April 24, 1928. 1,666,893

C. G. GARRARD

MECHANISM FOR PRODUCING CAM LIKE OR SIMILAR IRREGULAR MOTIONS

Filed Dec. 23, 1924 3 Sheets-Sheet 1

Fig.1.

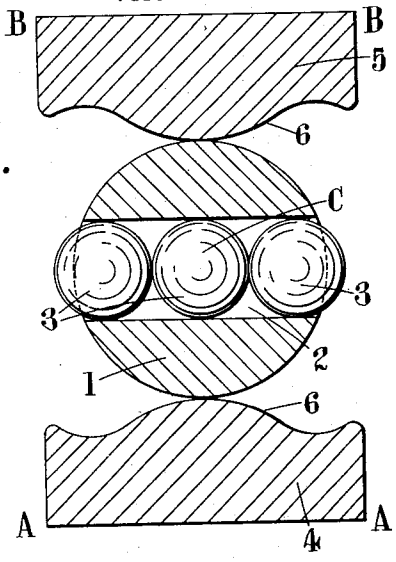


Fig.2.

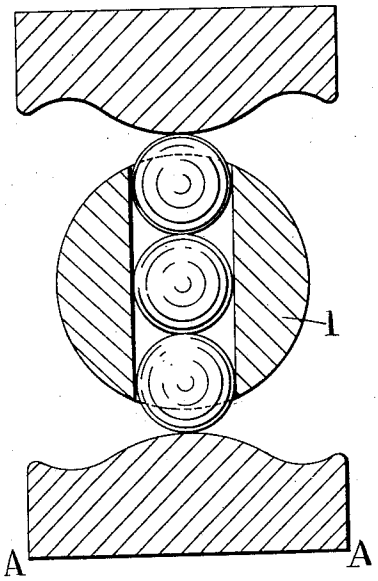
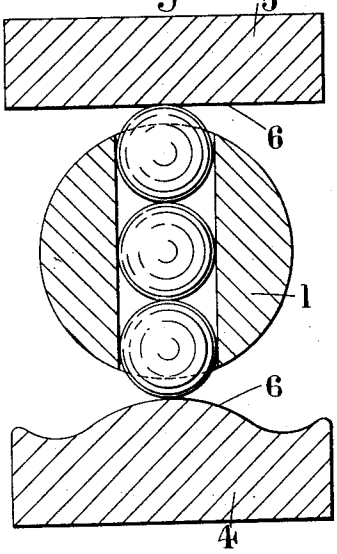


Fig.3.



Charles George Garrard INVENTOR

BY Darby & Darby

his ATTORNEYS

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Fig.4.

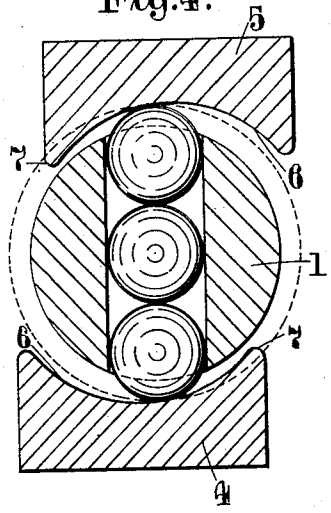


Fig.5.

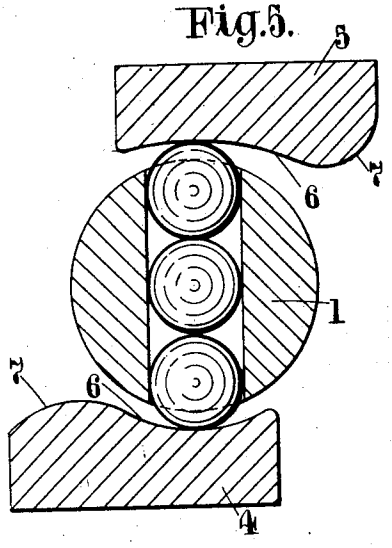
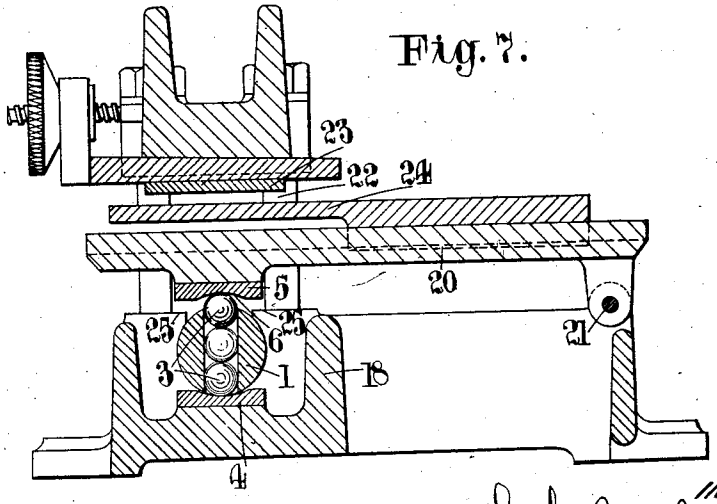


Fig. 7.



Charles George Garrard INVENTOR

BY

Darby & Darby

his ATTORNEYS

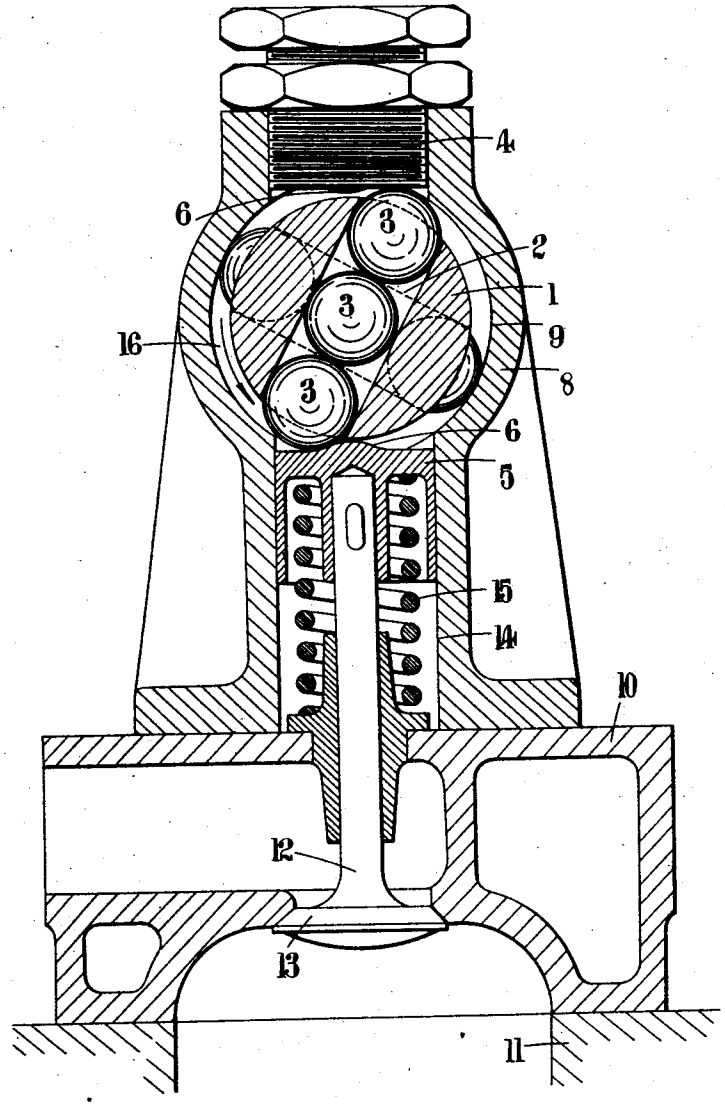
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C. G. GARRARD

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Fig.6.



Charles George Garrard INVENTOR

BY

Darby & Darby

his ATTORNEYS

Patented Apr. 24, 1928. 1,666,893

UNITED STATES PATENT OFFICE.

CHARLES GEORGE GARRARD, OF LONDON, ENGLAND, ASSIGNOR TO GEORGE STANLEY WALPOLE, OF LONDON, ENGLAND.

MECHANISM FOR PRODUCING CAM-LIKE OR SIMILAR IRREGULAR MOTIONS.

Application filed December 23, 1924, Serial No. 757,598, and in Great Britain June 5, 1924.

This invention relates to an improved mechanism for producing cam-like or similar intermittent motions.

As is well known a cam is a piece of mechanism which is used for changing a rotary motion into an intermittent reciprocating motion, and in this sense the motion produced by the device which is the subject of the present invention is cam-like. The invention can be applied to a very large variety of purposes for many of which cams have hitherto been used, and it is mainly, though by no means exclusively, intended for use in cases where the desired movement is to be effected against considerable pressure or in which frictional losses of energy are appreciable, and/or are to be avoided as far as possible.

Thus for example the device may be utilized for operating embossing or cutter-crush machines in which the work is arranged between upper and lower platens one of which is then forced against the other by means of rotary movement imparted to a cam shaft. Considerable pressure, depending on the nature of the work, has frequently to be exerted, and losses of energy take place, due to the friction between the cams and the surfaces contacting with them. The substitution of the present device for the cams enables considerable savings of energy to be effected, from which many advantages in operation accrue.

The device may also be utilized in printing presses, gold blocking presses, for operating the valves of internal combustion engines, and for many other purposes which need not be specified here.

According to the present invention the desired movement is produced by means of rolling bodies loosely mounted in a shaft or rotatable member and which roll on each other whilst the movement is being produced.

In carrying the invention into effect in a convenient form, balls or cylindrical rollers are loosely mounted within a transverse slot of a rotatable shaft, mandril, cage or the like, the outermost roller at each end of the slot protruding therefrom. The excess of the diameter at the protruding balls over that of the shaft or cage should slightly exceed the distance of travel of the member to be actuated. In operation the said protruding rollers each bear against and roll on a roller track. In most cases of applying the invention one track is fastened to the frame of the machine and the other to the part to be moved relative thereto, but both tracks may be fastened to movable members. The tracks may be either flat or curved, their shape being designed to give the intermittent motion of the character desired. Three, five or other odd number of rollers are used. The intermediate roller or rollers, may if desired, be made of smaller diameter than the protruding rollers. The dimensions of the slot are such as to provide just sufficient clearance for the rollers to rotate freely each about its own axis.

With an odd number of rollers, the motion of the rollers in contact with each other and with the two tracks is pure rolling without rubbing or sliding. The invention is therefore particularly adapted to produce intermittent cam-like movement under heavy pressure.

The balls or rollers and the tracks are preferably made of hardened and polished steel, as in ball bearing practice.

Any suitable means may be provided for retaining the rollers or balls within their slot and preventing them from falling out by gravity when owing to the position of the mandril, they are no longer supported by either of the tracks. For this purpose the edges of the slot may be slightly turned over, or any other convenient means, not interfering with the rotation of the rollers, may be employed.

I append drawings illustrating the invention.

Fig. 1 shows my cam device with one form of track.

Fig. 2 shows the same structure with the roller at right angles to its position of Fig. 1.

Fig. 3 shows a modification in which the upper track is a plane surface.

Fig. 4 is another modification showing circular tracks.

Fig. 5 is a still further modification showing another form of track.

Fig. 6 shows my invention applied to a valve structure.

Fig. 7 shows the invention applied to a press.

In Figs. 1 and 2 the mechanism produces

relative movement of two movable members, the two tracks have similar convex surfaces 6 over the operative portions, and a relatively rapid movement is produced. Fig. 1 shows the two tracks or movable members when closest together, Fig. 2 when furthest apart.

In Fig. 3, the surface of the track 4 is similar to that in Figs. 1 and 2, that of the track 5 is flat, and a slower movement is produced than that produced by the mechanism of Figs. 1 and 2. One of the tracks 4 or 5 may be fixed to the frame of the machine, the rollers will then move along the slot when in operative action, as well as rolling on each other.

In Fig. 4 both tracks 4 and 5 are concave over the greater part of their length at 6, and their intermediate relative movement is very slow while the rollers are rolling on said concave parts, and very rapid when the rollers are rolling round the rounded corners 7.

In Fig. 5, the concave surface 6 of the track 4 is concentric with the surface of the shaft 1, the concave surface 6 of the track 5 is of slightly greater radius of curvature, and the relative movement produced is still slower than that given by the mechanism of Fig. 4. The convex portions 7 of the two tracks are of much larger radius of curvature than in Fig. 4, and the corresponding portion of the relative movement of the tracks 4 and 5 is more gradual.

Fig. 6 illustrates the invention as applied in one form to operate the valves of an internal combustion engine.

Fig. 7 is a sectional view of an embossing or cutter crush machine operated by the invention.

It will be apparent that the improved mechanism can be put to many different uses and can be compounded in various ways, thus for example, a movement of the kind described can be utilized for operating the valves of internal combustion engines and the like or for regularly operating any desired assembly of reciprocating parts at regular and predetermined intervals. In the case of the valves of a multi-cylinder engine the mandril can be provided with a plurality of slots or holes arranged radially at various angles to suit the desired timing and a separate set of rollers or balls will be disposed within each slot or hole. The valve stem can be arranged in line so as to project into the housing for the mandril and each valve stem will then be operated in turn whenever the corresponding set of balls passes over it.

Fig. 6 refers to an engine with overhead valves, and shows one convenient form in which the invention may be carried into effect. Many other arrangements are however possible. The shaft 1 is mounted in a casing 8 fastened to the valve casing or cylinder-head casting 10, which is fastened to or integral with the cylinder casting 11. The casing 8 is provided with a cylindrical bore 9 coaxial with the shaft 1, on which the rollers 3 may roll with an easy fit. The fixed track 4 is an adjustable screw plug and its operative contact surface 6 comprises a spherical portion of small radius. The movable track 5 is in the form of a guide piston or cap fastened to the end of the valve stem 12 and slidable in a vertical cylindrical bore 14 of the casing 8. The arrangement of the valve rod 12, cap 5 and valve spring 15 is the usual well known one. The shaft is shown in an angular position in which the valve is closed on its seating, and the rollers 3 are beginning to open the valve 13, the rotation of the shaft being in the direction of the arrow 16. During opening or closing movement, the balls move along the slot 2, as well as roll on each other and the surfaces 6 of the fixed and movable tracks.

It is to be observed that the pressure exerted to open the valve against the resistance of the spring is transmitted through the three rollers from the fixed track 4 to the movable track 5, and that when the valve is full open and the pressure greatest there is no side pressure on any of the parts. In other positions of the valve during the opening or closing movement there is only a slight side pressure of the movable track 5 on the cylindrical bore 14, where the surface is ample, and of the two outer balls 3 on the walls of the slot 2. It is also to be observed that the valve is opened and closed twice in each revolution of the shaft 4, which therefore in a four stroke cycle engine turns at one fourth of the speed of the engine crank shaft.

Further in a multi-cylinder engine, the slots 4, in the shaft 1 are at different angles for each of the valves, and one set of three rollers will be in operative action between the fixed and movable tracks while other sets of rollers are rolling on the bore 9 of the casing. The device therefore in itself forms roller bearings for the valve shaft 1, and no other bearings, except to locate the shaft longitudinally, are required.

Fig. 6 shows the ease with which the invention can be adapted for overhead valves, doing away with tappet and levers and having extremely light weight subjected to the cam motion, and at the same time providing an easy method for adjusting the valve clearance from the opposite side of the cam shaft to the valve which is being operated, which adjustment can be made while the engine is working.

The relative motion of the valves, i. e. speed of opening and closing can be altered at any time by the shape of bottom end of adjusting screw 4 being designed as required.

also by the valve cap 5 being similarly designed and shaped.

The ball cam shaft 1 is not subjected to any pressure due to pushing open the valve, this pressure being between the adjusting screw and the valve cap, the ball cam shaft being subjected to torsion only and therefore requires supporting at the ends only, the balls themselves supporting it right along the housing bore due to the fact that the holes for these three balls having to be bored at various angles around the shaft.

The relative timing between valves and cylinders is fixed by the relative angles at which the slots in the cam shaft are bored, for the sets of balls or rollers. The bore must pass exactly across the centre of the shaft because this cam shaft requires to run at quarter engine speed, it having two positions at which valve is lifted.

The bored hole into which the cam shaft is fitted should be of the same diameter as that over the three balls or rollers. The balls or rollers will then rotate at a continuous speed and serve as a ball bearing supporting the shaft.

It is clear how simple and straightforward all the machinery operations are, and it will therefore follow how cheaply the arrangement can be made compared with the present practice.

The lift of the valve is the difference between the sum of the diameters of the three balls or rollers and the distance between the adjusting screw and the valve cap.

In Fig. 7, the track 4 is fastened to the frame 18 of the machine, and the movable track 5 to the table 20 pivoted at 21 to the frame. The cam shaft 1 is shown in the position when the table is lifted to its extreme upper position, and the "work" at 22 is being pressed between the upper platen 23 fixed to the frame of the machine and the lower or movable platen 24 fastened to the table 20. The lowest position of the table 20 is determined by the movable track 5 resting on supports 25 in fixed relationship to the frame, in which position the operative surface 6 of the track 5 is just clear of the surface of the cam shaft 1. The maximum pressure is exerted on the work when the mechanism is in or near the position shown in the drawings when a practically direct pressure is transmitted through the balls or rollers 3 from the fixed track 4 to the movable track 5 and thence to the work at 22. Usual well known means are provided for adjusting the upper platen according to the thickness of the work and the pressure to be exerted thereon, but these do not form any part of the present invention. In such machines the cam shaft may be oscillated to and fro by a hand lever or operated in any other manner.

I claim:

1. A cam-like mechanism for producing relative movement between two bodies from the rotational movement of a shaft, comprising two bodies, a cage on said shaft, said cage having a diametrical slot; an odd number of rollers, not less than three, loosely housed in said slot, and tracks for said rollers on said bodies, the sum of the diameters of the rollers exceeding that of the cage and the rollers being adapted to roll upon the two roller tracks fixed relatively to the said bodies.

2. A cam-like mechanism for producing movement of a machine part from the rotational movement of a shaft comprising two tracks forming part of the machine, one being fixed and the other movable, a cage on said shaft having a diametrical slot; an odd number of rollers, not less than three, loosely housed in said slot; the sum of the diameters of the rollers exceeding that of the cage and the rollers being adapted to roll upon the fixed roller track in fixed relationship to the frame of the machine and upon the movable roller track fixed relatively to the said machine part.

3. A cam-like mechanism for operating embossing and cutter-crush machines from the rotational movement of a shaft comprising a fixed and movable track on said machine, a cage on said shaft having a diametrical slot; an odd number, not less than three, of rollers loosely housed in said slot; the sum of the diameters of the rollers exceeding that of the cage and the rollers being adapted to roll upon the fixed roller track in fixed relationship with a stationary pressure member and upon the movable roller track fixed relatively to a movable pressure member of said machine.

4. A cam-like mechanism for producing relative movement between two bodies from the rotational movement of a shaft comprising a cage on said shaft; a plurality of rollers loosely housed in said cage; and roller tracks fixed relatively to the said bodies; said cage being so constructed that the sum of the diameters of the rollers exceeds that of said cage so that said rollers operate on said roller tracks twice for each revolution of said cage.

5. In a cam-like structure for producing intermittent harmonic motion from rotary motion, the combination with a cam surface of a rotating shaft, a cage on said shaft having a diametral slot therein and a plurality of rollers in said slot projecting above the surface of the cage, said rollers being adapted to move on said cam surface to exert a force thereon.

In testimony whereof, I have hereunto set my hand on this twelfth day of December, 1924.

CHARLES GEORGE GARRARD.