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R. R. FARRELL

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AUTOMATIC HAMMER

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Fig. 1.

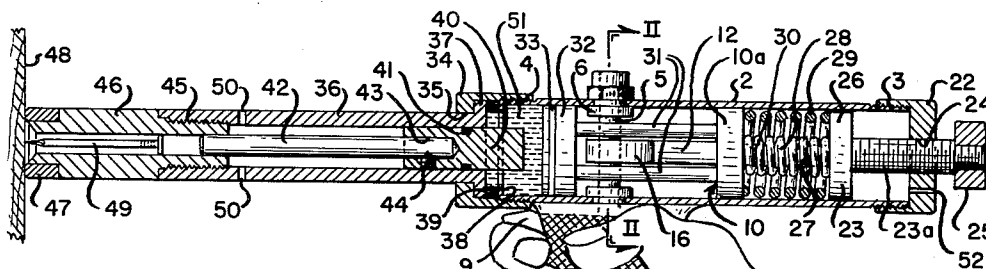


Fig. 2.

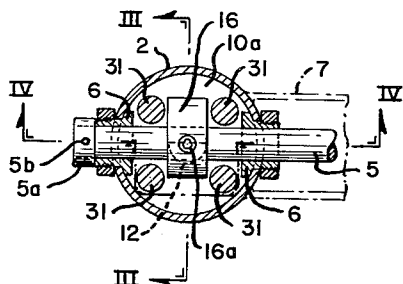


Fig. 3.

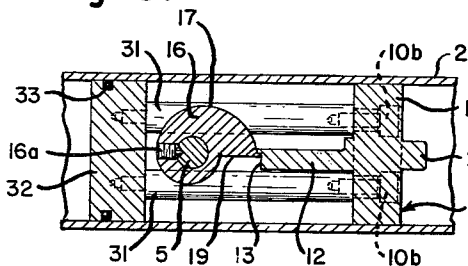


Fig. 4.

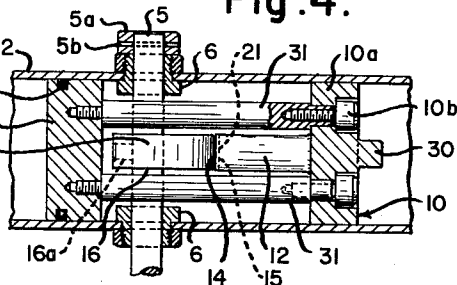
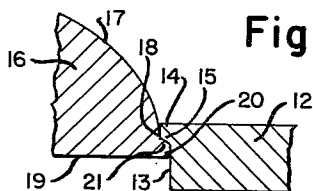


Fig. 5.



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3,203,610

AUTOMATIC HAMMER

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12 Claims. (Cl. 227-146)

The present invention relates to an automatic hammer employing a hydraulic lever through which a striker is operated by an impeller whereby the distance through which the striker travels, its speed of travel and the pressure exerted by it are each a multiple of the corresponding characteristics of the impeller.

My automatic hammer is compact, light in weight and low in cost. It may be easily handled and used by unskilled persons of ordinary strength and dexterity. It may be made in various sizes and capacities for various uses. In small sizes it may be adapted for driving tacks and nails. When used as a nail driver my automatic hammer has an outstanding advantage in that it can drive nails in relatively inaccessible places where a manually wielded hammer cannot be used since my automatic hammer may be simply inserted into such places, the driving action occurring within the hammer.

In larger sizes my automatic hammer may be adapted for driving stakes, tracks spikes, posts, piles and the like and may take the place of the more costly and cumbersome air or steam hammer or pile driver with attendant auxiliary equipment such as an air compressor or steam generator and unwieldy hoses associated therewith. It reduces labor cost as no air compressor or steam generator operator or attendant is required.

My automatic hammer may also be adapted for use as a pick or chisel as in construction work to break up old concrete or asphalt or to fracture or pulverize rock.

An important advantage of my automatic hammer is that as the resistance to an object being driven, such as the resistance of a plank to a nail being driven into the plank or the resistance of the ground to a stake or post being driven into the ground, increases the pressure exerted by the hammer increases. Conversely, when a nail is just being "started," when a relatively light or delicate blow is desired, my automatic hammer delivers such a blow.

The action of my automatic hammer depends upon a compound or multiplying arrangement of an impeller and a striker having portions which may be formed as pistons, the impeller being of relatively great cross-sectional area and the striker being of relatively small cross-sectional area, the impeller and striker being coupled through what I term a hydraulic lever. The action of a force upon the impeller, as, for example, a force derived from an electric motor driving an operating cam, activates the larger piston which through a completely confined fixed volume of non-compressible fluid causes a greatly increased stroke and velocity of the smaller piston. Since the force transmitted, except for friction losses, is constant the pressure exerted by the smaller piston is much greater than that exerted by the larger piston, pressure being force per unit area.

I provide an automatic hammer comprising a striker of relatively small cross-sectional area and an impeller of relatively great cross-sectional area in communication with each other through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, and means for rapidly advancing the impeller in the direction toward the completely confined fixed volume of non-compressible fluid, causing, since the volume of the non-compressible fluid remains constant, the striker to be projected in the direction away from the completely con-

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finied fixed volume of non-compressible fluid at higher speed than the speed of advance of the impeller, to exert greater pressure than the pressure exerted by the impeller on the completely confined fixed volume of non-compressible fluid and through a greater distance than that through which the impeller advances, enabling the striker to drive nails and do similar work. I preferably provide means for rapidly cyclically advancing and retracting the impeller in the directions toward and away from the completely confined fixed volume of non-compressible fluid, causing projection of the striker upon each advance of the impeller in the direction toward the completely confined fixed volume of non-compressible fluid.

I preferably provide spring means urging the impeller to advance in the direction toward the completely confined fixed volume of non-compressible fluid together with means retracting the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then releasing it to be advanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to project the striker in the direction away from the completely confined fixed volume of non-compressible fluid to act as a hammer. Desirably means are provided for altering at will the strength of the action of the spring means on the impeller. The means retracting the impeller are preferably rotary cam means; and I desirably provide means, such, for example, as an electric motor, for rotating the rotary cam means to cyclically retract the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then release it to be advanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to cyclically project the striker in the direction away from the completely confined fixed volume of non-compressible fluid.

I further provide an automatic hammer comprising a striker of relatively small cross-sectional area and an impeller of relatively great cross-sectional area in communication with each other through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, and means for reciprocating the impeller and thereby reciprocating the striker but at higher speed, through a greater distance and with the exertion of greater pressure than the impeller. Grip means are preferably applied to the automatic hammer for holding it, and I desirably provide control means adjacent the grip means for activating and deactivating the means for reciprocating the impeller. The means for reciprocating the impeller may include an electric motor and connections from the electric motor to the impeller, such as a rotary cam acting against spring means.

Means are preferably provided for cyclically advancing and retracting the impeller in the directions toward and away from the completely confined fixed volume of non-compressible fluid together with means effective upon rendering inoperative of the last mentioned means for stopping the impeller in the region of its extreme retracted position. More specifically, I prefer to employ spring means urging the impeller to advance in the direction toward the completely confined fixed volume of non-compressible fluid together with a rotary cam and means for rotating the rotary cam to cyclically retract the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then release it to be advanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to project the striker in

the direction away from the completely confined fixed volume of non-compressible fluid, the rotary cam having a camming surface extending progressively away from its axis to a high point whereafter it is cut away generally toward the axis to permit the spring means to advance the impeller in the direction toward the completely confined fixed volume of non-compressible fluid to operate the striker. The cam is preferably provided with a shoulder adjacent its high point adapted to engage the impeller when the means for rotating the cam are rendered inoperative for stopping the impeller in the region of its extreme retracted position.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawings I have shown a present preferred embodiment of the invention in which

FIGURE 1 is a longitudinal cross-sectional view through an automatic hammer constructed in accordance with my invention;

FIGURE 2 is a transverse cross-sectional view to enlarged scale taken on the line II—II of FIGURE 1;

FIGURE 3 is a fragmentary longitudinal cross-sectional view at right angles to FIGURE 1 to the same scale as FIGURE 2 and taken on line III—III of FIGURE 2;

FIGURE 4 is a view similar to FIGURE 3 of the same portion of the automatic hammer taken at right angles to FIGURE 3 and on the line IV—IV of FIGURE 2; and

FIGURE 5 is a fragmentary enlargement of a portion of FIGURE 3.

Referring now more particularly to the drawings, I provide a cylindrical casing 2 externally threaded at its right-hand end, viewing FIGURE 1, at 3 and at its left-hand end at 4. Intermediate the ends of the casing 2 a shaft 5 extends through the casing and is journaled in bearings 6. A collar 5a is pinned to the end of the shaft 5 by a pin 5b. Attached to the casing 2 and in effect forming an integral part of the casing is a grip portion 7 adapted to be gripped by a hand of the user as shown in FIGURE 1 when the automatic hammer is in use. The shaft 5 extends through the grip portion 7 to a prime mover designated generally by reference numeral 8 and which may comprise an electric motor with or without a gear reducer depending upon the type of motor employed and the field of use for which the automatic hammer is intended. A switch operated by a trigger 9 is provided in the grip portion 7, the trigger 9 being positioned to be operated by the forefinger when the automatic hammer is gripped by the grip portion as shown. When the trigger 9 is depressed inwardly of the grip portion 7 the circuit is closed and the shaft 5 is rotated. When the trigger 9 is released it is spring-pressed outwardly and the circuit is opened and the shaft 5 stops rotating. Thus the grip portion serves for holding and "aiming" the automatic hammer which is operated by "pulling the trigger."

Operating in the cylindrical casing 2 to the right of the shaft 5 viewing FIGURE 1 is an impeller 10, shown in this instance as comprising a head 10a having integral therewith and projecting to the left therefrom viewing FIGURES 1, 3 and 4 a cam follower 12 having a substantially flat extremity 13 with a projection 14 at one edge forming a transverse shoulder 15 (see FIGURE 5). The follower 12 is always in contact with a cam 16 fixed to the shaft 5 by a set screw 16a, the cam 16 having a camming surface 17 extending progressively away from its axis to a high point 18 whereafter it is cut away generally toward the axis at 19. The cam 16 has at its outward extremity a projection 20 (see FIGURE 5) forming a shoulder 21 adapted to cooperate with the shoulder 15 of the follower 12 as will presently be described.

The right-hand end of the cylindrical casing 2, viewing FIGURE 1, is closed by a cap 22 which is screwed onto the casing at 3 and is vented to the atmosphere at

52. Disposed in the right-hand end of the casing 2 are means for altering or adjusting at will the strength of the action of spring means presently to be described, such adjusting means being designated generally by reference numeral 23 and having a projecting threaded shank 23a threadedly engaging the cap 22 at 24 and having a knob 25 attached to its outer end as shown in FIGURE 1. The adjusting member 23 has at its left-hand end, viewing FIGURE 1, a crosshead 26 and a central guiding portion 27 projecting to the left from the crosshead 26. The crosshead 26 fits loosely in the casing 2 so as not to imprison air between it and the impeller 10. Disposed between the head 10a of the impeller 10 and the crosshead 26 are coaxial inner and outer compression coil springs 28 and 29. The spring 28 is guided at its right-hand end, viewing FIGURE 1, by the guiding portion 27 and at its left-hand end by a guiding projection 30 on the head 10a and the spring 29 is disposed about the spring 28. The strength of the action of the springs 28 and 29 on the impeller 10 is altered by turning the knob 25 which in turn rotates the adjusting member 23 which because of its threaded connection with the cap 22 moves inwardly or outwardly of the casing 2 depending upon the direction of rotation. Thus the strength of the action of the springs 28 and 29 may be altered at will.

The impeller 10 has struts 31 threaded into and carrying at the left-hand end thereof, viewing FIGURES 3 and 4, a piston 32 which is sealed to the interior of the casing 2 by a sealing ring 33 so that the impeller which includes the piston 32 operates in the casing 2 acting as a cylinder. The struts 31 are fastened to the head 10a by screws 10b.

The casing 2 has threaded onto its left-hand end, viewing FIGURE 1, at 4 a cap 34 having a central aperture 35. Extending through the aperture 35 is a cylinder 36 which has at its right-hand end, viewing FIGURE 1, an outwardly extending radial flange 37 which when the cap 34 is screwed onto the casing 2 is sealed to an internal flange 38 of the casing by a sealing ring 39. The sealing ring 39 also seals the flange 37 of the cylinder 36 to the cap 34. The cylinder 36 opens into the cylindrical casing 2 and a striker 40 operates in the cylinder 36 and projects into the cylindrical casing 2 as shown in FIGURE 1. As shown the striker 40 is in the form of a piston sealed to the cylinder 36 by a sealing ring 41. The striker 40 comprises a striking pin 42 the inner end of which is received in a socket 43 and fastened in place by a set screw 44.

Threadedly connected to the outer end of the cylinder 36 at 45 is a nail guide 46 having at its outer extremity a grommet 47 of resilient material to prevent marring a surface 48 against which the automatic hammer may be positioned in use. A nail 49 is shown in the nail guide 46. The outer extremity of the striking pin 42 enters the nail guide 46 and is guided thereby as shown in FIGURE 1. The cylinder 36 is provided with ports 50 through which it is vented to the atmosphere.

The portion of the automatic hammer including the end portion of the cylindrical casing 2 to the left of the piston 32 of the impeller 10, viewing FIGURE 1, and about the inner extremity of the striker 40 and in the region of the inner end of the cylinder 36 contains a completely confined fixed volume of non-compressible fluid 51 which constitutes what I call a hydraulic lever. The fluid 51 completely fills the space to the left of the piston 32 and about the inner end of the striker 40. The non-compressible fluid may be oil, water, mercury or other suitable liquid, oil being preferred. The fixed volume of non-compressible fluid is permanently enclosed and completely confined within the space described.

When the trigger 9 is depressed into the handle portion 7 the shaft 5 is rotated and with it the cam 16. The shaft 5 rotates in the counterclockwise direction viewing FIGURE 3. The springs 28 and 29 maintain the follower 12 continuously in contact with the cam 16. As the cam 16 rotates it gradually cams the follower 12 against the

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action of the springs 28 and 29 until the high point 18 of the cam passes out of contact with the follower whereupon the springs 28 and 29 advance the impeller 10 rapidly to the left, viewing FIGURE 1, or in the direction toward the completely confined fixed volume of non-compressible fluid 51. Such advance of the impeller causes the non-compressible fluid to flow in its confined space and project the striker 40 to the left to drive the nail 49. Because of the difference in areas between the piston 32 and the inner end of the striker 40 the striker moves to the left, viewing FIGURE 1, at a speed which is a multiple of the speed of the impeller and also moves through a distance which is a multiple of the distance through which the impeller moves and further exerts pressure on the nail which is a multiple of the pressure exerted by the impeller. In other words, through use of the hydraulic lever consisting of the completely confined fixed volume of non-compressible fluid 51 I transform a relatively slow motion through a relatively short distance at relatively low pressure into a relatively fast motion through a relatively great distance at a relatively high pressure.

As the camming surface 17 of the cam 16 comes around on each cycle it moves the impeller 10 against the action of the springs 28 and 29. Such movement of the impeller including the piston 32 causes a suction at the inner portion of the cylinder 36 which draws the striker 40 inwardly to its initial position ready for the succeeding cycle.

When the trigger 9 is released and the force rotating the shaft 5 is deactivated the shaft 5 rotates to some extent through inertia and finally stops when the shoulder 21 of the cam 16 engages the shoulder 15 of the follower 12, such position being shown in FIGURES 3 and 5. Thus at the end of each use of the automatic hammer, as, for example, after driving each nail, the striker is in its withdrawn position so that another nail may be inserted into the nail guide 46.

Upon each outward projection of the striker the striker drives the nail or exerts its force upon whatever object is being acted on until the resistance offered to further projection of the striker is equal to the force exerted on the striker. When less resistance is offered the striker moves farther outwardly or to the left viewing FIGURE 1. When greater resistance is offered the outward movement of the striker is more limited.

When a nail or other object is being driven the amplitude of movement or stroke of the striker at the beginning of the driving thereof is a minimum. Upon each successive stroke of the striker the amplitude increases and the acceleration of the striker correspondingly increases. Since the force exerted on the nail or other object is the product of mass and acceleration the force is least at the beginning of the driving of the nail and gradually increases so that it is at a maximum at the end of the operation. Conversely, when starting to drive a nail the first blow, when the nail is more susceptible to bending, is relatively light or delicate and as the nail is driven progressively into the plank or other object the force exerted upon each blow increases due to the increased acceleration which in turn is due to the increased amplitude of the stroke. Thus my automatic hammer has unprecedented nail driving efficiency.

While I have shown and described a present preferred embodiment of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

I claim:

1. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely con-

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finer fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, and means for rapidly advancing the impeller in the direction toward the completely confined fixed volume of non-compressible fluid, causing, since the volume of the non-compressible fluid remains constant, the striker to be projected in the direction away from the completely confined fixed volume of non-compressible fluid at higher speed than the speed of advance of the impeller, to exert greater pressure than the pressure exerted by the impeller on the completely confined fixed volume of non-compressible fluid and through a greater distance than that through which the impeller advances, enabling the striker to drive a nail in the nail guide through the open end thereof.

2. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, and means for rapidly cyclically advancing and retracting the impeller in the direction toward and away from the completely confined fixed volume of non-compressible fluid, causing upon each advance of the impeller in the direction toward the completely confined fixed volume of non-compressible fluid, since the volume of the non-compressible fluid remains constant, the striker to be projected in the direction away from the completely confined fixed volume of non-compressible fluid at higher speed than the speed of advance of the impeller, to exert greater pressure than the pressure exerted by the impeller on the completely confined fixed volume of non-compressible fluid and through a greater distance than that through which the impeller advances, enabling the striker to drive a nail in the nail guide through the open end thereof.

3. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, spring means urging the impeller to advance in the direction toward the completely confined fixed volume of non-compressible fluid and means retracting the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then releasing it to be advanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to project the striker in the direction away from the completely confined fixed volume of non-compressible fluid to act as a hammer to drive a nail in the nail guide through the open end thereof.

4. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-com-

pressible fluid, spring means urging the impeller to advance in the direction toward the completely confined fixed volume of non-compressible fluid, means for altering at will the strength of the action of the spring means on the impeller, and means retracting the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then releasing it to be advanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to project the striker in the direction away from the completely confined fixed volume of non-compressible fluid to act as a hammer to drive a nail in the nail guide through the open end thereof.

5. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, spring means urging the impeller to advance in the direction toward the completely confined fixed volume of non-compressible fluid and rotary cam means retracting the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then releasing it to be advanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to project the striker in the direction away from the completely confined fixed volume of non-compressible fluid to act as a hammer to drive a nail in the nail guide through the open end thereof.

6. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, spring means urging the impeller to advance in the direction toward the completely confined fixed volume of non-compressible fluid, rotary cam means and means for rotating the rotary cam means to cyclically retract the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then release it to be advanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to cyclically project the striker in the direction away from the completely confined fixed volume of non-compressible fluid to drive a nail in the nail guide through the open end thereof.

7. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, and means for reciprocating the impeller and thereby reciprocating the striker but at higher speed, through a greater distance and with the exertion of greater pressure than the impeller to drive a nail in the nail guide through the open end thereof.

8. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a

striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, means for reciprocating the impeller, grip means for holding the automatic hammer and control means adjacent the grip means for activating and deactivating the means for reciprocating the impeller, the impeller when moved toward the completely confined fixed volume of non-compressible fluid driving the striker to drive a nail in the nail guide through the open end thereof.

9. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, and means including an electric motor and connections from the electric motor to the impeller for reciprocating the impeller, the impeller when moved toward the completely confined fixed volume of non-compressible fluid driving the striker to drive a nail in the nail guide through the open end thereof.

10. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, means for cyclically advancing and retracting the impeller in the directions toward and away from the completely confined fixed volume of non-compressible fluid and means effective upon rendering inoperative of the last mentioned means for stopping the impeller in the region of its extreme retracted position, the impeller when moved toward the completely confined fixed volume of non-compressible fluid driving the striker to drive a nail in the nail guide through the open end thereof.

11. An automatic hammer comprising a nail guide having a nail receiving bore terminating in an open end, a striker of relatively small cross-sectional area extending into the nail guide from the opposite end thereof and an impeller of relatively great cross-sectional area in communication with the striker through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, spring means urging the impeller to advance in the direction toward the completely confined fixed volume of non-compressible fluid, a rotary cam and means for rotating the rotary cam to cyclically retract the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then release it to be advanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to project the striker in the direction away from the completely confined fixed volume of non-compressible fluid, the rotary cam having a camming surface extending progressively away from its axis to a high point whereafter it is cut away generally

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toward the axis to permit the spring means to advance the impeller in the direction toward the completely confined fixed volume of non-compressible fluid to operate the striker, the impeller when moved toward the completely confined fixed volume of non-compressible fluid driving the striker to drive a nail in the nail guide through the open end thereof.

12. An automatic hammer comprising a striker of relatively small cross-sectional area and an impeller of relatively great cross-sectional area in communication with each other through a completely confined fixed volume of non-compressible fluid, each of the striker and impeller being mounted and guided for movement in contact with and toward and away from the completely confined fixed volume of non-compressible fluid, spring means urging the impeller to advance in the direction toward the completely confined fixed volume of non-compressible fluid, a rotary cam and means for rotating the rotary cam to cyclically retract the impeller in the direction away from the completely confined fixed volume of non-compressible fluid and then release it to be ad-

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vanced by the spring means in the direction toward the completely confined fixed volume of non-compressible fluid whereby to cyclically project the striker in the direction away from the completely confined fixed volume of non-compressible fluid, the rotary cam having a camming surface extending progressively away from its axis to a high point whereafter it is cut away generally toward the axis to permit the spring means to advance the impeller in the direction toward the completely confined fixed volume of non-compressible fluid to operate the striker, the cam having a shoulder adjacent its high point adapted to engage the impeller when the means for rotating the cam are rendered inoperative for stopping the impeller in the region of its extreme retracted position.

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GRANVILLE Y. CUSTER, JR., *Primary Examiner*.