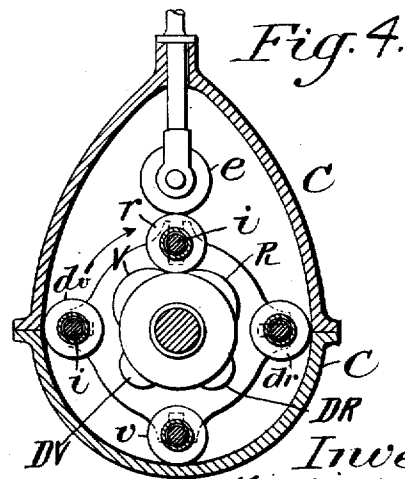
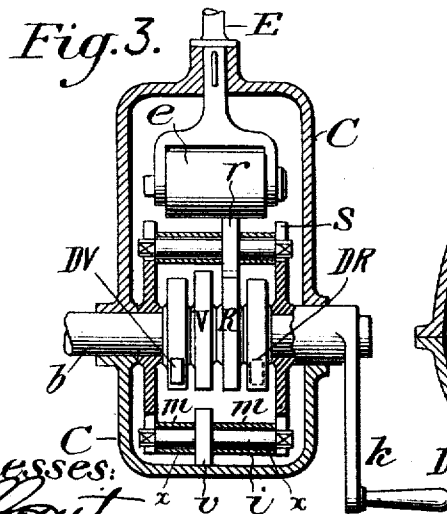
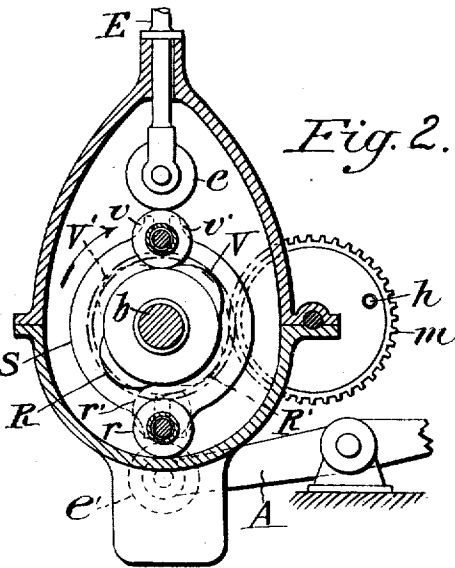
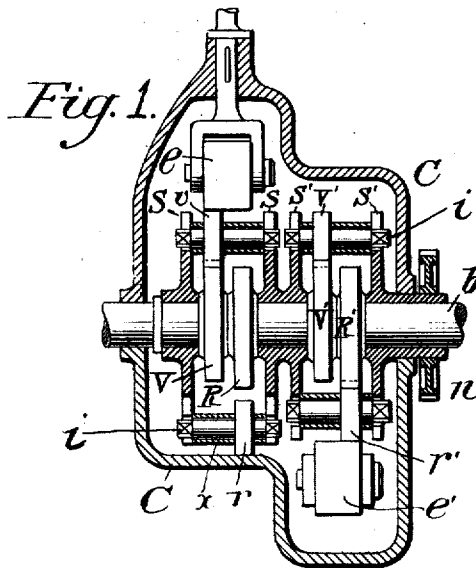


F. HENNINGER.
 REVERSING MECHANISM FOR INTERNAL COMBUSTION ENGINES.
 APPLICATION FILED AUG. 2, 1907.

1,013,491.

Patented Jan. 2, 1912.

2 SHEETS—SHEET 1.



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 L. H. Jones.

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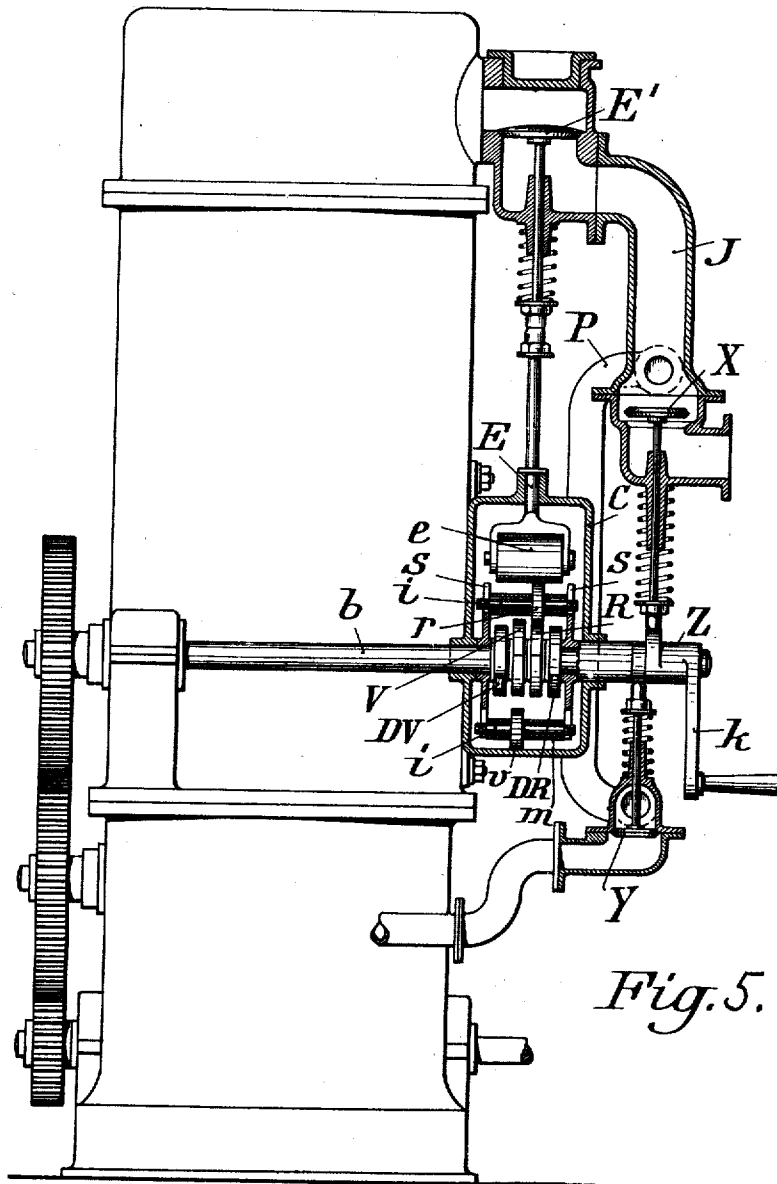


Fig. 5.

WITNESSES

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REVERSING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

1,013,491.

Specification of Letters Patent.

Patented Jan. 2, 1912.

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To all whom it may concern:

Be it known that I, FRIEDRICH HENNINGER, engineer, a subject of the Emperor of Germany, residing at Luisenstrasse 2, Deutz, near Cologne, Germany, have invented certain new and useful Improvements in Reversing Mechanism for Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to mechanism for operating and controlling the valve gear of engines in which the prime mover of the valve operating means is a cam shaft operated from the engine shaft, and the invention comprises the provision of means adapted to be inserted between the cam shaft and the valve stem to be adjusted in such interposed relation or to be entirely withdrawn from such relation whereby the valves may be appropriately operated to control and regulate the operation of the engine, either in a forward or a reverse direction or to suspend the operation of the engine entirely.

A characteristic feature of the invention resides in mounting the intermediate mechanism, which is adapted to be interposed between the cam shaft and the valves, in one or more carriers or supports which are rotatably mounted on the cam shaft and in such relation to the latter that the intermediate member or members which serve to transmit motion from the cams to the valves are free to move in a direction radial, or substantially radial, to the cam shaft. An essential advantage of this arrangement resides in the fact that no separate mounting for the interposed mechanism is required, inasmuch as the same is mounted directly on the cam shaft, wherefore the separately mounted transmitting mechanisms between the valves and the actuating shaft therefor, as employed in engines of this character as heretofore constructed, are dispensed with. Further advantage resides in the fact that the supports or bearers of the intermediate mechanism, on account of their concentric arrangement with the cam shaft, may be made in the form of disks or frames and the intermediate members, themselves, may be conveniently made in the form of rollers which are shiftable radially in the disks so that most of the work required in making and finishing the parts may be effected on a

lathe, or milling machine, thereby greatly reducing the cost of production.

In the accompanying drawings: Figure 1 is a longitudinal section through a valve actuating mechanism embodying the invention, said mechanism being adapted to operate both the inlet and exhaust valve of an engine. Fig. 2 is a vertical section taken at right angles to that shown in Fig. 1. Fig. 3 is a view corresponding to Fig. 1 showing a modified form of the invention adapted to be applied to a reversing engine having auxiliary means for starting the engine by compressed air or the like. Fig. 4 is a vertical section at right angles to that shown in Fig. 3. Fig. 5 is a vertical elevation partly in section of an engine having the form of the invention illustrated in Figs. 3 and 4 applied thereto.

In Figs. 1 and 2 there is illustrated a form of the invention adapted to be applied to a reversing engine in which the cam shaft *b* is provided with two sets of cams, indicated *V*, *R*, *V'*, and *R'*, which are adapted to control the actuation of both the inlet and discharge valves of an internal combustion engine, so that the direction of rotation of the engine may be determined by the position of the intermediate mechanism interposed between the cams and the elements directly connected with the valves. The several cams are disposed longitudinally of the shaft *b*, and may be conveniently arranged in the relative positions indicated in Fig. 1. The intermediate devices for transmitting motion from the cams to the valves are conveniently made in the form of rollers *v*, *r*, *v'*, and *r'*, mounted two and two at substantially diametrically opposite points in disk-form bearers or supports *S*, *S*, *S'*, *S'*, which are slotted as indicated to receive the spindles of the respective rollers and admit of said rollers being moved radially with respect to the disks and the crank shaft. The cams *V* and *R* serve to actuate the inlet valve for forward and reverse movement of the engine, by means of valve rod *E*, and, correspondingly, the cams *V'* and *R'* operate the exhaust or discharge valve through the rock-lever *A*, said valve stem *E* being provided with a roller *e* and the rock-lever *A* having a corresponding roller *e'*.

In the position of the parts shown in Figs. 1 and 2 motion is transmitted to valve stem *E* by the roller *v* which moves freely, inwardly and outwardly, in the slots in the

disks S S so that when the high part of cam V engages roller *v* the same is lifted and serves to lift the valve rod E. The roller *r*, which is mounted diametrically opposite roller *v* in the disks S, S, and disposed laterally with respect thereto and in alinement with cam R, serves, when the supporting disks are turned through 180°, to operate the inlet valve E from cam R and thereby to reverse the operation of the engine. In the same way, the rollers *v'* and *r'* engage and operate the rock-lever A to open the discharge or exhaust valve of the engine, and when the supporting carrier disks of said rollers are moved through 180°, the operation is to change the valve from forward to reverse position, as will be understood. In order to retain the rollers in proper relation in the slots in the carrier disks, there is provided an inclosing casing C, the bottoms and sides of which are generally circular and serve to engage and hold the rollers in the slots while the carriers S are being rotated from one position to another.

The position of the parts in Figs. 1 and 2 is that for forward running of the engine, the roller *v* standing under roller *e*, on the end of the inlet valve stem, and the roller *r'* lying above the roller *e'*, on the end of rock-lever A, so that, when the cam shaft is rotated, the cams V and R' will actuate the inlet and exhaust valves respectively, at appropriate intervals to control the admission and exhaust of the explosive charges. For reversing the engine it is only necessary to turn the connected sets or pairs of carrier disks S and S' through 180° so that the inlet valve will be actuated by cam R and roller *r*, and the exhaust valve will be operated by cam V' and roller *v'*. If the disks are turned a quarter of a revolution from the position indicated, all of the rollers are moved out of operative relation with the corresponding valve rods E and A, and the valves are not actuated.

From the foregoing, it will be apparent that the timing of the distribution, both as to period and duration, of opening and closing the inlet and exhaust valves, may be nicely regulated and adjusted by properly positioning the supports which carry the rollers *v*, *r*, *v'*, and *r'*, with respect to the co-operating cams. It will also be noted that, in the arrangement shown, the face of the rollers *e* and *e'* is sufficiently wide to co-operate with the two sets of rollers *v* and *r*, and *v'* and *r'*, respectively.

The simultaneous shifting of the carriers or disks S and S' may be effected in any convenient manner and to suit the conditions imposed by any particular design of engine, but an efficient shifting mechanism is that illustrated in Figs. 1 and 2, which comprises a spur gear *n* attached to the

sleeve-like end of the right hand bearer disk S', which gear meshes with a drive gear *m*, provided with a crank *h*, said gear *m* being mounted in a suitable journal on the side of casing C.

The several disks S and S', are rigidly connected together by the following means: The two intermediate disks S and S' may be cast as an integral structure, while the outer disks S and S' are separate. Bolts *i*, provided with square ends, are mounted in the radial slots and, although free to move in said slots in a radial direction, said bolts effectively prevent any relative rotation between the bearer disks themselves. The middle portions of the bolts *i* are preferably rounded and serve as shafts or pintles around which the several transmission rollers *v*, *r*, *v'*, and *r'*, freely revolve. In order to keep the several rollers, just referred to, in proper alinement with their co-operating cams, suitable spacing sleeves *a* are applied to the bolts.

In addition to the function heretofore ascribed to the casing C, the latter serves to protect the entire apparatus and, moreover, serves as a container for oil, which may be supplied in sufficient quantities to submerge the various moving parts, and cause the same to move smoothly and noiselessly.

As heretofore indicated, the form of the invention illustrated in Figs. 3 and 4 is adapted to reversing engines, which are provided with means for starting the engine in either direction by compressed air, the air being admitted by the regular inlet valve. To provide for the appropriate operation of the inlet valve for starting by air pressure, and normal operation in either direction, four cams and four rollers are required for the actuation of each valve. In the example shown, the apparatus is applied to the inlet valve only, and the distribution of the starting air and the explosive mixture is effected at four different periods according to the rotation of the several cams V, R, DV, and DR, disposed along the cam shaft *b*. As illustrated R is the reverse, and V the forward gas inlet cam, DV the forward and DR the reverse compressed air cam; and corresponding rollers, transmitting motion from these cams to the valve stem E, are indicated by *r*, *v*, *dv* and *dr*, and in the position of the parts indicated in Figs. 3 and 4, the engine is adjusted to be run backward by the explosive gas mixture. The several rollers *r*, *v*, *dr* and *dv*, are mounted in the disk like bearers S, S, in a manner altogether similar to that heretofore described, and clearly indicated in the drawings. By shifting the bearer disks S, S, by means of a handle *h* a quarter of a revolution from the position indicated in Figs. 3 and 4, the roller *dr* is brought below roller *e* on valve stem E and, therefore, the valve is coupled to its actuat-

ing mechanism through roller *dv* for operation of the engine in a forward direction by compressed air, cam DV serving to lift roller *dv* at the appropriate instant to effect this operation. After the engine has been thus started forward under compressed air and the first cycle has been completed, the disks S, S,* are shifted another quarter of a revolution in the direction of the arrow shown in Fig. 4 and roller *v* is brought below roller *e* which causes "forward" gas inlet cam V to lift the inlet valve through stem E and interposed roller *v*. A further shifting of the bearer disks S through 90° brings roller *dr* under the valve stem *sd* so that cam DR, which is the "reverse" air admission cam, controls the operation of the inlet valve. It will, therefore, be seen that by adjusting the bearer disks S the engine may be started forward by compressed air, after which the motive fluid may be regularly admitted or the engine may be reversed under air pressure for which the explosive mixture may be substituted, in the manner indicated. It will be understood, of course, that the roller *e*, on the end of valve stem E, is of sufficient breadth to be engaged by any of the lateral space rolls *r*, *v*, *dr* and *dv*, carried in the bearer disks S.

In Fig. 5 there is shown a practical application of the modification shown in Figs. 3 and 4 to an explosive engine. In said Fig. 5, P indicates a pipe or conduit leading from a source of compressed air for starting the engine, said pipe connecting with the inlet pipe J below the admission valve E', and above a stop valve X. Said pipe P is also provided with a stop valve Y below its connection with pipe J, and said valves X and Y are operated alternately by means of cams on the hub Z of crank K so that when valve X is opened, valve Y is closed and vice versa, and after the engine has been started by the compressed air, valve X is preferably left open to admit the explosive charges to pipe J, and valve Y is closed to shut off the compressed air supply.

In the several modifications shown, the description has been directed to the operations wherein the intermediate members, the sev-

eral rollers *v* and *r*, variously designated in Figs. 1 to 4, are so disposed as to either completely couple or uncouple the valve rods with their actuating cams, but it will be understood that, by adjusting the carriers with respect to the cams and the valve rods so as to dispose the intermediate transmitting members more or less laterally with respect to a line connecting the axes of the valve stems and the center of the cam shaft, without, however, moving the parts into inoperative relation, both the time and duration of admission and exhaust may be altered or regulated to meet the exacting requirements of efficient operation of the engine.

What I claim is:—

1. The combination with an engine and a controlling valve therefor, of a valve actuating mechanism comprising a cam shaft, disk like supports having radial slots therein loosely mounted on said cam shaft, a roller mounted in said slots and adapted to be moved radially therein by the cam shaft, and means for shifting said supports about the cam shaft to bring the roller into and out of operative relation with the cam shaft and the valve.

2. The combination with an engine having inlet and exhaust valves, of actuating mechanism for said valves comprising a cam shaft, a revoluble frame or support loosely mounted on said cam shaft and provided with slots substantially radial to said cam shaft, rollers slidably mounted in said radial slots and coöperating with cams on said cam shaft, and means for adjusting the frame or support about the cam shaft to bring appropriate rollers into and out of coöperative relation with the respective valves and the actuating cams therefor; whereby the engine may be started, regulated, reversed or stopped according to the relation of the several rollers and the corresponding valves.

In testimony whereof I affix my signature, in presence of two witnesses.

FRIEDRICH HENNINGER.

Witnesses:

LOUIS VANDORN,
M. KNEPPERS.