April 15, 1930. E. BOUILLON 1,754,216

DEVICE FOR TRANSFORMING A RECTILINEAR MOVEMENT INTO A CONTINUOUS ROTARY MOVEMENT

Filed Feb. 25, 1928 2 Sheets-Sheet 1

FIG. 1.

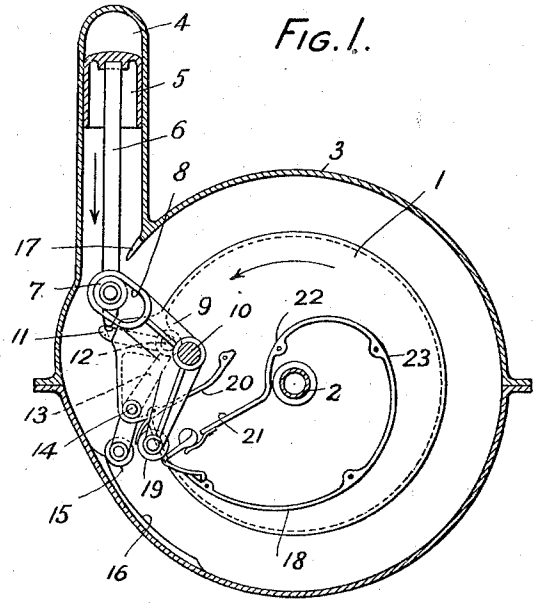


FIG. 2.

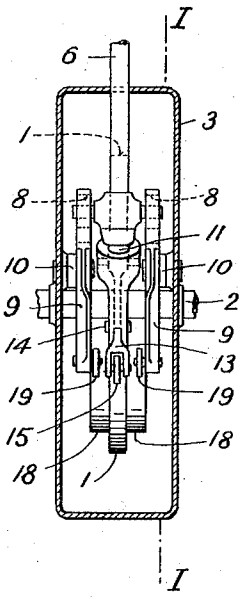


FIG. 3.

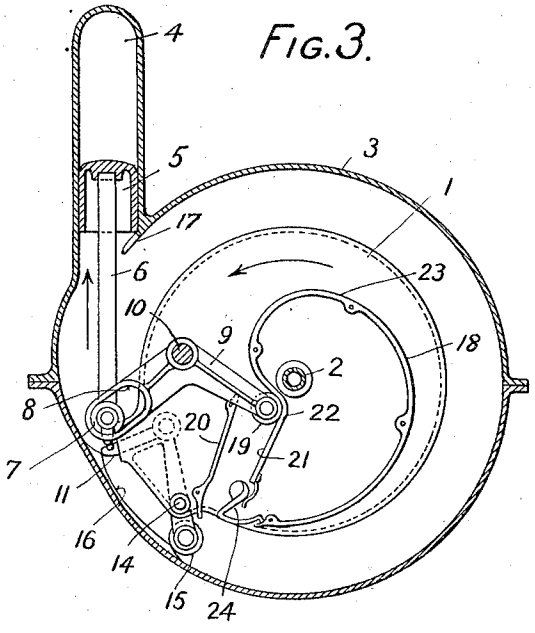
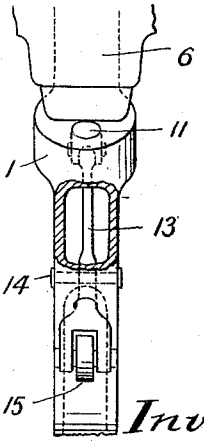


FIG. 4.



Inventor
Emile Bouillon
By Watson & Coleman
Attys

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FIG. 5.

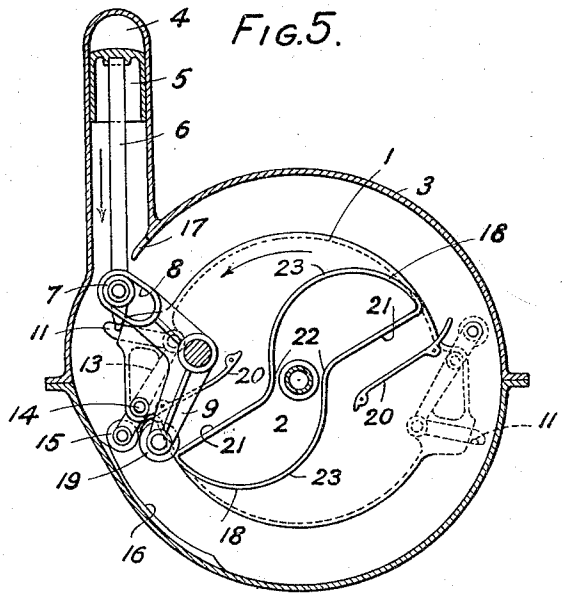


FIG. 6.

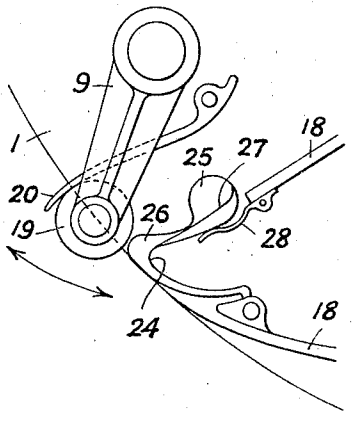
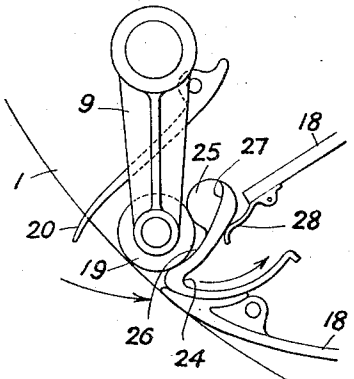


FIG. 7.



Inventor
Emile Bouillon
By Watson E. Coleman
Atty

Patented Apr. 15, 1930 1,754,216

UNITED STATES PATENT OFFICE

EMILE BOUILLON, OF BRUSSELS, BELGIUM, ASSIGNOR OF ONE-THIRD TO WALTER GEORGE TARRANT, OF BYFLEET, SURREY, ENGLAND, AND ONE-THIRD TO ROBERT ALLEN, OF CHILTEM RISE, NEAR READING, ENGLAND

DEVICE FOR TRANSFORMING A RECTILINEAR MOVEMENT INTO A CONTINUOUS ROTARY MOVEMENT

Application filed February 25, 1928, Serial No. 257,031, and in Belgium February 25, 1927.

This invention has for its object to transform a rectilinear movement such as and particularly, for example, the rectilinear movement of the rod of a power piston into a continuous rotary movement without the intermediary of a connecting-rod and crank system, and to ensure the return of the motor piston or other driving member by means of the rotary movement produced, but without the motor- or driving-member, for example, the piston rod, following this movement; the return of the motor- or driving-member, for example the piston rod, being capable of being made at a speed different from that at which the power stroke is effected and this return movement being either uniform or uniformly accelerated or retarded or comprising one or more periods at rest.

In other words, and in its particular application to motors, the invention has for its object to apply the motive effort of a single-acting piston tangentially to a wheel keyed on a shaft and to effect the return stroke of the piston by means of the rotary movement produced, without the rod of the said piston following this movement.

The device which forms the object of the invention essentially consists of a shaft, journalled in a casing supporting the motor member, for example the motor cylinder, this shaft having thereon a transverse arm at the end of which the said motor member, for example, the rod of the driving piston transmits the motive effort tangentially to the circle of revolution of the said arm whilst driving a lever which pivoted in the casing is guided by a cam of the rotating system in order to drive the motor-member during its return stroke.

A preferred form of construction of the invention, particularly in its application to motors, consists in forming the transverse arm by a spur projecting from a fly-wheel keyed on the driven shaft and on which are formed the cams or guides serving to guide the return lever for the motor-member.

Other characteristics of the invention will appear from the following description of an example of one way of carrying out the invention as applied to a motor and shown on the accompanying drawings.

Fig. 1 is a vertical section on the line 1—1 of Fig. 2 of a construction adapted to the operation of one working cylinder wherein the piston executes a forward and backward stroke for one revolution of the fly-wheel, the driving piston being in the position corresponding to the commencement of the working stroke.

Fig. 2 is a side view, the casing of the fly-wheel being partially removed and shown in section.

Fig. 3 is a view similar to Fig. 1, but showing the parts in the positions they occupy at the commencement of the back stroke of the piston.

Fig. 4 shows, detached from Fig. 2, the lever ensuring the positioning of the projecting spur of the fly-wheel upon which the motive effort is exerted.

Fig. 5 shows, in a vertical section similar to Fig. 1, a modification adapted to the operation of a motor allowing of two forward and two backward strokes of the piston for one revolution of the fly-wheel.

Figs. 6 and 7 show on a larger scale a detail of the construction of the guiding cam for the lever ensuring the return stroke of the motive piston.

The fly-wheel 1 is keyed on the shaft 2, which is journalled in the casing 3 forming a cover and carrying the motor cylinder 4, of which 5 indicates the piston, and 6 the rod which carries two rollers 7 engaged in the slots 8 of the bell-crank levers 9 pivoted at 10 in the casing 3 on either side of the fly-wheel 1. The power strokes of the piston 5 are transmitted to the fly-wheel 1 by the end of the rod 6 acting tangentially to the wheel on the spur 11 projecting therefrom. This spur 11, which slides in the wheel 1 is pivoted at 12 to one end of a lever 13 which is pivoted at 14 on the said wheel and is provided at its other end with a roller 15. This roller 15, during the rotation of the wheel in the direction indicated by the arrow thereon, bears in the casing on a cam 16 in order to rock the lever 13 and cause the spur 11 to project, when this spur should be sub-

jected to the action of the rod 6 of the piston 5 (Fig. 1) during the power stroke of this piston, which is produced in any known manner by known means which are not illustrated.

The cam 16 is so arranged that, during the operation of the rod 6, the end of the spur 11 describes a straight line.

The spur 11, because of its weight and also because of the fact that it is connected to the longer arm of the lever 13, is naturally projected outwardly by the action of centrifugal force. This effect greatly lessens the effort to be supplied by the roller 15 and will avoid hammering at the commencement of the cam 16. On the other hand, with a view to avoiding the striking of the rod 6 by the spur 11 due to a premature projection of the latter, two inclined planes 17 (spaced sufficiently to allow of the passage of roller 15) will hold the said spur 11 at a certain distance from the rod 6.

During the motive stroke imparted by the rod 6 to the wheel, by acting on its spur 11, this rod 6 actuates the bell-crank levers 9 which pass from the position indicated in Fig. 1 to that indicated in Fig. 3. At this moment, the useful stroke of the piston 5 being completed, the rotation of the fly-wheel brings the cams 18 carried by this wheel into contact with the rollers 19 of the levers 9 in order to bring back these levers from the position indicated in Fig. 3 to that indicated in Fig. 1 and thus effect the return stroke of the piston 5 by acting on its rod 6; the cycle described being repeated at each revolution of the wheel 1.

Supplementary cams or guides 20 are furthermore disposed on either side of the fly-wheel 1 in order to form with the cams 18 guides in which are engaged the rollers 19 of the levers 9 with a view to uniting or synchronizing the movements of the fly-wheel 1 and of the piston 5, particularly for placing this latter in the required position for starting the engine.

In Fig. 5, the fly-wheel 1 carries on either side two cams 18 and two cams 20 so as to obtain, by producing two rocking motions of the levers 9 per revolution, two back strokes of the motor piston, either with a view to working on a 4-stroke cycle, or with a view to obtaining two motive impulses per revolution by providing the fly-wheel wih a second spur 11 and the casing 3 with a second cam 16, shown in dotted lines.

The invention, by the multiplication of the number of power or motor cylinders and by the uniform and equal spacing of the points of application of the motive impulses on a fly-wheel with a number of cams or an appropriate number of fly-wheels keyed on the same shaft permits of rendering the motive pulsations largely unnoticeable and of obtaining, for example by the use of internal combustion engine cylinders, an excellent combustion or explosion turbine which is powerful and rotates slowly.

If the members or parts are only considered from the static point of view it will be seen that on turning the wheel 1 in the direction indicated by the arrow, the cams 20 overtake the rollers 19 which, rolling over the inclined plane thereof engage between these cams and the cams 18 and pass along the right-hand part 21 of the latter, thus causing the rocking of the levers 9 on their pivots 10 and the movement of the piston 5 in the direction indicated by the arrow in Fig. 5. The rotation of the wheel 1 continuing, the rollers 18 approach towards the centre of the wheel 1 and encounter a neutral portion 22 of the cams 18 which produces a period during which the levers 9 and piston 5 are at rest; then the convex portion 23 of the cams 18, which forms a kind of involute curve, produces the inverse rocking of the levers 9 and an inverse stroke of the piston 5.

In Figs. 6 and 7, the outer end of the cam 18 comprises a rocking nose 24 pivoted at 25, and forming an extension of the guiding curve 23 which the cam offers to the roller 19 of the lever 9. This nose 24 has two inclines 26 and 27 arranged one on each side of the pivot 25 in the part 21 of the cam presented to the roller 19 during the useful stroke of the piston 5, when the roller 19 engages between the guide 20 and the straight portion of the cam 18. This arrangement has the advantage of increasing the amplitude of oscillation of the lever 9 to ensure a complete return stroke of the piston 5 (Fig. 6) without hampering the beginning of the power stroke of this piston, the nose 24 being rocked at this moment (Fig. 7), under the action of roller 19 acting on the incline 26, to withdraw or recede. During this power stroke, the roller 19 strikes the incline 27 and brings the nose 24 back into the position shown in Fig. 6 where it is held under the action of centrifugal force to be presented anew to the roller 19 and be rocked thereby as has already been disclosed. The nose 24 is furthermore provided with a light spring 28 tending to hold it, particularly in the position indicated in Fig. 6.

I claim:—

1. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a rotatably mounted wheel, a piston, a rod carried thereby, means whereby upon the reciprocation of the piston said rod will engage said wheel tangentially thereof to impart rotary motion thereto, and means connected to the piston rod and controlled by said wheel for regulating the idling movement of the piston.

2. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a rotatably mounted wheel,

a piston, a rod carried thereby, means carried by and projecting from the peripheral face of the wheel designed to receive a working thrust from the rod reciprocating tangentially to the periphery of the wheel, and means coupling the piston rod and the wheel and controlled by said wheel for regulating the idling movement of the piston.

3. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a wheel, a piston and piston rod designed to reciprocate on a line tangentially to the periphery of the wheel, a spur carried by and projecting from the periphery of the wheel to receive an end thrust from the piston rod on its power stroke, and means for causing said spur to be extended at the proper period in the rotation of the wheel to receive the thrust of said rod.

4. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a rotatably mounted wheel, a piston, a piston rod carried by and extending rigidly from said piston, said piston and rod being designed to reciprocate in a line tangentially to the periphery of said wheel, means carried by the wheel upon its periphery for receiving a power thrust from said piston rod, and a control member having pivotal connection with said piston rod and with the wheel and actuated by said wheel for timing the idling movement of the piston.

5. A device for transforming a rectilinear movement into a continuous rotary movement comprising a rotatably mounted wheel, a piston, a piston rod carried by and extending rigidly from said piston, said piston and rod being designed to reciprocate in a line tangentially to the periphery of said wheel, means carried by the wheel upon its periphery for receiving a power thrust from said piston rod, a pivotally mounted control arm having pivotal connection with said piston rod, and a cam actuated by said wheel and operating said arm to time the idling movement of said piston.

6. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a rotatably mounted wheel, a piston and piston rod rigidly connected and designed to reciprocate in a line tangentially to the periphery of said wheel, a spur reciprocably mounted in the peripheral portion of the wheel to project radially thereof, and cam operated means timed to cause the projection of said spur to receive a power thrust from said piston rod.

7. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a rotatably mounted wheel, a piston and piston rod rigidly connected and designed to reciprocate in a line tangentially to the periphery of said wheel, a spur reciprocably mounted in the peripheral portion of the wheel to project radially thereof, cam operated means timed to cause the projection of said spur to receive a power thrust from said piston rod, a pivotally mounted bell crank having pivotal connection between one arm and said piston rod, and a cam element controlled by said wheel and operating upon the other arm of the bell crank to control and time the idling movement of the piston and piston rod.

8. In a device of the character described including an arm pivotally mounted at one end, means normally resisting movement of the arm in one direction, and a cam structure designed to act upon the free end of said arm having a portion thereof remote from the center of rotation formed to provide a yieldable surface designed to take up the shock incident to a forced engagement of said arm with the cam, said means maintaining engagement between the arm and cam.

9. In a device of the character described including an arm member pivotally mounted at one end and a power piston connected with the arm and operating to forcibly swing it at predetermined periods, a cam structure adapted to have the free end of the arm engaged thereagainst, formed to describe a substantially involute curve, said cam having a portion remote from the center of rotation thereof designed to yield when engaged by the free end of said arm moving under the influence of said piston, to reduce the shock incident to such contact of the arm therewith, said piston maintaining engagement of the arm with the cam.

10. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a circular rotatable body, a piston and piston rod rigidly connected and designed to reciprocate tangentially to the periphery of the body, means carried by the body upon its periphery for receiving a thrust from said rod upon operation of the piston, a cam upon one face of the body formed to describe a substantially involute curve and having a straight portion connecting the inner and outer ends of the curved portion thereof, a bell crank having loose pivotal connection between the free end of one arm and the piston rod and arranged to have the free end of the other arm brought into engagement with said cam, and means whereby that portion of the cam at the point of connection between the outer end of the curved and straight part thereof will yield to pressure placed thereon by the adjacent crank arm when the same is actuated by the piston.

11. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a circular rotatable body, a piston and piston rod rigidly connected and designed to reciprocate tangentially to the periphery of the body, means carried by the body upon its periphery for receiving a thrust

from said rod upon operation of the piston, a cam upon one face of the body formed to describe a substantially involute curve and having a straight portion connecting the inner and outer ends of the curved portion thereof, a bell crank having loose pivotal connection between the free end of one arm and the piston rod and arranged to have the free end of the other arm brought into engagement with said cam, means whereby that portion of the cam at the point of connection between the outer end of the curved and straight part thereof will yield to pressure placed thereon by the adjacent crank arm when the same is actuated by the piston, and an auxiliary cam arranged in substantially spaced parallel relation with said straight portion of the first mentioned cam for coaction therewith.

12. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a circular rotatable body, a piston and piston rod rigidly connected and designed to reciprocate tangentially to the periphery of the body, means carried by the body upon its periphery for receiving a thrust from said rod upon operation of the piston, a cam upon one face of the body formed to describe a substantially involute curve and having a straight portion connecting the inner and outer ends of the curved portion thereof, a bell crank having loose pivotal connection between the free end of one arm and the piston rod and arranged to have the free end of the other arm brought into engagement with said cam, means whereby that portion of the cam at the point of connection between the outer end of the curved and straight part thereof will yield to pressure placed thereon by the adjacent crank arm when the same is actuated by the piston, and an auxiliary cam arranged in spaced relation with the straight portion of the first mentioned cam and projecting beyond the periphery of the body for the reception of the cam engaging crank arm.

13. A device for transforming a rectilinear movement into a continuous rotary movement, comprising a circular rotatable body, a piston and piston rod rigidly connected and designed to reciprocate tangentially to the periphery of the body, means carried by the body upon its periphery for receiving a thrust from said rod upon operation of the piston, a cam upon one face of the body formed to describe a substantially involute curve and having a straight portion connecting the inner and outer ends of the curved portion thereof, a bell crank having loose pivotal connection between the free end of one arm and the piston rod and arranged to have the free end of the other arm brought into engagement with said cam, means whereby that portion of the cam at the point of connection between the outer end of the curved and straight part thereof will yield to pressure placed thereon by the adjacent crank arm when the same is actuated by the piston, that crank arm actuated by the cam having a friction roller for contact with the cam face, and an auxiliary cam comprising an elongated body arranged in spaced relation with the straight portion of the first mentioned cam and having pivotal connection with the first mentioned body and further having an end extending beyond the peripheral face of the supporting body.

In testimony whereof he has affixed his signature.

EMILE BOUILLON.