June 11, 1963 A. J. HEIDLER 3,093,114

PERCUSSION TOOL FOR TIGHTENING AND LOOSENING BOLTS AND NUTS

Filed Sept. 24, 1958 4 Sheets-Sheet 1

FIG. 1

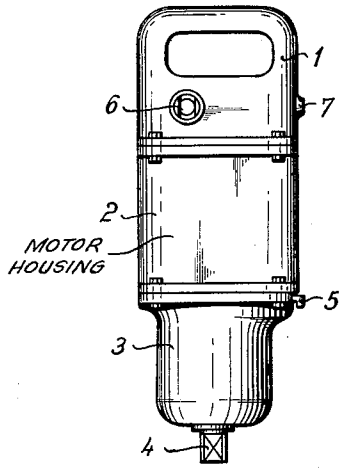


FIG. 8

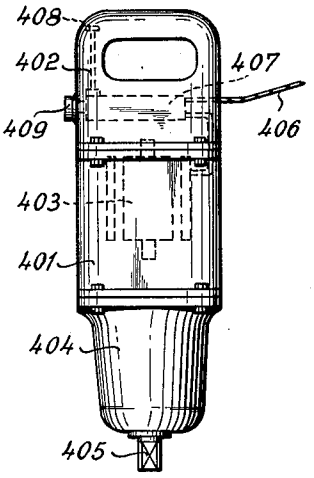
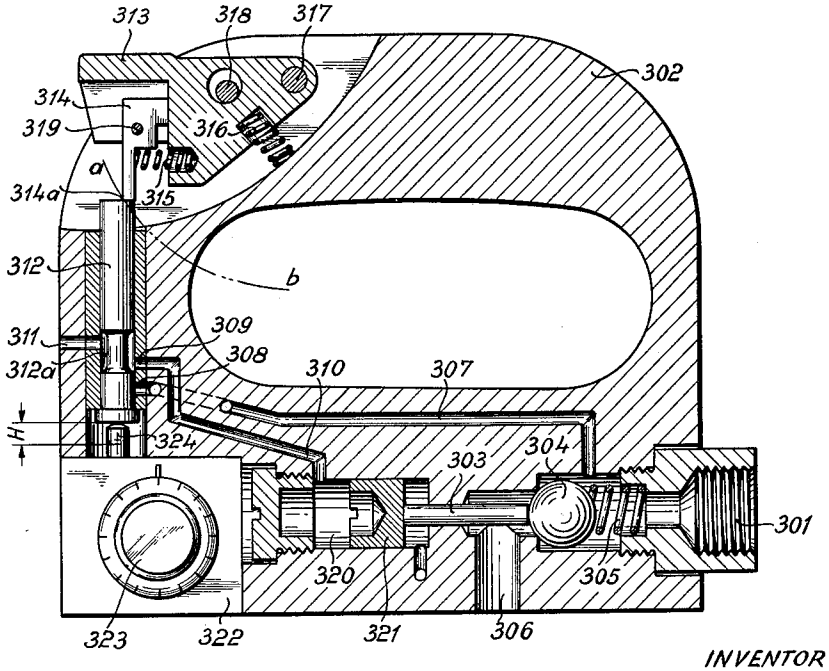


FIG. 7



INVENTOR

June 11, 1963 A. J. HEIDLER 3,093,114

PERCUSSION TOOL FOR TIGHTENING AND LOOSENING BOLTS AND NUTS

Filed Sept. 24, 1958 4 Sheets-Sheet 2

FIG. 2

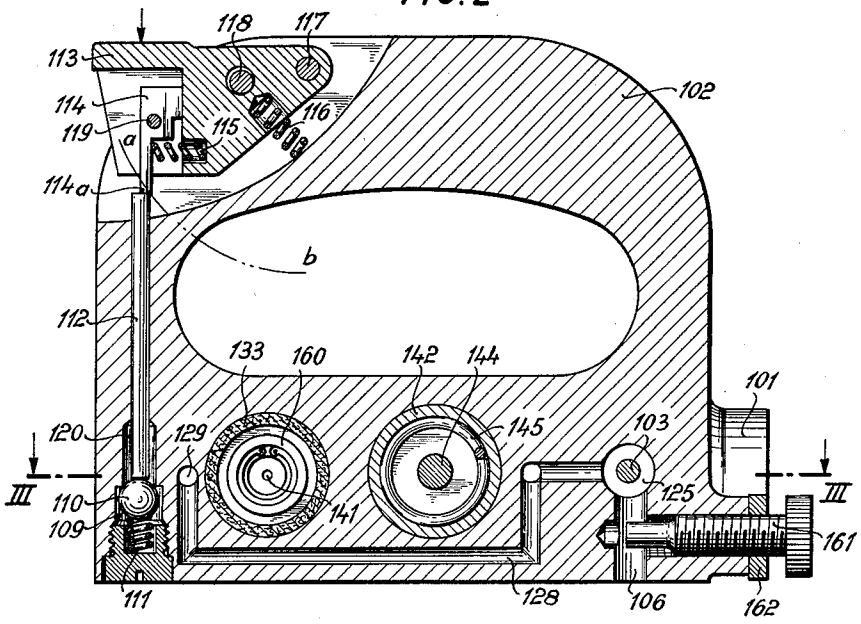
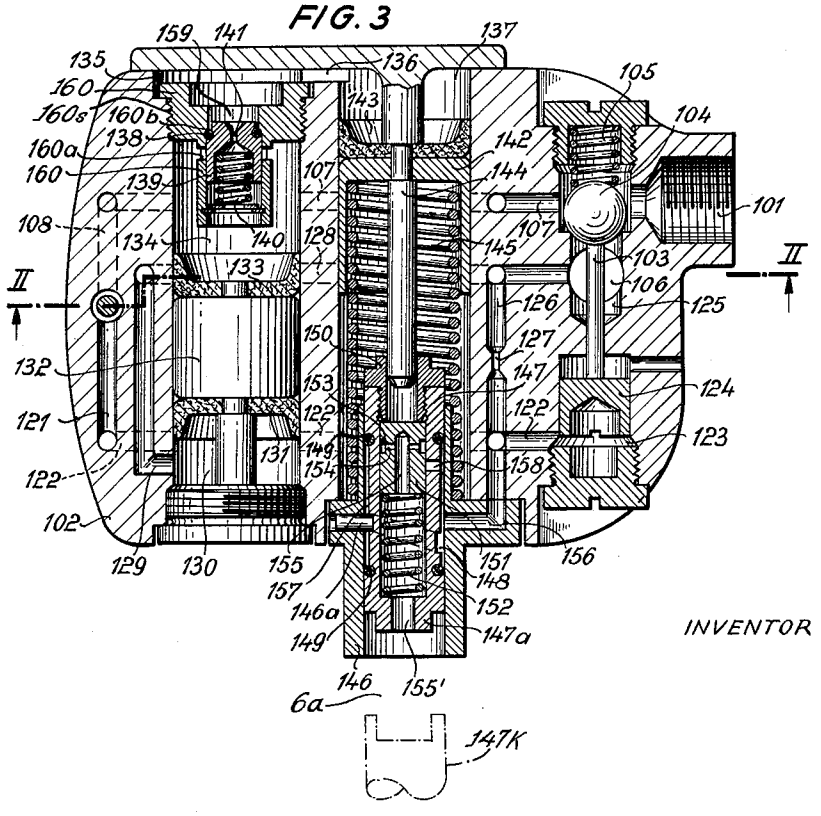


FIG. 3



INVENTOR

June 11, 1963 A. J. HEIDLER 3,093,114

PERCUSSION TOOL FOR TIGHTENING AND LOOSENING BOLTS AND NUTS

Filed Sept. 24, 1958 4 Sheets-Sheet 3

FIG. 4

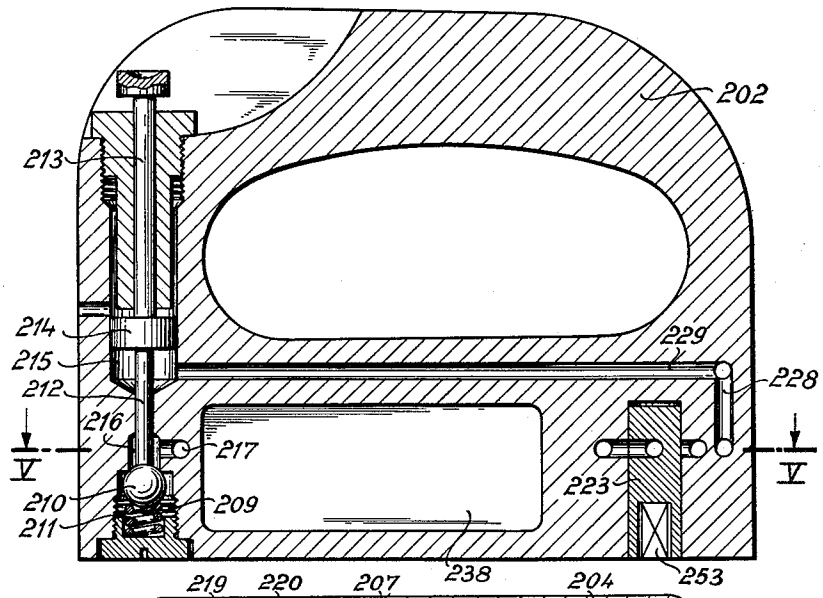


FIG. 5

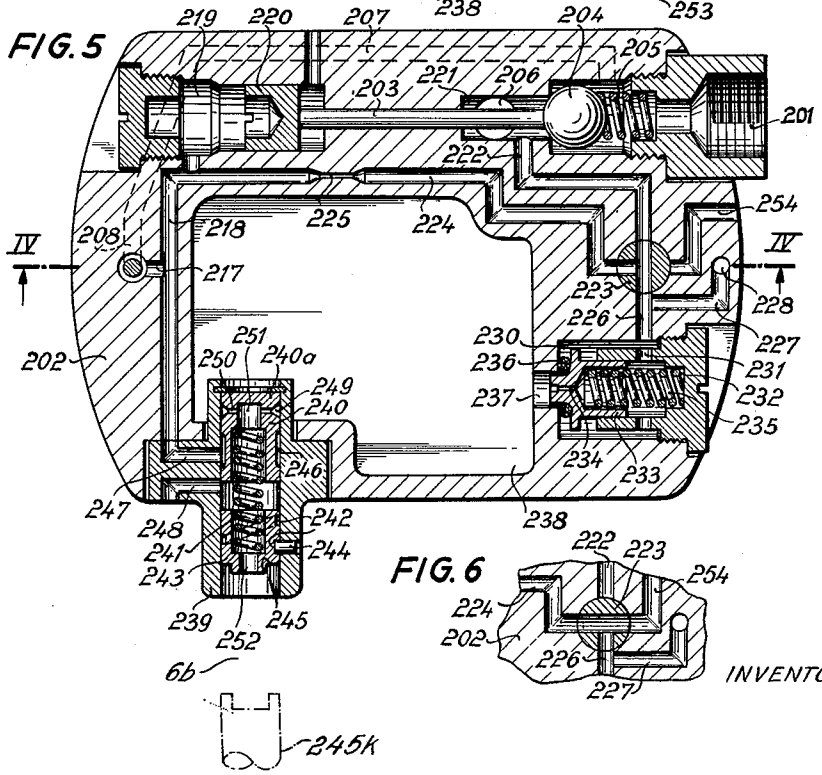


FIG. 6

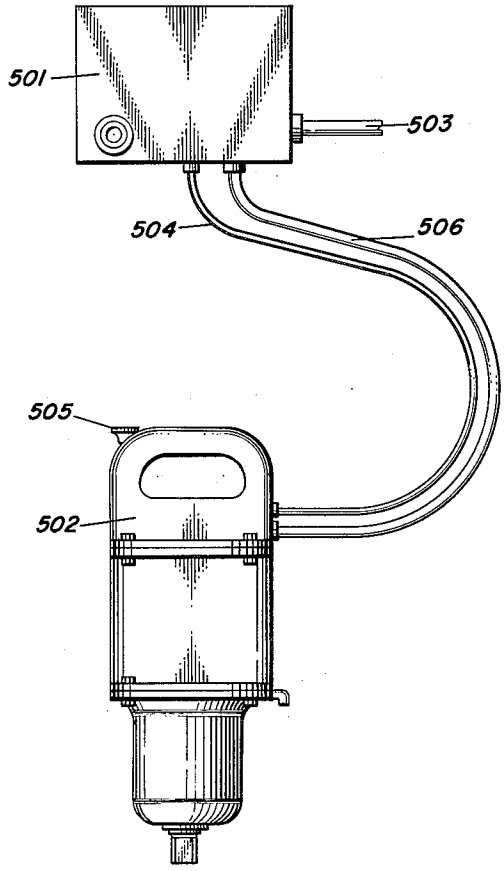
INVENTOR

June 11, 1963 A. J. HEIDLER 3,093,114

PERCUSSION TOOL FOR TIGHTENING AND LOOSENING BOLTS AND NUTS

Filed Sept. 24, 1958 4 Sheets-Sheet 4

FIG. 9



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PERCUSSION TOOL FOR TIGHTENING AND LOOSENING BOLTS AND NUTS

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Claims priority, application Germany Sept. 24, 1957
13 Claims. (Cl. 121—33)

Percussion tools are known which are driven by compressed air or electric current or hydraulically for the purpose of tightening and loosening bolts and nuts. For the sake of convenience such tools will be hereinafter referred to as impact wrenches. Their method of operation is that a rotating hammer transmits tangentially directed impacts to the working spindle, which is thereby given a jerky rotational movement. By means of a socket member fitted on to this spindle, the jerky rotational movement is transmitted to the bolts and nuts which are to be tightened.

Many attempts have been made to keep the degree of tightening obtained with impact wrenches constant by means of special devices. With all these proposals, complicated devices are necessary which make the wrench or tool substantially more expensive and heavier and in addition show various defects as regards the resulting accuracy.

The present invention is based on the principle that the degree of tightening between a nut and bolt in threaded engagement has a definite relation to the time of operation of the impact wrench which turns the nut, so that a plurality of nuts may be tightened to the same degree on a plurality of bolts respectively, provided that the bolts and nuts and the workpieces being secured thereby are uniform in size, shape and structure and provided further that each nut is driven with the same impact power and for the same length of time. Tests made with accurately operating impact wrenches have shown that the amount by which the bolt or nut is tightened remains constant within narrow limits if the impact time of the tool is accurately maintained and if the drive of the said tool and the dimensions of the bolts and nuts to be tightened are maintained constant.

According to the present invention, therefore, I equip an impact wrench with means which automatically reduce or cut off its power after the tool has run for a predetermined time.

The said means may incorporate a timing mechanism, such as a time switch or a time relay, which is set in operation when the impact wrench is switched on and reduces or cuts off the power of the tool on expiration of a predetermined running time. This time need not be a fixed time, but, as will hereinafter appear, it may be made to vary with the rate of energy supply to the tool. Moreover by selecting a timing mechanism which is adjustable to different running times, it is possible by varying the running time to obtain different degrees of tightening by the tool. It is possible to make the time switch pneumatic, electrical, hydraulic or mechanical, or comprise a combination of the said systems. The reduction or cutting off of power of the tool may be effected under the control of the timing mechanism by various means, for example, by reducing or shutting off the energy supply to the tool, or by a suitable clutch mechanism or, in the case of a pneumatic or hydraulic tool, by arranging the pneumatic or hydraulic mechanism for idle running. All that is necessary is that the tool, after elapse of the running time, either no longer transmits any force to the bolt or nut to be screwed in, or transmits only a reduced force to the bolt or nut; where the force is not completely

cut off it is desirable to so arrange the mechanism that the reduced force is insufficient to effect any further screwing in of the bolt or nut. Furthermore, it depends on actual circumstances whether the timing mechanism is built into the tool, whether it is connected in front of the tool, i.e., between the tool and a socket member to be fitted to the tool, or whether it is interposed at any desired point in the energy supply line. In a preferred form of the invention the timing mechanism is built into the tool and operates to reduce or shut off the energy supply to the tool.

Further features of the invention will be seen from the following description of various constructional examples given by reference to the drawing.

FIG. 1 is a side elevation of an impact wrench according to the invention with a built-in time switch mechanism,

FIG. 2 is a longitudinal section on the line II—II of FIG. 3 through the gripping handle of an impact wrench with a built-in preferred form of a hydraulic time relay operated by compressed air,

FIG. 3 is a cross section on the line III—III of FIG. 2,

FIG. 4 is a longitudinal section of a modification comprising a purely pneumatic control along the plane IV—IV of FIG. 5,

FIG. 5 is a cross section along the plane V—V of FIG. 4,

FIG. 6 is a fragmentary view of FIG. 5 in the position for anti-clockwise rotation of the tool, while the three-way valve 223 in FIG. 5 is positioned for clockwise rotation.

FIG. 7 is a longitudinal section through another modification, with a built-in mechanical timing mechanism.

FIG. 8 is a diagrammatic view of another modification comprising an electrically driven impact wrench with an electric time relay in the handle.

FIG. 9 shows a further embodiment of the invention in which the timer mechanism is arranged in the air supply line outside of the impact wrench.

There is disclosed in FIG. 1 a pneumatically powered impact wrench which includes a grip member 1, a motor housing 2 and the housing 3 of the percussion mechanism. Projecting from the bottom end of said housing 3 is a square shaft 4 on which a socket member or the like can be mounted. The energy is supplied to the driving tool through the union 7. Depending on the driving means used for the tool, this union can consist of an electric cable or of hoses for liquid under pressure or compressed air. A reverse lever 5 serves for changing over the driving tool from clockwise to anti-clockwise rotation and vice versa. As so far described, the impact wrench is already known, for example, from Amtsberg U.S. Patent 2,768,546, issued October 30, 1956, which describes in detail the mechanism of a conventional impact wrench in which the invention may be embodied. According to the invention, a time switch mechanism is provided in the grip member 1 of the tool, various embodiments of such mechanism being hereinafter described. The time switch mechanism is provided with means for setting the running time, these means being accessible from outside by means of a key connection 6 and being adapted to be externally actuated.

In the constructional form described with reference to FIGS. 2 and 3, driving air enters the grip member 102 by way of a union 101 and leaves the said grip when a main valve is opened in the manner hereinafter described, the air passing through a passage 106 which leads to the motor (not shown) of the impact wrench; the main valve comprises a valve member 104 which is biased towards its seating by the spring 105 but which can be moved away from its seating by a spindle 103 to allow the air to pass through the passage 106. By means of a throttle screw 161, which is secured by a locking nut 162, the supply of air to the motor can be throttled and thus the

power and the turning moment of the driving member adjusted within wide limits. Through passages **107** and **108**, compressed air also reaches a chamber **109** adjacent an initiating valve which, like the main valve above described, consists of a valve member **110** actuable by a spindle **112** and biased towards its seating by a spring **111**. When the initiating valve is closed, it bars movement of the compressed air beyond the chamber **109**. However, the spindle **112** can be moved to open the valve by means of a quick-action trigger **113** thus allowing the compressed air to enter a chamber **120**. The trigger **113** is pivotally mounted on a pin **117**. A pin **119** is fixed on the trigger **113**. Mounted to rotate on the pin **119** is a latch **114**. If pressure is applied with the thumb in the direction of the arrow to the trigger **113**, the point **114***a* of the latch **114** describes a path on the arc *a*—*b* around the pin **117**, so that the spindle **112** immediately returns to its closed position after brief opening of the initiating valve **110**. The travel of the trigger **113** is limited by a pin **118** and, when the thumb pressure is released, the latch **114** and trigger **113** return to their original positions under the influence of springs **115**, **116** respectively.

As a result of this brief opening of the initial valve, compressed air is conducted through the chamber **120** and passages **121**, **122** to a chamber **123** where it strikes a piston **124**, displaces this forwardly against the action of the spring **105** and thereby opens the main valve displacing the valve member **104** through the spindle **103**. Compressed air, coming from **101**, now flows through a chamber **125** and passage **106** to the motor of the tool, which thereby starts to operate. At the same time, compressed air passes from the chamber **125** by way of a passage **126** through the constricted portion **127**, whence it passes into the passages **121**, **122** and into the chamber **123** and in this way prevents the piston **124** retracting to its downward position (as seen in FIG. 3). From the chamber **125**, compressed air also travels through passages **128** and **129** to a chamber **130**, where it displaces forwardly a piston **132**, this piston being arranged to slide in a cylindrical bore in the grip member **102**; the piston **132** is provided at each end with washers, shown as **131** and **133** respectively. On the remote side of the piston **132** from the chamber **130** are four further chambers **134**, **135**, **136** and **137** (which can be seen in FIG. 3) and these are filled with hydraulic oil (or with another suitable liquid). Oil can flow freely between chambers **135**, **136** and **137** at all times, but the chamber **134** is separated from the chambers **135**, **136**, **137** by a non-return valve (to be described later) although a narrow bore **141** in the valve member **139** of the non-return valve affords a permanent communication between chambers **134** and **135**. With the forward travel of the piston **132**, hydraulic oil must pass through this bore **141** whereby a slow steady filling of the chambers **135**, **136**, **137** is produced, this causing a simultaneous rapid forward movement of a piston **142** and washer **143** against the bias of a spring **145**.

The grip member **102** also has fixed thereon a cylinder **146** in which a valve body **147** is arranged to be rotatable and longitudinally displaceable; the said valve body **147** is sealed with O-rings **149** and is provided with a spiral groove **148**. A pin **146***a* fixed in the cylinder **146** engages in the spiral groove **148** of the valve body, so that when the latter is rotated with a key **147***k* (for which purpose it is suitably shaped at its end **147***a*) it carries out a longitudinal displacement in the cylinder **146** corresponding to the pitch of the spiral groove **148**. The connection **6***a* between the projection **147***a* and the key **147***k* corresponds in function to the connection **6** depicted in FIG. 1, and provides a manipulative means for regulating the interval of time between the opening and the closing of the main valve **104**, as will be described later. Arranged in the valve body **147** is a slide valve **151** which is pushed by a spring **152** against an abutment screw **150** and which has an annular groove **153** which is connected to atmosphere through passages **154**, **155**, **155'**. The compressed air collected in the passages **121**, **122** also fills a passage **156** and an annular chamber **157** around part of the valve body **147** between the O-rings **149**. When the piston **142** is moved forwardly a pin **144** fixed thereon displaces the slide valve **151** to such an extent that the annular groove **153** coincides with a passage **158** through the valve body **147** communicating with the annular chamber **157**, whereupon the compressed air in the passages **121**, **122**, **157** and in the chamber **123** escape to atmosphere. The constricted portion **127** is of such a size that the quantity of compressed air which subsequently flows therethrough is not sufficient to maintain the pressure necessary for holding the piston **124** open. Consequently, the main valve is closed by seating of the valve member **104**, thereby cutting off the supply of live air through the passage **106** leading to the motor (not shown) in the motor housing **2**. This, of course, terminates the drive of said motor and the delivery of torsional impacts to the square shaft **4**.

The length of time that the impact wrench operates is determined by the interval between the opening of the ball valve **104** under manual control and the closing of said valve under automatic control. This interval can be regulated to suit the conditions of different kinds and sizes of workpieces, by inserting the key **147***k* into driving engagement with the valve body extension **147***a* and by rotating the valve body **147** to produce relative axial movement between the latter and the fixed cylinder **146** due to the helical connection **146***a*, **148**. The effect of such axial adjustment is to vary the amount of movement required by the piston **142** before the pin **144** engages and displaces the slide valve **151**.

When the air motor in housing **2** is stopped, the chamber **125**, the passages **126**, **128**, **129** and chamber **130** are also immediately emptied through the passage **106** and through the motor, so that the spring **145** forces the piston **142** back thus returning the oil quickly to the chamber **134** and the piston **132** to its initial position (FIG. 3). The hydraulic oil does not have to pass through the narrow bore **141** owing to the operation of the non-return valve which will now be described. This non-return valve comprises a relatively stationary valve body **160** which has an enlarged head affixed to the grip member **102** by a screw threaded connection **160***s* in order to seal the upper end of chamber **134**. The valve body has a central bore **159** communicating at all times with the chamber **135**. Below the bore **159** the valve body has a counterbore to house the valve member **139** and, where the bore **159** meets the cylindrical counterbore in which slides the valve member **139**, a seating **160***b* is formed, the valve member being pressed against this seating through an O-ring **138** by a spring **140**. Passages **160***a* are made in the wall of the valve body **160**, and, when the piston **142** is forced back as above described, the pressure of oil in the chamber **135** forces the valve member **139** off its seating, so that the oil can flow rapidly through the bore **159** and passages **160***a* into the chamber **134**.

The purely pneumatic construction of a percussion tool with a time relay arranged in the handle according to FIGS. 4, 5 and 6, differs from the construction shown in FIGS. 2 and 3 by being equipped with a three-way valve **223** having at one end a square recess **253** by which it is coupled to the reverse lever **5**, the said three-way valve switching on the time switch with clockwise rotation of the tool and switching it off with anti-clockwise rotation. This makes it possible when loosening a bolt or nut to stop operations when the loosening process is completed.

The compressed air enters the grip member **202** at **201**. Reference numerals **203**, **204**, **205** represent the main valve spindle, the main valve member and the main valve spring (as did the reference numerals **103**, **104**, **105** in FIGS. 2 and 3) and **206** the passage which leads to the

motor of the percussion tool. The passages 207 and 208, chamber 209 and initiating valve member 210, spring 211 and spindle 212 have the same purpose as the similar parts in FIGS. 2 and 3 (which are designated by reference numerals lower by 100 in each case). The trigger 213 consists of a longitudinally movable rod surmounted by a thumb piece. When the tool is switched to clockwise rotation, and the thumb piece is depressed, compressed air passes through a chamber 216 and passages 217 and 218 into a chamber 219, where it advances a piston 220 and thus opens the main valve by displacing the valve member 204. Similarly to the constructional form described with reference to FIGS. 2 and 3, compressed air flows from 201 by way of a chamber 221 and passage 206 to the motor of the tool, whereby this starts to operate. At the same time, compressed air passes from the chamber 221 through a passage 222, the three-way valve 223 and a passage 224 through a constricted portion 225, whence it passes through the passage 218 to the chamber 219 and prevents the machine from stopping. Through the other passage of the valve 223 compressed air also passes, immediately after opening the main valve 204 by way of passages 226, 227, 228, 229 to a chamber 215 and, through a piston 214, forces the trigger 213 upwardly against the pressure of the thumb, so that the initiating valve member 210 is again seated under bias of the spring 211. Furthermore, compressed air travels from the passage 226 by way of a chamber 230 and passage 231 to a chamber 232, whence it flows through a narrow bore 234 in a valve member 233 and a passage 237 into the filling chamber 238 which is closed on all sides and slowly fills the said chamber.

Fixed on the grip housing 202 is a cylinder 239 in which a piston 240 biased by a spring 241 is arranged to be longitudinally displaceable. The end face 240*a* of the piston is acted upon by the pressure actually obtaining in the filling chamber 238. The tension of the spring 241 can be varied by turning a member 243 provided with a spiral groove 242 engaged by a pin 244 on the cylinder 239. The member 243 is shaped at its end 245 to be engaged by a key 245*k* so that it can be rotated in order to adjust its longitudinal position. The key cooperates with the complementary end portion 245 to form a detachable connection 6*b* which is comparable in function to the connection 6 of FIG. 1 and the connection 6*a* of FIG. 3. As soon as the pressure of the filling chamber 238 overcomes the pressure of the spring, the piston 240 is moved against the action of the spring 241 whereupon an annular groove 246 round the outside of the piston 240 provides communication between passages 247 and 248 leading to the passage 218 and to atmosphere respectively, so that the compressed air in the passage 218 and chamber 219 escapes to atmosphere, the piston 220 is relieved of pressure and the main valve member 204 is seated, closing the main valve. The size of the constricted portion 225 is again such that the quantity of compressed air subsequently flowing from the passage 224 is not sufficient to maintain the pressure in the chamber 219 which is necessary to hold the piston 220 in its forward position. Any air which may leak away from the annular groove 246 round the piston 240 in the position shown in FIG. 5 is permitted to escape to atmosphere through an annular groove 249 and passages 250, 251 and 252. With the seating of the main valve member 204 and the stopping of the machine, the chambers 221, 230, 232, and 215 are also immediately emptied again to atmosphere through the motor of the machine.

The valve member 233 carries an O-ring 236 and is biased by a light spring 235 into the position shown in FIG. 5. On chamber 230 being emptied to atmosphere, the valve member 233 is unseated against the spring bias by the excess pressure obtaining in the filling chamber 238, so that this chamber also is emptied into atmosphere by way of the passage 237, chamber 230, passage 226 and by way of the motor (not shown) in housing 2. As a result, the piston 240 also returns to its starting position, so that the machine is ready for the next operation. The trigger 213 can also be actuated again, since as stated above, the chamber 215 has also been emptied with the stoppage of the machine.

With anti-clockwise rotation of the tool, i.e., when loosening bolts or screws, the three-way valve 223 has the position shown in FIGURE 6. By actuating the trigger 213, the piston 220 is pushed forward by the pressure being set up in the chamber 219 in the same way as described for clockwise rotation and unseats the main valve member 204. However, since the three-way valve 223 blocks the compressed air coming from the chamber 221 and passage 222, the chamber 215 remains without pressure, so that the trigger 213 can be held in the depressed position as long as desired. As long as this is done the initiating valve member 210, also remains unseated and compressed air can flow to hold the main valve open, although a small amount of this compressed air discharges through the constricted portion 225 and by way of the passage 224, three-way valve 223 and a passage 254 into atmosphere (FIGURE 6). If the thumb is removed from the trigger 213, the initial valve member 210 is seated by the pressure of the spring 211. The compressed air from chamber 219 discharges by way of the constricted portion 225 by the aforementioned path, and the main valve member 204 is seated. Due to the anti-clockwise setting of the three-way valve 223, it is also not possible for any compressed air to reach the filling chamber 238, so that the piston 240 remains in its position shown in FIG. 5 and the switching-off process which would be produced by connection of the passages 247 and 248 does not take place.

In the constructional form shown in FIG. 7, a spring-operated clockwork mechanism 322 is provided, which is set in operation on switching on the percussion tool and initiates the switching-off process of the said tool after a time interval which can be adjusted by means of the button 323. The compressed air entering the handle 302 at 301 can initially only travel through the passages 307 and 308 as long as the main valve member 304 is on its seating. By actuating the trigger device 313 to 319, which operates in the same way as the trigger 113 to 119 in FIG. 2, a slide valve 312 is first of all pushed downwardly, so that a plunger 324 associated with the clockwork mechanism 322 travels a distance H, whereby the clockwork mechanism is set in operation. At the same time, compressed air reaching the passage 308 moves by way of an annular passage 312*a* around a constricted portion of the member 312 and passages 309 and 310 to reach a chamber 320, where it unseats the main valve member 304 through a piston 321, and valve spindle 303 against the action of valve spring 305 so that compressed air flows through the passage 306 to the motor.

After the running time of the clockwork mechanism adjusted by the button 323 has elapsed, the power of a spring or the like (not shown) is released by the said mechanism and this spring force causes the plunger 324 bearing on the clockwork mechanism to travel upwardly through the distance H. As a result, the slide valve 312 is restored to the position shown in FIG. 7, so that the compressed air in the chamber 320 flows to atmosphere through the passages 310, 309, annular passage 312*a* and a passage 311, whereby the main valve is closed and the tool is stopped.

In the electrically driven impact wrench according to FIG. 8, the casing is again in three parts comprising a handle 402, a main body 401 and a lower housing 404. The driving motor 403 is arranged in the main body 401 and through a gear (not shown in the drawing) which is arranged in the lower housing 404 and which is for example equipped with an overload clutch, the said motor drives the driven spindle terminating in a square portion

405. The current flowing in the supply cable 406 is switched on and off by a commercially available electric time switch 407 in the handle 402, for which purpose a trigger 408 must be actuated. The desired running time can be set at a setting button 409. The time switch 407 may consist, for example, of a time relay obtainable commercially from the Allgemeinen Elektrizitätsgesellschaft with the code number "AEG PL No. 53/5520."

As already mentioned, the desired degree of tightening of the driven nut or bolt (not shown) can be adjusted by varying the time setting of the timing mechanism, for example, by turning the key 147*k* or 245*k*. However, within the range of very small time, this adjustment produces inaccurate results as a small difference in the time setting will cause quite a considerable difference in the degree of tightening. This is the reason for the throttle screw 161 shown in FIG. 2 and which can be incorporated in pneumatically or hydraulically driven impact wrench. By adjusting the throttle screw 161, the degree of tightening can be varied without at the same time varying the time setting of the timing mechanism also in the range of small values with satisfactory accuracy.

With the pneumatic-hydraulic construction of the timing relay according to FIGS. 2 and 3 and with the purely pneumatic construction according to FIGS. 4 and 5, there is obtained the further advantage that fluctuations in power of the impact wrench owing to fluctuating pressure of the operating air are largely compensated for by the fact that the lower pressure of the air automatically causes a lengthening of the relay time, as the hydraulic oil or the air flows more slowly through the narrow bore 141 or 234 because of this lower pressure and consequently the instant of switching off is delayed. Conversely, the relay time is shortened with a rise in the air pressure.

It is understood that with each type of impact wrench, i.e., with those having an electrical driving means and also those operated by compressed air, the time switch or time relay can also be arranged externally of the tool in the energy supply line. This is shown in FIG. 9 in which casing 501 comprises a complete valve unit such as is shown in FIGURE 7. This is connected by pressure tubing 506 (such as tubing supply line 306 in FIG. 7) to grip member 502 of the impact wrench. Located in the grip member is pressure switch 505 which switch operates a member positioned in the casing 501 and corresponds to trigger 313 in FIG. 7 through a Bowden cable or the like 504. Furthermore, the changeover switch which is shown in FIGS. 4, 5 and 6 and which, in addition to reversing the motor, switches in the time switch with clockwise rotation and switches it out with anti-clockwise rotation, can also be provided in the construction described with reference to FIGS. 2 and 3 and in the electrical construction described with reference to FIG. 8.

A change-over to low power instead of complete switching off can also be used in order to ensure that a determined maximum degree of tightening is not exceeded. This change-over to low power is obtained in the construction according to FIG. 3 when the main valve member 104 has a spherical seating which is not absolutely air-tight, so that after the valve has closed, the tool still continues to run at reduced speed and thus reduced percussive power.

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

1. A time control mechanism for a fluid-operated percussion tool motor comprising an inlet for the operating fluid, a supply line leading to the fluid-operated motor, a main fluid operated fluid flow regulating valve in said supply line having a fully open position and a flow preventing or restricting position, an operating chamber operatively connected to the main valve, a passage branched off the supply line between the inlet and the main valve and leading to the operating chamber for the main valve, a manually-operable fluid flow regulating valve in the passage having open and closed positions so that by opening the manually-operable valve the main valve is also fully opened, a fluid operated timing mechanism, a passage leading to the timing mechanism from the aforementioned passage between the manually-operable valve and the operating chamber, means operatively connected with the timing mechanism to cause the movement of the main valve to the flow preventing or restricting position at the end of a time interval, means for zeroing the timing mechanism after the said time interval, means for causing the shutting of the manually operable valve before the end of the said time interval, and means for ensuring that the main valve remains fully open during the whole of the said time interval.

2. A time control mechanism according to claim 1 wherein the timing mechanism comprises a first cylinder and a second cylinder, a piston mounted in each cylinder, a chamber at one end of the first cylinder into which leads the said passage to the timing mechanism, a chamber at the other end of the first cylinder leading into a chamber at one end of the second cylinder through a narrow bore, hydraulic fluid in the said chambers, a one-way valve allowing free flow of hydraulic fluid in the direction from the second cylinder to the first cylinder, and a spring biasing the piston in the second cylinder in a direction to cause the said free flow of hydraulic fluid through the one-way valve.

3. A time control mechanism according to claim 1 wherein the timing mechanism comprises a filling chamber into which leads the said passage to the timing mechanism through a narrow bore, and a spring biased piston open at one end to the air in the filling chamber to be actuated thereby against the bias of the spring.

4. A time control mechanism according to claim 1 wherein the means for causing the movement of the main valve to the flow restricting position comprises a spring which biases the main valve to this position and a valve operatively connected with the timing mechanism to connect the operating chamber for the main valve to atmosphere at the end of the said time interval.

5. A time control mechanism according to claim 1 wherein the means for causing the shutting of the manually operable valve before the end of the said time interval comprises a spring which biases the manually operable valve to shut position and a trigger member having a latch operatively connected with the valve for operation of the same, whereby manual movement of the trigger member initially causes the manually operable valve to open and thereupon allows substantially immediate shutting thereof.

6. A time control mechanism according to claim 1 wherein the means for causing the shutting of the manually operable valve before the end of the said time interval comprises a spring which biases the manually operable valve to shut position, a valve spindle, a piston on the valve spindle, a manually operable member for moving the piston in a direction to move the valve to open position, a chamber on the opposite side of the piston from the manually operable member and a passage from that chamber to the supply line between the main valve and the fluid-operated motor.

7. A time control mechanism according to claim 1 wherein the means for ensuring that the main valve remains fully open during the whole of the said time interval comprises a passage branched off the supply line between the main valve and the fluid operated motor and leading through a constricted portion to the operating chamber for the main valve.

8. A power operated impact wrench tool comprising a rotatable output shaft adapted to drive a workpiece with a series of torsional impulses, a motor for driving said shaft with a series of rotational impacts, a source of power, an initiating element movable between a normal position and an operated position, manually controlled means for effecting movement of the initiating element from the normal to the operated position, means operable

upon such movement for starting the operation of the tool, a time delay control means including a timing element movable forward from an idle position to an operating position, means for moving the timing element forward from its idle position upon operation of the initiating element, said control means including means for retarding the motion of the timing element whereby the latter moves gradually and progressively from normal toward operating position during the delivery of impacts, said motion retarding means controlling the motion of the timing element whereby the latter is arranged to attain a predetermined operating position after the lapse of a predetermined interval of time following the operation of the initiating element, means for terminating the delivery of torsional impacts to the shaft, said terminating means being operable automatically in response to the movement of the timing element to said predetermined operating position, and means for adjusting the distance between the idle position and the operating position of said timing element whereby to regulate the duration of the rotational impacts.

9. A power operated impact wrench tool according to claim 8, in which the time delay control means comprises a cylinder, a piston reciprocable in said cylinder and means for progressively imparting relative axial movement between the piston and cylinder while power is supplied to the motor, and in which the terminating means includes a control device adapted to be engaged upon such relative axial movement through a predetermined distance.

10. A power operated impact wrench according to claim 9 in which the motor is operated by pressurized air received from said source of power, and in which the means for progressively imparting relative axial movement between the piston and cylinder is operated by live air from said source, whereby any reduction or increase in the pressure of the live air is compensated by a reduction or increase in the rate of movement of the piston relative to the cylinder with a corresponding increase or decrease respectively in the time interval required for the operation of the shut down device.

11. A power operated impact wrench comprising a rotatable output shaft adapted to drive a workpiece with a series of torsional impulses, an air motor for driving said shaft with a series of rotational impacts, an inlet adapted to be connected to a source of live air, a passageway leading from said inlet to the motor, a main valve in said passageway movable between open position and flow restricting position to energize or de-energize the motor respectively, a manipulative trigger, a valve opening piston arranged to open the main valve, fluid pressure means responsive to the manipulation of the trigger for moving the piston to valve opening position, locking means effective on such movement of the piston to lock the latter in valve opening position irrespective of the position of the trigger, time delay control means comprising a movable element arranged to start moving upon opening of the main valve and to continue moving progressively and gradually in one direction, and releasing means operable upon movement of said movable element through a predetermined distance to disable the locking means and thereby effect movement of the main valve toward flow restricting position.

12. A power operated impact wrench comprising a rotatable output shaft adapted to drive a workpiece with a series of torsional impulses, an air motor for driving said shaft with a series of rotational impacts, an inlet adapted to be connected to a source of live air, a passageway leading from said source to the motor, a main valve in said passageway movable between open and closed position to energize or de-energize the motor respectively, manually controlled means for opening the main valve to initiate the driving of the workpiece, and time delay means for moving the main valve to a flow preventing or flow restricting position to terminate or limit the driving of the workpiece, said time delay means comprising a cylinder providing a piston chamber, a piston reciprocable therein, yielding means for constantly urging the piston rearward toward an idle position, means for admitting pressure fluid in said chamber in back of the piston to move the latter forward in opposition to said yieldable means, a control device adapted to be actuated upon predetermined relative axial movement between the piston and cylinder, and means responsive to the operation of the control device for moving the main valve to flow preventing or flow restricting position.

13. A power operated impact wrench according to claim 12, in which the fluid which is admitted to the rear end of the piston chamber has a pressure directly proportional to the pressure of live air at the source whereby variations in live air pressure at the source cause corresponding variations in the speed of movement in the time delay piston and hence compensate for the increased or reduced power by decreasing or reducing respectively the time of operation of the impact wrench.

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