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ENGINE, AND PARTICULARLY INTERNAL COMBUSTION ENGINE

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Fig. 1

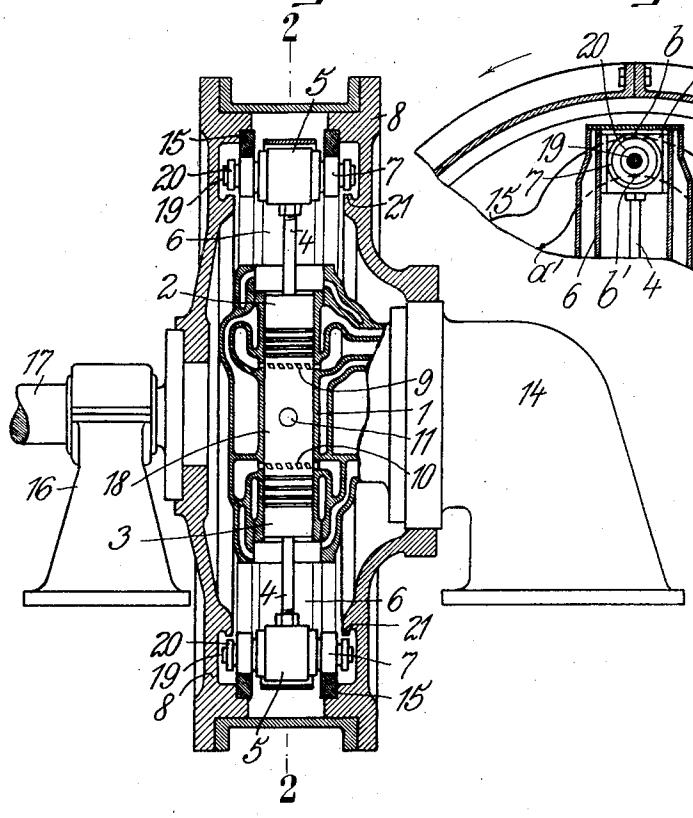
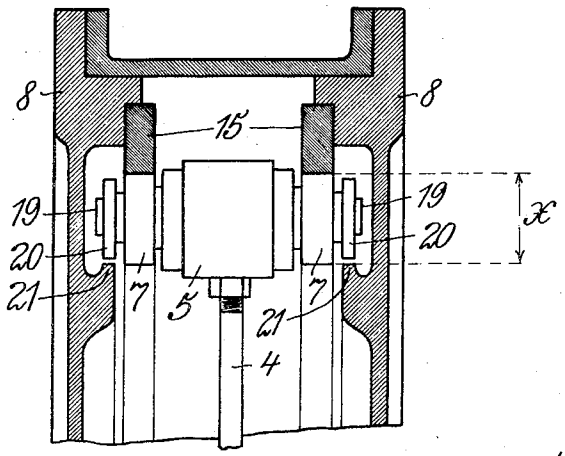


Fig. 2

Fig. 3



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ENGINE, AND PARTICULARLY INTERNAL-COMBUSTION ENGINE.

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To all whom it may concern:

Be it known that I, HERMANN MICHEL, a citizen of Germany, and resident of Voorde, in Holstein, Germany, have invented certain new and useful Improvements in Engines, and Particularly Internal-Combustion Engines, of which the following is a specification.

My invention relates to engines, and particularly to internal combustion engines of the two-cycle type in which the pistons cooperate with a cam track. When the cam track is stationary and the cylinders rotate, the arising centrifugal forces enable the engine, during its normal running, to operate satisfactorily even if a single external cam track is used, against which bear rollers mounted directly or indirectly on the pistons. During the starting operation, however, and also while the engine is coming to a stop, the centrifugal forces and the compression do not reach their normal values, and in view of this there is added an auxiliary internal cam track for positively giving the necessary motions to the pistons.

Since under the operating conditions explained above the rollers exert pressure on the main cam track and on the auxiliary track alternately, there is danger of shocks occurring whenever the direction of such pressure changes, and in order to avoid this the distance between the two tracks has hitherto been made either exactly equal to the diameter of such rollers, or (when using one roller to engage the main track and a different roller to engage the auxiliary track) the diameters of the rollers were of such a size that the rollers would be permanently in simultaneous light contact with the respective tracks. With such constructions, the engine will not knock or rattle when the direction of the pressure exerted on the cams is reversed, just as in engines with a crank shaft drive all play is avoided at the shaft bearings and crank bearings, in order to prevent knocking or rattling of the drive.

The present invention relates more specially to that type of an engine having a controlling cam, in which the cylinders are stationary whereas a fly-wheel or the like carries the rotary cam, the main track being constructed in such a manner that a single cam track will suffice for a machine of this type, during its normal operation. This result is obtained by designing and constructing those cam track portions which control the compression stroke from the point at which acceleration is reversed (that is to say, the second half of the compression stroke) in such a manner that the checking or retardation of the drive parts which is allowed by these cam track portions will at each point be smaller than the checking or retardation due to compression. Thus, taking into consideration the forces tending to accelerate the mass of the parts of the drive, the forces required to retard said parts in accordance with the shape of the track will, even during the second half of the compression stroke, be smaller than the forces which the compression exerts on the piston. The rollers will therefore always remain in contact with the cam track, assuming, of course, that both compression and the mass forces of the drive parts have their normal value and that in other respects the engine is operating properly. It will be understood that in this case also an auxiliary cam track is required to act during the starting of the engine and while it is coming to a stop.

The present invention contemplates using, in a structure of the character indicated above, a main cam track of the kind mentioned but located at a relatively greater distance from the auxiliary cam track, so that the rollers connected with the pistons will not touch the auxiliary track at the time they are in contact with the main track. Owing to the play thus purposely left between the rollers and the cam tracks there will indeed be a certain knock or rattle during the starting of the engine and while it is coming to a stop, but this is not a serious objection in practice, and, in fact, it offers a definite advantage in that this knock produces a distinct readily recognizable sound when there is any defect, so that trouble that may endanger the engine if allowed to remain unremedied, will be discovered during starting so that proper repairs or adjustments may be made before any serious harm results.

For instance, friction between a piston and its cylinder may be increased unduly by expansion of the piston due to excessive heating, or by the piston rings sticking or seizing owing to combustion residues (carbon deposits). With an engine having a crank drive, or a cam mechanism with rollers in permanent contact with the respective tracks, the increase in friction resulting

under the circumstances just mentioned will not be perceived until the particular piston becomes tightly jammed and interferes with the running of the engine, or even causes some part of the drive to break. The damage thus entailed is very serious. If, however, as in my present invention, the distance between the two cam tracks is purposely made greater than absolutely necessary to accommodate the roller, so that, owing to the increased looseness or play thus provided, the roller will touch only the main track during the normal running of the engine, the existence of abnormal friction or resistence will be revealed as soon as such disturbance arises, because in that event the gas pressure within the cylinder will be used up in overcoming the frictional resistance and will therefore be insufficient to give the piston such an acceleration as to keep its roller continuously against the main track. In the case of such a disturbance, therefore, the rollers will be knocked to and fro between the main track and the auxiliary track, and will thereby, at the very beginning of the disturbance, produce a peculiar, readily noticeable hum or rattle. Attention is thus called at once to the existence of trouble, and the proper remedy can be applied before any damage results.

Thus, with constructions as generally employed hitherto, particularly with engines having a plurality of cylinders, any excessive friction at one of the pistons would be discovered only after jamming of the piston had injured or even broken the respective cylinder. The present invention, however, insures a special cooperation between the mass acceleration forces of the parts of the drive, the gas pressure within the cylinder, and the particular shape of the main cam track, enabling the auxiliary cam track to be utilized for giving an audible indication of any trouble or disturbance, at the very beginning thereof, so as to provide unfailing means for avoiding a cylinder's being injured by a defective operation of the corresponding piston.

When adopting the expedient of causing separate rollers to engage the main track and the auxiliary track respectively, and if in this case the main roller and the companion auxiliary roller are mounted coaxially on the same crosshead, the amount of play required for the purposes of my present invention can be secured by making the distance between the main cam track and the auxiliary cam track but slightly greater than the sum of the radii of said two rollers.

A satisfactory and preferred embodiment of the present invention is illustrated by the accompanying drawings, in which Fig. 1 is a section, taken lengthwise of the axis of rotation, showing an engine constructed according to my improvement; Fig. 2 is a partial cross section, taken on line 2—2 of Fig. 1; and Fig. 3 shows the upper portion of Fig. 1, upon an enlarged scale.

The particular two-cycle internal combustion engine represented in the drawings has two stationary cylinders, forming a unit 1, supported on one side by a bracket or carrier 14, and containing the opposed reciprocating pistons 2 and 3, connected by rods 4 to the crossheads 5. The latter are movable radially along stationary guides 6, and carry rollers 7 cooperating with rotary cam tracks. These tracks are formed on, or secured to, rings 15 fastened to fly-disks or fly-wheels 8 rigidly connected so as to move in unison. One of the fly-wheels is journaled on the carrier 14, the other is connected directly to a driven shaft 17 journaled in a bearing 16.

Liquid fuel is introduced through an opening 11 into the combustion or working chamber 18 of the cylinder unit 1, which chamber is common to both pistons 2 and 3. The scavenging air enters through the scavenging slits 10 controlled by the piston 3, while the exhaust gases escape through the slits 9 controlled by the piston 2.

The main or outer tracks cooperating with the rollers 7 are composed of track portions or elements each extending from an outer point b to an inner point a and again to the next outer point b, each of these elements controlling a complete two-cycle operation. The section of each element extending from the point c to the point a, which section controls the second half of the compression stroke, is given such a configuration that, during normal running of the engine, the forces required to retard the parts of the drive in accordance with the shape of the track will be smaller than the forces which the compression within the chamber 18 exerts on the piston. Owing to this arrangement, the rollers 7 will be pressed forcibly and continuously against said main cam tracks as soon as the compression and the mass forces (momentum) of the parts of the drive have attained their normal values. Therefore, if the normal running of the engine were the only operative condition to be considered, the main cam tracks b—a—b would be sufficient.

On the axles 19 of the rollers 7 are further mounted additional rollers 20, which cooperate with the auxiliary (inner) cam tracks b'—a'—b', arranged in such a relation to main cam tracks b—a—b that the rollers 7 and the companion rollers 20 may engage the respective tracks at diametrically opposite points (with reference to the axis of such companion rollers). The auxiliary cam tracks are provided on annular ledges 21 forming part of the fly-wheels 8, and are parallel to said main cam tracks. In the particular construction illustrated, in

which companion rollers 7 and 20 are coaxial, the distance x (Fig. 3) between any point of the auxiliary cam track $b'—a'—b'$ and the adjoining main cam track $b—a—b$ is slightly larger than the sum of the radii of said rollers, but sufficiently so to insure the rollers 20 being out of contact with the auxiliary cam track when the companion roller 7 engages the main cam track, and vice versa.

During the starting (cranking) of the engine the piston 2, through its auxiliary rollers 20, bears on the annular ledges 21, that is to say, on the auxiliary cam tracks, while the piston 3 with its main rollers 7 bears on the rings 15, that is to say, on the main cam tracks. Therefore both pistons will be given the proper motions for starting, if the shaft 17 and the fly-wheels 8 and the cam tracks connected therewith, are rotated by a starting crank, a so-called self-starter, or any approved mechanism (not shown). As soon as the engine attains its normal running condition, the pressure within the chamber 18 will cause the auxiliary rollers 20 of piston 2 to move out of contact with the ledges 21, and the companion rollers 7 are brought into contact with the main cam tracks. Thus during the normal running of the engine all the rollers 7 carried by the cross heads 5 will be maintained in permanent contact with the main (outer) cam tracks.

Should the friction between any piston and its cylinder become excessive for any reason such as lack of proper lubrication, the continuous contact between the rollers 7 of that piston and the main track, and the resulting positive operation, are no longer maintained, the piston lagging behind during the outward stroke since the pressure forcing it outward is no longer sufficient, after overcoming the piston friction, to give the moving parts an acceleration corresponding to the shape of the tracks. Owing to such lagging or retardation, the auxiliary rollers 20 will come in contact with the annular ledges 21, but will be pushed again toward the main tracks, by the action of the auxiliary tracks. This operation will be repeated as the cam tracks rotate, and a characteristic rattling noise will be produced. The engineer, having his attention attracted by this unusual noise, will thus notice the defective operation of the piston at the very start of the trouble, and will therefore be able to apply the proper remedy before material injury results.

The construction set forth herein is applicable not only to internal combustion engines of the type described, but to any other engine having stationary cylinders and rotary fly-wheels operated by means of a cam track.

Various modifications may be made without departing from the nature of my invention as defined in the appended claims.

I claim:

1. An engine comprising stationary cylinders, pistons reciprocating therein, a rotary fly-wheel provided with a main cam track, operating members connected with the pistons and engaging said cam track to rotate the fly-wheel, the latter also having an auxiliary cam track for active cooperation with said members during the starting operation and while the engine is coming to a stop, those portions of the main cam track which are operative during the second half of the inward piston stroke being so constructed that the distance between the two cam tracks is sufficient to keep the said operating members out of contact with the auxiliary track when they are in engagement with the main track.

2. An engine comprising stationary cylinders, pistons reciprocating therein, a rotary fly-wheel provided with a main cam track, main operating rollers connected with the pistons and engaging said cam track to rotate the fly-wheel, auxiliary rollers likewise connected with said pistons, said fly-wheel also having an auxiliary cam track for cooperation with said auxiliary rollers during the starting operation and while the engine is coming to a stop, those portions of the main cam track which are operative during the second half of the inward piston stroke being so constructed that the distance between the two cam tracks is sufficient to keep the auxiliary rollers out of contact with the auxiliary track when the main operating rollers are in engagement with the main track.

3. An engine comprising stationary cylinders, pistons reciprocating therein, a rotary fly-wheel provided with concentric and parallel main and auxiliary cam tracks of different diameters, main operating rollers connected with the pistons and engaging said main cam track to rotate the fly-wheel, auxiliary rollers each coaxial with one of the first-named rollers and adapted for cooperation with said auxiliary track during the starting operation and while the engine is coming to a stop, those portions of the main cam track which are operative during the second half of the inward piston stroke being so constructed that the distance between the two cam tracks is sufficiently greater than the sum of the radii of a main roller and the companion auxiliary roller, whereby to keep the auxiliary rollers out of contact with the auxiliary track when the main operating rollers are in engagement with the main track.

In testimony whereof I have signed this specification.

HERMANN MICHEL.