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IMPACT WRENCH

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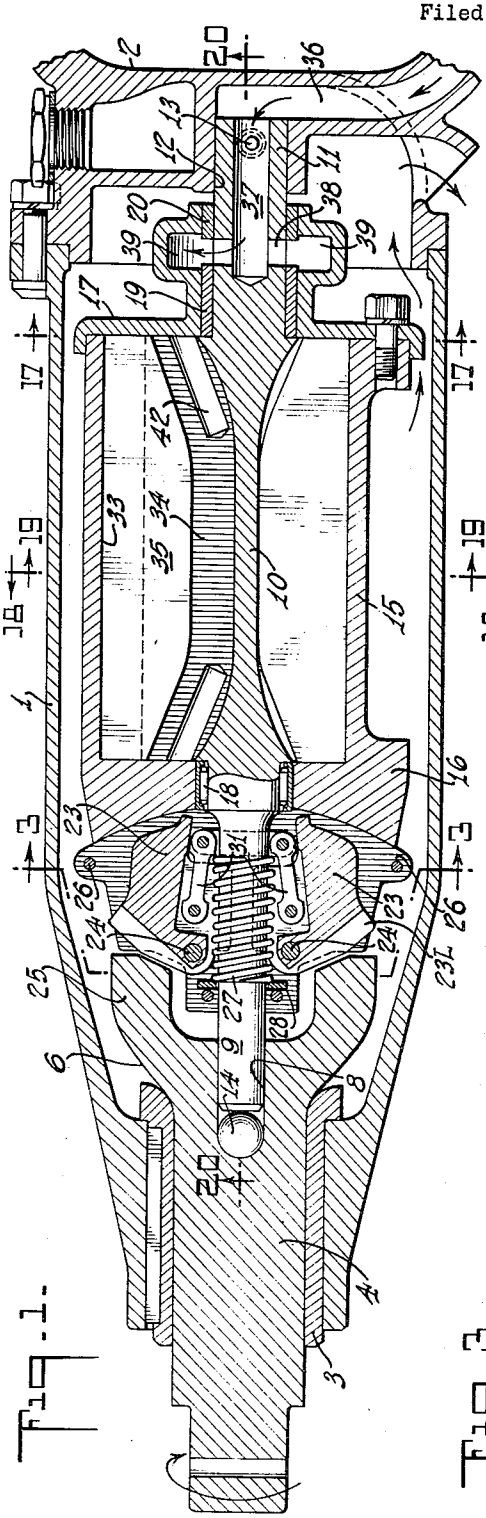

Fig. 1.

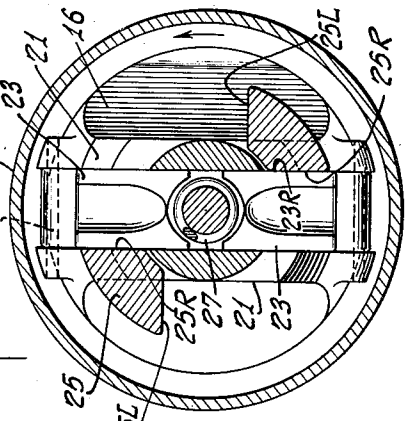

Fig. 4.

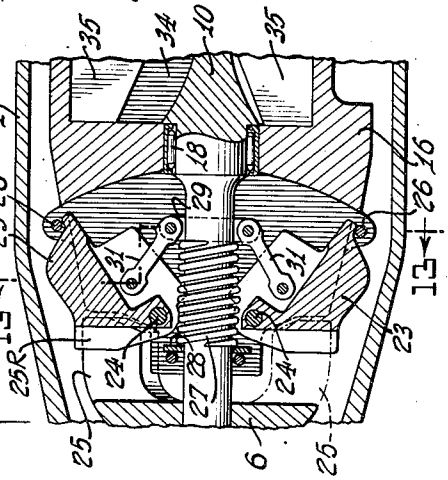

Fig. 2

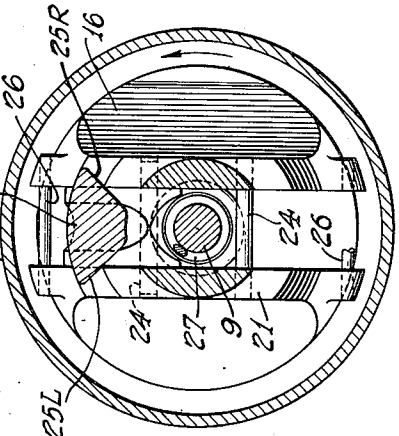

Fig. 3.

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IMPACT WRENCH

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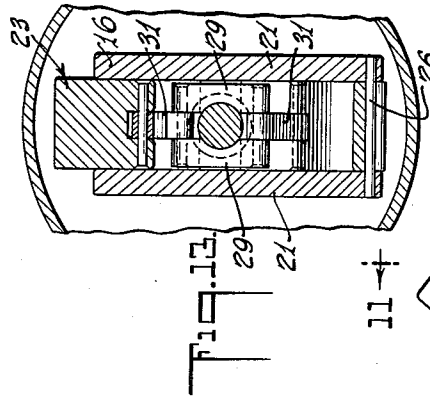

Fig. 13.

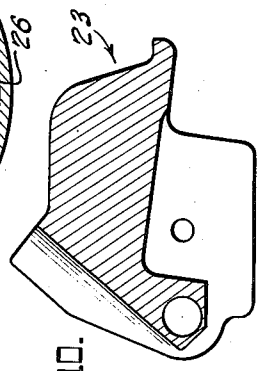

Fig. 10.

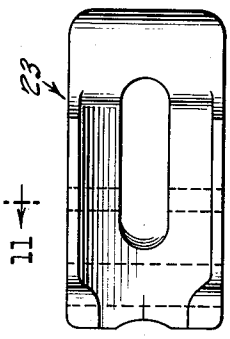

Fig. 12.

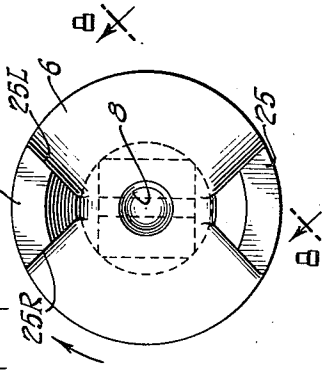

Fig. 7.

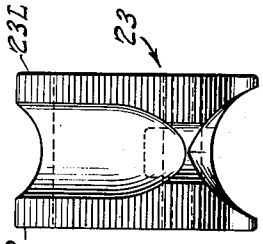

Fig. 9.

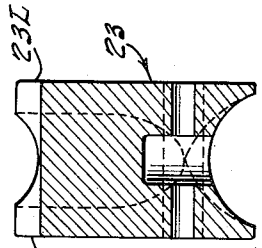

Fig. 11.

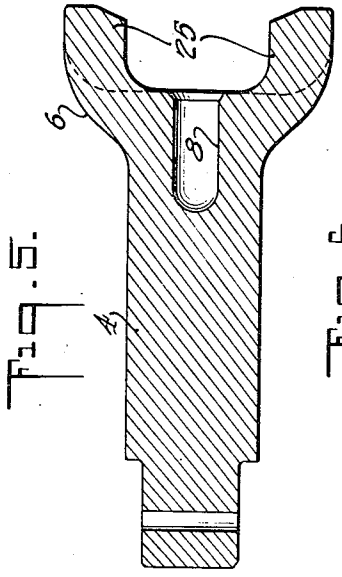

Fig. 5.

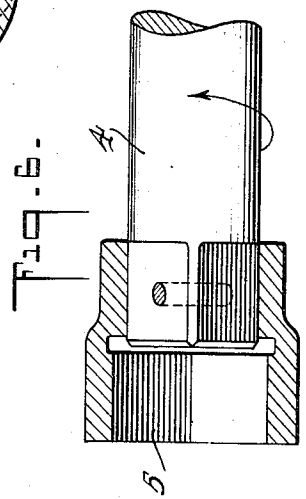

Fig. 6.

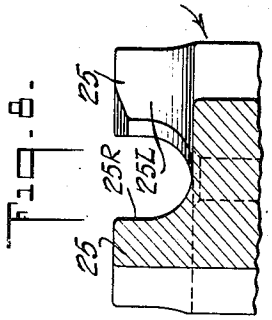

Fig. 8.

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IMPACT WRENCH

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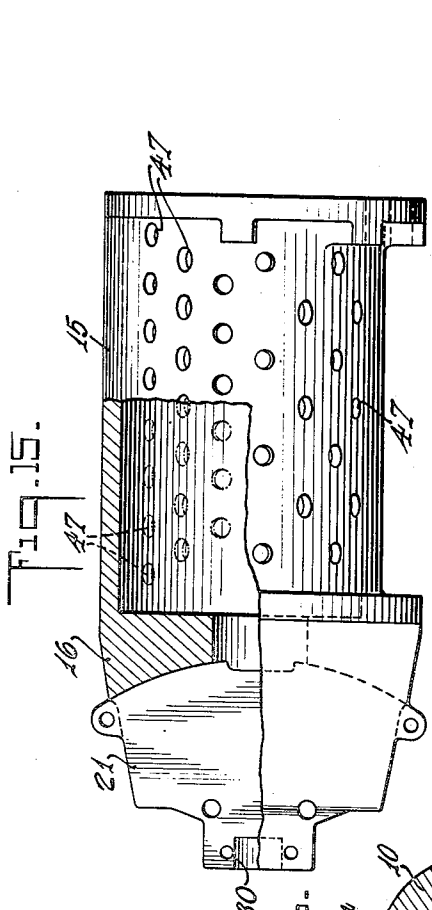

Fig. 15.

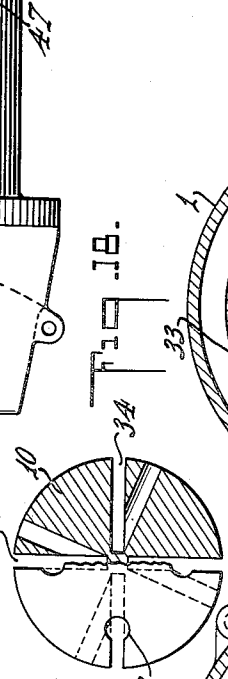

Fig. 16.

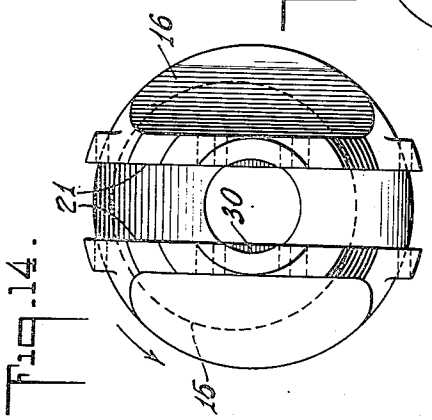

Fig. 14.

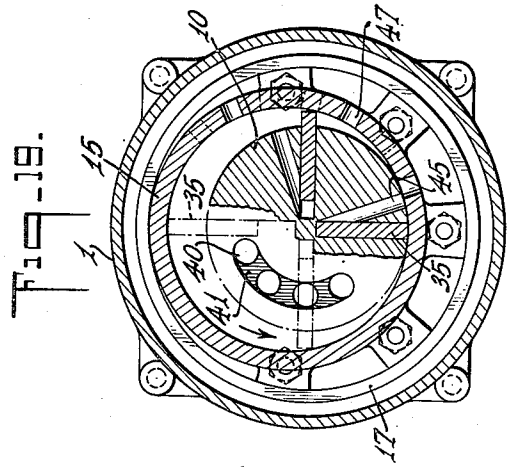

Fig. 19.

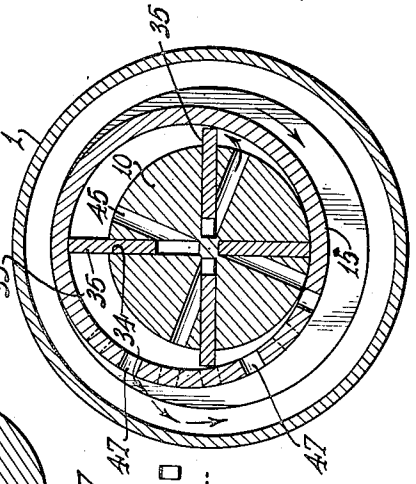

Fig. 18.

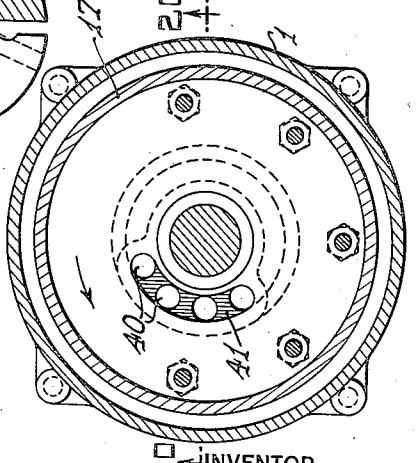

Fig. 17.

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Fig. 20.

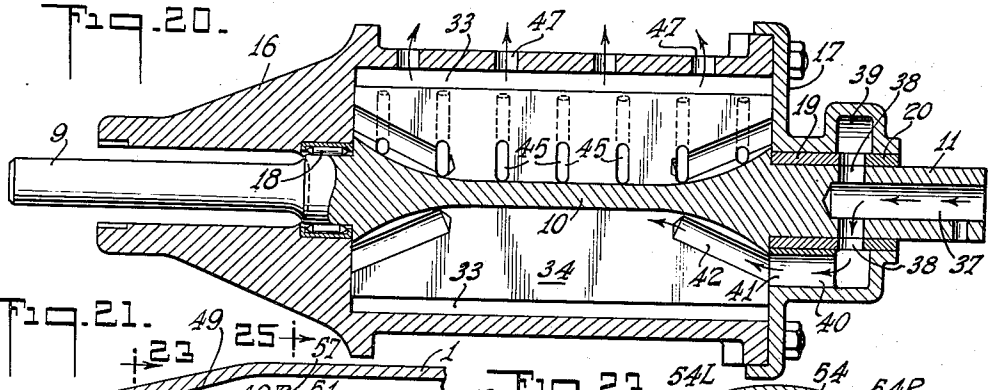


Fig. 21.

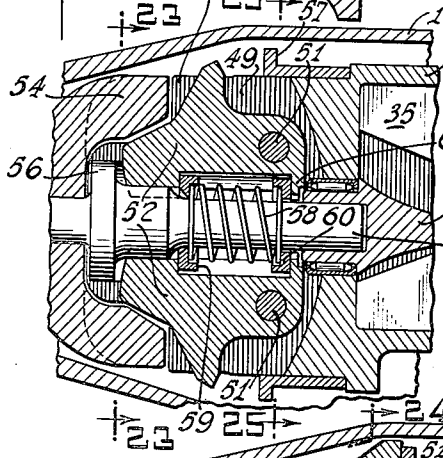


Fig. 23.

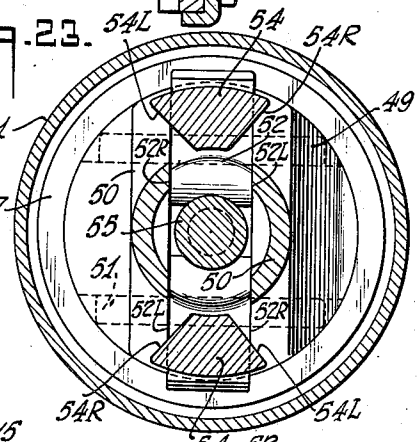
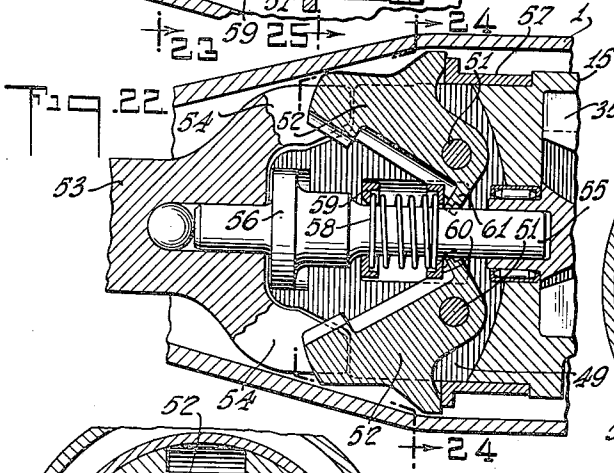


Fig. 22.



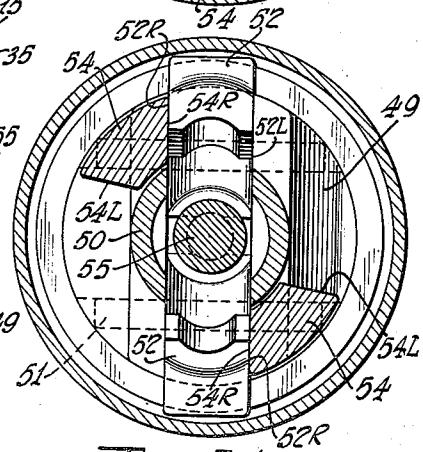
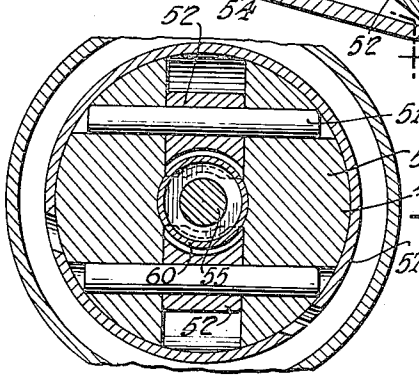


Fig. 24.

Fig. 25.



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Patented Oct. 29, 1940

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UNITED STATES PATENT OFFICE

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IMPACT WRENCH

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Application June 5, 1937, Serial No. 146,565

34 Claims. (Cl. 192—30.5)

This invention relates to power operated tools for driving nuts, bolts and the like with a rotational hammer action.

The usual impact wrench comprises a tool head, an anvil integral with the head, a rotatable hammer for delivering impacts to the anvil, a rotary motor and reduction gearing for driving the hammer, a torsionally resilient coupling between the gearing and the hammer, and torque responsive means for causing successive declutching of the hammer with respect to the anvil, each declutching movement being followed by an impact as the hammer reengages the anvil. The motor continues to drive the hammer through the resilient coupling as the hammer moves axially toward the anvil, the relation between the rotative and axial speeds of the hammer being predetermined so that the clutch jaws on the hammer and anvil are properly aligned at the instant the blow is delivered. These prior wrenches, therefore, do not permit much variation in the mean speed of the motor without causing misalignment and excessive wear on the clutch jaws and, accordingly, a governor is provided to fix the speed of the motor. An objection to the use of a governor is that it limits the speed of the motor not only during the impacting period but also during the run-up period when the tool head encounters relatively slight resistance to rotation.

Among the objects of the invention are to simplify the construction and reduce the manufacturing and maintenance expense of impact wrenches by obviating the necessity of the usual governor, torsional coupling and reduction gearing.

Another object is to reduce the weight of a machine of this type without reducing the angular momentum of the hammer or the force of the blow.

Another object is to reduce the time consumed in running up a nut or bolt before it becomes seated and impacting begins.

A further object is to adapt an impact wrench for operation at different mean speeds to deliver blows of selected intensity.

One of the features of the invention resides in a rotary air motor having a cylinder revolving around the stator, said cylinder being integral with or directly connected to the hammer to be rotated therewith as a unit. The blades are mounted in the stator and therefore are not subjected to the shocks attendant upon sudden stopping of the rotating elements. The utilization of the outer cylinder of the air motor as an integral part of the hammer assembly effects a substantial reduction in the weight and size of the machine, since the rotating cylinder has a large moment of inertia or fly-wheel effect which supplements that of the hammer. The absence of the usual gearing between the motor and hammer makes it unnecessary to provide a resilient coupling to protect the gears from impact stresses.

Another feature of the invention resides in a centrifugal or speed responsive clutch between the hammer and anvil. The clutch permits rapid rotation of the wrench socket when the resistance to rotation is slight, whereas machines which must for their operation be equipped with governors, because of a torque responsive clutch mechanism, are unable to realize such running speed under no-load conditions.

The operator may vary the intensity of the hammer blows by controlling the air pressure supplied to the motor, and the clutch is so arranged that, irrespective of the selected intensity of blow, the impacting surfaces will be properly aligned after each separation.

Other objects and features of the invention will appear more clearly from the following description taken in connection with the accompanying drawings in appended claims.

In the accompanying drawings wherein Figs. 1 to 20 inclusive illustrate one embodiment of the invention and Figs. 21 to 25 inclusive a modification:

Fig. 1 is a longitudinal section of a wrench showing the parts in declutched position with the hammer dogs clearing the anvil jaws, the wrench socket being omitted and the handle being broken away;

Fig. 2 is a fragmentary longitudinal section showing the hammer dogs meshing with the anvil jaws;

Fig. 3 is a cross section, as indicated by the broken line 3—3 in Fig. 1, looking rearwardly, one of the anvil jaws and one of the hammer dogs being omitted;

Fig. 4 is a cross section in the same plane as Fig. 3 but showing the dogs in mesh with the anvil jaws;

Fig. 5 is a longitudinal section of the tool head and anvil unit;

Fig. 6 is a longitudinal section of the wrench socket, showing a portion of the tool head and anvil assembly in elevation;

Fig. 7 is an end view of the anvil, looking forwardly;

Fig. 8 is a longitudinal section of a fragmentary

portion of the anvil, as indicated by the arrows 8 in Fig. 7;

Fig. 9 is a front elevation of one of the hammer dogs;

Fig. 10 is a longitudinal section of the hammer dog shown in Fig. 9;

Fig. 11 is a cross section of the hammer dog, looking forwardly as indicated by the arrows 11 in Fig. 10;

Fig. 12 is a bottom or inside view of the hammer dog;

Fig. 13 is a cross section, as indicated by broken line 13—13 in Fig. 2 showing the hammer dogs and the associated links;

Fig. 14 is an elevation of the front end of the hammer and cylinder unit;

Fig. 15 is a side view, partly in elevation and partly in section, of the hammer and cylinder assembly;

Fig. 16 is an end view, partly in elevation and partly in section, of the motor core or stator, looking forwardly;

Fig. 17 is a cross section, as indicated by the arrows 17 in Fig. 1, showing the end plate for the rotary motor;

Figs. 18 and 19 are cross sections, taken through the motor, as indicated by the arrows 18 and 19 respectively in Fig. 1;

Fig. 20 is a longitudinal section of the rotary motor, looking upwardly as indicated by the arrows 20 in Fig. 1, the blades being omitted;

Fig. 21 is a fragmentary longitudinal section illustrating a modified clutch arrangement, the parts being shown in the declutched position;

Fig. 22 is a view similar to Fig. 21 but showing the clutch jaws in driving relationship to the anvil jaws;

Fig. 23 is a cross section as indicated by the arrows 23 in Fig. 21;

Fig. 24 is a cross section as indicated by the arrows 24 in Fig. 22; and

Fig. 25 is a cross section as indicated by the arrows 25 in Fig. 21.

Figs. 9 to 12 inclusive are drawn to a scale twice as large as that of the remaining figures.

Referring particularly to Fig. 1, a casing 1 is bolted to a back-head 2 which is provided with a grip handle (not shown). The casing tapers at its front end where it receives a bushing 3 supporting a driven shaft or tool head 4 for rotation therein.

As shown in Figs. 5 and 6, the front end of the tool head is adapted for attachment to a wrench socket 5 while the rear end is integrally connected to an anvil 6. The anvil has a recess 8 receiving a stator shaft 9, which is integral with and coaxial with a stator core 10 and a rear shaft 11, the latter being supported in a socket 12 in the back-head 2. A lock screw 13, threaded in the back-head, projects into a hole in the rear stator shaft 11 to hold the stator assembly against both rotary and axial movements. A ball bearing 14 positioned in the bottom of the recess 8 cooperates with the bushing 3 to hold the tool head 4 against axial movement while permitting rotation of the head.

The rotor assembly comprises a cylinder 15, a hammer 16 integral with the cylinder, and an end plate 17 bolted to the rear end of the cylinder. The cylinder is eccentric with respect to core 10 and stator shafts 9 and 11. As seen in Figs. 1 and 20, the hammer is supported by a roller bearing 18 on the stationary shaft 9 while the end plate is mounted for rotation on bushings 19 and 20 on the rear stator shaft 11. The cylinder is co-extensive in length with the stator core 10 and therefore is held against axial movement. The front end of the hammer is slotted to provide a pair of walls 21, the inner surfaces of which are parallel and the outer surfaces of which taper toward the free end.

Centrifugal clutch mechanism is interposed between hammer 16 and anvil 6. The clutch mechanism comprises a pair of hammer dogs 23 received between the hammer walls 21 and mounted for oscillatory movement about transverse pins 24. The dogs or pawls are adapted to be thrown by centrifugal force from the declutched position shown in Fig. 1 to the engaging position shown in Fig. 2. The anvil 6 has a pair of widely spaced jaws 25, each having impacting surfaces 25R and 25L on its opposite sides. As shown in Figs. 9 to 13 inclusive, each dog has parallel sides slidably engaging the hammer walls 21 and terminating in impact surfaces 23R and 23L, adapted for cooperation with the surfaces 25R and 25L respectively on the anvil jaws. Outward movement of the pawls 23 is limited by stop pins 26 each mounted in the hammer 16 and lying in the path of the tail end of the associated pawls.

Yieldable means urge the dogs toward the declutched position shown in Fig. 1 in opposition to centrifugal force. The declutching means comprises a spring 27, surrounding shaft 9 and interposed between a fixed washer 28 and a slidable collar 29. The washer is seated in the bottom of a recess 30 in the hammer 16 (see Figs. 14 and 15) and is retained by removable pins. As shown in Fig. 13, the collar comprises two sections supporting transverse pins upon which links 31 are pivoted. The outer ends of the links are pivoted to the respective dogs 23, each of the latter being recessed to receive the associated link. The pins supporting the dogs and the declutching means are removable so that the dogs may be replaced after they become worn.

The motor for driving the hammer is illustrated in Figs. 1 and 15 to 20 inclusive. The eccentricity of the cylinder 15 provides a revolving crescent-shaped chamber 33 between the cylinder and the stator core 10. The core has radial slots 34 in which blades 35 are mounted for radial movement. The blades separate the inlet side of the crescent-shaped chamber from the exhaust side. Pressure fluid, such as compressed air, is admitted to the interior of the cylinder from a live air passageway 36 in the back-head 2 (see Fig. 1) under control of a throttle valve (not shown) through longitudinal passage 37 and radial ports 38 in the stator shaft 11 and annular chamber 39 and longitudinal bores 40 in the end plate 17 (see Figs. 17, 19 and 20). An arcuate groove 41, connecting bores 40, communicates successively with ports 42 in the stator core 10 to deliver air to the bottoms of the slots 34 adjacent the inlet side of the crescent-shaped chamber 33. Pressure fluid acts against the inner edges of the blades 35 to hold them in tight contact with the revolving cylinder 15. Ports 45 in the stator core 10 extend outwardly from the bottoms of the slots 34 to supply pressure fluid to the inlet side of the crescent-shaped chamber 33. The exhaust side is connected through ports 47 to atmosphere.

The operation of the embodiment of the invention illustrated in Figs. 1 to 20 inclusive is as follows: Live air is continuously delivered to the arcuate groove 41 in the revolving end plate 17 from whence it is conveyed through a registering slot, or slots, 34 and ports 45 of the stator to the

inlet side of chamber 33, the exhaust side being vented at all times. As seen in Fig. 18, the difference in pressures on opposite faces of the blades 35 tend to cause counter-clockwise rotation of the core 10 and clockwise rotation of the cylinder 15. Since the core is fixed to the casing 1 it cannot turn, but the cylinder 15 is free to rotate, carrying with it the hammer 16 and end plate 17.

As the hammer 16 starts to rotate, the clutch elements are in the Fig. 1 position, with the dogs 23 held out of the orbital path of the anvil jaws 25 by means of the declutching spring 27. The speed of the motor and hammer increases rapidly to cause the dogs 23 to be thrown into mesh with the anvil in response to centrifugal force, whereupon torque is delivered through the registering impact surfaces 23R and 25R on the dogs and anvil jaws respectively. Assuming that the tool head 4 is driving a right hand bolt, nut or screw (not shown) which, at this time, offers relatively slight resistance to rotation, the cylinder 15, hammer 16, anvil 6 and tool head 4 rotate as a unit. Due to the absence of the usual reduction gearing and governor, the motor is adapted to drive the nut or bolt at a high speed, for example 3000 R. P. M., during the run up period. When the driven element becomes seated, and its resistance to rotation increases, the speed of the motor, and consequently the centrifugal force on the dogs, diminishes until the centrifugal force is overpowered by the spring 27 and the dogs are then restored to the Fig. 1 position.

As soon as the dogs are declutched, the motor is relieved from the load on the tool head and is permitted to speed up, throwing the dogs forwardly. Movement of a dog relative to the hammer may begin when the former passes out of rotative alignment with the bevelled end face of one jaw 25 and ends when the dog strikes the stop pin 26, which usually occurs before the dog has revolved far enough to strike the succeeding jaw. Thus, the impact surfaces 23R and 25R on the dogs and anvil respectively are in proper alignment at the instant the blow is delivered irrespective of the mean speed of the motor. This is an important improvement over prior devices in which the striking element was arranged to move axially as well as rotationally up until the instant that the blow was struck, and in which the rotative speed had to be fixed to correspond to the axial speed in order that the striking and stricken surfaces would properly register. By terminating axial movement of the dogs prior to the completion of the rotary movement, the present design of clutch permits the operator, by utilizing different air pressures, to vary the mean speed of the motor and therefore the strength of the blow without disturbing the alinement of the impact surfaces 23R and 25R at the instant of impact. Continued rotation of the motor causes a succession of rotary hammer blows, each followed by a sudden stoppage or abrupt reduction of speed of the rotor 15, 16, declutching of the dogs 23 by spring 27, release of the load on the motor, sudden acceleration of the latter, forward movement of the dogs under centrifugal force and a succeeding impact to complete the cycle.

It has been found that the friction between the impact surfaces 23R and 25R has a tendency to hold the dogs in mesh after each impact, even when the declutching spring 27 is not opposed by any substantial centrifugal force. In order to prevent such binding of the clutch, with the consequent stalling of the motor under load, the steel tool head 4 is made sufficiently long that it has an appreciable torsional elasticity. As a result, the impact is immediately followed by a rebound of the hammer unit oppositely to the direction of drive, which permits the spring to withdraw the dogs during the instant that the impact surfaces are out of engagement. The impact surfaces 23R and 25R may stick together occasionally, however, if the wrench is used to tighten bolts and nuts whose resistance to rotation increases gradually instead of suddenly. In such event the operator may release the clutch by momentarily throttling the supply of air to the motor.

Figs. 21 to 25 inclusive illustrate a modified form of clutch mechanism in which the movement of the impact portions of the dogs is generally in and out as distinguished from the back and forth movement in the first described embodiment. The modified clutch may be driven by a motor similar to the one described and which comprises a cylinder 15 rotating about a stator core 10. A hammer 49, integral with the cylinder, is slotted to provide two walls 50, the inner surfaces of which are parallel. Transverse pins 51 pivotally support two dogs 52, the side faces of which slidably engage the hammer walls. The front portions of the side faces of the dogs constitute impact surfaces 52R and 52L. As anvil 53 has two spaced jaws 54, the side faces of which include the impact surfaces 54R and 54L. A shaft 55 is detachably supported at its ends by sockets formed in the anvil 53 and core 10 respectively. The shaft has an enlarged portion 56 fitting within a recess in the hammer walls 50 near the front end of the hammer and serving as a bearing for the latter. A split ring 57, surrounding the hammer 49, acts as a stop for limiting outward movement of the dogs 52 under the influence of centrifugal force.

Yieldable means, tending to hold the dogs 52 in the Fig. 21 position, comprise a spring 58 surrounding shaft 55 and interposed between washers 59 and 60. Washer 59 is seated against a shoulder on the shaft 55 while washer 58 seats against hooked ends 61 on the dogs.

When the hammer 49 starts rotating, the front ends of the dogs 52 clear the anvil jaws 54 as seen in Fig. 21. Centrifugal force develops as the motor increases its speed and the front ends of the dogs are thrown outwardly into mesh with the jaws. The cycle of operation is substantially the same as in the case of the embodiment first described, the impact surfaces 52R and 54R engaging with a continuous drive while under a slight load and with a succession of impacts when the anvil 53 offers a greater resistance to rotation.

Both forms of clutches have been described in connection with a motor designed to rotate in a right-hand or clockwise direction looking forwardly. The clutches, per se, are reversible to operate in substantially the same manner for either direction of rotation, the impact surfaces 23L and 25L, or 52L and 54L being effective when the clutch is driven in a left-hand direction. The clutch may be driven by any suitable type of non-reversible or reversible engine. The type described, which has a rotating cylinder actuated by fluid pressure, is preferred because of its ability to start and stop quickly and because of the high moment of inertia of the rotating mass in proportion to the weight of the machine.

The illustrative embodiment of the motor may be converted to adapt it for rotation in the opposite direction by transposing the locations of the cylinder ports 40 and 47 relative to the crescent-shaped chamber 33 and by reversing the location of the stator ports 44 relative to the blades 35.

It will be apparent that further modifications and adaptations of the illustrative embodiments of the inventions may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. An impact clutch comprising a rotatable hammer, means for driving said hammer, a rotatable anvil having spaced jaws, dogs pivoted to said hammer and having impact surfaces positioned to move into the orbital path of the jaws in response to centrifugal force, and spring means carried by the hammer and arranged to oppose such centrifugal force for moving the dogs out of the orbital path of the jaws, said spring means acting in a direction longitudinal with respect to the axis of rotation of the hammer.

2. An impact clutch comprising a rotatable hammer, dogs carried by said hammer, each dog having striking surfaces on its opposite sides, an anvil having spaced jaws, each jaw having surfaces on its opposite sides adapted to receive impacts from said striking surfaces, said dogs being mounted for movement relative to the hammer into the orbital path of said jaws in response to centrifugal force, and spring means for opposing said centrifugal force to move the dogs to decluching position.

3. An impact clutch comprising a rotatable hammer, dogs carried by said hammer and supported for rotation with the hammer and for oscillatory movement relative to the hammer, each dog having striking surfaces on its opposite sides, and anvil having spaced jaws, each jaw having impact receiving surfaces on its opposite sides, said striking surfaces being positioned to be moved into the orbital path of the impact receiving surfaces in response to centrifugal force, stop means carried by the hammer for limiting movement in response to centrifugal force, and means responsive to a reduction in speed of the hammer for moving the dogs out of the orbital path of the jaws.

4. An impact clutch comprising a rotatable anvil having rearwardly projecting jaws, a rotatable hammer supported adjacent the rear ends of said jaws, dogs pivoted to said hammer for movement about axes transverse to the axis of rotation of the hammer, impact surfaces on said dogs positioned to be moved forwardly into the orbital path of the jaws, and means responsive to a reduction in speed of the hammer for moving the impact surfaces rearwardly out of the orbital path of the jaws.

5. An impact clutch comprising a rotatable hammer, impact elements carried by the hammer and adapted to move away from the axis of the hammer in response to centrifugal force, yieldable means tending to move said impact elements toward the axis of the hammer in opposition to such centrifugal force, an anvil having spaced jaws adapted to receive rotary blows delivered by said impact elements, said jaws being positioned to move in an orbital path surrounding that of the impact elements when the latter are in their innermost positions and registering with the impact elements when the latter are in their outermost positions, and means preventing movement of the impact elements relative to the hammer in the direction of rotation of the hammer.

6. In a tool of the character described, a rotatable driven shaft, a rotatable hammer, releasable clutch mechanism interposed between said hammer and shaft, said clutch mechanism comprising striking and stricken impact surfaces arranged to prevent relative rotation between said hammer and shaft when said impact surfaces are in engagement and comprising automatic means for disengaging said impact surfaces upon termination of an impact, and a rotary motor for driving said hammer, said motor having a stator and a rotor and fluid pressure means for driving said rotor, said rotor having a rigid driving connection with the hammer, whereby said rotor and hammer rotate in unison and the angular momentum of the hammer is supplemented by that of the rotor.

7. In a tool of the character described, a rotatable driven shaft, a rotatable hammer, means including clutch mechanism interposed between said hammer and shaft for intermittently locking the hammer against rotation relative to the shaft, and a rotary motor for driving said hammer, said rotary motor having a stator and a rotor surrounding said stator, said hammer being rigidly connected to the rotor to rotate in unison therewith.

8. An impact clutch comprising a hammer rotatable in either direction, a rotatable anvil having a jaw provided with impact receiving surfaces on its opposite sides, a dog pivoted to the hammer and having impacting surfaces on its opposite sides, centrifugal means for moving the dog into the orbital path of the jaw, and automatic means for moving the dog out of the orbital path of the jaw, whereby to cause the dog to deliver a succession of rotary impacts to said anvil jaw, said dog being secured against movement relative to the hammer in the direction of rotation of the hammer.

9. An impact clutch comprising a driving member rotatable in either direction, a dog pivoted to said driving member and carried thereby, said dog having impacting surfaces on its opposite sides, a rotatable anvil adapted to be driven by said driving member and having a jaw provided with impact receiving surfaces on its opposite sides, centrifugal means responsive to the speed of the driving member for moving the dog into the orbital path of the jaw, automatic means for moving the dog out of the orbital path of the jaw, said impacting surfaces and impact receiving surfaces being flat whereby to cause the dog to deliver a succession of rotary impacts to the jaw over a substantial area, said dog being secured against movement relative to the hammer in the direction of rotation of the hammer.

10. In a tool of the character described, the combination of a rotatable hammer, a rotatable anvil, and clutch mechanism between the hammer and anvil adapted under certain conditions of operation to cause the hammer to drive the anvil continuously, and under other conditions to cause the hammer to deliver a succession of rotary impacts to the anvil, said clutch mechanism comprising spaced jaws integral with the anvil, a plurality of dogs carried by the hammer for delivering such impacts, said dogs being mounted on axes transverse to the axis of rotation of the hammer for movement in response to centrifugal force into the orbital path of the anvil jaws.

11. An impact clutch comprising a rotatable hammer, a rotatable anvil adapted to be driven thereby, a plurality of jaws carried by the anvil, a pin carried by the hammer and extending transverse to the axis of rotation of the hammer, and a dog pivotally mounted on said pin for movement into and out of the orbital path of the anvil jaws.

12. An impact clutch according to claim 11 in which the dog is mounted in a slot in the hammer, the sides of the dog slidably engaging the side walls of the slot.

13. An impact clutch comprising an anvil having spaced impact receiving jaws revoluble within a fixed orbital path, a coaxially rotatable impact hammer having a substantial moment of inertia, impact surfaces carried by said hammer and secured at all times against any component of movement relative to the hammer in the direction of rotation of the hammer, spring means urging said impact surfaces out of the orbital path of the anvil jaws to permit the hammer to rotate independently of the anvil, centrifugal means opposing said spring means for moving said impact surfaces into the orbital path of the anvil jaws and means for resisting rotation of the anvil to cause the spring means periodically to overcome the centrifugal means but to permit the centrifugal means to overcome the spring means while the hammer is released.

14. An impact clutch comprising a rotatable anvil, a coaxially rotatable hammer, said anvil having one or more jaws positioned to revolve in a definite orbital path, one or more impact dogs carried by the hammer, centrifugal means for moving the dog into the orbital path of the anvil jaw to deliver a rotational hammer blow to the anvil, automatic means for moving the dog out of the orbital path of the jaw, and means constraining the dog for movement relative to the hammer in longitudinal and radial directions and inhibiting movement of the dog relative to the hammer in the direction of rotation of the hammer.

15. An impact clutch comprising an anvil having spaced jaws provided with impact receiving surfaces on opposite sides, a hammer coaxially rotatable with the anvil, impact elements carried by the hammer, means securing said impact elements at all times against any component of movement relative to the hammer in the direction of rotation of the hammer, each impact element having impact delivering surfaces on its opposite sides and in parallel planes, centrifugal means for moving the impact elements into the orbital path of the anvil jaws, and spring means for opposing said centrifugal means for automatically returning the impact elements out of the orbital path of the jaws to permit the hammer to rotate independently of the anvil, said centrifugal means and spring means acting to move the impact elements in a direction parallel to the planes of the impact delivering surfaces.

16. An impact clutch comprising a rotatable anvil having a pair of circumferentially spaced impact receiving jaws, a coaxially rotatable hammer positioned rearwardly of the anvil and having a rearwardly open radial slot, a pair of impact dogs having side faces slidably fitting the side walls of the slot, said dogs being mounted on pivotal axes extending parallel to each other and perpendicular to the side walls of the slot, said dogs having impact delivering portions on their side faces automatically movable into and out of the orbital path of the anvil jaws for causing the hammer to deliver a succession of rotational hammer blows to the anvil, centrifugal means for causing pivotal movement into the path of the jaws and arranged to maintain a continuous driving relation between the hammer and anvil when a high speed of the hammer is maintained, and means automatically overcoming said centrifugal means when the speed of the hammer becomes abnormally low.

17. An impact clutch comprising a rotatable anvil having a pair of circumferentially spaced impact receiving jaws, a coaxially rotatable hammer positioned rearwardly of the anvil and having a rearwardly open radial slot, a pair of impact dogs having side faces slidably fitting the side walls of the slot, said dogs being mounted on pivotal axes extending parallel to each other and perpendicular to the side walls of the slot, said dogs having impact delivering portions on their side faces automatically movable into and out of the orbital path of the anvil jaws for causing the hammer to deliver a succession of rotational hammer blows to the anvil, centrifugal means for causing pivotal movement into the path of the jaws and arranged to maintain a continuous driving relation between the hammer and anvil when a high speed of the hammer is maintained, yieldable means continuously opposing the centrifugal force, said yieldable means comprising a helical spring coaxial with the axis of rotation of the hammer, a pilot shaft for holding the hammer and anvil in coaxial relationship, said shaft being surrounded by the spring and having a portion fitting a socket in the anvil.

18. An impact clutch comprising a rotatable hammer, a rotatable anvil having spaced jaws provided with impact receiving surfaces, impact dogs carried by the hammer and movable into the annular path of the jaws in response to centrifugal force to deliver a succession of impacts to said jaws, automatic retracting means operable upon termination of an impact to move the dogs out of the annular path of the anvil jaws, each of said dogs being guided on the hammer for relative movement only in a plane coincident with the axis of rotation of the hammer, whereby the hammer is positively locked against rotation ahead of the jaws.

19. An impact clutch according to claim 18 in which said automatic retracting means comprises an expansion spring continuously acting on the dog and adapted to be overcome by centrifugal force during rotation of the hammer between impacts.

20. An impact clutch according to claim 18 in which said dogs are pivoted respectively about axes extending parallel to each other on opposite sides of the axis of rotation of the hammer and perpendicular to the axial plane in which the dogs move.

21. In an impact clutch, a rotatable impact hammer having a radially extending slot, a pair of impact dogs positioned partly in said slot on opposite sides of the axis of rotation of the hammer, pins about which the respective dogs are pivoted, said pins extending parallel to each other and perpendicular to the side walls of the slot, each dog having an impact delivering surface on one side at a movable part of the dog, whereby said impact delivering surface may be moved into and out of the path of a rotatable driven element, said dogs being automatically movable into impact delivering position in response to centrifugal force, the sides of the dogs

fitting the sides of the slot whereby the hammer is locked against rotary movement ahead of the dogs at the time an impact is delivered.

22. In an impact clutch, a rotatable impact hammer according to claim 21 which also comprises yieldable means carried by the hammer and urging the dogs toward releasing position in opposition to centrifugal force and adapted to disengage the dogs from the driven element upon a reduction in speed of the hammer.

23. In an impact clutch, a rotatable impact hammer according to claim 21 in which each dog has impact delivering surfaces on its opposite sides whereby the impact clutch is adapted for operation in either direction of rotation.

24. In an impact clutch, a rotatable impact hammer according to claim 21 in which said dog is constantly biased toward releasing position by a spring having sufficient tension to release the dog when the hammer is substantially at rest but is overpowered by centrifugal force when the hammer is rotating independently of the anvil.

25. An impact clutch comprising a rotatable impact hammer, a rotatable anvil at the forward end of the hammer, said anvil having one or more circumferentially spaced jaws, one or more impact dogs mounted on said hammer and guided thereby for movement in a plane which includes the axis of the hammer, each dog being mounted for turning about a pivot extending perpendicular to said plane, each dog having an impact surface automatically engageable with said anvil in response to centrifugal force and automatically releasable therefrom, said pivots being positioned near the inner and forward extremity of the respective dogs, wherby the impact surface of the dog swings outwardly and forwardly in moving to engaging position and is close to the pivot to minimize the moment of the frictional force resisting release of the dog upon termination of an impact.

26. An impact clutch comprising a rotatable anvil having circumferentially spaced jaws, a coaxially rotatable impact hammer at the rear end of the anvil and having an extension surrounded by the orbital path of the anvil jaws, said hammer having side walls defining a radial slot open at the front end of the hammer, one or more impact dogs slidably fitting the walls of the slot and pivoted about an axis extending perpendicular to said walls, the pivot axis being near the rear end of the dog, the front end of the dog being adapted to be surrounded by the orbital path of the anvil jaw and movable in response to centrifugal force outwardly into the path of said jaws to deliver a succession of rotary hammer blows thereto.

27. An impact clutch according to claim 26 in which the dog has a hook portion projecting inwardly from the rear end and a spring is arranged to act against the hooked end to bias the dog in a direction opposite to the movement in response to centrifugal force.

28. An impact clutch according to claim 26 which also includes a stop ring surrounding the slotted part of the hammer to limit movement of the dog in response to centrifugal force.

29. An impact clutch comprising a rotatable hammer, impact elements carried by the hammer and adapted to move away from the aixs of the hammer in response to centrifugal force, an anvil having spaced jaws adapted to receive rotational hammer blows delivered by said impact elements, said jaws being positioned to move in an orbital path surrounding that of the impact elements when the latter are in their innermost positions and registering with the impact elements when the latter are in their outermost positions, means preventing movement of the impact elements relative to the hammer in the direction of rotation of the hammer, and means automatically operable upon the delivery of a hammer blow to move said impact elements toward the axis of the hammer in opposition to centrifugal force.

30. In a device of the character described, the combination of a driving head having rotation imparted thereto in either direction, a rotatable driven head, stationary clutch jaws on said driven head, rotation transmitting clutch jaws pivotally carried by said driving head centrifugally movable into operative engagement with said stationary jaws irrespective of the direction of rotation of said driving head and capable of release to enable relative rotation between said heads, said clutch jaws arranged and disposed in a manner causing each operative engagement thereof to transmit a rotative impact to said driven head, and means automatically effecting said release upon a predetermined reduction in the rotary speed of said driving head.

31. In a device of the character described, the combination of a driving head having rotation imparted thereto in either direction, a rotatable driven head, clutch means between said heads including weights pivotally carried by said driving head for rotation therewith and a lug stationary on said driven head, said weights being centrifugally movable into engagement with said lug and disposed in a manner enabling during normal condition of operation transmission of rotation between said heads and under abnormal conditions of operation transmission of rotary impacts to said driven head irrespective of the direction of rotation of said driving head.

32. In a device of the character described, the combination of a driving head having rotation imparted thereto in either direction, a rotatable driven head, interengageable clutch means between said heads capable of release to enable relative rotation therebetween, said clutch means including weights pivotally carried by said driving head centrifugally movable irrespective of the direction of rotation of said driving head for effecting the interengagement aforesaid, said clutch means arranged and disposed in a manner causing each interengagement thereof to transmit a rotary impact to said driven head, and means automatically effecting said release upon a predetermined reduction in the rotary speed of said driving head.

33. In a device of the character described, the combination of a driving head having rotation imparted thereto in either direction, a rotatable driven head, a clutch jaw stationary on said driven head, clutch means carried by said driving head movable into rotation transmitting engagement with said clutch jaw and capable of release to enable relative rotation between said heads, said clutch means being centrifugally movable into operative engagement with said clutch jaw irrespective of the direction of rotation of said driving head, and means associated with said clutch means automatically effecting said release upon a predetermined reduction in the rotary speed of said driving head.

34. In a device of the character described, the combination of a driving head having rotation imparted thereto in either direction, a rotatable driven head, lugs integral with said driven head,

weights pivotally carried by said driving head suddenly engageable with said lugs due to the centrifugal force resulting from the rotation of said driving head for imparting a rotative impact to said driven head in a direction corresponding to the direction of rotation of said driving head, and means associated with said weights for automatically effecting their release from said lugs to enable said driving head to gain momentum preparatory to the sudden reengagement of said weights with said lugs.

LESTER A. AMTSBERG.

CERTIFICATE OF CORRECTION.

Patent No. 2,219,883. October 29, 1940.

LESTER A. AMTSBERG.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 27, for the word "in" before "appended" read --and--; line 39, strike out the comma after the semicolon; page 3, second column, line 31, for "As" read --An--; page 4, first column, line 41, claim 3, for "and" read --an--; page 5, first column, line 24, claim 13, after "jaws" insert a comma; page 6, first column, line 70, claim 29, for "aixs" read --axis--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of December, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.