April 6, 1943. C. S. WEYANDT ET AL 2,315,993

PERCUSSION TOOL

Filed Oct. 3, 1941 2 Sheets-Sheet 1

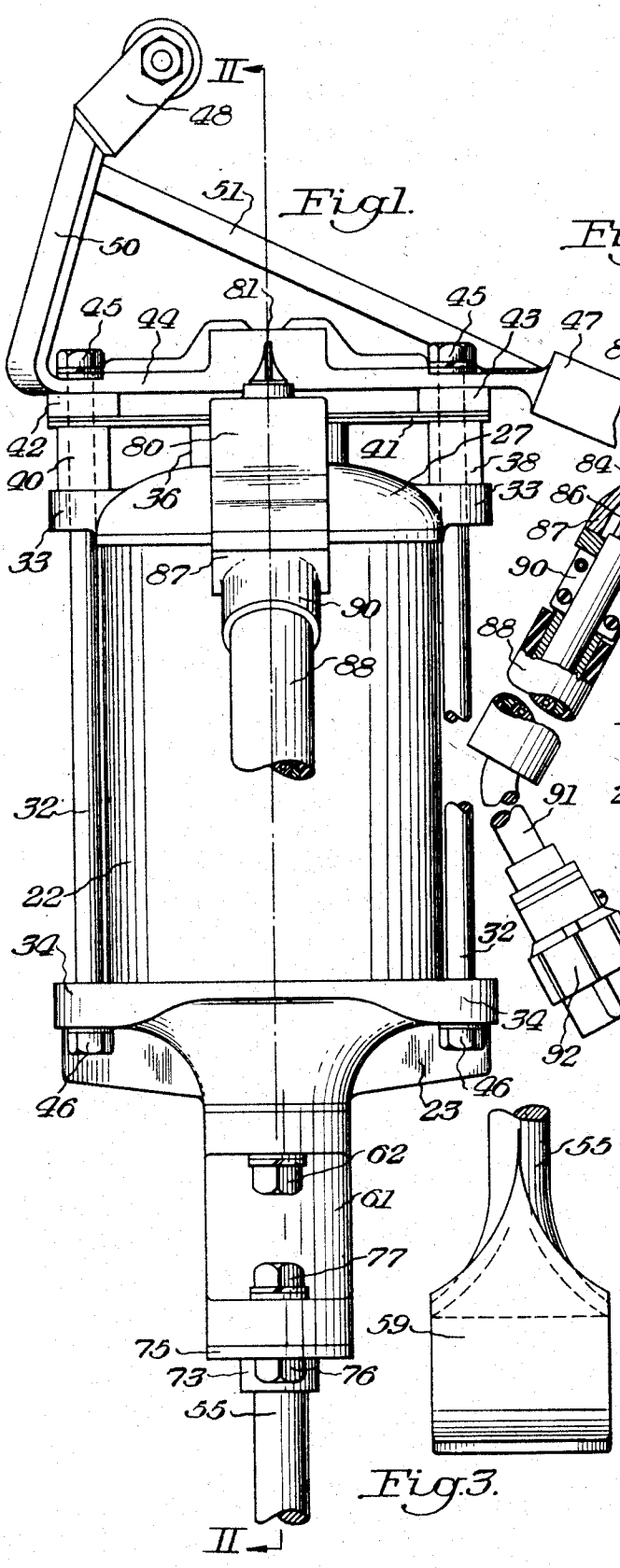

Fig. 1.

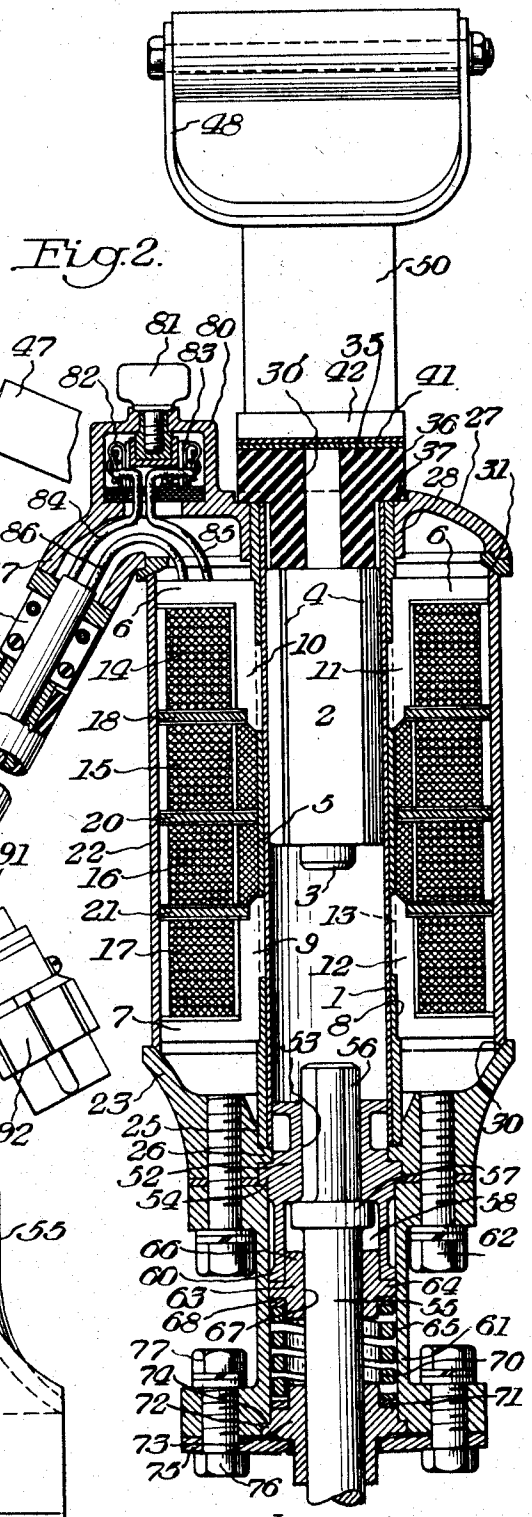

Fig. 2.

Fig. 3.

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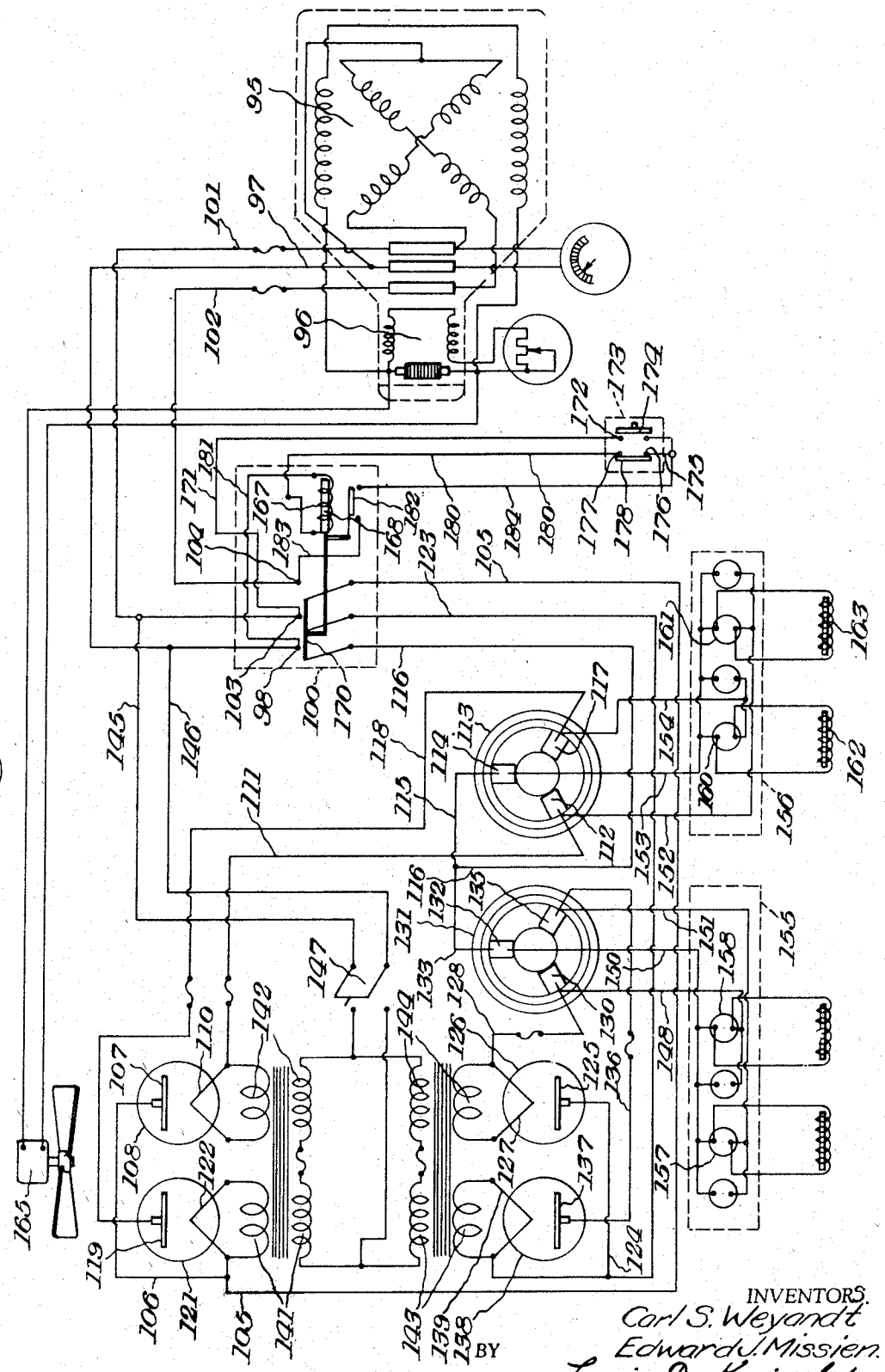

Fig 4.

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2,315,993

PERCUSSION TOOL

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Application October 3, 1941, Serial No. 413,533
In Belgium June 4, 1938

11 Claims. (Cl. 172—126)

The present invention relates to improvements in electrically operated percussion tools, and relates specifically to electrical reciprocating tie tampers.

It is an object of the invention to provide an improved buffer for such apparatus which is simple in construction, and has a long life. More specifically, it is an object to provide a buffer of solid inherently resilient material which will withstand high temperature, is not affected by grease or oil, and which has great durability under rapidly repeated impact.

Another object is the provision of a percussion tool having a free reciprocating piston operated by a pulsating field in synchronism therewith, which may be used in non-horizontal position, and which may be lifted from the work without destroying the synchronism of the piston.

A further object is the provision of a percussion tool having few wearing parts which may be readily replaced when they become worn.

A further object is the provision of a tie tamper for rock ballast intended to carry heavy loads, which has high power, and which is operated from a source of alternating current without make and break devices.

A further object is the provision of a tie tamping apparatus for operating one or more tie tampers, and which may be remotely controlled to start or stop simultaneously.

The accompanying drawing shows a preferred modification of the invention by way of illustration, in which

Figure 1 is a side elevation of a tie tamper,

Figure 2 is a sectional view taken on line II—II of Figure 1,

Figure 3 is an illustration of the tamper bar, and

Figure 4 is a wiring diagram showing the operation of the invention.

Referring to Figure 2, a removable slotted bushing 1 is provided of non-magnetic stainless steel which guides the magnetic piston or striking element 2 which reciprocates therein. Piston 2 is made of silicon nickel steel having a striking extension 3 at one end which is tipped with a hard non-magnetic metal such as cobalt-chromium-vanadium alloy known as "Stellite." The piston 2 has four slots 4 approximately 1⅜ inch wide and ⅜ inch deep to reduce waste currents therein. A cylinder 5 is provided in which the bushing 1 is removably located, and end laminations 6 and 7 are circumferentially arranged about the cylinder 5 on flat portions 8 provided on its outer surface and are secured thereto by welding or in any other suitable manner. The end laminations 6 and 7 have pole tips 9, 10, 11 and 12 in openings 13 in the barrel 5 flush with the inner surface. The operating winding of the hammer comprises four coils 14, 15, 16 and 17 connected in series, the inner coils 15 and 16 being of copper wire and the outer coils 14 and 17 being of aluminum wire or an aluminum alloy wire. Metallic separators or washers 18, 20 and 21 limit longitudinal expansion, brace the windings against coming loose and conduct heat rapidly to the outside surrounding case 22 which is made of high silicon low carbon steel of high electrical resistance which tends to diminish eddy current losses. The aluminum and copper coils provide maximum heat dissipation and materially reduce the weight of the coil structure.

A bottom cover 23 has a bore 25 surrounded by a flange 26 and the barrel 5 and a bushing 1 extending from the laminations are received in the bore and abut the flange 26. A top cover 27 has a bore 28 to receive the extending barrel 5 and bushing 1 therein. Cover 22 has bevelled edges received by the bevelled flanges 30 of the bottom cover and a washer 31 at the top cover and tie rods 32 extend through holes in the lugs 33 and 34 of the top and bottom covers.

A core stop or buffer 35 comprises a cylindrical body extending into bushing 1 with a slight clearance. Preferably the core stop is composed of a solid compressible material selected from the group comprising polymerized butadiene and its homologues and substitution products, for example "Neoprene" which I believe to be polymerized chloro-2-butadiene-1,3 and "Cogene" or "Ameripol" sold by B. F. Goodrich Tire & Rubber Company, which I believe to be a copolymer of butadiene or its homologues and acrylonitrile. This core stop has a flange 36 which abuts a shoulder 37 on the top cover and engages the end of bushing 1 and cylinder 5. Spacers 38 and 40 have holes therein through which pass the tie rods 32 and spring leaves 41 are held between spacers 38 and 40 and clamps 42 and 43. A hole 30' is provided in buffer 35 which passes through springs 41 to allow the escape of air from the bushing 1, which otherwise would interfere with the operation of the apparatus. The circulation of air also assists in cooling the buffer. A handle structure 44 has holes therein to receive the tie rods 32 and nuts 45 at the top end and nuts 46 at the bottom hold the parts in assembled relation. The handle structure 44 has a laterally extending offset handle 47 and a handle 48 at the end of extension 50 which is braced by posts 51,

At the lower end of the apparatus a bushing 52 having a hexagonal bore 53 therein is received in the bushing 1 and has a flange 54 abutting the flange 26 of bottom cover 23. A tamper bar 55 has a non-circular end 56 received in the guide bore 53 to prevent the bar from turning and a flange 57 on the tamper bar is received in a recess 58 in an extension 60 of the bushing 52. The tamper bar has a blunt end 59.

The bushing 52 is held in place between the cover 23 and a flanged housing 61 secured to the cover by bolts 62. The split bushing 63 has a flange 64 received in the bore 65 of the housing 61 and has a hub 66 extending into recess 58, the flange 64 abutting the end of extension 60. A circular hole 67 in bushing 63 receives the tamper bar 55 with a sliding fit. The hub 66 of the bushing limits outward movement of the flange 57 on the tamper bar. A washer 68 seats against flange 64 and a spring 70 abuts a washer 68 at one end and abuts washer 71 which in turn abuts flange 72 of a round split bushing 73 seated on a shoulder 74 at the end of housing 61. A retaining plate 75 overlies the bushing 73 and is held in place by the bolts and nuts 76 and 77, the tamper bar 55 passing through bushing 73. This construction enables ready removal of the tamper bar by disconnecting housing 61 from the motor bottom cover 23.

An operating switch case 80 mounted on the cover 27 carries a turn switch 81 making contact across terminals 83 and 82 to which are connected wires 84 and 85. Wire 85 connects to one end of coil 14 and the end of coil 17 is connected with wire 86. Wires 86 and 84 pass through extension 87 of the top cover, through strain relief hose 88 which is clamped by a suitable clamp 90 to the extension 87, and through the cable 91 which may be of any desired length to a plug 92 which preferably is of the two point weatherproof bayonet joint type.

The preferred electrical circuit for operating the apparatus is shown in Figure 3. Current from an alternating current generator, which preferably is a two phase generator, diagrammatically indicated at 95 and which is excited by exciter 96, is conducted by common return wire 97 to terminal 98 of a line switch 100, and wires 101 and 102 conduct current to terminals 103 and 104 of said switch. When the switch 100 is closed one current impulse of one phase passes by wires 105 and 106 to the anode 107 of a thermionic rectifier tube 108, from cathode 110 and by wire 111 to a terminal 112 of a line receptacle 113. Common return terminal 114 is connected by wires 115 and 116 to common switch terminal 98.

The next current impulse of the same phase passes from terminal 98 by wires 116 and 115 to common receptacle terminal 114 and from receptacle terminal 117 and wire 118 to anode 119 of rectifier 121, thence by cathode 122 and wire 105 to terminal 104. Similarly, one current impulse of the second phase is conducted by wires 123 and 124 to the anode 125 of a rectifier tube 126, thence by a cathode 127 and wire 128 to terminal 130 of receptacle 131 and from common receptacle terminal 132 by wires 133 and 116 to common terminal 98. The next current impulse passes from terminal 98 by wires 116 and 133 to receptacle terminal 132 and from receptacle terminal 135 by wire 136 to anode 137 of the tube rectifier 138, thence from cathode 139 and wire 123 to switch terminal 103. The four rectifier tubes derive heating current from a transformer comprising pairs of coils 141, 142, 143 and 144 supplied by wires 145 and 146 through switch 147.

The receptacles 113 and 131 are connected by a cable about 250 feet long carrying wires 148, 150 and 151, and wires 152, 153 and 154 which terminate at one end in a suitable plug to be plugged into receptacles 113 and 131. At their other ends the cables carry units shown diagrammatically at 155 and 156 having two terminal receptacles 157, 158, 160, 161, etc. Any desired number of such two terminal receptacles may be provided, depending on the number of tampers to be operated from the circuit. Eight such receptacles are shown. The plug 92 of a tamper unit can be inserted into any one of the receptacles and when two tampers are so connected, for example, to receptacles 160 and 161, one rectified wave of one phase passes through the coil 162 which diagrammatically represents a tamper, and the other rectified wave of the same phase passes through coil 163 which diagrammatically represents the other tamper.

Preferably, the tubes are cooled by an electric fan 165 or other cooling device deriving its current from the exciter 96.

Referring to Figure 2, each time the piston 2 moves to the lower end of the barrel 1 it strikes the end 56 of the tamper bar 55. When the apparatus is raised from the work the flange 68 of the tamper bar engages the bushing 63, and the spring 70 bearing against bushing 63 is tuned to keep the piston in synchronism with the current impulses under non-working conditions. When the tamper bar rests on the ballast the bar is in its upper position, and when the piston strikes the bar it permits a forward movement of the bar against the ballast, pushing the ballast ahead of it. The next current impulse passing through the coil pulls the piston 2 upward, causing it to strike the buffer 36. In designing the buffer, it should be so dimensioned that its resistance to compression is enough to maintain the piston within certain limits of its working stroke, so that the piston will remain synchronized with the rectified wave impulse. Synchronization also depends on the length of the stroke of the piston, its weight and the electromagnetic energy supplied by the coil. For example, I prefer to use a piston weighing about 4 to 4½ pounds, having a stroke between 3⅞ and 4¼ inches and delivering about 600 to 850 blows per minute, and preferably about 750 per minute against the tamper bar. Where F is the current frequency the number of blows delivered per minute is $F/2\times60$. For example, operating from a 120 volt alternating current source of 25 cycle primary current at an energy input of 900 watts, the number of blows would be $25/2\times60=750$ per minute.

The synthetic rubber substitute core stop is of particular advantage in that it has a longer life than a metal spring, is resistant to heat, oil or grease, its use reduces the weight of the tamper and the number of parts required and thus reduces the cost of manufacture. It also eliminates a large amount of noise, which is important in railway work where excess noise prevents the workmen from hearing the approach of a train. If desired, the spring 61 may be replaced by a suitable member made of "Neoprene," "Ameripol," or any other suitable polymerized butadiene type of syntheic rubber substitute.

The system herein disclosed moves the free piston in both directions by current impulses of

the same polarity with a considerable period of zero energy between current impulses, the current impulses being obtained by a rectifier from a single phase alternating current applied to one continuous winding to produce a pulsating magnetic field, and has a dead center point which occurs when the approximate center of the piston is at the approximate center of the air gap, that is half way between pole tips 9 and 10. Successful operation of this apparatus depends, among other things, upon accurate timing of the piston movement, uniformity of the periodic occurrences of the pulsating magnetic field, length of stroke of the reciprocating elements, its mass and cross sectional area, the length of the reciprocating element and the length of the air gap, and the natural period of the buffer or resilient member at each or both ends of the piston stroke. The piston must be at approximately the end of its stroke in order that the apparatus shall be self-starting, and in order to overcome the inertia of the piston, the buffers or resilient members at the ends of the piston stroke have a natural period of vibration the same or greater than the number of blows struck against it by the piston. Preferably a higher natural period is used to be certain that the full inertia of the piston is overcome so that the piston is moved away from the end of its stroke rapidly enought to be caught by the magnetic field. As the present apparatus is always in non-horizontal position during operation, the dead center point always will be overcome either by the weight of the piston or by the rebound of the buffer members. This construction is especially desirable in an apparatus of this type, in that only one winding need be employed to move the piston in both directions, thereby providing a greater length of stroke with a shorter winding. However, our invention is not restricted to this type of tool and may be applied to any of the various known types of percussion tools, as for example, the two coil structure shown in Patent No. 1,723,830, issued August 6, 1929, to Carl S. Weyandt.

The line switch 100 preferably is electromagnetically controlled from a remote point to start and stop the tampers. The remote control mechanism comprises a solenoid 167 having an armature 168 connected to contact switch member 170. Current from terminal 103 passes by wire 171 to terminal 172 of remote control switch member 173 and when starting switch 174 is closed between terminals 172 and 174 the current continues by wire 175 across switch terminals 176 and 177 closed by switch member 178 and by wire 180 through solenoid 167 to close switch member 170, and continues by wire 181 to common terminal 98. Actuation of armature 168 closes switch 182 so that when switch member 174 is released by the operator and opened by a spring (not shown) the current continues to flow from terminal 104 and wire 183 through switch 182 and by wire 184 through switch 178 and by wire 180 through coil 167 to terminal 98, thus holding switch member 170 closed. To open the main circuit switch member 178 is moved to open position, thus breaking the circuit through solenoid 167 and allowing a spring (not shown) to move switch members 170 and 182 to open position. A spring (not shown) closes switch 178 when released by the operator.

This arrangement of remote control is of particular advantage in tie tamping as it enables the watchman to warn the workmen against approaching trains by opening the line switch and stopping operation of the tampers, and after the train passes he can automatically start the tampers operating. In this way, the output of the workmen can be better controlled as they are stopped at the proper time without confusion and started again without needless loss of time. Where the foreman acts as watchman, the services of a special watchman may be eliminated.

This application is a continuation in part of my application Serial No. 210,645, filed May 28, 1938, for Percussion tool.

What we claim and desire to secure by United States Letters Patent is:

1. In a percussion tool, a tubular guide member, electromagnet laminations surrounding said member and providing a dead center air gap substantially at the middle of the member, a piston adapted to reciprocate in said guide member, coil means surrounding said laminations, means to supply substantially spaced successive current impulses of like polarity to said coil means to provide a single pulsating magnetic field to reciprocate said piston, a tool adapted to be struck by said piston at one end of its stroke, resilient means providing a stop for said tool, and a buffer selected from the group comprising polymerized butadiene and its homologues and substitution products or copolymers thereof with unsaturated compounds at the opposite end of said tubular member, said resilient means and buffer being adapted to maintain the piston in synchronism with the pulsating magnetic field.

2. In a percussion tool, a tubular guide member, electromagnet laminations surrounding said member, a piston adapted to reciprocate in said guide member, coil means surrounding said laminations, means to supply current impulses to said coil means to provide an actuating magnetic field to reciprocate said piston, a tool adapted to be struck by the piston at one end of its stroke, resilient means providing a stop for said tool and a buffer selected from the group comprising polymerized butadiene and its homologues and substitution products of copolymers thereof with unsaturated compounds at the opposite end of the tubular member, said resilient means and buffer being adapted to maintain the piston in synchronism with the actuating magnetic field.

3. In a percussion tool, a tubular guide member, electromagnet laminations surrounding said member, a piston adapted to reciprocate in said guide member, coil means surrounding said laminations, means to supply current impulses to said coil means to provide an actuating magnetic field to reciprocate said piston, a tool adapted to be struck by the piston at one end of its stroke, a buffer selected from the group comprising polymerized butadiene and its homologues and substitution products of copolymers thereof with unsaturated compounds at the opposite end of the tubular member, said tool and buffer being adapted to maintain the piston in synchronism with the actuating magnetic field.

4. In a percussion tool, a tubular guide member, electromagnet laminations surrounding said member, a piston adapted to reciprocate in said guide member, coil means surrounding said laminations, means to supply current impulses to said coil means to provide an actuating magnetic field to reciprocate said piston to deliver six hundred or more impacts per minute, a tool adapted to be struck by the piston at one end of its stroke, and a buffer selected from the group comprising polymerized butadiene and its homologues and substitution products of copolymers thereof with

unsaturated compounds located adjacent the end of the guide member opposite the tool and having air escape means, said tool and buffer being adapted to maintain the piston in synchronism with the actuating magnetic field.

5. In a percussion tool, a tubular guide member, electromagnet laminations surrounding said member and providing a dead center air gap substantially at the middle of the member, a piston adapted to reciprocate in said guide member, coil means surrounding said laminations, means to supply substantially spaced successive current impulses of like polarity to said coil means to provide a single pulsating magnetic field to reciprocate said piston, a tool adapted to be struck by said piston at one end of its stroke, resilient means providing a stop for said tool, and a buffer of polymerized chloro-butadiene at the opposite end of said tubular member, said resilient means and buffer being adapted to maintain the piston in synchronism with the pulsating magnetic field.

6. An apparatus comprising a reciprocating piston, electromagnetic means for reciprocating said piston to deliver six hundred or more impacts per minute, a tool at one end of the stroke of the piston located to be struck thereby, and a buffer of synthetic rubber substitute at the other end of the piston stroke located to be struck thereby.

7. In a percussion tool adapted to be operated in non-horizontal position, a tubular guide member, magnet laminations surrounding said member and providing a dead center air gap substantially at the middle of said member, a free piston adapted to reciprocate in said guide member, coil means surrounding said laminations, means to supply substantially spaced successive current impulses of like polarity to said coil means to provide a single pulsating magnetic field to reciprocate said piston, a tool adapted to be struck by said piston at one end of its stroke, resilient means providing a stop for said tool, and a buffer at the opposite end of said tubular member, said resilient means and buffer being adapted to maintain the piston in synchronism with the pulsating magnetic field.

8. An apparatus comprising a reciprocating piston, means for reciprocating said piston to deliver six hundred or more impacts per minute, a tool at one end of the stroke of the piston located to be impacted thereby, and a buffer of polymerized butadiene type of synthetic rubber substitute at the other end of the piston stroke located to be impacted thereby.

9. An apparatus comprising a reciprocating piston, means for reciprocating said piston to deliver 600 or more impacts per minute, a tool at one end of the stroke of the piston located to be impacted thereby, and a buffer of copolymerized butadiene and its homologues with acrylonitrile at the other end of the piston stroke located to be impacted thereby.

10. In a percussion tool, a tubular guide member, electromagnet laminations surrounding said member and providing a dead center air gap substantially at the middle of the member, a piston adapted to reciprocate in said guide member, coil means surrounding said laminations, means to supply substantially spaced successive current impulses of like polarity to said coil means to provide a single pulsating magnetic field to reciprocate said piston, a tool adapted to be struck by said piston at one end of its stroke, resilient means providing a stop for said tool, and a buffer of the polymerized substituted butadiene type at the opposite end of said tubular member, said resilient means and buffer being adapted to maintain the piston in synchronism with the pulsating magnetic field.

11. In a percussion tool, a tubular guide member, electromagnet laminations surrounding said member and providing a dead center air gap substantially at the middle of the member, a piston adapted to reciprocate in said guide member, coil means surrounding said laminations, means to supply substantially spaced current impulses of like polarity to said coil means to provide a single pulsating magnetic field to reciprocate said piston, a tool adapted to be struck by said piston at one end of its stroke, resilient means providing a stop for said tool, and a buffer of copolymerized butadiene and its homologues with acrylonitrile at the opposite end of said tubular member, said resilient means and buffer being adapted to maintain the piston in synchronism with the pulsating magnetic field.

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