June 24, 1930. J. J. BOLAND 1,765,713

INTERNAL COMBUSTION ENGINE

Filed Nov. 1, 1929 3 Sheets-Sheet 1

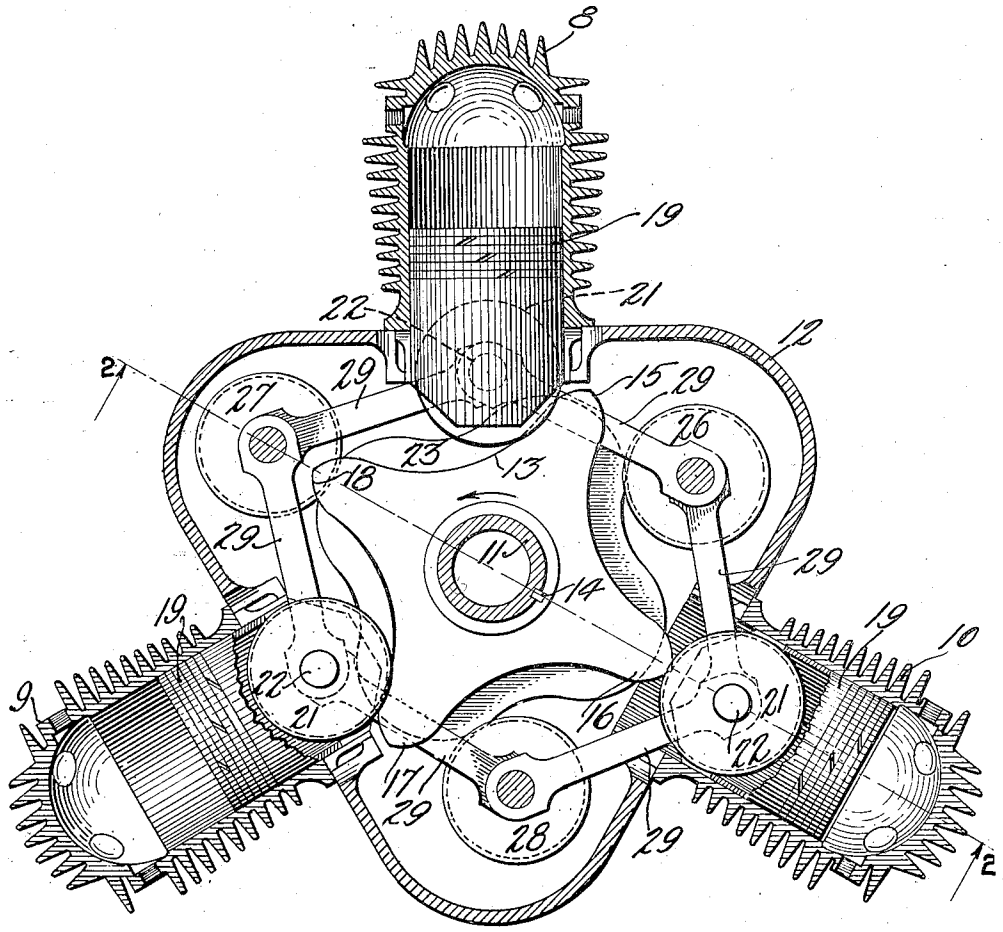

Fig. 1.

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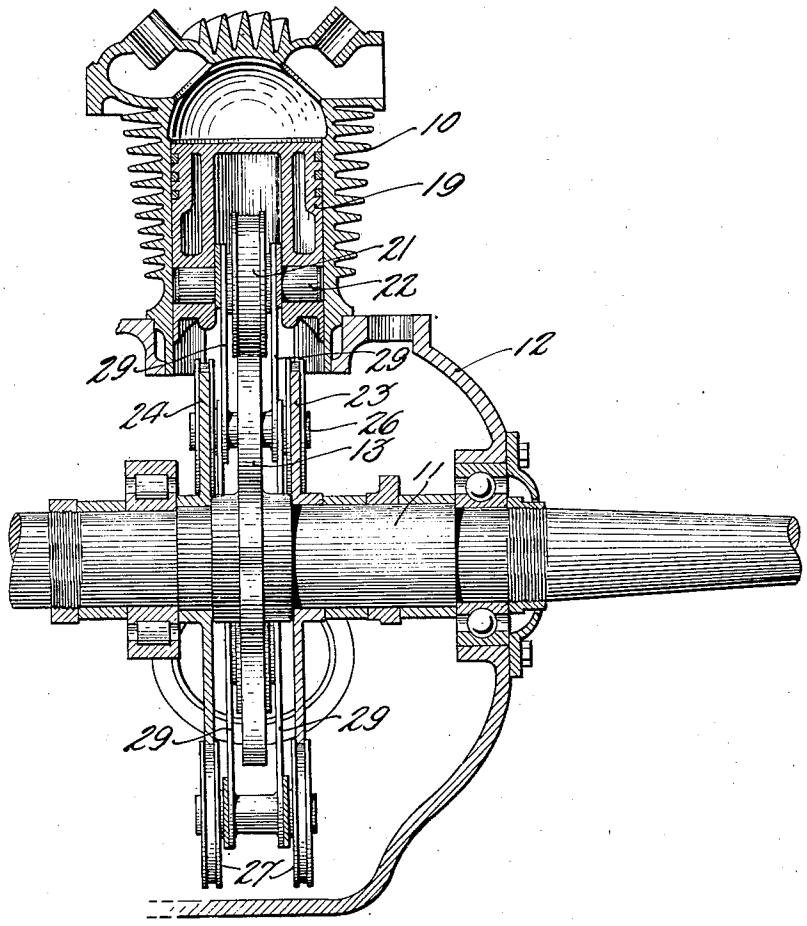

Fig. 2.

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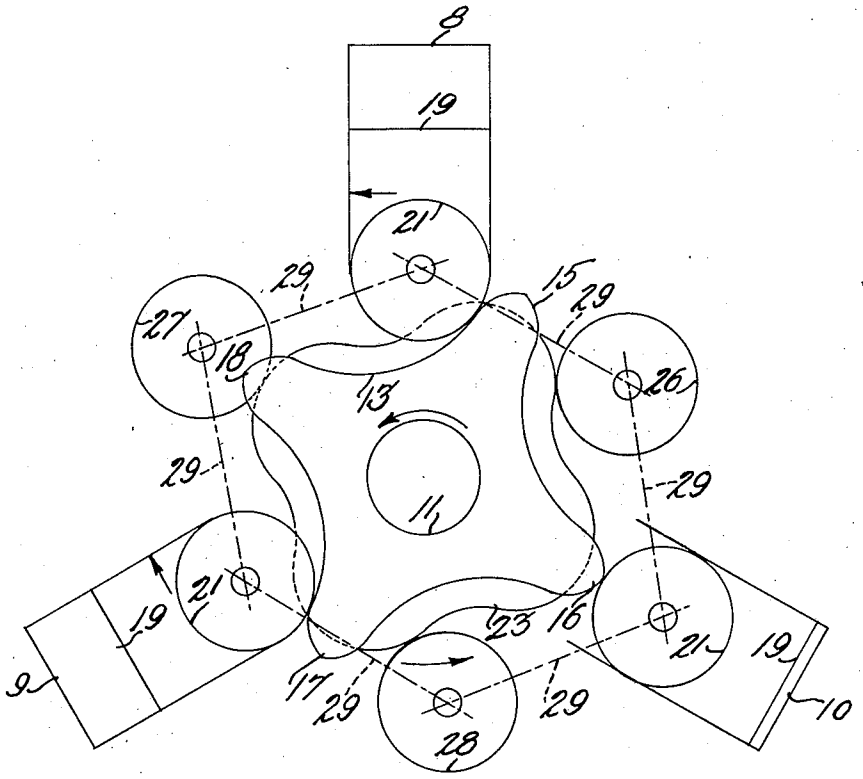

Fig. 3.

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UNITED STATES PATENT OFFICE

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INTERNAL-COMBUSTION ENGINE

Application filed November 1, 1929. Serial No. 404,122.

This invention relates to internal combustion engines having reciprocating pistons and more particularly to that type of engine wherein such reciprocating pistons transmit their thrust to the drive shaft by means of rollers and suitable cams in place of the usual connecting rods and cranks.

It is a requisite with an engine of such construction that these rollers constantly engage the peripheral portion of the cam under all movements of the pistons and it will be readily understood that any lost motion between the operating parts will not only greatly reduce the efficiency of the engine as a whole but will also result in a rapid deterioration of the parts with the resultant increase in various noises resulting therefrom.

In the past it has been found extremely difficult to maintain these piston rollers in constant engagement with the cam particularly at high speeds, and it will be readily appreciated that the condition resulting from such lack of contact is much the same as that resulting from loose connecting rod bearings in the conventional crank-shaft engine.

Another more serious problem that has confronted the designers of this type of engine in the past, was the elimination or reduction of the extremely high side pressures of the pistons against the cylinder walls which are induced by the action of the piston rollers against the cam, particularly during each power stroke.

Accordingly it is an object of the present invention to provide an improved mechanism having new and novel features in which the construction is such as not to be subject to the usual objections hereinbefore set forth.

In the present disclosure I have illustrated a means whereby side pressures of the pistons can be substantially eliminated in a multi-cylinder engine by interconnecting the piston rollers together in series with a set of intermediate rollers which operate in conjunction with a cam means in a manner as to equalize the side pressures between the pistons and to restrain them against any tendency towards lateral motion.

As shown in the drawings, I have provided a pair of cam members mounted on the drive shaft and disposed on either side of the main driving cam. These cams are formed with a different contour than that of the main cam and are engaged by separate sets of rollers which are linked to the piston rollers. With the additional improvements hereinafter more particularly described it will be seen that two of the objects are attained by the same mechanism, namely that the piston rollers are not only effectively constrained to remain in contact with the co-acting cam periphery, but also that the pistons themselves cannot be subjected to the usual side pressures so common to a cam engine.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings and a careful consideration of the following particular description and claims of one form of the invention as herein disclosed.

In the drawings:

Figure 1 is a cross section of the present invention with portions of the pistons broken away.

Figure 2 is a longitudinal section taken on the line 2—2 of Fig. 1.

Figure 3 is a diagrammatic view similar to Fig. 1.

With reference to the drawings, the present preferred embodiment comprises a plurality of conventional air-cooled cylinders 8, 9 and 10 arranged radially about a centrally disposed drive shaft 11, said cylinders and drive shaft being suitably supported, respectively on and within the engine casing 12.

A main driving cam 13 is mounted upon the shaft 11 and secured thereto by a key 14, said cam being provided with a plurality of lobes 15, 16, 17 and 18.

Each piston 19 is provided with a roller 21 rotatably mounted upon the usual wrist pin 22, said rollers being provided with side flanges and adapted to ride on the cam 13 in a manner as to rotationally drive the shaft

11 by means of the cam when the timed explosions occur within the cylinders 8, 9, and 10. It should be noted that one of the rollers 21 is always disposed in a driving position relative to the cam 13.

On either side of the cam 13 there are mounted, also in driving relation with the shaft 11, a pair of cam elements 23 and 24 which are identical in peripheral conformation but of a profile somewhat different than the main driving cam 13. In rolling contact with the cams 23, 24 there are mounted a number of double rollers 26, 27, and 28 which straddle the main cam 13 and which are connected to the rollers 21 by a series of linkages 29 conveniently disposed on either side of the piston rollers but intermediate the ends of the double rollers 26, 27 and 28.

It will be seen from Figs. 1 and 3 that the above mentioned rollers 26, 27 and 28 are disposed radially between the cylinders and that they do not at any time tend to operate the drive shaft 11. The function of these rollers is to co-act with the cams 23, 24 in such a manner as to create a force which when transmitted through the linkages, will constrain the piston rollers to follow the outline of the cam 13 and thus enforce a constant bearing relation therewith during the operation of the engine.

Another and equally important function of the mechanism just described, which was hereinbefore referred to, is the one which eliminates the usual side pressure of the pistons such as are common to this type of engine. With reference to the diagram shown in Fig. 3 of the drawings and assuming the engine to be of the two cycle variety, it will be seen that the piston 19 of cylinder 9 is on the firing stroke (rotation of the shaft as indicated by the arrow) while cylinder 10 is in the act of firing and the piston of cylinder 8 being on the compression stroke. It should be noted that with the roller of cylinder 9 transmitting the piston thrust to the cam lobe 17, there is a component force generated due to the position of the roller on the cam, said force tending towards lateral displacement of the piston in the direction indicated by the arrow which would ordinarily cause side pressures. With cylinder 8, which is on the compression stroke, the cam lobe 15 is also imposing two forces upon the piston, namely, an initial side thrust which is transformed into an axial thrust by the resistance of the cylinder walls, but it should again be noted that the side thrust of this piston is in a direction opposed to that of the one of cylinder 9. Also with the arrangement of the intermediate rollers 26, 27 and 28 as shown in the drawings, it will be seen that the cam 23 is tending to move the intermediate roller 28 in the direction indicated by the arrow thereon which is in a direction opposed to that of the roller 21, and said rollers being connected by the linkages 29, the forces are acting largely in opposite directions which has a tendency to equalize them. In view of the fact that all of the rollers are connected in series by the linkages, it will be understood that the tendency of any one piston towards side pressures is also resisted by all the other pistons within their cylinders and that the combined restraint is more than sufficient to overcome the tendency of any one piston towards side pressures.

I have cited herein just a few of the forces and counter forces in describing the operation of the present invention, but it should be understood that there are also present additional forces that have not been touched on. Those not mentioned will however be apparent to those skilled in the art.

There was no intention of depicting any particular type of engine cylinder in the drawings inasmuch as the improved construction herein disclosed is adapted for either two cycle or four cycle operation.

Variations may be resorted to within the scope of the invention and portions of the improvements may be used without the others, whilst not departing from the spirit of the invention.

Having thus described my invention, I claim:

1. In a reciprocating piston engine having a drive shaft, the combination of a plurality of cylinders arranged radially about the drive shaft, pistons adapted to reciprocate in said cylinders, a main driving cam secured to the drive shaft and rotationally actuated by the thrust of the pistons, a further cam means having a peripheral contour dissimilar to that of the main cam, a plurality of elements having a rolling contact with said cam means, and a series of linkages articulated both to said rolling elements and to said pistons; said linkages adapted to restrain the pistons against lateral displacement.

2. In a reciprocating piston engine having a drive shaft, the combination of a plurality of cylinders arranged radially about said drive shaft, pistons within the cylinders provided with rollers, a main driving cam secured to the drive shaft and adapted to be rotationally actuated by the thrust of the pistons which is transmitted to the cam by means of said rollers, a further cam means on said shaft having a peripheral contour dissimilar to that of the main cam, a plurality of elements having rolling contact with said cam means, and a series of linkages articulated both to said rolling elements and to said piston rollers; said linkages adapted to restrain the pistons against lateral displacement and to maintain all the rolling means respectively in contact with said cam and said cam means.

3. In a reciprocating piston engine having a drive shaft, the combination of a plurality

of cylinders arranged radially about said drive shaft, pistons adapted to reciprocate in said cylinders, a main driving cam secured to said drive shaft, rollers rotatably mounted in said pistons and drivably engaging said cam, a pair of cam elements mounted on the drive shaft and disposed on either side of the main cam, spaced apart rollers adapted to straddle the main cam, all of said rollers being disposed circumferentially about said drive shaft; the last said rollers being alternately arranged relative to the piston rollers, and linkages connecting all of said rollers in series.

4. In a reciprocating piston engine having a drive shaft, the combination of a plurality of cylinders arranged radially about said drive shaft, pistons in said cylinders, a main driving cam secured to the drive shaft, rollers rotatably mounted in said pistons and drivably engaging said cam, a further cam means disposed adjacent the driving cam, rollers disposed intermediate said cylinders and engaging said cam means, and linkages connecting all of said rollers in series.

5. An engine according to claim 4 in which the said further cam means has a different peripheral conformation than the first said main driving cam.

6. An engine according to claim 4 in which the said further cam means comprises two cam elements disposed on either side of the main driving cam.

Signed at Keyport, in the county of Monmouth, and State of New Jersey, this 31st day of October, 1929.

JOSEPH J. BOLAND.