Dec. 24, 1935. W. F. TROTTER 2,025,318

VIBRATING DEVICE

Filed March 2, 1934 2 Sheets-Sheet 1

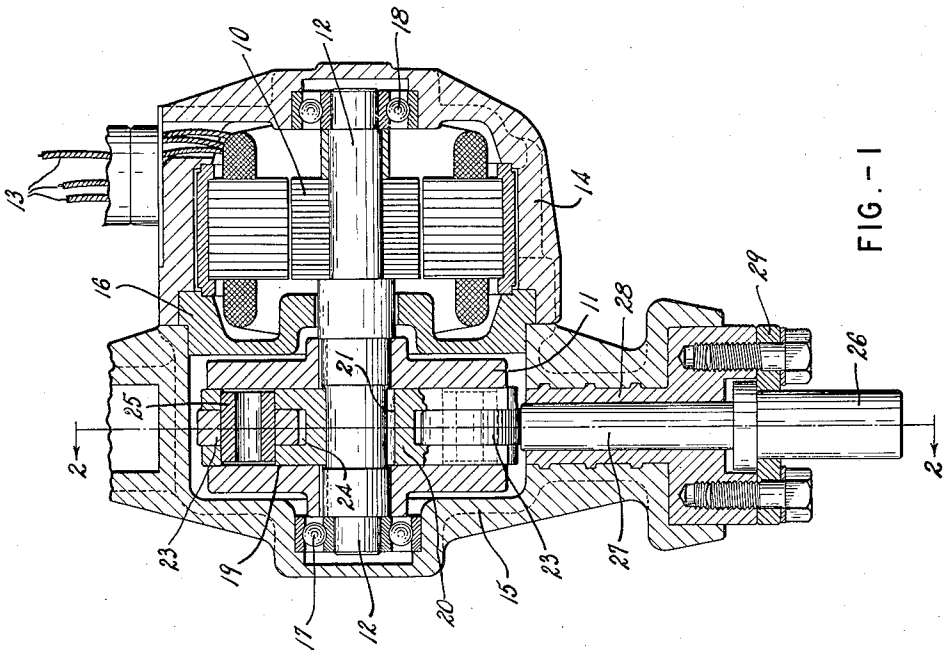


FIG. - 1

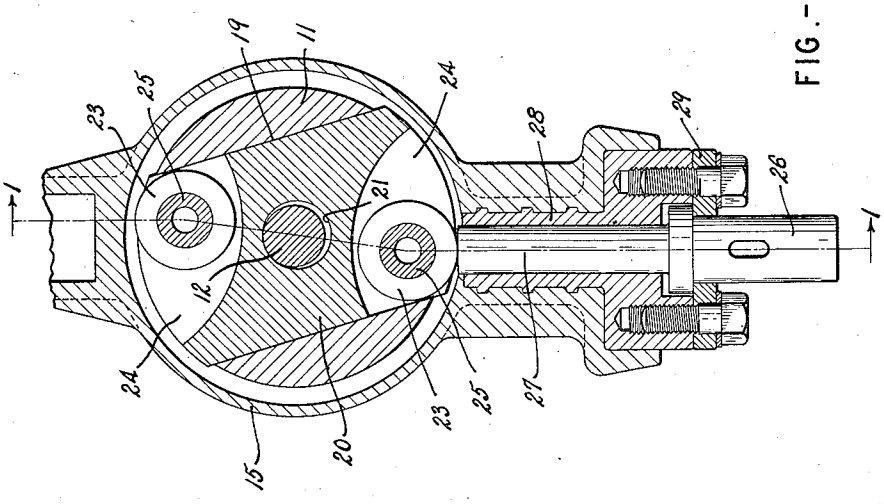


FIG. - 2

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Filed March 2, 1934 2 Sheets-Sheet 2

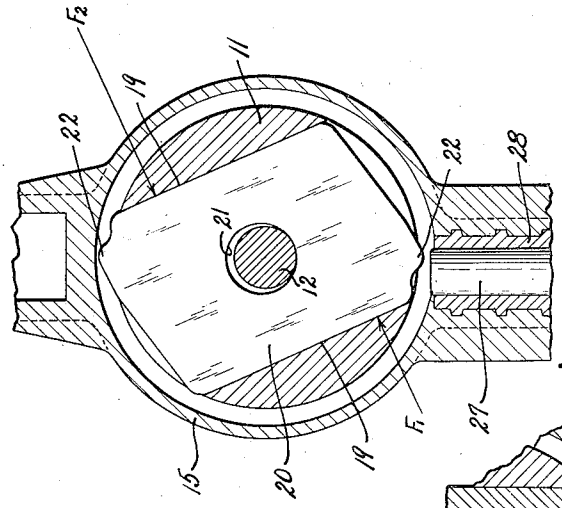


FIG. - 5

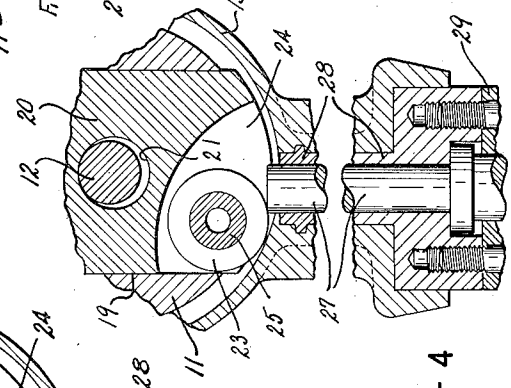


FIG. - 4

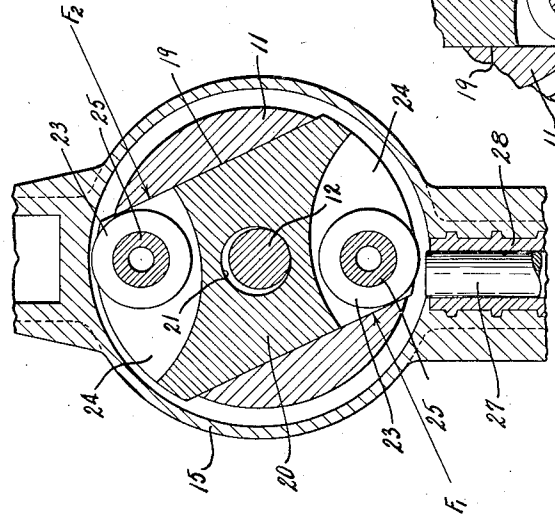


FIG. - 3

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UNITED STATES PATENT OFFICE

2,025,318

VIBRATING DEVICE

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Application March 2, 1934, Serial No. 713,766

5 Claims. (Cl. 125—33)

This invention relates to a vibrating device or power hammer and more particularly to that type in which repeated blows are imparted to a longitudinally movable tool or anvil by impacts of a striker member which forms part of a hammer body which rotates continuously in the same direction.

An object of the invention is to provide a hammer member of greater mass than has hitherto been practicable in a device free of objectionable vibration. This is accomplished by using the entire mass of the rotatable body to deliver the blows, by keeping the mass of the hammer member substantially in centrifugal balance at all times, and by absorbing the rebound from each impact in a manner to minimize vibration.

Another object of the invention is to provide a striker member which is double acting in effect, that is to say, is arranged to deliver two blows during each complete rotation.

A further object of the invention is to provide in a rotatable hammer member a striker member having a plurality of striking portions movable relative to the axis of rotation from inoperative to striking position and arranged so that the rebound from an impact moves the active striking part to inoperative position and the next striking part to striking position.

The invention also contemplates means for absorbing striker rebound in a radial direction when a blow is struck and cushioning the same by an oppositely acting centrifugal force, means for rotating a hammer member by forces equally distributed about the axis of rotation, and other novel features which will appear from the accompanying description and drawings.

In the drawings, Fig. 1 is a sectional view along the line 1—1 of Fig. 2, showing a longitudinal view of my improved hammer, together with motor driving means therefor; Fig. 2 is a transverse sectional view along the line 2—2 of Fig. 1 showing the anvil fully advanced and before recession of the striker; Fig. 3 is a section similar to Fig. 2 showing the striker fully withdrawn; Fig. 4 is a detail view showing the position of the parts at the instant of impact; while Fig. 5 is a view similar to Fig. 3 showing a modified form of striker member.

My invention comprises in general a rotatable hammer member and suitable motor means for rotating the same continuously in one direction. A frame or casing serves to completely house these parts. The hammer member comprises a striker and a carrier therefor. The carrier is slotted transversely and the striker is arranged for limited reciprocating motion in the slot diametrically of the carrier to produce alternate striking positions of its two striking parts. An anvil member or tool is supported for reciprocation in the frame with one end normally held in the path of the rotating striker when the latter is in its striking position. The blows are delivered by the entire mass of the rotating hammer member acting through the striker. The hammer member is of sufficient mass and is rotated at suitable speed to deliver the required blow when the striker impacts the anvil member. My improved hammer member provides the maximum impact possible in a given size of rotating hammer because the entire rotating mass delivers the blow. The striker is movable radially or diametrically of the carrier between its advanced striking and its retracted positions. It is arranged to be held in its outer or striking position by centrifugal force acting upon the striker with a force dependent upon the mass of the striker and its radius of gyration. Upon impacting the anvil member the striker rebounds and the parts are so arranged that the rebound takes place in a radial direction toward the axis of rotation of the hammer. Two advantageous results follow. First, there is little or no tangential or rotative effect caused by the rebound of the striker. In certain types of rotating hammers now used the rebound of the striker causes a rotative effect opposed to the rotation caused by the driving connection of the tool, which unbalances the tool and greatly reduces the velocity of the rotating hammer. Second, the centrifugal force is acting radially outwardly on the striker at the moment of impact, whereas the rebound acts radially inwardly. Thus the rebound is cushioned and is retarded by the effect of centrifugal force acting on the striker.

The striker might extend from the center of the carrier outwardly in only one direction so as to deliver but one blow per revolution. I prefer, however, to extend the striker diametrically across the carrier, as shown, and to limit its movement on each side of the axis of rotation. The reaction from the blow delivered by one end causes the striker to rebound so that the end which has just delivered an impact recedes to non-striking position, while simultaneously the opposite end is advanced to striking position. The tool thus delivers two blows per revolution. The parts are so arranged that striker rebound takes place radially inwardly, as mentioned above. During the first part of this striker movement centrifugal force acts on the striker

radially outwardly toward the impact-delivering end, because the center of mass of the striker is on that side of the axis of rotation. This force cushions the rebound and avoids the jar otherwise relayed to the handle of the tool. During the latter part of the striker movement, as the center of mass of the striker passes the axis of rotation, centrifugal force acts to aid the striker movement and advance the opposite end of the striker to its striking position. Since the eccentricity of the center of mass of the striker with respect to the axis of rotation is small, the striker never develops sufficient momentum on this outward movement to cause appreciable jar.

In the form illustrated, the armature **10** of an electric motor and a carrier **11** are rigidly mounted upon a common shaft **12**. Suitable electrical conductors **13** provide current for the operation of the motor. The parts are conveniently housed by means of casing member **14** surrounding the motor, casing member **15** surrounding the carrier and a partition member **16** separating the two casings, all of these parts being suitably secured together, as for instance by means of bolts, not shown. The shaft **12** may be supported for rotation in the casing members, as by means of bearings **17** and **18**.

The carrier is in centrifugal balance and in the form shown is cylindrical. It is provided with a transversely extending slot **19** extending entirely through the carrier from side to side. Within this slot a striker **20** is supported for reciprocation diametrically across the carrier. The sides of the striker conform to the sides of the slot opening through the carrier so as to provide a sliding fit. The striker is relatively long and wide, thus providing a large mass of metal compared to that usually found in the striker members of rotary tools of similar types. In the embodiment shown the width of the striker is well over half the diameter of the cylindrical carrier. The movement of the striker transversely in its slot is limited by contact with a portion of the carrier or a part movable therewith. In the instant case, the striker has a central opening **21** through which the shaft **12** passes, there being slight play between the sides of the opening and the shaft to permit endwise movement of the striker. The center of gravity of the striker is thus shifted slightly from one side of the axis of the shaft to the other each time a blow is delivered.

The striker has a relatively large mass but the arrangement is such that the apparatus as a whole is not subject to objectionable vibration even at high speeds because the striker **20** is but slightly out of centrifugal balance at any time.

The striker may be solid, and provided with a striking head **22** on each end, as shown in Fig. 5. However, for the purpose of increasing efficiency and reducing the loss due to friction, I prefer to form the striker member as shown in Figs. 1 to 4 in which rollers **23** are inserted in slots **24** in each end of the striker with suitable bearings **25** secured to the side walls of the slots in a manner to provide a free running roller. Thus the rollers project slightly beyond the arcuate ends of the hammer member in position to contact the anvil member **27**.

If the device is to be used as a vibrator the striker member will be arranged to deliver a blow to some part to be vibrated. I have illustrated simply a blow-delivering tool **26** having an anvil portion **27** and supported in the frame or casing for reciprocation. The portion of the frame surrounding the blow-delivering member may be lined with anti-friction metal **28** and a retaining member or plate **29** may be arranged to prevent the member falling out of the frame. It will be noted that the path of the reciprocating anvil portion lies intermediate a radius and a tangent to the circular path of travel of the impact-delivering end of the striker.

The rotation of the carrier and striker member is counter-clockwise as viewed in Figs. 2 to 5. The position of the striker at the instant of impact is shown in Fig. 4. The curved surface of roller **23** exerts a camming action on member **27**. At the same time roller **23** is moving toward member **27** due to its arc of travel about the axis of hammer rotation. Thus a glancing blow is struck which does not greatly reduce the speed of rotation of the hammer. Figs. 2 to 4 illustrate the positioning of the parts so that rebound takes place substantially in a radial direction. In Figs. 2 and 4 it will be noted that the center of gravity of the striker is on that side of the shaft axis on which the blow is being struck. The rebound of the striker carries the center of gravity past the axis of the rotating shaft into the position indicated in Fig. 3, where the opposite end of the striker is in position to deliver a blow upon the additional rotation of the carrier 180°. It will be obvious that centrifugal force tends to maintain the striker in either of its extended positions after the striker is placed in one of those positions. That is to say, as the striker moves from the position of Fig. 2 to the position of Fig. 3, until the center of gravity of the striker coincides with the axis of rotation, centrifugal force opposes the movement and softens the rebound, while after the center of gravity of the striker has passed the axis of the shaft, centrifugal action tends to carry the striker toward the position of Fig. 3 and to hold it there until the opposite end of the striker has delivered a blow to the anvil whereupon the rebound again reverses the center of gravity of the striker with respect to the shaft axis.

Upon the delivery of a blow the hammer is slightly retarded and acceleration is provided by the application of forces equally distributed about the axis of rotation. The application of these forces may be represented by the arrows F_1 and F_2 in Figs. 3 and 5 and it will be noted that these forces form a balanced couple about the central shaft which avoids any unbalanced effect which would occur if such force were applied at one side only of the rotating shaft.

Two advantages result from the construction of the double acting hammer as shown. In the first place, two impacts are obtained every revolution. In the second place, the energy of the rebound is used to position the striker for the succeeding impact. In strikers having but one hitting position it is necessary to reverse the natural direction of the rebound to position the striker member for the following impact. It results, therefore, that my hammer efficiently conserves energy in utilizing the power of rebound in the manner described.

The kinetic energy of a moving body varies directly as its mass times the square of its velocity. The mass of my improved hammer includes substantially the entire assembly of rotating parts comprised within the substantially cylindrical casing enclosing the said parts. That is to say, the mass is practically the maximum which can be placed in a given casing. This hammer is rotated at high velocity. Each blow is a glancing

blow, accompanied by a rebound or recession of the striking member. The velocity of the rotating mass is only slightly retarded and hence a high kinetic energy is always maintained. This is due to the fact that the parts are so arranged that the center of gravity of the striker at the moment of impact is angularly in advance of a radius connecting the axis of rotation and the point of impact between the striker end and the anvil member.

At the same time, the power of the actuating motor is conserved because the striker and its carrier form a substantially centrifugally balanced rotating mass. The carrier element is for all practical purposes in absolute balance without the use of any counter-weight and the striker moves but slightly out of balance during the use of the tool. This structure contributes to uniformity of rotation at high speeds without jolting or jarring of the shafts or bearings. The parts are so arranged that the path of travel of the striker diametrically across the carrier at the moment of impact is angularly in advance of a radius connecting the axis of rotation and the point of impact between the striker end and the anvil member.

The apparatus comprises few parts and is cheaply constructed as the hammer enclosing casing is substantially an unobstructed cylinder and the carrier and the striker are of simple form and not easily broken.

Another advantage of the double acting striker is that it provides a great number of impacts while holding the central shaft to a conservative number of revolutions.

What I claim is:

1. In a device of the class described, the combination of a frame, a carrier rotatable therein, means for continuously rotating said carrier, an anvil member supported for reciprocation in said frame and having a portion adapted to lie adjacent the periphery of the rotating carrier, a rigid striker having two impact-delivering ends, means supporting said striker on said carrier for movement in a definite path diametrically across said carrier, means limiting said striker movement to position its center of gravity a short distance each side of the axis of rotation of said carrier, whereby to present said impact-delivering ends alternately in position to impact said anvil portion, and said striker and anvil portion being so arranged that the rebound of said striker when one end impacts said anvil portion moves the other end of said striker into impact-delivering position.

2. In a device of the class described, the combination of a frame, a shaft rotatable therein, means for continuously rotating said shaft, a rigid striker having two impact-delivering ends, means mounting said striker for rotation with said shaft and for free movement in a single path diametrically across said shaft axis, means limiting said movement to position the center of gravity of said striker a short distance on opposite sides of the axis of said shaft, an anvil member supported for reciprocation in said frame, said anvil member having a portion adapted to lie in the path of that end of said striker lying on the same side of the shaft center as the center of gravity of said striker, and said striker and mounting means and anvil member being so arranged that the rebound of said striker when one end impacts said anvil portion moves the other end of said striker into impact-delivering position.

3. A device as in claim 2, in which said anvil member is supported for reciprocation in a path intermediate a radius and a tangent to the circular path of travel of the impact-delivering end of said striker.

4. A device as in claim 2, in which the parts are so arranged that the center of gravity of said striker at the moment of impact is angularly in advance of a radius connecting said axis of rotation and the point of impact between said striker end and said anvil member.

5. A device as in claim 2, in which the parts are so arranged that said striker path at the moment of impact is angularly in advance of a radius connecting said axis of rotation and the point of impact between said striker end and said anvil member.

WALTER F. TROTTER.