambers *b* and *d* are large, the former being entirely closed and the latter in communication with the exhaust port. Chamber *a* is empty, chamber *b* contains a new charge uncompressed, chamber *c* contains a new charge compressed, and chamber *d* contains a burnt charge. The charge in chamber *c* is exploded and drives the pistons 20 and 21 apart until they assume the position shown in Fig. 4. The separation of the pistons causes a new charge to be drawn into chamber *a*, and at the same time chambers *b* and *d* are reduced in size, so that the charge is compressed in chamber *b* and the burnt charge in chamber *d* driven out of the exhaust port. Owing to the gear connection between the crank shaft 15 and the cylinder, the cylinder rotates in the direction of the arrow, so that the ports and ignition device follow the pistons 21 as indicated by the arrow. Owing to the use of cranks, the rotation of the crank shaft and therefore of the cylinder does not bear the same relation to the movement of the pistons throughout their stroke. The result is that as the pistons approach the position shown in Figs. 4 and 11, the cylinder moves relatively faster, and the piston 21, *i. e.*, that moving in the same direction as the cylinder, advances beyond its position in Figs. 4 and 11, as shown in Fig. 10, and then returns to its proper position. The piston 20 is traveling in the opposite direction to the cylinder, so that it is obvious how this latter piston will pass the exhaust port at the same time that the piston 21 passes the inlet port by advancing beyond its position and then retreating as the cylinder continues to move at a uniform rate. In this way, the inlet port 32 passes the piston 21, the exhaust port 33 passes the piston 20, and the ignition device passes the other piston 21, thus bringing the inlet port into communication with chamber *d*, the exhaust port into communication with chamber *c*, and the ignition device into communication with chamber *b*. This means that chamber *a*, into which the new charge has been drawn, is now closed; chamber *d*, from which the burnt charge has been expelled, is now in communication with the inlet port; chamber *c*, in which the exploded charge has been fully expanded, is in communication with the exhaust port; and chamber *b*, which contained the new charge, is in communication with the ignition device. On the next explosion, the pistons resume their original position, as shown in Fig. 5, and at the same time the cylinder advances a quarter revolution, so that the ignition device is in communication with the charge compressed in chamber *a*, and so on. The explosion in chamber *a* moves the pistons, to the position of Figs. 4 or 6, and the cylinder to the position shown in Fig. 6, with the ignition device in communication with chamber *d* containing a compressed charge. An explosion in chamber *d* returns the parts to the positions shown in Fig. 3.

From the foregoing, it will be seen that the device operates on the four cycle principle, and that explosion, exhaust, intake and compression occur in the order named in each of the chambers in succession. In this way, the pistons are uniformly heated, so that distortion does not occur. The expansion of the fired charge always occurs between the ignition device and the exhaust port, and for this reason, this portion of the jacket space is utilized as a gas passage leading to the inlet port, so that the cool gas entering from the carbureter absorbs heat from the cylinder wall, and is thereby preheated to a considerable degree. The exhaust gases flow through the remainder of the jacket space, which covers that portion of the cylinder within which compression is occurring, and warms this portion of the cylinder. At the same time, the exhaust gas is cooled, and therefore the pressure drops, so that this jacket space serves the purpose of a muffler. The cooling of the hotter parts of the cylinder and warming of the cooler parts has the effect of maintaining more or less uniform temperature throughout the circumference, so that the

cylinder is not distorted by unequal expansion and leakage past the pistons caused. If desired, cooling may be effected in the ordinary manner by passing water through the jacket space instead of passing the gases through it. If desired, the closed end wall of the cylinder and the head, as well as the pistons themselves, may be water cooled. Such an arrangement is obvious, and requires no description or illustration.

If the apparatus is to be used with steam or compressed air as motive fluid, it will be necessary to alter the ratio between the cranks 27 and 28, and the cranks 29, so that the pistons will close up almost into engagement with each other instead of coming to rest a considerable distance apart, as shown, and as is necessary in an internal combustion machine, owing to the limitations of compression. The ignition device will be removed and motive fluid admitted here as well as at the inlet port 32. An additional exhaust port will be required. Steam will be admitted at the opening for the ignition device, and the additional exhaust port used only when the ratio between the cylinder and crank shaft is retained. If desired, the ratio may be changed to 1:1, and one each of the pistons 20 and 21 removed, and the length of cranks correspondingly altered, so that the pistons, in place of traveling each something less than one-quarter of a revolution, travel approximately half a revolution each.

From the foregoing description, it will be obvious that the apparatus is extremely simple in construction, and may be very cheaply and quickly manufactured. There are no valves, as the pistons and cylinder working in combination perform the functions of valves, and therefore all loss of power through leakage at this point is eliminated.

Having thus described my invention, what I claim is:—

In combination a rotary cylinder, a shaft arranged centrally of said cylinder, two pairs of pistons, a carrier for each pair of pistons, one of said carriers being mounted on the shaft and fixed thereto, and the other carrier being loosely mounted on the shaft and having a sleeve extending through the casing, said pistons being adapted to oscillate in the casing, inlet and discharge ports in the casing, an ignition device carried by the casing, said inlet port, discharge port, and ignition device being brought by the movement of the casing to different positions in relation to the pairs of pistons to coöperate in succession with the spaces between said pistons, whereby the combustible fluid is admitted to the spaces in succession, compressed, fired and discharged, a shaft parallel with the shaft first mentioned, a gear connection between the said shaft and the casing for rotating the same, a pair of cranks on said shaft, a crank arm on the center shaft of the casing, a crank arm on the sleeve of one set of pistons, and a pitman between said crank arms and the cranks of the shaft having the gear, substantially as described.

In witness whereof, I have hereunto set my hand.

EPHRAIM LABERGE.