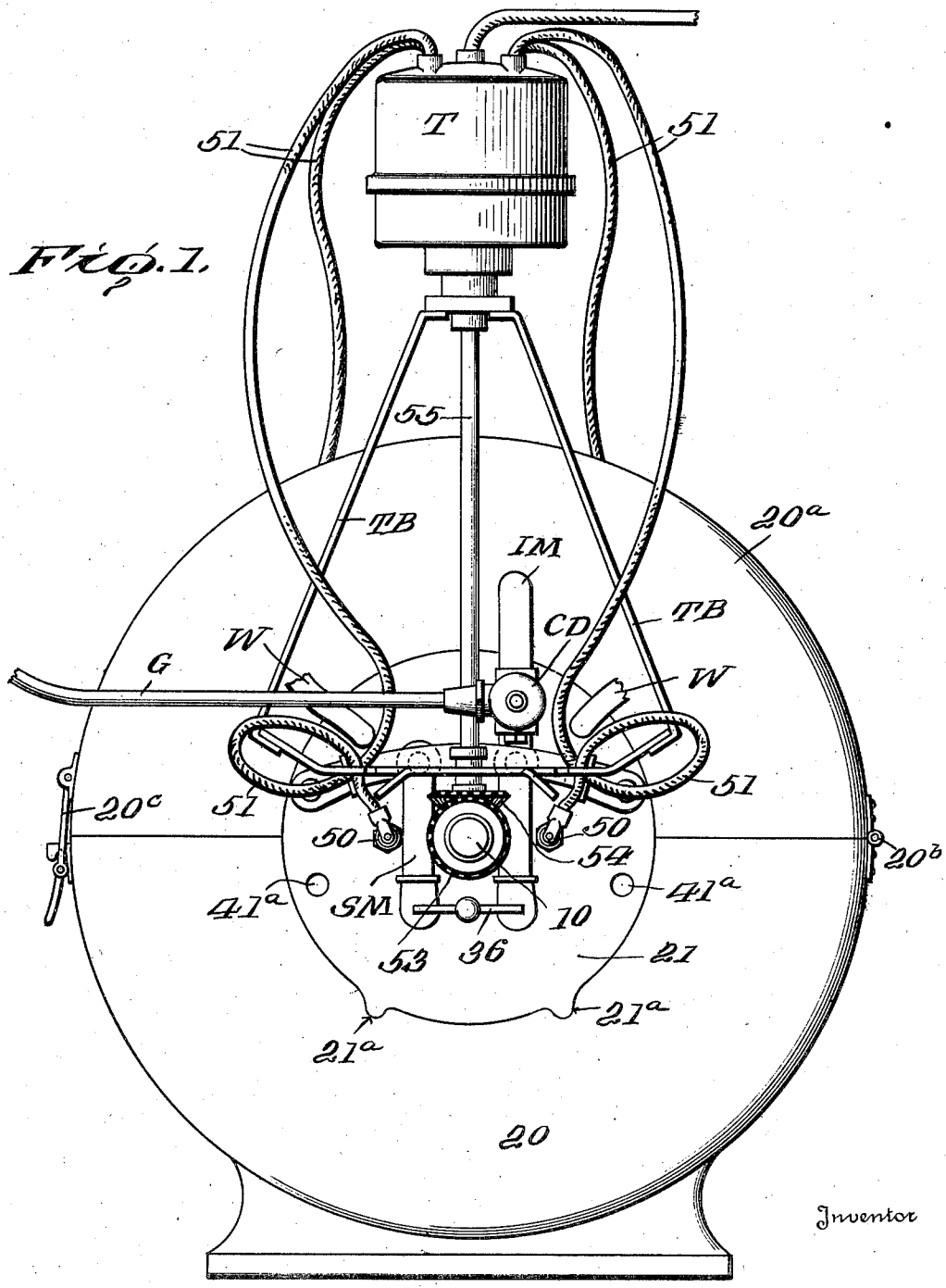
Aug. 8, 1939. B. T. WAGERS 2,168,502

INTERNAL COMBUSTION ENGINE

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Fig. 1.



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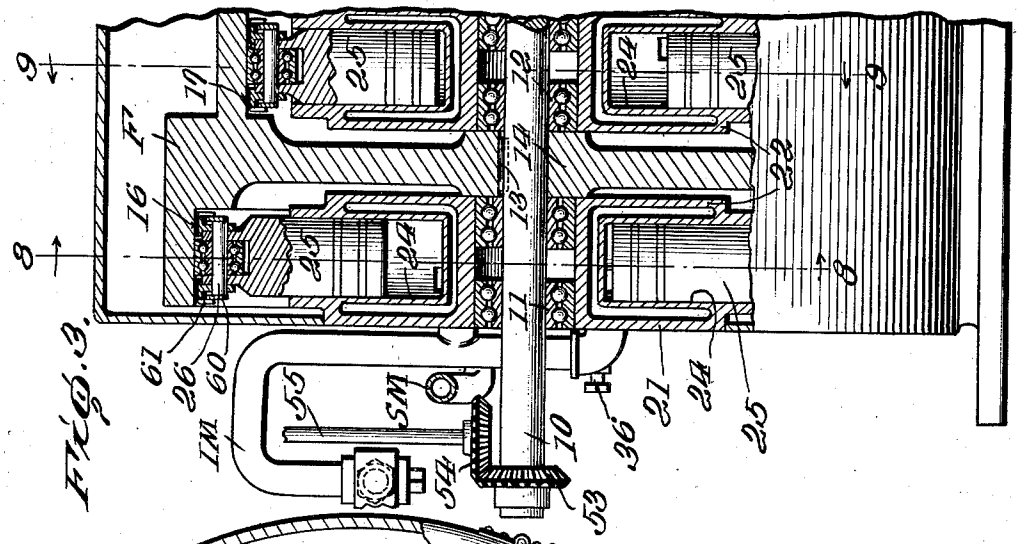


Fig. 3.

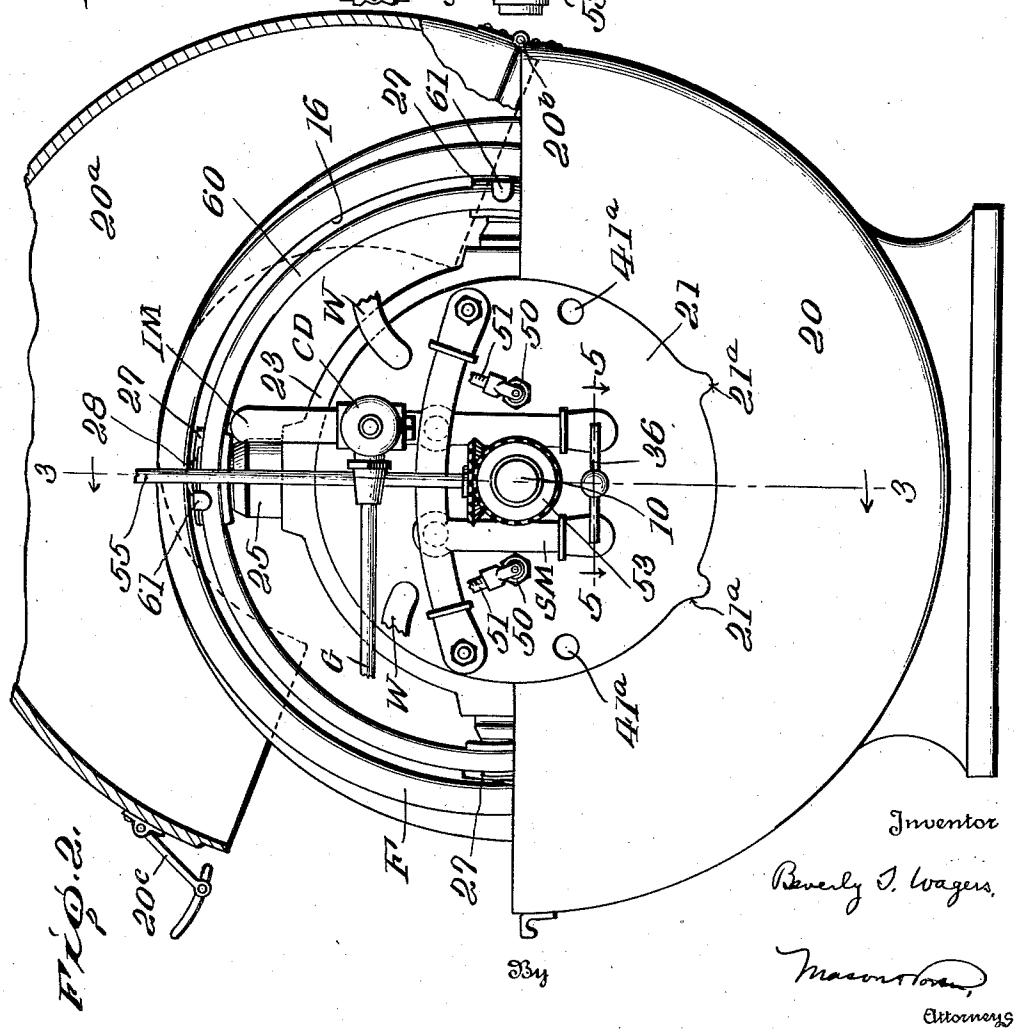


Fig. 2.

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INTERNAL COMBUSTION ENGINE

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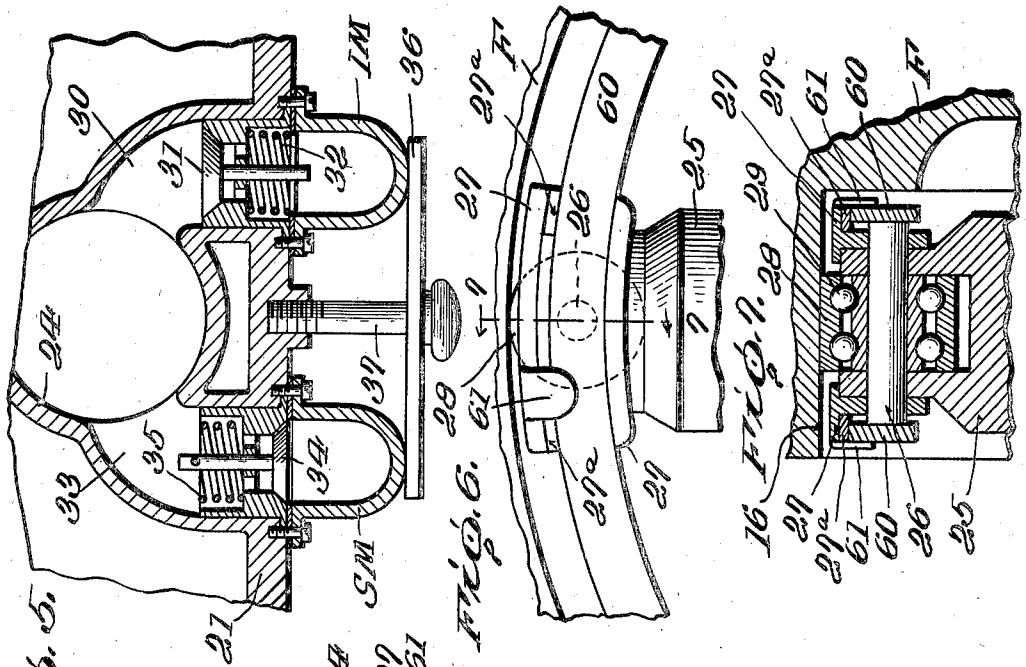


Fig. 5.

Fig. 6.

Fig. 7.

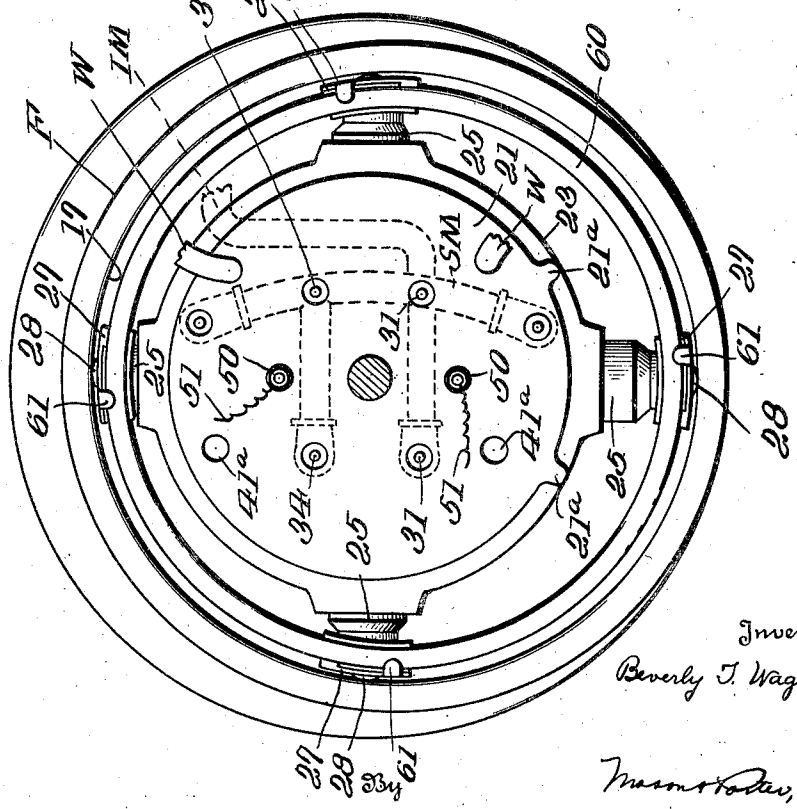


Fig. 4.

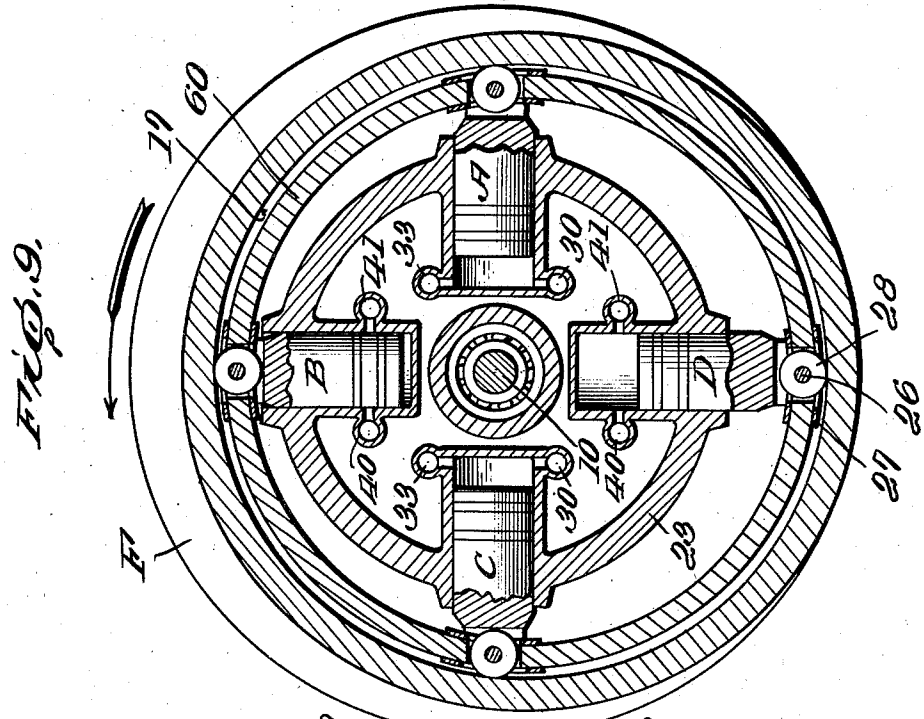
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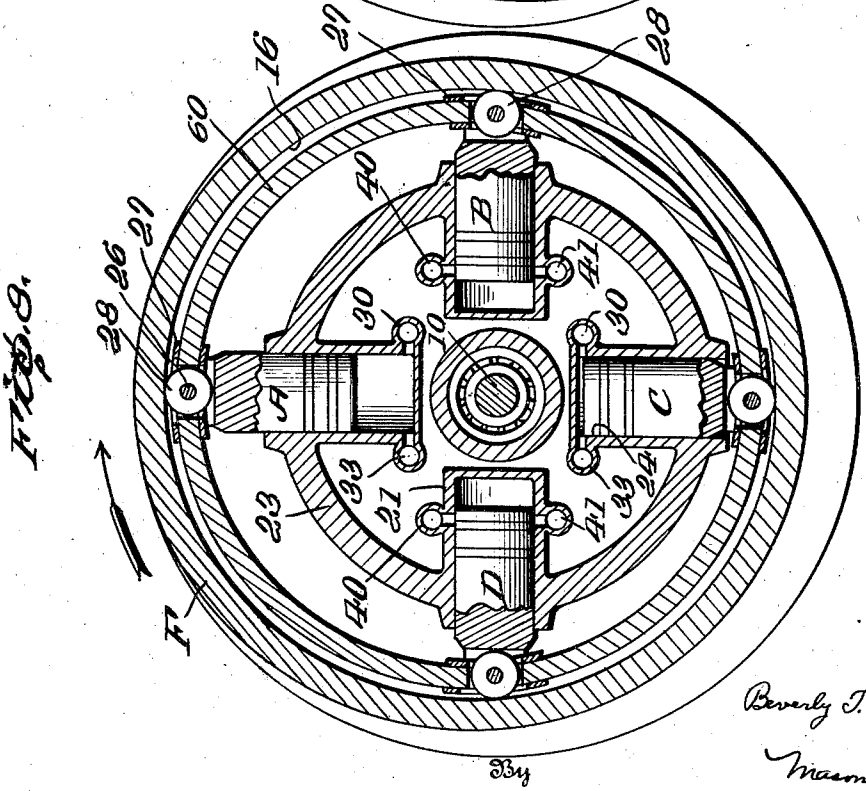
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Aug. 8, 1939. B. T. WAGERS 2,168,502

INTERNAL COMBUSTION ENGINE

Filed Aug. 10, 1936 4 Sheets-Sheet 4





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Patented Aug. 8, 1939 2,168,502

UNITED STATES PATENT OFFICE

2,168,502

INTERNAL COMBUSTION ENGINE

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Application August 10, 1936, Serial No. 95,236

4 Claims. (Cl. 123—55)

This invention relates to an engine of the expansible chamber type and is more particularly concerned with an internal combustion engine.

One of the features of the present invention is the provision of an engine having combustion and compression cylinders, with connecting passage means for joining compression cylinders with combustion cylinders and operative for preparing an explosive charge, pistons operating in the respective cylinders, and a relatively rotatable cam member for compelling coordinate movements of the compression pistons during the operation of the combustion pistons.

Another feature of the invention is the provision of an expansible chamber engine having a rotatable fly wheel provided with an eccentric surface, a cylinder structure with piston means, said piston means operating upon and being operated by the eccentric cam surface.

A further feature of the present invention is the provision of an expansible chamber engine in which a fly wheel is provided with a plurality of eccentric surfaces, and has a substantially uniform cross-section and substantially uniform mass throughout its periphery; the several surfaces having their maximum and minimum distances from the common axis peripherally spaced with respect to one another so that the fly wheel is at least in static balance; together with a cylinder structure located within the fly wheel and a plurality of pistons operating in the cylinders and cooperating with the surfaces for effecting rotation of the fly wheel and for preparing the explosive charges utilized in combustion.

With these and other features as objects in view, an illustrative form of practicing the invention is shown on the accompanying drawings, in which:

Fig. 1 is an end view of such illustrative engine.

Fig. 2 is a similar view, with parts broken away, and with the cover portion of the casing partly raised.

Fig. 3 is an upright sectional view substantially on line 3—3 of Fig. 2.

Fig. 4 is a view showing the opposite end of the engine from that indicated in Figs. 1 and 2, with the casing removed and the manifolds in dotted line.

Fig. 5 is a sectional view substantially on line 5—5 of Fig. 1, on a larger scale.

Fig. 6 is a detail view, on a large scale, showing the end of one piston with its roller arrangement.

Fig. 7 is a sectional view substantially on line 7—7 of Fig. 5.

Figs. 8 and 9 are diametrical views indicating the timing of the banks of cylinders at the two ends of the illustrative engine, and are substantially on lines 8—8 and 9—9 of Fig. 3 respectively.

In this illustrative form, the engine is shown as having two banks of cylinders located in parallel planes, each bank comprising two combustion cylinders and two compression cylinders, the combustion cylinders being located 180 degrees apart about the common axis, and the compression cylinders being similarly spaced. The banks of cylinders at the two ends of the engine are displaced 90 degrees with respect to one another; that is, the compression cylinders are arranged in a vertical plane in Figs. 1, 2 and 8, and in a horizontal plane in Figs. 4 and 9.

The common axis of the system is defined by a rotatable shaft 10 supported in suitable bearings 11, 12 and connected by a key 13 with the hub 14 of a fly wheel structure F. Internally, the two faces of the fly wheel structure are bored eccentrically, to provide cylindrical cam surfaces 16, 17. From Fig. 3, it will be noted that the fly wheel is balanced, as an equal amount of metal is provided at its rim throughout its periphery, so that adequate static balancing is present: and since the same cross-sectional area is provided at all radial planes, a substantial dynamic balance is likewise present.

The banks of cylinders are provided in relatively fixed cylinder structures, one such structure being provided at each end of the engine and being mounted on the lower section 20 of a fixed casing, with the outer end wall 21 exposed therethrough, so that the periphery of this end wall provides a flange for resting in a semi-circular trough provided at the corresponding end of the casing portion 20. The wall 21 has projections 21*a* which are received in corresponding notches of the casing section 20 to prevent relative rotation of the fixed cylinder structures with respect to the casings, while the engine is under load and permitting easy separation from this casing. The upper section or cover 20*a* of the casing is secured to the lower portion by a hinge 20*b*, and has thin margins which overlap corresponding portions of the lower section 20 of the casing, so that the device is sealed when the casing sections 20, 20*a* are brought together. A latch 20*c* is provided for securing the casing sections together.

Each of the fixed cylinder structures may be formed as an integral casting comprising the end walls 21 and 22 and the peripheral wall 23.

Spaced at 90 degrees from each other, about the axis of the shaft 10, are the cylindrical walls 24 which provide cylinders. It will be noted that these wall structures provide ample space for the circulation of water within the same and around the several ports and the cylinders 24. Water connections are provided for the inlet and outlet of water which may be delivered thereto by a pump and passed therefrom to a radiator in the usual way for recirculation.

Each cylinder is provided with a piston 25 which may be provided with compression and oil sealing rings. The outer end of each piston is connected by a piston pin 26 with a slide block 27, and this same piston pin supports a roller 28 by means of anti-friction bearings 29, the roller 28 traveling along the eccentric cylindrical surface 16 or 17.

The cylinders and pistons have been designated as A, B, C and D in each bank, in Figs. 8 and 9, being arranged in order to have a clockwise rotation of the fly wheel in Figs. 1, 2 and 8, corresponding to a counterclockwise rotation in Figs. 4 and 9. Fuel, such as gasoline, is delivered through a supply pipe G to a suitable carbureting device CD, and thence to an intake manifold IM which is provided with connections leading to inlet ports for each of the compression cylinders in the corresponding bank. It is preferred to employ independent carbureting devices CD for each of the fixed cylinder structures. Each intake manifold IM has its communication with the corresponding cylinders A, C, through individual ports 30, each closed by an automatic poppet valve 31 which is normally held in closed position by a valve spring 32.

From the compression cylinders, the compressed fuel mixture is delivered through a passage 33 to an automatic outlet poppet valve 34 which is normally held closed by a valve spring 35, but opens to permit the compressed mixture to escape from the corresponding cylinder into the supply manifold SM, in which it is passed under pressure to the combustion cylinders. As shown in Figs. 1, 2 and 5, the manifolds are held clamped by a strap 36 and a screw 37. The supply manifold SM for each fixed cylinder structure is of T shape, and leads to passages 40 cored into the fixed cylinder structures and having communication by ports with the interiors of the respective combustion cylinders B, D, these ports being exposed by the corresponding piston when the latter approaches the outward limit of its travel relative to the cylinder. Further passages 41 are cored into the fixed cylinder structures and communicate by similar ports, so that the spent gases of combustion can be discharged therethrough and through the openings 41*a* (Figs. 1, 2 and 4) to the atmosphere or a silencing device, in the usual way.

For the purpose of igniting the charges in the combustion cylinders B, D, each of these is provided with a spark plug 50 which is connected by high tension conductors 51 with a timing device T which operates during each revolution therein to close circuits from an ignition coil (not shown) to and through the conductors 51 successively, in the usual way, at angular intervals of 90 degrees of movement of the fly wheel structure. The movement in the timing device T (which may be of well known construction and connected in the usual way) is obtained from the shaft 10 by the bevel gear 53 which is in mesh with a bevel gear 54 on the timing shaft 55, the bevel gears 53 and 54 having the same diameter and the same number of teeth. The timing shaft 55 and the timer T are supported by brackets TB secured to the end wall 21 (Fig. 1), so that these structures need not be disturbed when the upper section 20*a* of the casing is raised for inspection.

Each slide block 27 has frictional contact by the bearing pads 27*a* with a pair of rings 60 which are similarly connected with each of the slide blocks for the corresponding cylinder bank, and which thus operate to hold the uppermost piston of Fig. 8, for example, against relative inward movement, and compel the pistons to maintain their rollers 28 engaged with the fly wheel surface 16 or 17. To prevent separation of the rings, each block 27 is provided with ears 61 which engage the face of the corresponding ring which is opposite to that presented toward the body of the block 27. It will be noted that the rings 60 extend across the ends of the piston pins 26 and thus serve to prevent axial movement of these pins.

The lower section 20 of the casing preferably receives an oil supply which normally stands at a level slightly below the notches 21*a*. During the rotation of the fly wheel, the oil is carried therewith so that this oil in part drops over the moving parts, and for another part is projected against the inner surface of the casing and runs down over the surface; and is delivered at the points where there is sliding or rolling friction within the fixed cylinder structures. In particular, it will be noted that this assures an abundant lubrication of the rollers 28 and their mountings at the ends of the pistons, of the slide blocks 27 with respect to the rings 60, of the pistons themselves, and of the bearings 11, 12 and other parts.

In operation, while the device is rotating, fuel is delivered through the pipes G to the carbureting devices CO, and thence by the intake manifolds IM to the automatic intake valves 31. As a compression piston, at A for example, moves out to the position shown in Fig. 8, it thus draws the combustible mixture through the port 30 into the corresponding cylinder. This outward movement of the piston A is produced during the rotation of the flywheel, as this flywheel operates against the roller 28 of the opposite compression piston C to force this latter inward, since this movement of the roller is accompanied by a lifting of the rings 60 and therewith a lifting of the piston A. In Fig. 8, the flywheel has its maximum eccentricity at the roller 28 for piston A, and the minimum eccentricity at the roller 28 for piston C, these two pistons being operative in compression cylinders. As the flywheel continues to move in the direction of the arrows, its inner surface 16 therefore operates to force the roller 28 of piston A inward: and a further movement is imparted through the rings 60 for forcing the piston C downward, that is, outward with respect to the shaft 10. The movement of the piston A thus compresses the mixture in the corresponding cylinder and causes its ejection through the port 33 and past the automatic outlet valve 34 into the supply manifold SM.

The movement of the flywheel has also caused the minimum eccentricity of the surface 16 to move clockwise and thus to operate (Fig. 8) upon the roller 28 of the combustion piston D to force this piston inward, and also by action of the ring 60 to force the slide block 27 and the roller 28 of piston B outward (assuming that no

explosion has yet occurred) until piston B uncovers the intake port **40** so that the compressed combustible mixture in the supply manifold SM enters the cylinder B.

The continued movement of the flywheel operates by its surface **16** against the roller **28** of piston B to force this piston inward to compress the mixture which has just been received therein. Adjacent the height of compression, in the usual way, the timing device T operates for closing the circuit so that a spark is delivered at the spark plug **50** of the cylinder B and explosion occurs therein. This produces a relatively outward effort of piston B which is exerted through the roller **28** against the eccentric inner surface **16** of the flywheel to continue the flywheel in its movement. Ultimately the outward movement uncovers the exhaust passage **41**, so that the spent gases of combustion are expelled, and then fresh mixture is received from the supply manifold SM, in the usual way for two-stroke engines, to fill the cylinder, whereupon the cycle of operation for cylinder B is repeated.

The compression cylinders A and C operate oppositely, one delivering compressed mixture into the supply manifold SM while the other is drawing in such mixture from the intake manifold IM. Hence the supply manifold SM is under pressure; and it will further be noted that the pressure in each compression cylinder is approaching a maximum during the time when the corresponding port **40** of a combustion cylinder is opened by its corresponding piston.

The combustion cylinder D is operated in the same way, but oppositely in phase, so that the firing of the cylinders B and D in the bank of cylinders occurs at 180 degrees apart, with two explosions per revolution of the fly wheel. In this illustrative engine, there are two such banks of cylinders which are disposed 90 degrees with respect to one another, so that there are four explosions and four power impulses for each revolution of the flywheel and shaft **10**. As shown in Figs. 8 and 9, the inward movement of the piston A of the compression cylinder in one bank is occurring simultaneously with the outward expansion movement of the piston B of a combustion cylinder in the other bank, these cylinders A and B being located in an axial plane through the shaft **10** which intersects the axes of these cylinders, so that the compression and expansion efforts are occurring together, and the power for one may be derived from the other without transfer of the energy therefor around the periphery of the flywheel.

It will be noted that the upper section **20***a* of the casing may be raised while the device is operating at idling or low speed, without disconnection of any of the operating parts, so that inspection can be accomplished. Further, the internal structures may be lifted from the lower section of the casing without difficulty, as these structures are supported on the casing but not connected thereto in such a manner that separation of operating parts is necessary: and hence the removal and replacement may be easily and quickly accomplished.

It is obvious that the invention is not limited solely to the form of construction shown, but that it may be modified in many ways within the scope of the appended claims.

I claim:

1. In an engine of the character described wherein is provided a bank of cylinders and pistons reciprocable in and projecting radially from said cylinders, a shaft, and power transmitting connections between said pistons and said shaft comprising, a flywheel secured to the shaft and having an internal circular eccentric cam surface, a pin carried by each piston and extending parallel said shaft, a roller rotatable on each pin and engaging the cam surface, a block rockable on each pin, and a ring joining all the pistons for conjoint movement and passing adjacent each piston and engaging slidably with each pin carried block.

2. In an engine of the character described wherein is provided a bank of cylinders and pistons reciprocable in and projecting radially from said cylinders, a shaft, and power transmitting connections between said pistons and said shaft comprising, a flywheel secured to the shaft and having an internal circular eccentric cam surface, a pin carried by each piston and extending parallel said shaft, a roller rotatable on each pin and engaging the cam surface, a block rockable on each pin, and a ring joining all the pistons for conjoint movement and passing adjacent each piston and engaging slidably with each pin carried block, each said block having means for preventing axial movement of the ring.

3. In an engine of the character described wherein is provided a bank of cylinders and pistons reciprocable in and projecting radially from said cylinders, a shaft, and power transmitting connections between said pistons and said shaft, a flywheel on said shaft having a cam track, a plurality of means each carried by a piston and movably opposing said cam track, and endless means joining the last mentioned means and mounting same for sliding movement therein.

4. In an engine of the character described wherein is provided a bank of cylinders and pistons reciprocable in and projecting radially from said cylinders, a shaft, and power transmitting connections between said pistons and said shaft, a flywheel on said shaft having a cam track, rollers contacting said cam track, and endless means mounting the rollers and joining the pistons for conjoint bodily movement including cam-opposing means carried by each piston and supporting said rollers.

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