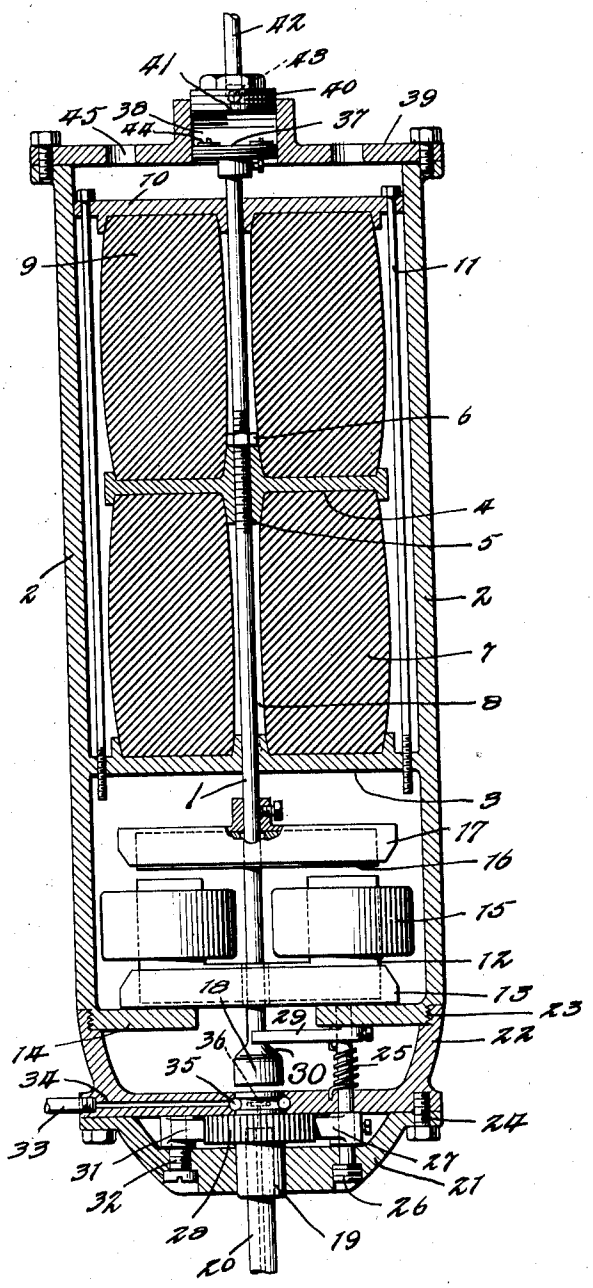
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PERCUSSIVE TOOL

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PERCUSSIVE TOOL

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This invention relates to percussive tools, such for example, as rock drills, riveting hammers, chipping hammers and the like.

The object of the invention is to provide an improved and simplified form of tool capable of operation at a very high rate of speed so as to enable repeated blows or impacts to be struck with a rapidity greatly in excess of that obtainable with existing tools.

The invention essentially comprises an electromagnetic motor or operating means and a resilient means cooperating therewith, the motor and resilient means acting together in synchronism to produce and maintain a suitable striker or hammer member in vibration or reciprocatory movement at a predetermined high frequency and with a desired or controlled amplitude of vibration.

The invention is illustrated in the accompanying drawing as applied to a rock drill, the figure being a vertical, longitudinal section of the drill.

The particular construction shown comprises a substantially cylindrical casing within which are enclosed the striker or hammer rod and the mechanism for maintaining said rod in a state of vibration or longitudinal reciprocation at a predetermined frequency and at a high rate of speed. This mechanism includes a resilient means normally holding the striker or hammer rod in a neutral position but capable of being deflected in either direction from said neutral position and when so deflected tending to restore the striker rod to said neutral position, and electromagnetic means for causing rapidly repeated deflection of the resilient means, to thereby maintain the striker rod in vibration or reciprocation along its axis.

The striker rod (1) is arranged centrally of the casing (2) and is guided for axial vibration or reciprocation therein by means of a partition (3) which may be integral with or secured to the casing in any suitable manner intermediate the ends thereof. The rod is also guided at its upper end as will later appear.

Secured to the striker rod (1) above the partition (3) is a plate (4), which may be conveniently mounted upon the rod by means of screw threads (5) and held in the desired position by means of a lock nut (6). Interposed between the plate (4) and the partition (3) is a block or cylinder (7) of rubber, having a central aperture (8) to accommodate the rod (1). Above the plate (4) is a second similar block or cylinder (9) of rubber, which is interposed between the plate (4) and an upper plate (10) fitting within the upper part of the casing (2). This upper plate (10) is connected by means of a plurality of bolts (11) with the partition (3), the heads of the bolts engaging the upper side of the plate and the lower ends thereof being threaded into the partition, thus providing for adjustment of the position of the plate (10) relatively to the partition (3). By thus adjusting the plate (10) relatively to the partition the initial stress or compression under which the rubber blocks or cylinders are placed may be varied as desired.

Beneath the partition (3) is arranged the electromagnetic means for maintaining the striker rod in vibration. In the form shown such means comprises a substantially C-shaped laminated core (12) mounted in a suitable core holder (13) of non-magnetic material, which may conveniently be secured to inwardly projecting lugs or supports (14) formed at the lower end of the casing (2). The core (12) is provided on the upwardly projecting arms or poles thereof with energizing coils (15). Above and suitably spaced from the upper ends of the poles of the core (12) is a reciprocable laminated armature (16) which may be mounted in a holder (17) of non-magnetic material, which is secured in any suitable manner to the striker rod (1). The armature (16) and the core (12) are suitably apertured to permit the passage of the striker rod therethrough.

The coils (15) are connected with a suitable source of alternating or pulsating current, whereby the armature (16) is intermittently attracted toward the poles of the core (12) thereby moving the striker rod (1) in the downward direction. This movement of the rod, through the plate (4) secured thereto, deflects or compresses the rubber block or cylinder (7) between the plate and the par-

tition (3) and thus builds up in the rubber block a restoring force which, when the attraction of the armature toward the poles of the core ceases between the alternations or pulsations of current, tends to restore the striker rod and the parts carried thereby upwardly to the neutral positions thereof. Due to the inertia of the striker rod and the parts moving therewith the rod and said parts will be carried upwardly beyond the neutral position and the upper rubber block or cylinder (9) will be deflected or compressed between the plate (4) and the upper plate (10), building up in this block also a restoring force tending to restore the striker rod and parts carried thereby downwardly to the neutral position. This downward movement of the striker rod and parts carried thereby will be assisted by the attractive force of the core (12) upon the armature (16), and as the striker rod and plate reach the neutral position the attractive force of the core on the armature, together with the inertia of the parts will carry the striker rod and plate downwardly beyond the neutral position, again deflecting or compressing the lower rubber block (7) and again building up therein a restoring force for effecting the next upward movement of the striker rod and parts connected thereto. This vibration or reciprocation of the striker rod will continue as long as the current is supplied to the energizing coils.

It will be understood that the attractive forces are intermittently applied to the armature (16) in such manner as to cause the striker rod to vibrate or reciprocate at a predetermined frequency, and that the rubber blocks or cylinders (7 and 9) are so designed as to their size and resiliency as to also maintain the striker rod in vibration at this same predetermined frequency. That is to say, the blocks or cylinders are so designed that when deflected or compressed in the manner described, restoring forces are built up therein of the necessary magnitude to return the striker rod and parts carried thereby to the neutral position in the same time as taken to move the rod and parts from said position. Thus the electro-magnetic means and said blocks or cylinders properly cooperate in synchronism with each other to maintain the striker rod and associated parts in vibration or reciprocation at said predetermined frequency, and with a desired amplitude of vibration, which may be varied by varying the strength of the current supplied.

The rubber blocks or cylinders (7 and 9) are preferably placed under an initial stress or compression, and this is effected by suitably adjusting the bolts (11) so as to vary the distance between the partition (3) and the upper plate (10).

The lower end of the striker rod (1) is enlarged to provide an impact or hammer portion (18), and beneath this hammer portion is mounted the chuck (19) within which the drill steel (20) is arranged, the chuck receiving the impacts or blows from the striker rod and imparting them to the drill steel. This chuck is mounted centrally in suitable bearing portions of a lower cap section (21), and an intermediate end section (22) which is suitably secured, as by means of screw threads (23), to the lower end of the casing (2), the cap section (21) in turn being suitably secured to the intermediate section, as by means of screws (24).

The position of the armature (16) with respect to the poles of the core (12), and the position of the impact face of the hammer portion (18) of the striker rod with respect to the upper face of the chuck (19) may be adjusted or determined by rotational adjustment of the striker rod, which by reason of the screw threaded engagement of this rod with the plate (4) held between the rubber blocks (7 and 9) will enable vertical adjustment of the rod to be effected. The relative adjustment of the parts is such that the impact or blow is always taken by the chuck (19), the armature not coming into contact with the pole faces. The plate (10) and the upper block (9) are removed to permit access to the lock nut (6) to permit the desired movement of the rod and to lock the rod in its adjusted position. The upper plate (10) may also have a splined connection with the striker rod to normally prevent rotation of the latter and to hold the armature in proper relation to the pole faces.

Any suitable means may be provided for effecting rotation of the chuck (19) and drill steel mounted therein. In the form of means shown for this purpose the reciprocating movements of the striker rod are utilized to effect the desired rotation. Such means comprises a spindle (25) rotatably supported by the sections (21 and 22) and one of the lugs (14), and held in place by means of a threaded plug (26). Secured to the spindle (25) between the sections (21 and 22) is a pawl (27) adapted to engage ratchet teeth (28) formed on the chuck (19). Also secured to the spindle (25) adjacent the lug (14) is an arm (29) which at its inner end is adapted to coact with the cam-shaped portion (30) formed between the striker rod proper and the hammer portion (18) thereof. Thus as the striker rod reciprocates, the arm (29), spindle (25) and pawl (27) will be oscillated about the axis of the spindle in one direction by the cam (30) and in the other direction by a suitable spring, and during each such oscillation the pawl will engage the ratchet teeth (28) and will impart a partial rotation to the chuck and drill steel. It will be understood that the inner end of the pawl may be provided with a yieldable tooth portion adapted to yield on the backward stroke

of the pawl in order to pass the ratchet teeth. A suitable number of stop pawls, such as 31, may be provided mounted on studs (32) threaded into the cap section (21) and engaging the ratchet teeth to prevent reverse rotation of the chuck.

Water may be supplied to the drill steel during cutting through a suitable pipe (33) connected to a channel (34) formed in the lower part of the intermediate section (22) and leading to an annular groove (35), formed partly in the upper portion of the chuck and partly in the surrounding wall of the intermediate section (22). The water is conducted from said annular groove to the drill steel by means of holes (36) drilled in the chuck and leading into the upper end of the socket in the chuck in which the drill steel is mounted. Alternatively air under pressure may be supplied through the pipe (33) for blowing out the drill steel.

The air under pressure for blowing out the drill steel may be furnished by the reciprocating movement of the striker rod (1). For this purpose the upper end of the striker rod has secured thereto in any suitable manner a piston member (37) which works within a cylinder (38) formed in the upper end plate (39) secured to the upper end of the casing (2). The outer end of the cylinder is closed by means of a screw threaded plug (40) having an outlet (41) connected with a suitable pipe (42) and provided with a suitable check valve (43). The piston (37) is provided with inlet valves (44) and the end plate (39) is provided with suitable air inlet openings (45). Thus on the downward movement of the striker rod, air will be drawn into the cylinder (38) through the valves (44) in the piston, and on the upward movement of the rod this air will be compressed and forced out through the pipe (42) which may be suitably connected with the pipe (33) leading to the interior of the chuck member (19). It will be understood that by screwing down the plug (40) more or less into the upper end of the cylinder (38) the pressure to which the air is compressed may be varied.

It will further be understood that in the case of a rock drill the same will be provided with the necessary means for supporting or mounting the same for use in the conventional manner well understood in this art, and that in the case of other percussive tools suitable provision will be made for holding or mounting the tools to permit proper operation thereof.

What I claim and desire to secure by Letters Patent is:—

1. A percussive tool, comprising in combination, a reciprocable striker member, an armature secured to said member, electromagnetic means arranged to apply attractive forces to said armature at a predetermined frequency, to move said striker member in one direction, resilient means associated with said striker member and deflected by said movement thereof and when so deflected developing a restoring force for effecting the return movement of said member, and other resilient means deflected by said return movement of said striker rod and developing a restoring force acting in the same direction as said attractive forces, said resilient means being designed and arranged to maintain the striker member in reciprocatory movement at a predetermined frequency in synchronism with the frequency of said attractive forces.

2. A percussive tool, comprising in combination, a reciprocable striker member, an armature secured to said member, electromagnetic means arranged in electro-magnetic relation to said armature and adapted when energized to produce attractive forces effective upon said armature to move the same at a predetermined frequency, a plate member secured to said striker member, rubber blocks disposed at opposite sides of said plate member, and relatively stationary means engaging the opposite sides of said rubber blocks, said blocks being so designed that when compressed due to movement of said striker member by said electro-magnetic means restoring forces will be alternately developed therein such as to maintain said striker member in reciprocatory movement at said predetermined frequency.

3. A percussive tool, comprising in combination, a casing, reciprocating parts reciprocably mounted within said casing, connected for movement as a unit, and including an armature and a striker member, electro-magnetic means supported within said casing in electromagnetic relation to said armature, and resilient means within said casing connected with one of said reciprocating parts, said electro-magnetic means and said resilient means acting jointly and in synchronism with each other to cause said reciprocating parts to vibrate or reciprocate and to maintain them in vibration or reciprocation at a predetermined frequency, a chuck member carried by said casing and positioned relatively to one end of said striker member to receive blows or impacts therefrom, and air compressing means at the opposite end of said casing and operated by said striker member.

4. A percussive tool, comprising in combination, a casing, a striker member reciprocably mounted within said casing, an armature secured to said striker member, electromagnetic means mounted within said casing and arranged to apply electro-magnetic impulses to said armature at a predetermined frequency, a plate member secured to said striker member, rubber blocks positioned at opposite sides of said plate member, stationary means within said casing engaging the opposite faces of said rubber blocks, the lat-

ter being so designed as to maintain said striker member in reciprocatory movement at the said predetermined frequency, and a chuck member carried by said casing and positioned relatively to one end of said striker member to receive blows or impacts therefrom.

5. A percussive tool, comprising in combination, supporting means, a striker member reciprocably mounted in said supporting means, an armature secured to said member, electro-magnetic means supported by said supporting means in electromagnetic relation to said armature and adapted when energized to produce recurrent attractive forces effective upon said armature to move the same at a predetermined frequency, a plate member secured to said striker member, elastic masses disposed at opposite sides of said plate member, and relatively stationary means engaging the opposite sides of said elastic masses, said masses being so designed that when compressed due to movement of said striker member by said electro-magnetic means, restoring forces will be alternately developed therein such as to maintain said striker member in reciprocatory movement at said predetermined frequency.

6. A percussive tool, comprising in combination, supporting means, a striker member reciprocably mounted in said supporting means, an armature secured to said member, electro-magnetic means supported by said supporting means in electromagnetic relation to said armature and adapted when energized to produce recurrent attractive forces effective upon said armature to move the same at a predetermined frequency, a plate member secured to said striker member, elastic masses disposed at opposite sides of said plate member, and relatively stationary means engaging the opposite sides of said elastic masses and relatively adjustable to place said masses under a predetermined initial stress, said masses being so designed that when compressed due to movement of said striker member by said electromagnetic means, restoring forces will be alternately developed therein such as to maintain said striker member in reciprocatory movement at said predetermined frequency.

7. A percussive tool, comprising in combination, a support, reciprocatory means mounted in said support, including a striker member, and constituting a predetermined mass to be vibrated, electromagnetic means mounted in said support in electromagnetic relation to a part of said reciprocatory means and adapted when energized to produce attractive forces effective upon said reciprocatory means to cause repeated movement thereof at a predetermined frequency, and resilient means mounted in said support and connected with a part of said reciprocatory means, said resilient means being arranged to be deflected in one direction from its neutral position by the movement of said reciprocatory means by said electromagnetic means and to be deflected in the opposite direction by the inertia of said reciprocatory means, and being predesigned with respect to said predetermined mass that it is inherently capable under repeated deflection of developing within itself restoring forces such as to maintain said reciprocatory means in movement at said predetermined frequency.

8. A percussive tool, comprising in combination, a support, reciprocatory means mounted in said support, including a striker member, and constituting a predetermined mass to be vibrated, a vibratory means mounted in said support and connected with a part of said reciprocatory means, said vibratory means being predesigned and constructed so that it is inherently capable under repeated deflection in opposite directions of developing within itself restoring forces of such magnitude as to maintain itself and said predetermined mass in vibratory movement at a predetermined frequency, and electromagnetic means mounted in said support in electromagnetic relation to a part of said reciprocatory means and adapted when energized to produce actuating forces effective upon said reciprocatory means to repeatedly deflect said vibratory means.

9. A percussive tool, comprising in combination, a support, reciprocatory means mounted in said support, including a striker member, and constituting a predetermined mass to be vibrated, vibratory means mounted in said support and connected with a part of said reciprocatory means, means for placing said vibratory means in itself under a predetermined stress, said vibratory means being predesigned and constructed when under said predetermined stress to be inherently capable of maintaining said predetermined mass in vibratory movement at a predetermined frequency, and electromagnetic means mounted in said support in electromagnetic relation to a part of said reciprocatory means and adapted when energized to produce recurrent actuating forces effective upon said reciprocatory means to maintain said vibratory means in vibratory movement at said predetermined frequency.

10. A percussive tool, comprising in combination, a support, reciprocatory means mounted in said support, including a striker member and an armature, and constituting a predetermined mass to be vibrated, resilient means mounted in said support and connected with a part of said reciprocatory means, said resilient means being predesigned and constructed to be inherently capable in itself of maintaining said predetermined mass in vibratory movement at a predetermined frequency, and an electromagnet mounted in said

support in electromagnetic relation to said armature and adapted when energized to produce recurrent attractive forces effective upon said armature and upon said resilient means to maintain the latter in vibratory movement at said predetermined frequency.

In testimony whereof I affix my signature.

JAMES A. FLINT.