Feb. 20, 1934. E. H. W. WEIBULL 1,948,409

STRIKING TOOL

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Fig. 1.

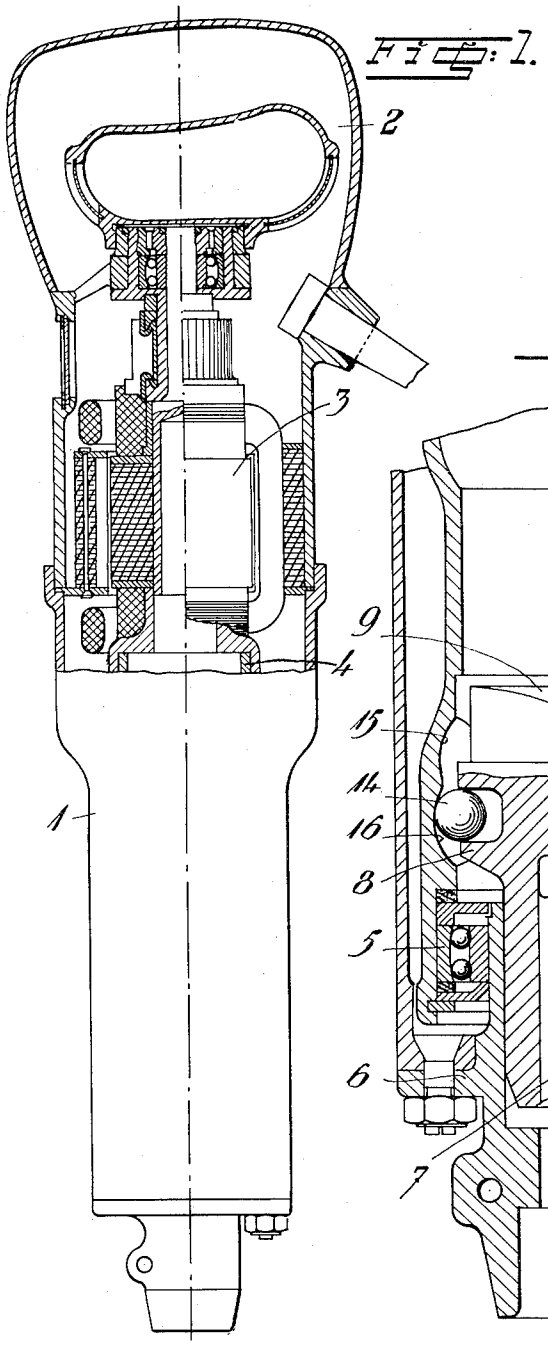
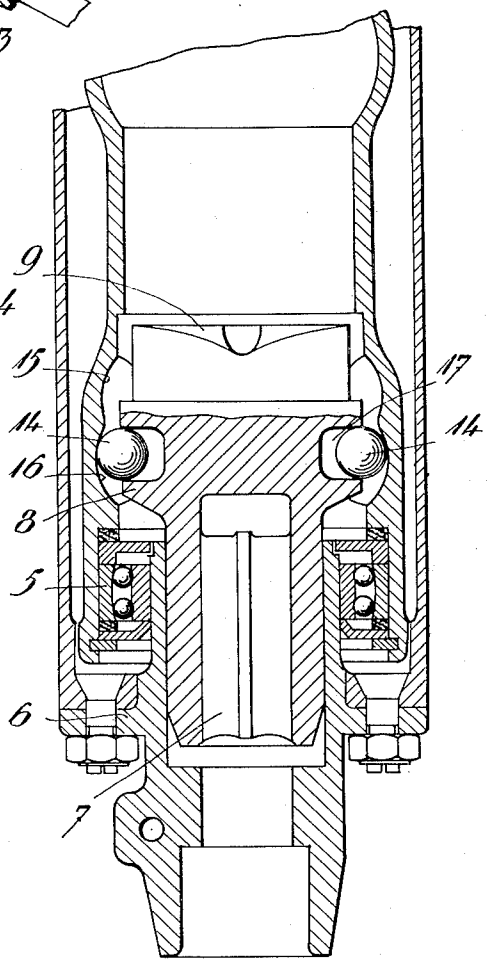



Fig. 5.




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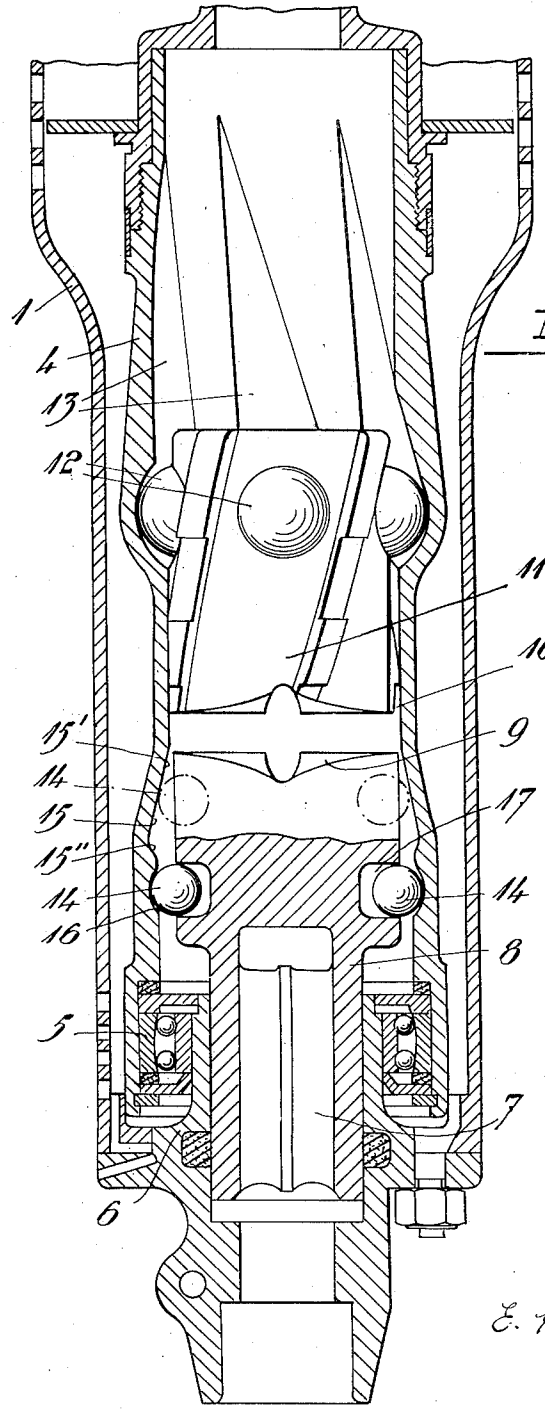



Fig. 2.

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STRIKING TOOL

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Fig. 3.

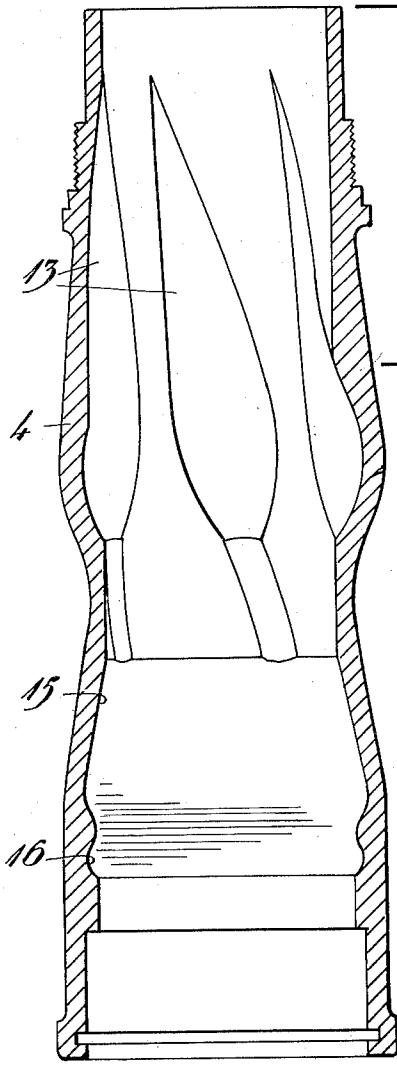



Fig. 4.

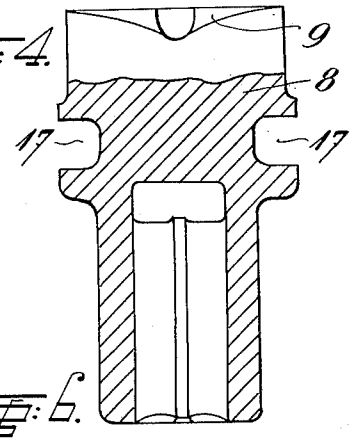



Fig. 6.

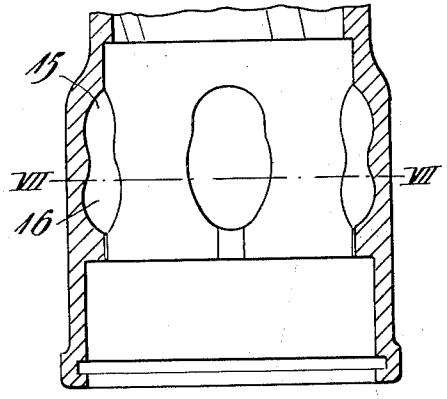
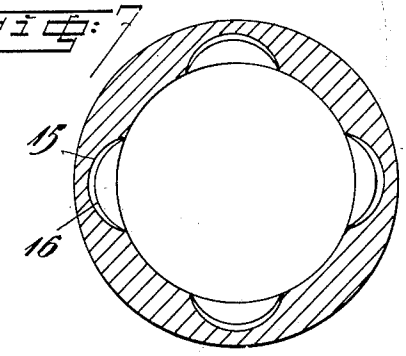



Fig. 7.




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Fig. 8.

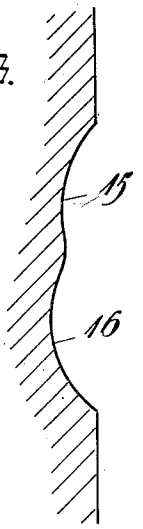



Fig. 9.

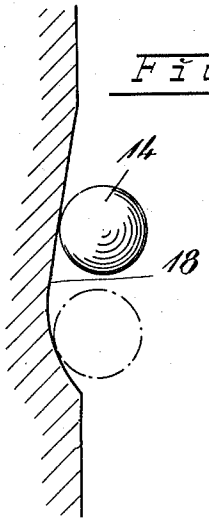



Fig. 10.

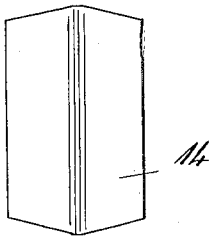



Fig. 11.

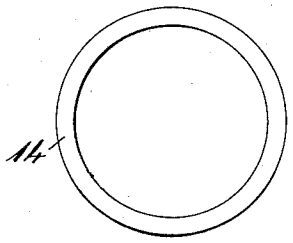



Fig. 12.

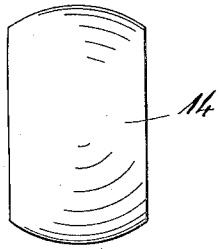
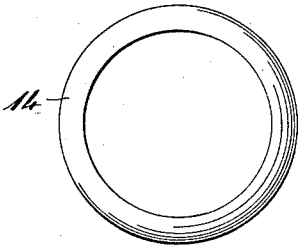



Fig. 13.




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Patented Feb. 20, 1934 1,948,409

# UNITED STATES PATENT OFFICE

1,948,409

## STRIKING TOOL

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Application May 7, 1932, Serial No. 609,932, and in Sweden May 12, 1931

12 Claims. (Cl. 125—33)

The present invention relates to motor-driven striking-tools of the kind in which a reciprocating and, as an alternative, also rotating striking-member transmits striking-energy to an axially movable anvil or tool holder, wholly or partly, surrounded by a sleeve rotated by the motor. The object of this invention is to provide such a resilient support of the anvil in axial direction so as to allow it to return automatically after each stroke to a certain working position previously determined and adapted to the motion of the striking-member. According to a special embodiment of the invention a similar arrangement may be used to maintain the anvil in a predetermined position of rest, when the tool runs idle.

In order to repress the recoil of the anvil in motor-driven striking-tools of the present kind, coil springs have hitherto been used, by means of which the displacement of the anvil in the direction towards the striking-member has been limited. Such springs are, however, very unreliable, require large space and render the assembling and the dismounting of the tool difficult.

According to the present invention, instead of using springs or other hitherto known means for impeding and eventually arresting the recoil motion of the anvil, the rotating motion of a rotatable member, such as the above mentioned rotatable sleeve surrounding the anvil is utilized for this purpose by arranging means developing centrifugal force incident to the rotation of said rotatable member, and by adapting said means so as to act upon the anvil in response to said centrifugal force in the desired way during its recoil motion.

This novel principle of guiding the recoil motion of the anvil may be realized by arranging between said rotatable sleeve and the anvil one or more rolling-bodies so as to partake, wholly or partly, in the rotating motion of said sleeve and also in the axial motions of the anvil, said rolling-bodies developing centrifugal force, during said rotating motion; there being also provided guiding means adapted to coact with said rolling-bodies in response to said centrifugal force so as to effect the desired impeding and arresting action upon the anvil during its recoil motion.

Said guiding means may consist of one or more guiding faces arranged on the rotatable sleeve of such shape so as to force said rolling-bodies, which are arranged to partake in the axial motions of the anvil, towards their axis of rotation in opposition to the action of said centrifugal force during the recoil motion of the anvil, thereby counteracting the recoil motion.

The rolling-bodies may, for instance, be loosely arranged in a circular groove on the anvil, and the guiding faces may be shaped so as to approach the axis of the anvil in the direction of the recoil motion. The guiding faces may thus be formed concave towards said axis with their upper parts approaching said axis. The guiding faces may be formed as surfaces of rotation about said axis, or they may consist of a number of surfaces, each one limited in the peripheral direction and embracing the rolling-bodies so as to force them to wholly partake in the rotation of the sleeve. It has, however, been found that the friction between the rolling bodies and the sleeve is sufficient to give to the former a satisfactory motion of rotation, wherefore the simpler way of forming the guiding face as a surface of rotation may be used to advantage. Especially is this the case of the interspace between the sleeve and the anvil is filled with a suitable lubricant, whereby the friction between the sleeve and the rolling bodies is increased.

The guiding faces may be formed so as to arrest the anvil in a predetermined axial position most suitable for transmitting the striking-energy of the striking-member to the anvil.

Another object of the invention is to provide means whereby the anvil can be kept out of reach of the striking member, when the tool is running idle. Said means may for instance consist of a particular guiding face adapted to coact with the rolling-bodies. Said guiding-face may, for instance, be provided with a part projecting towards the axis of the anvil, which projection limits the movement of the anvil towards the striking member when the anvil is not in use. Said guide face may be arranged below the above described guide face for repressing the recoil motion of the anvil, and be separated from the same by means of said projecting part.

Other features characteristic of the invention will be more closely set forth in connection with the description of the embodiments shown in the annexed drawings.

Fig. 1 shows a tool, in side view, constructed according to the invention, Fig. 2 shows the bottom part of the same tool in longitudinal section, and Figs. 3 and 4 illustrate some details. Fig. 5 shows a longitudinal section through the bottom part of the tool in a slightly modified embodiment. Fig. 6 shows a detail of the tool in Fig. 5, and Fig. 7 is a section on the line VII—VII in Fig. 6. Figs. 8 and 9 illustrate details of two

more embodiments and Figs. 10, 11, 12, 13 show other embodiments of rolling-bodies of non-spherical shape.

Referring to Figs. 1–4, 1 is the frame of the tool provided with the handle 2. The top part of this frame 1 contains an electric motor 3, the rotor of which is rigidly connected with a sleeve 4 which has its bottom end supported by a ball-bearing 5 at the outside of a support-sleeve 6. Mounted to be displaced and to slide in the interior of this sleeve 6 is an anvil 8 provided with a channel 7. The anvil has its top-end provided with oblique shoulders 9 cooperating with corresponding shoulders 10 located on the striking-member 11, which is mounted to be displaced in the top part of the sleeve 4. The striking-member is provided with radially mounted balls 12 cooperating with oblique guide-grooves 13 in the sleeve in such a way that after the recoil, produced by the stroke of the oblique shoulders 10 against the shoulders 9, the striking-member 11 will again be imparted an advancing striking-motion by the pressure of the balls 12 against the oblique guide-grooves 13, said balls being acted upon by centrifugal force.

Between the sleeve and the anvil there are arranged one or more rolling-bodies, preferably in the form of a number of balls 14, which are loosely inserted in a circular peripheral groove 17 in the anvil, so as to enable the balls to rotate around the longitudinal axis of the anvil and at the same time to partake in the axial motions of the anvil. The interior of the sleeve 14 is provided with one or several guiding faces 15, 15', 15'', 16, so formed that the balls 14 during different phases of the operation of the tool rest against different parts of said guiding faces.

When the tool is brought into operation and the sleeve 4 is rotated by the motor, the balls 14 will follow the sleeve more or less in this rotation, depending on how the guiding faces are formed. According to Figs. 1–4, the guiding faces are formed as surfaces of rotation about the longitudinal axis of the anvil. It has been found that the friction between the balls and the sleeve is sufficient to give to the balls a satisfactory speed of rotation for the purposes explained below. Said speed of rotation may, however, be increased by filling the interspace between the sleeve and the anvil with a greasy lubricant, whereby the friction between the balls and the sleeve is augmented.

When the balls 14 are thus rotating in the groove 17 they develop centrifugal force and are pressed with increased force against the guiding faces. One part 15 of said guiding faces has the object of coacting with the balls 14 so that the balls will exert an impeding and finally an arresting action upon the anvil during its recoil motion. For this purpose, said part 15 of the guiding faces is given such a shape that the balls 14, during the recoil motion of the anvil, are forced inwardly toward the axis of the anvil in opposition to the centrifugal force developed by the balls during their rotation. Said guiding face 15 may, therefore, as shown, have a generatrice, which approaches the axis of the anvil in the direction of its recoil motion, so that a surface of conical or concave form towards said axis is formed. When the balls, thus, during the recoil motion of the anvil are forced to approach toward the axis of the anvil, the centrifugal force developed by them will oppose this motion. The necessary energy to overcome this resistance has to be taken from the kinetic energy of the anvil. Hence, the recoil motion of the anvil will be gradually impeded, and by giving a correct shape to the guiding face 15, it will be possible to finally arrest the anvil at a desired position, indicated by dotted lines in Fig. 2, the balls then resting against the upper part 15' of the guiding face 15. The guiding face 15 should be so formed that the anvil, when thus arrested, occupies the most favorable position for obtaining new striking-energy from the reciprocating striking-member 11. The balls 14, which are constantly rotating, will, owing to the effect of centrifugal force, tend to remove away from the axis of the anvil and will therefore operate to press the anvil downwards. Thus, the balls 14 will assist the anvil in its motion during a power-stroke but oppose its motion during the recoil stroke in a manner similar to a spring. In order to arrest the downward motion of the anvil, the guiding face 15 may be provided with an inwardly projecting part 15'', so that, when the balls enter upon the part 15'', they are caused to move towards the axis of the anvil in opposition to centrifugal force. They will then in a similar manner, as described above, arrest the anvil in a desired position, provided that said part 15'' has been given a correct shape and that the striking-motion of the anvil is so great that the balls will enter upon said part 15'' of the guide face.

When the tool is lifted from the work and, thus, is running idle with the striking-member 11 still reciprocating and the sleeve 4 still rotating, it is of importance that the anvil is automatically brought out of reach of the striking-member. For this purpose, there is provided on the interior of the sleeve 4 an inwardly projecting surface so arranged that, when the striking-member hits the idle anvil, the latter is pressed downwards so far that the balls 14 will pass said projecting surface, which afterwards will prevent the anvil from moving again towards the striking-member, unless forced to do so, as for instance by pressing the tool against the work. According to a preferred form of the invention, said projecting surface may be the same as the above-mentioned lower part 15' of the guiding face 15 and may be continued downward with an outwardly curved guiding face 16. After passing the surface 15'' the balls 14 will then rest against the surface 16. As the centrifugal force tends to keep the balls as remotely as possible from the axis of rotation, it is apparent that the balls will offer resistance against any effort to move them upwards past the surface 15''. The position of the balls when the tool is running idle is shown in full lines in Fig. 2. When a tool inserted in the anvil, for instance a rock-drill, is pressed against the work, the anvil is pressed upwards, and the balls are forced to pass the projecting surface 15'' and again enter upon the guiding face 15.

Instead of forming the guiding faces 15, 16 as surfaces of rotation, as shown in Figs. 1–4, they may consist of a number of surfaces, each limited in a peripheral direction, as illustrated in Figs. 5–7. Each separate guiding face is then formed as a recess in the interior surface of the sleeve 4, and into each one of them a ball 14 is entered so that the balls are forced to wholly participate in the rotation of the sleeve.

A somewhat modified form of the guiding faces 15, 16 is illustrated in Fig. 8.

According to the invention, it is not necessary to use two guide-faces 15, 16, but these may be

replaced by a single face 18, as shown in Fig. 9. In this case, the anvil 8 will be automatically—i. e. without any action from the striking-member 11—put out of the way of the striking-member, as soon as the tool is raised from the work. The ball 14 shown by full lines indicates the axial position of the ball and, thus, of the anvil during operation of the tool, the ball shown by dotted lines indicating the axial position of the anvil with the tool running idle.

Instead of balls 14 other kinds of rolling-bodies may be used, for instance having the shape shown in Figs. 10, 11 and 12, 13 respectively.

Different parts in the modifications illustrated in Figs. 5–9 are designated by the same numerals as corresponding parts in Figs. 1–4.

Having now particularly described the nature of my invention and the manner of its operation, what I claim is:

1. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, a rotatable member, means for imparting a rotary motion to said rotatable member, and means adapted to act on the anvil in response to centrifugal force developed incident to the rotation of said rotatable member so as to effect an impeding and eventually arresting action upon the anvil during its recoil motion.

2. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, a rotatable member, means for imparting a rotary motion to said rotatable member, rolling bodies adapted to act on the anvil and arranged to develop centrifugal force at the rotation of said rotatable member, and guiding means adapted to coact with said rolling bodies in response to said centrifugal force so as to effect an impeding and eventually arresting action upon the anvil during its recoil motion.

3. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, a rotatable member surrounding the anvil, means for imparting a rotary motion to said rotatable member, rolling bodies adapted to act on the anvil and arranged to develop centrifugal force at the rotation of said rotatable member, and a guiding face arranged on said rotatable member and adapted to coact with said rolling bodies in response to said centrifugal force so as to effect an impeding and eventually arresting action upon the anvil during its recoil motion.

4. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, a rotatable member surrounding the anvil, means for imparting a rotary motion to said rotatable member, rolling bodies adapted to partake in the axial motion of the anvil and arranged to develop centrifugal force at the rotation of said rotatable member, and a guiding face arranged on said rotatable member and adapted to coact with said rolling bodies in response to said centrifugal force so as to effect an impeding and eventually arresting action upon the anvil during its recoil motion.

5. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, a rotatable member surrounding the anvil, means for imparting a rotary motion to said rotatable member, rolling bodies adapted to partake in the axial motion of the anvil and to be imparted a rotary motion by said rotatable member so as to develop centrifugal force, a guiding face for said rolling bodies arranged on said rotatable member, said guiding face having such a shape so as to force said rolling bodies towards the axis of rotation in opposition to the action of said centrifugal force during the recoil motion of the anvil thereby impeding and eventually arresting said motion.

6. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, a rotatable member surrounding the anvil, means for imparting a rotary motion to said rotatable member, rolling bodies loosely arranged in a circular groove on the anvil, a guiding face arranged on said rotatable member and adapted to impart a rotary motion to said rolling bodies so as to develop centrifugal force, said guiding face having such a shape so as to force said rolling bodies towards the axis of rotation in opposition to the action of said centrifugal force during the recoil motion of the anvil thereby impeding and eventually arresting said motion.

7. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, rolling bodies loosely arranged in a circular groove on the anvil, a guiding face for said rolling bodies formed as a surface of rotation about the axis of the anvil and arranged on a rotatable member, means for rotating the latter, said guiding face having such a shape so as to force the rolling bodies towards the axis of the anvil during the recoil motion of the latter, and thereby bring them to develop a centrifugal force that impedes and eventually arrests the recoil motion.

8. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, rolling bodies loosely arranged in a circular groove on the anvil, a guiding face for said rolling bodies formed as a surface of rotation about the axis of the anvil and arranged on a rotatable member, means for rotating the latter, the generatrice of said guiding face approaching the axis of the anvil in the direction of its recoil motion so as to force the rolling bodies towards said axis during said motion, thereby bringing them to develop a centrifugal force that impedes and eventually arrests the recoil motion.

9. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, a rotatable member, means for imparting a rotary motion to said rotatable member, means adapted to act on the anvil in response to centrifugal force developed incident to the rotation of said rotatable member so as to effect an impeding and eventually arresting action upon the anvil during its recoil motion, and means for removing and keeping the anvil out of touch with the striking member when the tool is running idle.

10. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, a rotatable member surrounding the anvil, means for imparting a rotary motion to said rotatable member, rolling bodies adapted to partake in the axial motion of the anvil arranged to develop centrifugal force at the rotation of said rotatable member,

and a guiding face arranged on said rotatable member and adapted to coact with said rolling bodies in response to said centrifugal force so as to effect an impeding and eventually arresting action upon the anvil during its recoil motion, said guiding face being provided with means coacting with said rolling bodies so as to keep the anvil out of touch with the striking member when the tool is running idle.

11. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, rolling bodies loosely arranged in a circular groove on the anvil, a guiding face for said rolling bodies formed as a surface of rotation about the axis of the anvil and arranged on a rotatable member, means for rotating the latter, said guiding face being concave towards the axis of the anvil so as to force the rolling bodies towards said axis during the axial motions of the anvil, thereby bringing them to develop centrifugal forces that impede said motions.

12. In a striking tool, a striking member, means for imparting a reciprocating motion to said striking member, an axially movable anvil engageable by said striking member, rolling bodies loosely arranged in a circular groove on the anvil, a guiding face for said rolling bodies formed as a surface of rotation about the axis of the anvil and arranged on a rotatable member, means for rotating the latter, said guiding face being concave towards the axis of the anvil so as to force the rolling bodies towards said axis during the axial motions of the anvil, thereby bringing them to develop centrifugal forces that impede said motions, said guiding face being provided with an inwardly projecting part, adapted to keep the anvil out of touch with the striking member when the tool is running idle.

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