United States Patent

[11] 3,581,501

[72] Inventor **Gunter Kruger**
Gifhorn, Germany

[21] Appl. No. **859,073**
[22] Filed **Sept. 18, 1969**
[45] Patented **June 1, 1971**

[73] Assignee **International Telephone and Telegraph Corporation**
New York, N.Y.

[32] Priority **Sept. 28, 1968**
[33] **Germany**
[31] **P1777231.5**

[54] **CONTROL SYSTEM FOR PNEUMATICALLY OPERATED TOOLS**
8 Claims, 3 Drawing Figs.

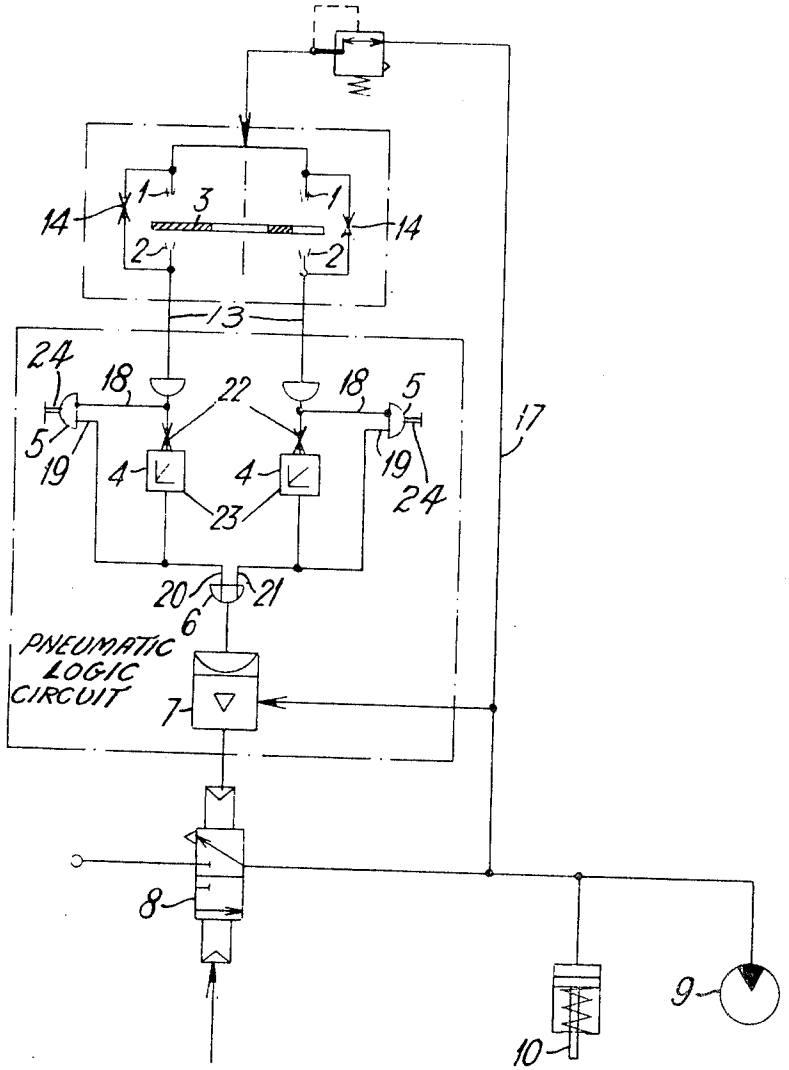
[52] **U.S. Cl.** **60/57**, 91/3, 137/83
[51] **Int. Cl.** **F15b 13/02**
[50] **Field of Search** 91/3; 60/57; 137/83

[56] **References Cited**
UNITED STATES PATENTS

1,729,850	10/1929	Wunsch	91/3
2,965,076	12/1960	Zeisloft	91/3

Primary Examiner—Edgar W. Geoghegan
Attorneys—C. Cornell Remsen, Jr., Walter J. Baum and Paul M. Hemminger

ABSTRACT: A control for switching off the air supply to a pneumatically operated rotating tool when the tool stops rotating. A pneumatic logic circuit including two free jet nozzles and an interrupter disc rotating with the tool creates a pulse signal when the tool rotates and a continuous signal when the tool stops. The logic circuit cuts off the pneumatic supply to the tool when a continuous signal is sensed, thereby insuring that the air supply to the tool is not cut off until full torque is produced.



PATENTED JUN 1 1971

3,581,501

SHEET 1 OF 2

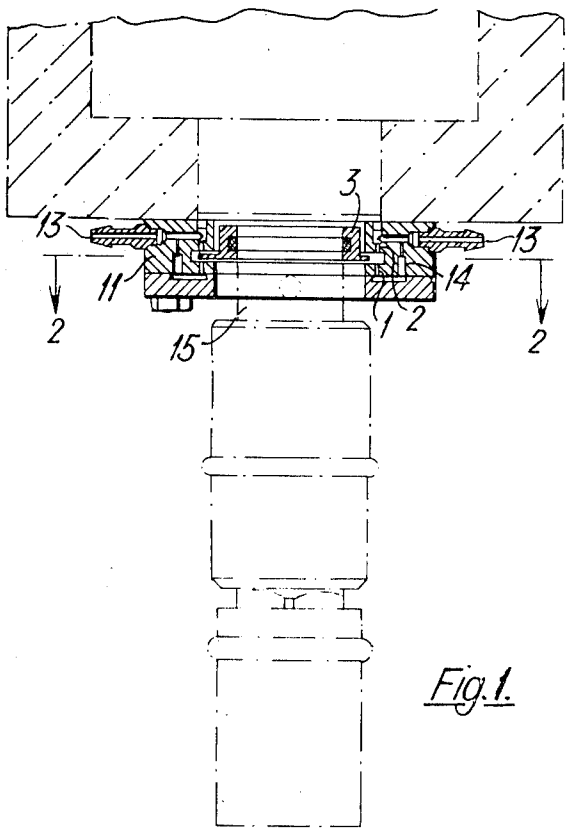


Fig. 1.

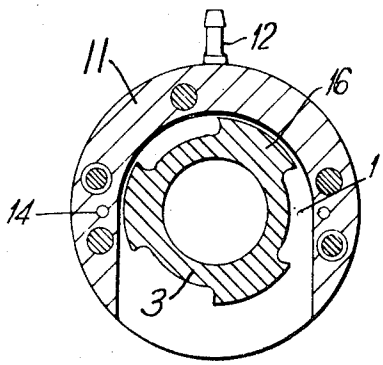


Fig. 2.

INVENTOR
Gunter Kruger
BY Gennaro L. Pasquale
Agent

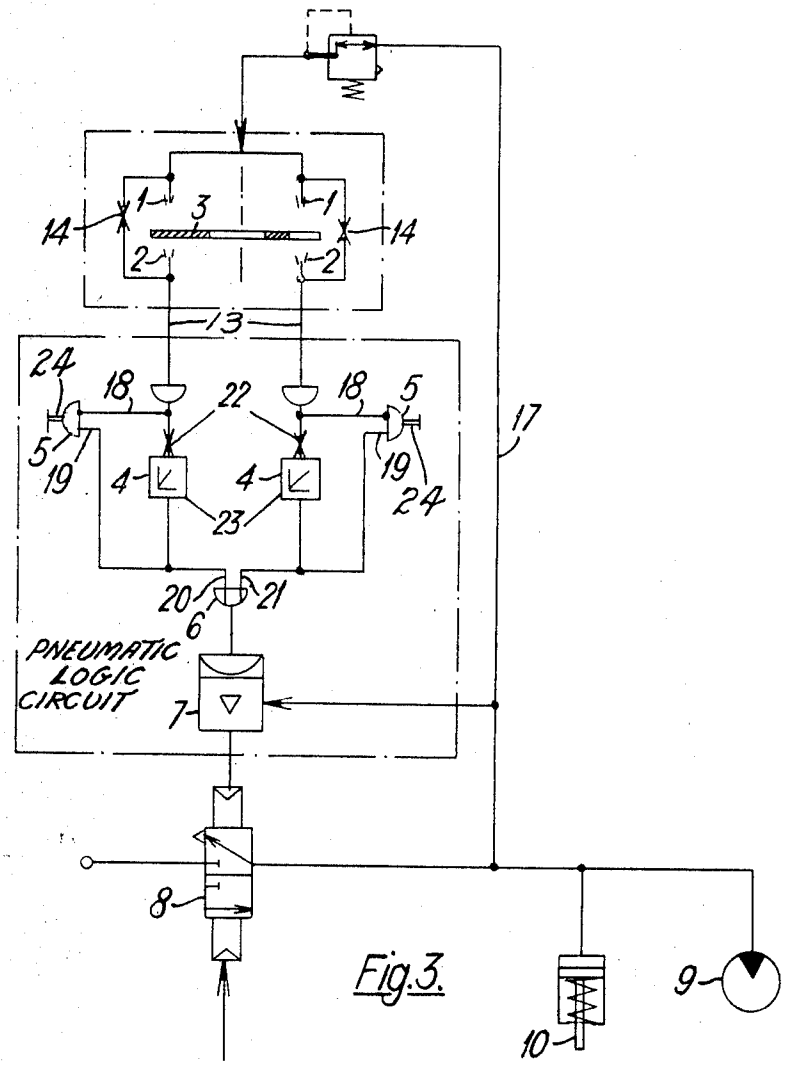


Fig.3.

Inventor
Gunter Kruger
By Gennaro L. Pasquale
Agent

CONTROL SYSTEM FOR PNEUMATICALLY OPERATED TOOLS

CROSS REFERENCE TO RELATED APPLICATION

This application is filed under the provisions of 35 USC 119 with a claim for the benefit of the filing date of an application covering the same invention filed on Sept. 28, 1968 Ser. No. P 17 77 231.5 in the Federal Republic of Germany.

BACKGROUND OF THE INVENTION

The invention relates to a switch-off device for pneumatically operated machine tools and particularly for pneumatically operated screwdrivers.

Heretofore pneumatically operated machine screwdrivers have been switched off, if not by the machine operator, via a timer having a time period which is a function of the maximum screwing time. Since each screw does not evenly fit along the threads when the screwing tool is applied or the key head is not evenly caught in when applied on the screw head, an indeterminate amount of time is wasted so that the period of the timer always involves the uncertainty that the whole torque generated by the screwdriver is not transmitted to the screw; that is, the screwdriver is switched off before the screw is tightened.

SUMMARY OF THE INVENTION

The object of the invention is to provide a pneumatically operated screwdriver which will switch off only after the screw no longer turns so that full application of the screwdriver torque is insured.

The present invention achieves this object by a pneumatic pulse generator which produces a pulse signal as long as the screwdriver rotates. The output of the pulse generator is connected to a logic circuit which cuts off the pneumatic supply to the screwdriver when a continuous signal is received from the pulse generator. The pneumatic pulse generator is equipped with two free jet nozzles, with two catch nozzles opposite to the latter and with an interrupted disc rotating with the screwdriver shaft. The pneumatic pulse generator and the whole pneumatic logical circuit are fed by a pneumatic auxiliary circuit. The free jet nozzles and catch nozzles are oppositely disposed in an annular body which is screwed on the fixture of the screwdriver and has an approximately U-shaped profile on account of an annular groove in the inner wall.

Interrupter lobes provided on the periphery of the interrupter disc extend into the groove of the annular body between the free jet nozzle and the catch nozzle so that in each position of the interrupter disc a free jet nozzle is pneumatically connected with the corresponding catch nozzle.

Air ducts, each of which is provided with a choke bore to the pulse output, are arranged parallel to the free jet nozzles. The outputs of the catch nozzles are in each case connected with a pneumatic equivalent of an RC element which consists of a nozzle and an air receiver and with the negated input of an inhibition element. The output of the air receiver communicates with the second input of the inhibition element and with the input of a common pneumatic OR element. The output of the inhibition element communicates with atmosphere.

The pneumatic OR element which receives its input pulses from the pneumatic equivalents of the RC element is followed by a binary pneumatic power amplifier which itself is followed by the control valve for the pneumatic main circuit.

In one embodiment of the invention a pneumatic interlocking device is provided in the main circuit to prevent the screwdriver from lifting too early.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a longitudinal section through a pulse generator mounted on the support of a pneumatically operated screwdriver.

FIG. 2 is a cross section view taken on the plane indicated by 2–2 of FIG. 1 showing the shape of the interrupter dic.

FIG. 3 is a schematic representation of the pulse generator and logic circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2 in particular there is shown an annular body 11 screwed on the support of the screwdriver. Two free jet nozzles 1 and two catch nozzles 2 are disposed diametrically opposite to each other.

The annular body 11 has an approximately U-shaped cross section due to an annular groove in its inner wall. Both the free jet nozzles 1 are arranged in one branch and both the catch nozzles 2 are arranged in the other branch oppositely to the latter so that the air jet passing out from the free jet nozzle 1 is caught into the opposite catch nozzle 2 and can be further worked up. The interrupter lobes 16 formed by recesses on the periphery of the interrupter disc 3 rotating with the screwdriver shaft 15 extend into the groove in the inner wall of the annular body 11 which separates the free jet nozzles and the catch nozzles from each other. Therefore, as the interrupter disc 3 rotates, a pulsing signal will be transmitted to each catch nozzle. When the interrupter disc is stationary, a continuous signal is transmitted to one catch nozzle. The pulse outlet connections 13 lead laterally from the catch nozzles 2 to the pneumatic logic circuit. In the annular body a duct 14 having a choke bore is placed parallel to each of the free jet nozzles 1. The duct 14 likewise communicates with the pulse output 13 and is intended to protect the catch nozzles 2 against impurities from atmosphere. Compressed air is supplied through the connection 12.

FIG. 3 shows diagrammatically the pulse generator and pneumatic logic circuit in the rest position. From the pneumatic main circuit which supplies compressed air to the screwdriver motor 9 via the slide valve 8 and to the pneumatic interlocking device 10 which prevents the screwdriver from lifting too early, part of the pressure is branched off into an auxiliary circuit 17 for supply to the pneumatic pulse generator and the whole pneumatic logic circuit. The catch nozzles 2 of the pulse generator which are pneumatically connected with or separated from the free jet nozzles 1 via the interrupter disc 3 are in each case connected with the input of a pneumatic equivalent to a RC element 4 consisting of a nozzle 22 and an air receiver 23 and with the negated input of an inhibition element 5 via line 18. The second input of the inhibition element 5 is connected to the output of the air receiver via line 19 while the output communicates with atmosphere. The outputs of the two air receivers are connected via lines 20 and 21 with the inputs of a common pneumatic OR element 6 whose output signal is brought to a binary power amplifier 7 which is fed from the pneumatic main line. The amplifier 7 is followed by a slide valve 8 located in the main line to the screwdriver 9 and to the pneumatic interlocking device 10. This slide valve 8 cuts off or releases the whole pneumatic supply.

The device functions as follows. In the beginning of a cycle, control valve 8 is open and allows airflow to the screwdriver motor 9, the interlocking device 10, the pneumatic logic circuit and the free jet nozzles 1. The interrupter disc 3 is so designed that, with the screwdriver spindle rotating, the interrupter lobes 16 formed by the recesses on the periphery of the disc alternatingly release or interrupt the airflow between a free jet nozzle 1 and the opposite catch nozzle 2. The air pulses of the pulse generator of about 100 mm. water which are thus received effect a mutual charging of the air receiver 23. The receivers and nozzles are so designed that a full charging is not brought about when the screwdriver shaft 15 is rotating. When the signal is pulsed, a rapid exhaustion of the air receiver to atmosphere commences via inhibition element 5 because of the absence of a signal at the outlet of the catch nozzle 2 which is directly connected to the negated input of the inhibition element 5. When the screwdriver has produced its full torque, the screwdriver shaft 15 is brought to standstill; now the pneumatic pulse generator transmits a continuous signal to one of the air receivers 23 whereby the receiver can be fully charged and a signal appears at one of the inputs of

the OR element 6 which transmits an output signal which is amplified in the binary power amplifier 7 in order to operate the control slide 8 so that supply of compressed air to the whole pneumatic system is interrupted and thus the screwdriver 9 is stopped and the interlocking device released. The cutting off of the pneumatic supply eliminates the signal to the negated input of the inhibition element 5 thereby allowing the air receiver to discharge to atmosphere via line 24. This then allows the whole cycle to be repeated again.

The invention insures that the screwdriver is switched off only after it has generated its full torque and the switch-off pulse is given as a result of the locking of the screwdriver spindle. Thereby the problem of an untimely switching-off of the screwdriver is obviated.

It is not necessary to allow additional time in order to secure that the screw is tightened as it is in the case with screwdrivers which are switched off by a time relay. Hence a pulse time is reduced in mechanical assembly.

A further advantage consists in that each machine tool equipped with such a switch-off device is protected against damage in case the torque to be transmitted exceeds the permissible value.

It will be appreciated that the invention illustrated and described herein may be modified by those skilled in the art without deviating from the spirit and scope of the invention as set forth in the following claims.

I claim as my invention:

1. A system for switching off the pneumatic supply to a rotatable tool when the tool stops rotating comprising:

at least two free jet nozzles with spaced catch nozzles;

an interrupter disc adapted to rotate with the tool and between the free jet nozzles and the catch nozzles to provide a pulse signal when the tool is rotating, the interrupter disc designed so that at least one free jet nozzle is pneumatically connected to its catch nozzle at every position of the interrupter disc to provide a continuous pneumatic signal when the tool is not rotating; and

a pneumatic logic circuit connected to the outputs of the catch nozzles for controlling the pneumatic supply to the tool, the logic circuit cutting off the pneumatic supply to the tool when a continuous signal is received from any catch nozzle.

2. The system of claim 1 wherein; the free jet nozzles and the pneumatic logic circuit are powered by air drawn from the pneumatic supply line going to the tool, and the output of the pneumatic logic is fed to a control valve in the pneumatic supply line.

3. The system of claim 1 wherein; the disc rotates in an annular groove in the inner wall of an annular housing surrounding the edge of the disc, and the free jet nozzles and catch nozzles are located on opposite sides of the groove.

4. The system of claim 2 wherein; the disc rotates in an annular groove in the inner wall of an annular housing surrounding the edge of the disc, and the free jet nozzles and catch nozzles are located on opposite sides of the groove.

5. The system of claim 1 including choked pneumatic ducts parallel to each free jet nozzle and catch nozzle.

6. The system of claim 1 wherein the pneumatic logic circuit comprises:

a nozzle and an air receiver connected in series to each catch nozzle;

a pneumatic inhibition member connected across each nozzle and air receiver, each inhibition member having a negated input from the inlet to the nozzle, a positive input from the outlet of the air receiver, and an outlet connected to atmosphere;

a pneumatic OR member having inlets connected to the outlets of each air receiver and an outlet connected to a pneumatic power amplifier; and

mean responsive to the output of the amplifier for cutting off the pneumatic supply to the tool.

7. The system of claim 2 wherein the pneumatic logic circuit comprises:

a nozzle and an air receiver connected in series to each catch nozzle;

a pneumatic inhibition member connected across each nozzle and air receiver, each inhibition member having a negated input from the inlet to the nozzle, a positive input from the outlet of the air receiver, and an outlet connected to atmosphere; and

a pneumatic OR member having inlets connected to the outlets of each air receiver and an outlet connected to a pneumatic power amplifier.

8. The system of claim 3 wherein the pneumatic logic circuit comprises:

a nozzle and an air receiver connected in series to each catch nozzle;

a pneumatic inhibition member connected across each nozzle and air receiver, each inhibition member having a negated input from the inlet to the nozzle, a positive input from the outlet of the air receiver, and an outlet connected to atmosphere;

a pneumatic OR member having inlets connected to the outlets of each air receiver and an outlet connected to a pneumatic power amplifier; and

means responsive to the output of the amplifier for cutting off the pneumatic supply to the tool.