

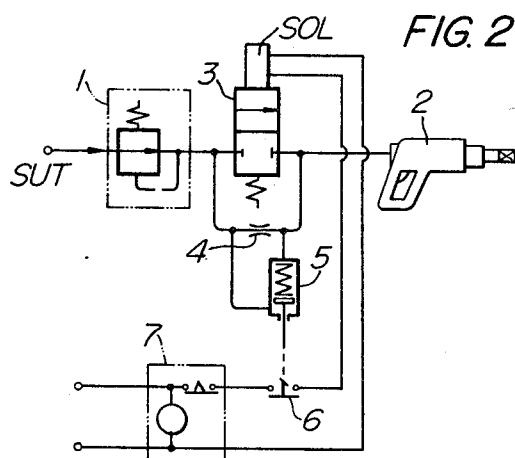
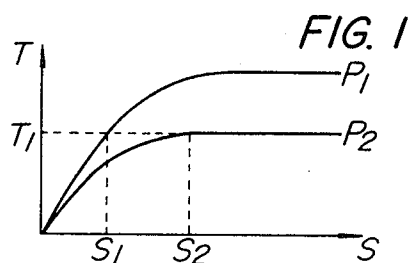
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TORQUE CONTROL DEVICE FOR AIR WRENCHES

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TORQUE CONTROL DEVICE FOR AIR WRENCHES
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1 Claim

ABSTRACT OF THE DISCLOSURE

A torque control device for a pneumatic wrench with a pressure reducing valve for regulating the pressure of air to be supplied to the wrench, a change-over valve provided in a passage for the air, and a timer adapted to actuate the changeover valve in response to a pressure variation in the passage and to return the changeover valve to its original position after expiration of a predetermined period of time, so that the pneumatic wrench operates under a certain pressure of the air supplied for a predetermined period of time. A specific embodiment includes a ratchet-type switch inserted in the electric circuit for energizing and de-energizing the changeover valve, which cooperates with the timer.

The present invention relates to a device for controlling the torque of pneumatic wrenches such as the so-called impact wrench wherein rotational energy accumulated in a rotor is converted into impact energy by means of a ratchet mechanism so as to impart a torque to a driven member such as a screw.

In tightening a member, such as a screw, with a pneumatic wrench, a highly complicated operation has heretofore been required involving readjustment of the tightening force by the use of a torque wrench, wherever the the tightening force is limited so as to fall within a predetermined range. In order to deal with such problem, various forms of pneumatic wrenches have hitherto been proposed which are capable of controlling the torque to be generated thereby to a desired value beforehand and thereby restricting the tightening force. However, since most of these conventional pneumatic wrenches are of the type having a control device accommodated therein, they are inevitably large and heavy. Consequently, these wrenches have the drawbacks that they are inconvenient in handling, complicated in construction and difficult in maintenance and adjustment, and further that they are only applicable to relatively small-sized screws. The same is more or less true with the pneumatic wrenches of the type having a control device attached on the exterior thereof. Namely, the wrenches of this type are generally complicated in construction, complicated in torque setting operation and difficult to maintain.

According to the present invention, there is provided a torque control device which not only may be readily attached to the conventional pneumatic wrenches but which is easy to maintain and adjust. Further, this invention is capable of controlling the torque in a stable manner and is effective in shortening the operating period of an associated wrench and preventing wasteful consumption of the air used.

In order that the present invention may be more clearly understood, reference may now be had to the accompanying drawings in which the present invention is illustrated by way of example and in which:

FIG. 1 is a chart illustrating the operational characteristic curve of a pneumatic wrench; and

FIG. 2 is a system diagram of an embodiment of the torque control device.

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Referring to FIG. 1, there is shown the general relationship between torque T to be generated by a pneumatic wrench, and operating period S of and pressure P supplied to the pneumatic wrench. As will be seen from this chart, a desired torque T_1 may be obtained by restricting the operating period of the pneumatic wrench to S_1 at a pressure P_1 or alternatively by restricting the pressure to P_2 and operating the wrench for a period S_2 or more. The former method is advantageous in shortening the operating period of the wrench but has the drawback that the torque to be obtained is unstable, whereas the latter method has the advantage that it is possible to obtain a relatively stable torque as a result of operation for a sufficiently prolonged period but on the other hand has the drawback that pressurized air used tends to be consumed wastefully or a desired torque cannot be obtained if the operating period is not sufficiently long. It will, therefore, be understood that, in order to obviate the foregoing drawbacks, both methods should be combined in a suitable manner. Namely, a desired stable torque T_1 can be obtained positively and without waste of air and time by setting the supply pressure at P_2 and also restricting the operating period to S_2 .

Based on this concept, the device of the present invention includes a pressure reducing valve for regulating the pressure of air supplied to an associated pneumatic wrench and a change-over valve for shutting down a passage for said air to thereby stop the operation of the wrench after a predetermined lapse of time, said change-over valve being actuated automatically by means of a timer, whereby the pressure of the air supplied to the wrench and the operating period of said wrench are regulated to desired values respectively, so as to control a torque to be obtained.

FIG. 2 shows an embodiment of the inventive device using an electrical timer. In this embodiment, a pneumatic system comprises a pressure reducing valve 1 for regulating the pressure of air under pressure supplied from a pressurized air supply source SUT to an associated pneumatic wrench 2 and an electromagnetically operative change-over switch 3 interposed between said pressure reducing valve 1 and said wrench 2 to change-over the supply passage from the former to the latter. The inlet side and the outlet side of the change-over valve are communicated with each other through a throttling portion 4 and a pressure difference produced between both sides of the throttling portion 4 is utilized to actuate a switch actuator 5. The electric system, on the other hand, consists of a ratchet type switch 6 adapted to be actuated by said switch actuator 5, a time switch 7 arranged to be opened in a predetermined period of time and a solenoid SOL to actuate the aforementioned change-over valve 3. When the air wrench 2 is not in operation, the main pressure supply passage leading from the pressure reducing valve 1 to the wrench 2 is closed by the change-over valve 3 as shown in the figure and, therefore, the pressures on the front and back sides of the throttling portion 4 are held in a balanced state. The switch actuator 5, therefore, is inoperative, holding the switch 6 in an open position. Upon opening a valve provided in the wrench 2 to set said air wrench in operation, the pressurized air present on the back side of the throttling portion 4 is first consumed and thus a pressure difference is developed between both sides of the throttling portion. As a result, the switch actuator 5 is actuated by the pressure difference, bringing the switch 6 into a closed position, although the wrench 2 has not yet been set in motion under this state. Upon closing the switch 6, the solenoid SOL is energized to bring the change-over valve 3 into an open position and thereby the wrench 2 is set in motion. The switch 6 is continuously held in the closed position even after the switch actuator 5 is returned to its original position upon disappearance

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of the pressure difference between both sides of the portion 4. After expiration of a predetermined period of time, the time switch 7 is actuated to deenergize the solenoid SOL and the change-over valve 3 is closed to stop the operation of the wrench 2. Upon closure of the change-over valve 3, as will be understood, a pressure difference is developed again between both sides of the throttling portion 4, so that the switch actuator 5 is again actuated thereby bringing the ratchet type switch 6 into the open position. By closing the valve in the wrench 2, the pressure difference is eliminated, and the switch actuator 5 is returned to its original position. Thus, the entire device is brought into the inoperative position completely in which said device had been before the operation.

As will be understood from the foregoing description, since, according to the present invention, the torque generated by the pneumatic wrench is controlled automatically by regulating the air pressure supplied to the wrench and the duration of supplying it, the operator is only required to actuate the valve in the wrench and to hold it until the operation is stopped automatically, there being no necessity for readjustment of the tightening force by the use of a torque wrench or the like as has been required with the conventional wrenches. With the inventive device, therefore, it is possible to perform the tightening operation with ease which has heretofore required a skill of the operator, and also to afford a uniform tightening strength to a part to be tightened as required. Consequently, it is possible to avoid excess or shortage of tightening force or wasteful consumption of the pressurized air resulting from an unduly prolonged operation of the wrench, which have been experienced even by those skilled in the tightening operation using an impact wrench, as a result of difficulty in determining the time of completion of tightening. A still further advantage of the inventive device is that it may be readily attached to the air wrenches of conventional forms and can be handled with ease.

We claim:

1. A torque control device for a pneumatic wrench,

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comprising an air pressure reducing valve for regulating the pressure of air supplied to said pneumatic wrench, a main air conduit between said air pressure reducing valve and said pneumatic wrench, a solenoid-operated change-over valve provided in said main air conduit for opening and closing said conduit, a branch passage including therein a throttle valve in series, the up-stream end of said passage opening in said main air conduit between said pressure reducing valve and said changeover valve and the down-stream end of said passage opening in said main air conduit at between said changeover valve and said pneumatic wrench, a pneumatically-operated switch actuator actuated by the pressure difference created in said branch passage across said throttle valve, an electric circuit for energizing the solenoid of said changeover valve, a timer switch provided in the circuit to open the circuit at a predetermined time after said pneumatic wrench is caused to operate by the opening of an operator's valve of said wrench, and a ratchet-type switch provided in said circuit and actuated by said switch actuator to close the circuit only when said switch actuator is actuated by the opening of said operator's valve in said pneumatic wrench and to open said circuit only when said switch actuator is actuated when the timer switch opens said electric circuit to close said changeover valve in said main air conduit.

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