Feb. 10, 1959

W. FAHRNI

2,872,914

PERCUSSION MACHINE

Filed Jan. 22, 1957

3 Sheets-Sheet 1

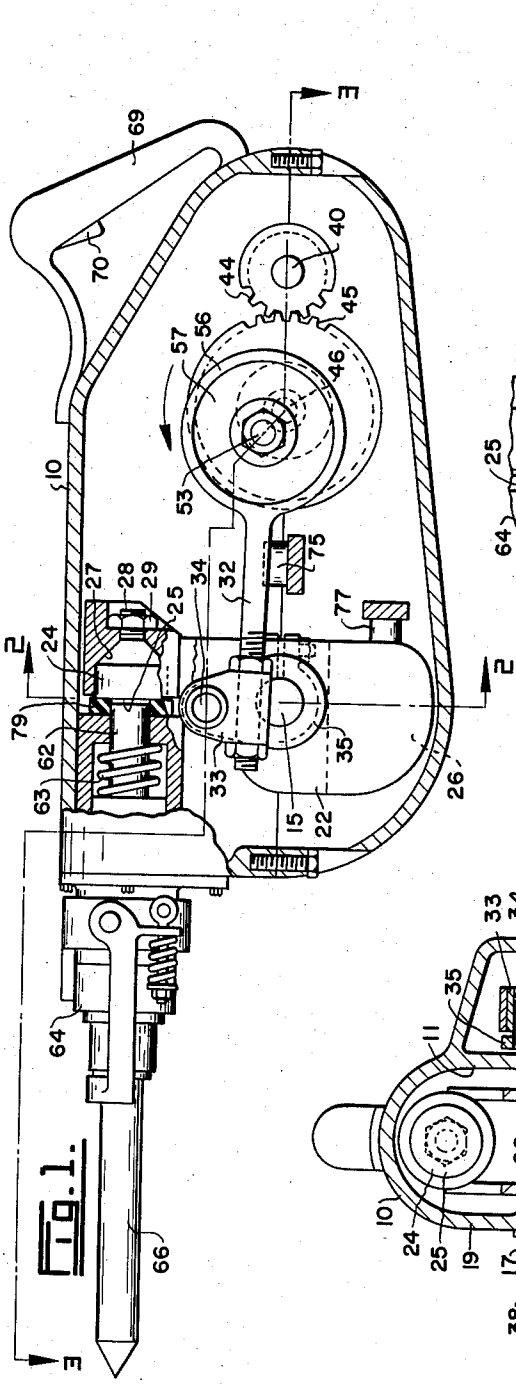


FIG. 1.

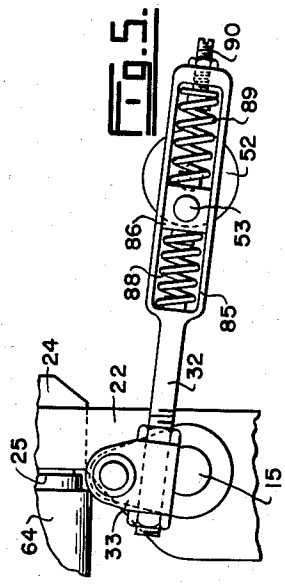


FIG. 5.

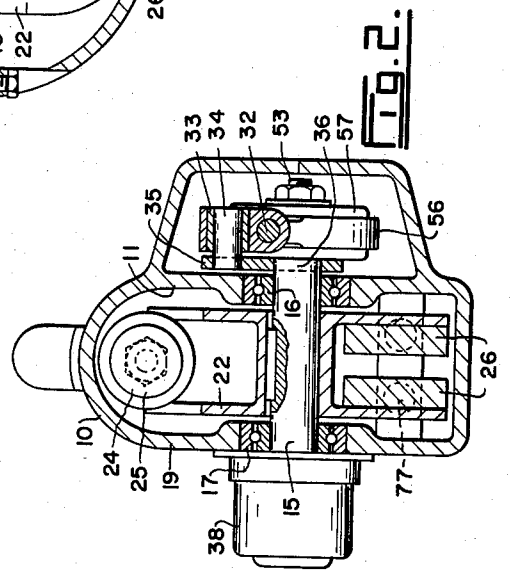


FIG. 2.

INVENTOR
WALTER FAHRNI
BY
Fetherstonhaugh & Co.
ATTORNEYS

Feb. 10, 1959 W. FAHRNI 2,872,914

PERCUSSION MACHINE

Filed Jan. 22, 1957 3 Sheets-Sheet 2

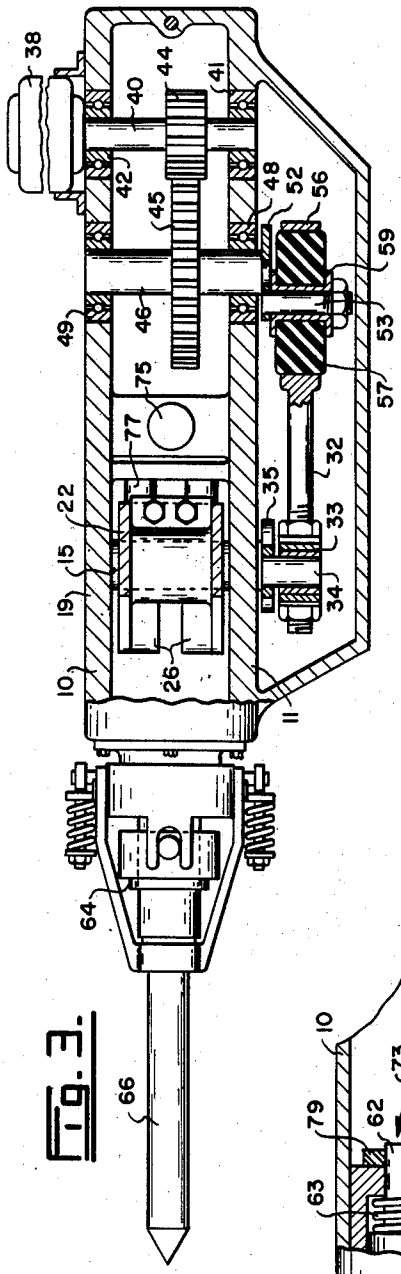


Fig. 3.

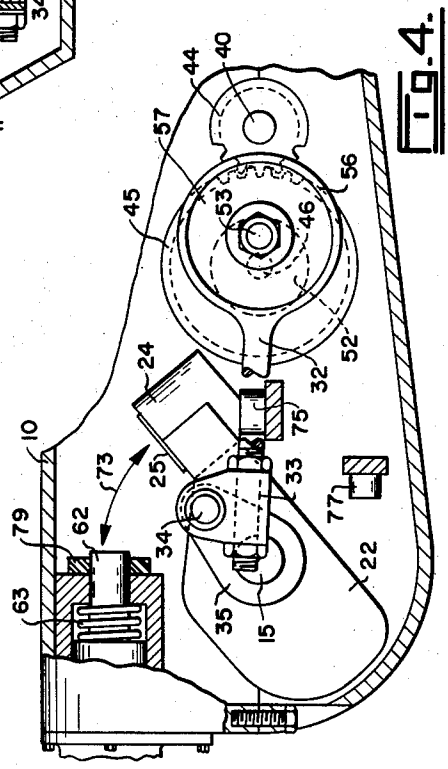


Fig. 4.

INVENTOR
WALTER FAHRNI
BY
Fetherstonhaugh & Co.
ATTORNEYS

Feb. 10, 1959 W. FAHRNI 2,872,914

PERCUSSION MACHINE

Filed Jan. 22, 1957 3 Sheets-Sheet 3

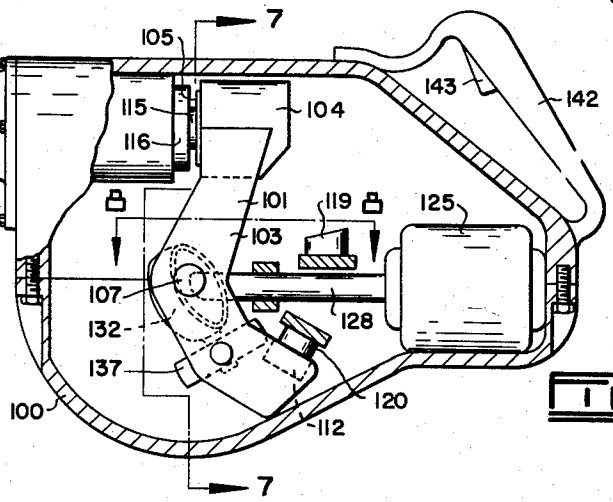


Fig. 6.

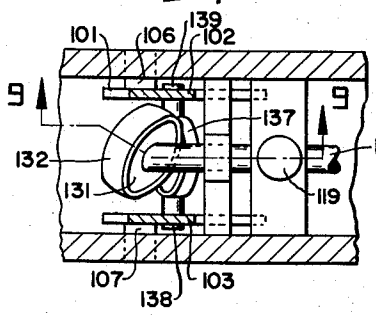


Fig. 8.

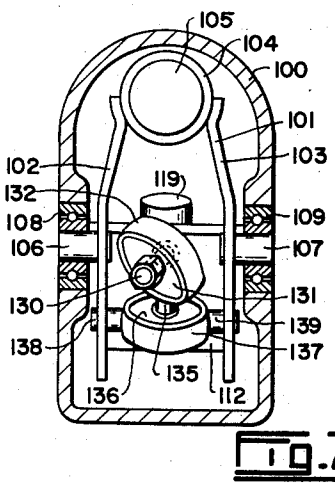


Fig. 7.

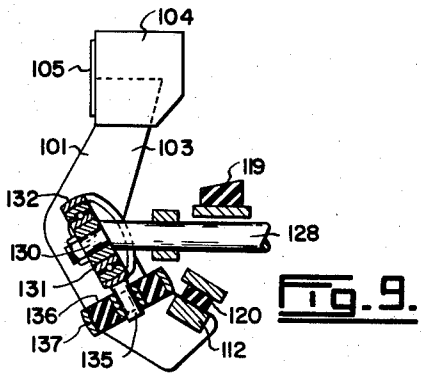


Fig. 9.

INVENTOR
WALTER FAHRNI
BY
Fetherstonhaugh & Co.
ATTORNEYS

United States Patent Office 2,872,914
Patented Feb. 10, 1959

2,872,914

PERCUSSION MACHINE

Walter Fahrni, Vancouver, British Columbia, Canada

Application January 22, 1957, Serial No. 635,475

13 Claims. (Cl. 125—33)

This invention relates to percussion machines that may be used as power driven hammers, rock drills, and the like.

An object of the present invention is the provision of a percussion machine which may be used with different types of tools, said machine transferring a rotary motion into a reciprocating motion for delivering hammer blows at high speed. The machine delivers a high percentage of the supplied energy to the point of impact with relatively little vibration or recoil; it eliminates the necessity of highly stressed parts, trigger actions or complex linkage; and it has comparatively little bulk and weight.

Another object is the provision of a percussion machine having a blow-producing element that is subjected to a whip-like action in order to obtain the maximum force from each blow.

A percussion machine according to the present invention comprises a rocker arm mounted for rotation about an axis spaced from the ends thereof, a hammer head at one end of the arm, a counterweight at the opposite end of the arm, a hammer shaft having an inner end aligned with the hammer head, a tool holder in engagement with the shaft, and means connected to the rocker arm for rapidly reciprocating the latter around its axis through back and forth strokes to cause said arm rapidly to strike the end of the hammer shaft aligned therewith, said shaft end being so located that it is struck each time by the hammer head before the rocker arm reaches the end of a normal stroke during reciprocation thereof.

Examples of this invention are illustrated in the accompanying drawings, in which,

Figure 1 is a side elevation of one form of percussion machine with the near wall of the casing thereof broken away and showing the hammer head at the end of its striking stroke,

Figure 2 is a vertical section taken on the line 2—2 of Figure 1,

Figure 3 is a horizontal section taken on the line 3—3 of Figure 1,

Figure 4 is a fragmentary view similar to Figure 1 showing the hammer head at the end of its return or non-striking stroke,

Figure 5 is a fragmentary side elevation of the rocker arm with an alternative form of driving connection therefor,

Figure 6 is a view similar to Figure 1 illustrating still another alternative form of percussion machine,

Figure 7 is a vertical section taken on the line 7—7 of Figure 6,

Figure 8 is a fragmentary horizontal section taken on the line 8—8 of Figure 6, and

Figure 9 is a fragmentary section taken on the line 9—9 of Figure 8.

Referring to Figures 1 to 4 of the drawings, 10 is a housing having a vertical supporting wall 11 therein. This wall has been omitted from Figure 1 for the sake of clarity. A comparatively heavy shaft 15 is rotatably mounted in suitable bearings 16 and 17 carried by wall

11 and an outer wall 19 of housing 10, see Figure 2. A rocker arm 22 is fixedly mounted on shaft 15 for rotation therewith. This arm is adapted to rotate around the axis of the shaft, said axis being spaced from the ends of the arm. The rocker arm has a hammer head 24 on one end thereof, said head having a striking face 25, and a counterweight 26 at its opposite end on the opposite side of shaft 15. In actual practice, the arm may be provided with a socket 27 into which the hammer head 24 removably fits, said head being in the form of a weight mass having a rearwardly projecting stud 28 upon which a nut 29 is threaded to hold the head in position.

Suitable means is connected to the rocker arm 22 for rapidly reciprocating it around the shaft axis. This means may be connected directly to the arm or for the sake of balance in the percussion machine, it may be indirectly connected thereto, as shown.

In this example, a link 32 is secured by a connector 33 to a pin 34, said pin projecting from a connecting arm 35 that radiates from the end 36 of shaft 15 which projects through and beyond supporting wall 11 of the housing. When the tool is in the position shown in Figures 1 to 4, connecting arm 35 projects upwardly from the shaft beside connector 33. Pin 34 is fixedly connected to this arm and is rotatably connected to the connector. When the connecting arm is in the vertical position, the rocker arm is at the striking end of its reciprocating stroke.

A suitable source of power, such as an electric motor 38, is provided at any desired point relative to housing 10. In this example, the motor is mounted on wall 19 and projects laterally from the housing, see Figure 3. This motor has a driven shaft 40 projecting into the housing and journalled in bearings 41 and 42 located in walls 11 and 19, respectively. A pinion gear 44 fixedly mounted on this shaft meshes with a larger gear 45 fixedly mounted on another shaft 46, the latter shaft being journalled in bearings 48 and 49 carried by said walls. A crank web or disc 52 is fixedly mounted on the end of shaft 46, said end projecting through wall 11. A crank pin 53 projects outwardly from disc 52 spaced from the centre of rotation thereof. When shaft 46 rotates, pin 53 moves around the axis of the shaft and forms the element for reciprocating rocker arm 22.

It is preferable resiliently to connect pin 53 to link 32. This may be done by providing the link with a frame 56 surrounding and spaced from the pin. A resilient pad 57 formed of rubber or other suitable material is carried by the frame and engages the pin. In other words, the pin projects through the pad. In order to reduce wear, the pad may have a sleeve 59 extending therethrough into which the pin rotatably fits.

A hammer shaft 62 is slidably mounted in housing 10 in any desired manner, said hammer shaft having an inner end aligned with hammer head 24. The actual mounting and parts associated with this hammer shaft are well known in the art. As is usual, this shaft is loaded by spring 63 so that its inner end is normally spaced slightly beyond the normal path of reciprocation of the hammer head, as shown in Figure 1. A suitable tool holder 64 is in engagement with shaft 62, said holder being adapted to receive and hold any one of several different types of tools, such as a pointed striker 66. As the tool holder does not actually form part of this invention, it does not need to be described herein in detail. However, during operation, the pointed striker 66 or other tool is pressed against the surface being operated upon and housing 10 is moved towards said surface so that hammer shaft 62 is moved into the path of hammer head 24.

The housing 10 may be provided with a pistol-type grip

69 which may have a trigger 70 for operating an electric switch, not shown, for controlling motor 38.

During operation of the machine, the hammer head 24 is reciprocated along an arcuate path indicated by the numeral 73 in Figure 4. A rebound cushion 75 is so positioned in the housing that it is engaged by the upper end of the rocker arm or the hammer head when the latter reaches the end of its outer stroke away from the hammer shaft, see Figure 4. A damping or recoil pad 77 is so positioned in housing 10 that it is engaged by the counter weight end of the rocker arm when the hammer shaft 62 is in its normal or inoperative position, as shown in Figure 1. Another damping cushion 79 may be provided at the inner end of the hammer shaft in such a position that it is struck by the hammer head when the hammer shaft is in the inoperative position.

When it is desired to use the percussion machine, a desired tool, such as a hammer, rock drill, or the like is inserted into a holder 64. When motor 38 is set into operation, crank pin 53 reciprocates link 32 which, in turn, causes the rocker arm 22 to reciprocate around the axis of shaft 15. When the machine is held in operative position with the hammer shaft 62 moved inwardly of housing 10 against the pressure of spring 63, the hammer head 24 rapidly strikes the inner end of the hammer shaft. The force of these blows is transferred through to the tool 66. When the hammer head is at the end of the back stroke away from the hammer shaft, its motion is dampened by cushion 75. Similarly, if the hammer shaft 62 is not pressed inwardly, the movement of the head is dampened as it reaches the opposite end of its stroke by pads 77 and 79 which are engaged by the counterweight end of the rocker arm and the hammer head, respectively.

The impact of the hammer head on the hammer shaft should occur when the hammer mass reaches its maximum velocity. If it were not for the resilient pad 57, this would be when the hammer head is approximately midway along its striking stroke. However, owing to the resilient return of the drive means and the inertia and momentum of the reciprocating weights when operating at high speeds, there is a decided lag so that the greater velocity is reached after the crank pin 57 is past centre, at which time the hammer head strikes the hammer shaft. There is also a sort of snap or whip-like action during the last part of the head stroke when the rubber tension on either side of the crank pin tends to equalize as the motion of said pin in the general direction of the hammer shaft slows down. It will be noted that all the reciprocating parts are included in the hammer weight, that is, with the weight of the hammer head and the parts moving with it, so that their momentum is added to the striking force. Thus, none of the power is wasted in moving parts that do not contribute to the force of the blow.

The snap or whip-like action of the hammer head is also caused by the rapid forward movement of pin 53 in a direction substantially parallel with the hammer shaft followed by the sudden slowing up of this movement as the pin swings downwardly along its circular path of rotation. As the head movement lags behind that of the pin owing to the resiliency of pad 57, it is suddenly accelerated by said pad, and the head reaches its maximum velocity as it reaches the hammer shaft.

Figure 5 illustrates a slight variation of the form of the invention illustrated in Figures 1 to 4. In this form of the invention, link 32 has an elongated frame 85 connected thereto, in which a block 86 is slidably mounted. Crank pin 53 is journalled in this block, and equalizing springs 88 and 89 extend from opposite sides of the block to the ends of the frame. The tension of these springs may be adjusted by means of a set screw 90 threaded in the outer end of the frame and bearing against spring 89.

The alternative of Figure 5 operates in the same manner as the form of the invention described above. Crank pin 53 is resiliently connected to link 32 and, consequently, rocker arm 22 through springs 88 and 89. These springs, therefore, operate in much the same manner as the resilient pad 57.

Figures 6 to 9 illustrate still another form of the invention. The principle of operation is the same as the previous machine but the driving connection between the power source and the hammer head is different.

This percussion machine includes a housing 100, and a rocker arm 101 in the form of spaced side members 102 and 103 carrying at one end thereof a hammer head 104 having a striking face 105. The rocker arm is carried by aligned stub shafts 106 and 107 journalled respectively in bearings 108 and 109 carried by the housing walls, see Figure 7. The rocker arm is rotatable around the common axis of the stub shaft. A counterweight 112 is carried by the arm at the end thereof remote from the hammer head.

A hammer shaft 115 is movably carried by the housing and has an inner end adapted to be moved into the path of travel of the hammer head 104 in the same manner as shaft 62 of the previously-described machine. This shaft is engaged by or connected to a tool holder, not shown. A resilient pad 116 is provided near the inner end of shaft 115 to be engaged by the hammer head when said shaft is in its retracted or normal position. A damping pad or cushion 119 is provided at the outer end of the path of travel of the hammer head and another damping pad 120 is positioned in the housing so that it is engaged by counterweight 112 when the hammer shaft is in its inoperative position.

A suitable source of power, such as electric motor 125, is provided for rapidly reciprocating the rocker arm and its hammer head. In this example, the motor is located within housing 100, and has a power shaft 128 extending to a position between the side members of the rocker arm 101. This shaft has a pin 130 projecting outwardly from its outer end at an angle to the longitudinal axis of the shaft. This pin projects through a bearing 131 positioned within a circular frame 132, and the latter has a pin 135 projecting downwardly therefrom into a resilient pad 136 formed of rubber or other suitable material. The latter pad is located in a frame 137 which has stub shafts 138 and 139 projecting laterally therefrom, said shafts being respectively journalled in side members 102 and 103 of the rocker arm 101. Frame 137 acts as a link connected to this rocker arm through shafts 138 and 139, and to pin 135 by resilient pad 136.

Housing 100 may be provided with a pistol-like grip 142 having a trigger switch 143 for operating motor 125.

The percussion machine of Figures 6 to 9 generally functions in the same manner as the first-described machine. A desired tool is inserted in the tool holder and pressed against the surface that is to be worked upon. The housing 100 is pressed in the direction of the surface to cause the inner end of hammer shaft 115 to move into the path of the hammer head 104 which is being rapidly reciprocated by the motor 125. The angularly-set pin 130 moves in a circle within bearing 131. This causes frame 132 to wobble which, in turn, causes pin 135 to reciprocate in a direction extending longitudinally of shaft 128. The reciprocation of the pin causes rocker arm 101 to reciprocate in a path back and forth around the common axis of stub shafts 106 and 107. Hammer head 105 rapidly strikes the inner end of hammer shaft 115. The back and forth movements of this head are dampened at the opposite ends of its strokes by pads 119 and 120. The resiliency of pad 136 causes the hammer mass to be at approximately its maximum velocity each time the hammer shaft is struck. The resiliency of pad 136 results in a snap or whip-like action of the hammer head in the same way as described above in connection with pad 57.

What I claim as my invention is:

1. A percussion machine comprising a rocker arm

mounted for rotation about an axis spaced from the ends thereof, a hammer head at one end of the arm moved through an arcuate path by said arm, a counterweight at the opposite end of the arm, a hammer shaft having an inner end aligned with the hammer head arcuate path, a tool holder in engagement with the shaft, a pin mounted for reciprocation through a short stroke, a source of power connected to the pin for causing rapid reciprocation thereof, a link extending from the pin to the rocker arm and connected to the latter, and resilient means connecting the pin to the link so that reciprocation of the pin reciprocates the rocker arm rapidly around its axis through back and forth strokes to cause said arm rapidly to strike the end of the hammer shaft aligned therewith, said shaft end being so located that it is struck each time by the hammer head just before the rocker arm reaches the end of a stroke during reciprocation thereof.

2. A percussion machine as claimed in claim 1 in which the resilient connecting means is a rubber pad connected to the pin and the link.

3. A percussion machine as claimed in claim 1 including spring means connected to the hammer shaft normally retaining the inner end thereof out of the path of travel of the hammer head, said shaft inner end being struck by the hammer head only when the shaft is moved against the spring means to position its inner end in the head path, and a damping cushion at the inner end of the shaft positioned to be engaged by the hammer head only when the hammer shaft is retained out of the path of travel of the head.

4. A percussion machine as claimed in claim 3 including a rebound cushion at the opposite end of the hammer head arcuate path from the hammer shaft and the damping cushion, said rebound cushion being engaged by the arm at the end of each stroke away from the shaft, whereby the rocker arm reciprocates between and against the damping and rebound cushions while the hammer shaft inner end is retained out of the path of travel of the hammer head.

5. A percussion machine comprising a rocker arm mounted for rotation about an axis spaced from the ends thereof, a hammer head at one end of the arm, a counterweight at the opposite end of the arm, a hammer shaft having an inner end aligned with the hammer head, a tool holder in engagement with the shaft, a pin mounted for reciprocation through back and forth strokes, a source of power connected to the pin for causing rapid reciprocation thereof, a frame surrounding and spaced from the pin, a rubber pad carried by the frame and engaging the pin, and a link connected to the frame and to the rocker arm, said pin through the pad and link rapidly reciprocating the rocker arm around its axis through back and forth strokes to cause said arm rapidly to strike the end of the hammer shaft aligned therewith, said shaft end being so located that it is struck each time by the hammer head just before the rocker arm reaches the end of a stroke during reciprocation thereof.

6. A percussion machine as claimed in claim 5 in which the pin projects from a crank web, said web being connected to and rotated by the power source.

7. A percussion machine as claimed in claim 5 in which the pin is reciprocated by another pin projecting from the end of a power shaft at an angle to the axis of the latter, said power shaft being rotated by the power source.

8. A percussion machine comprising a rocker arm mounted for rotation about an axis spaced from the ends thereof, a hammer head at one end of the arm, a counterweight at the opposite end of the arm, a hammer shaft having an inner end aligned with the hammer head, a tool holder in engagement with the shaft, a pin mounted for reciprocation through back and forth strokes, a source of power connected to the pin for causing rapid reciprocation thereof, an elongated frame, a block slidably mounted in the frame, said pin being journalled in the

block, equalizing springs extending between the ends of the frame and the block, and a link connected to an end of the frame and to the rocker arm, said pin through the block, frame and link rapidly reciprocating the rocker.

9. A percussion machine as claimed in claim 8 including means in the frame for adjusting the pressure of the equalizing springs.

10. A percussion machine comprising a rocker arm mounted for rotation about an axis spaced from the ends thereof, a hammer head at one end of the arm moved through an arcuate path by said arm, a counterweight at the opposite end of the arm, a hammer shaft having an inner end aligned with the hammer head arcuate path, a tool holder in engagement with the shaft, a motor, a pin connected to and rapidly rotated in a small circular path by the motor, resilient means at and connected to the pin, and connecting means connecting the resilient means to the rocker arm to reciprocate the latter through short back and forth strokes around its axis as the pin is rotated in its circular path to cause the head of said arm rapidly to strike the end of the hammer shaft aligned therewith, said shaft end being so located that it is struck by the hammer head just before the rocker arm reaches the end of a stroke during reciprocation thereof.

11. A percussion machine comprising a rocker arm mounted for rotation about an axis spaced from the ends thereof, a hammer head at one end of the arm, a counterweight at the opposite end of the arm, a hammer shaft having an inner end aligned with the hammer head, a tool holder in engagement with the shaft, means connected to the rocker arm for rapidly reciprocating it around its axis through back and forth strokes to cause said arm rapidly to strike the end of the hammer shaft aligned therewith, said shaft end being so located that it is struck by the hammer head just before the rocker arm reaches the end of a stroke during reciprocation thereof, a damping cushion aligned with the counterweight so positioned that it is engaged by the latter immediately after the hammer head strikes the hammer shaft.

12. A percussion machine comprising a rocker arm mounted for rotation about an axis spaced from the ends thereof, a hammer head at one end of the arm moved through an arcuate path by said arm, a counterweight at the opposite end of the arm, a hammer shaft having an inner end aligned with the hammer head arcuate path, a tool holder in engagement with the outer end of the shaft, spring means connected to the shaft normally retaining the inner end thereof out of the path of travel of the hammer head, means connected to the rocker arm for rapidly reciprocating it around its axis to move the head through back and forth strokes in the arcuate path thereof, said shaft inner end being struck by the hammer head only when the shaft is moved against the spring means to position its inner end in the head path, said shaft end being so located when in the head path that it is struck by the head just before the rocker arm reaches the end of a stroke during reciprocation thereof, and a damping cushion at the inner end of the shaft positioned to be engaged by the hammer head only when the hammer shaft is retained out of the path of travel of the head.

13. A percussion machine as claimed in claim 12 including a rebound cushion spaced from the hammer shaft and the damping cushion, said rebound cushion being engaged by the arm at the end of each stroke away from the shaft, whereby the rocker arm reciprocates between and against the damping and rebound cushions while the hammer shaft inner end is retained out of the path of travel of the hammer head.

References Cited in the file of this patent

UNITED STATES PATENTS

1,209,614	Osborne et al.	Dec. 19, 1916
1,788,547	Brown	Oct. 14, 1930