

- [54] **TOOL DEVICES OF THE VARIABLE TORQUE TYPE**
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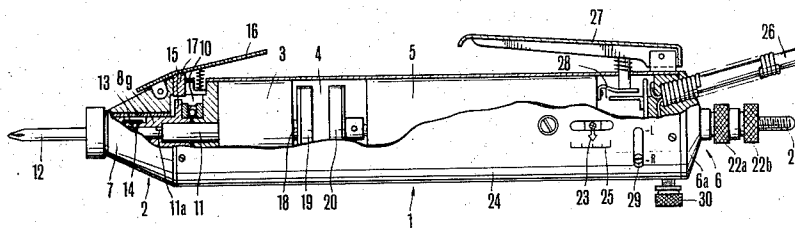
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[57] **ABSTRACT**

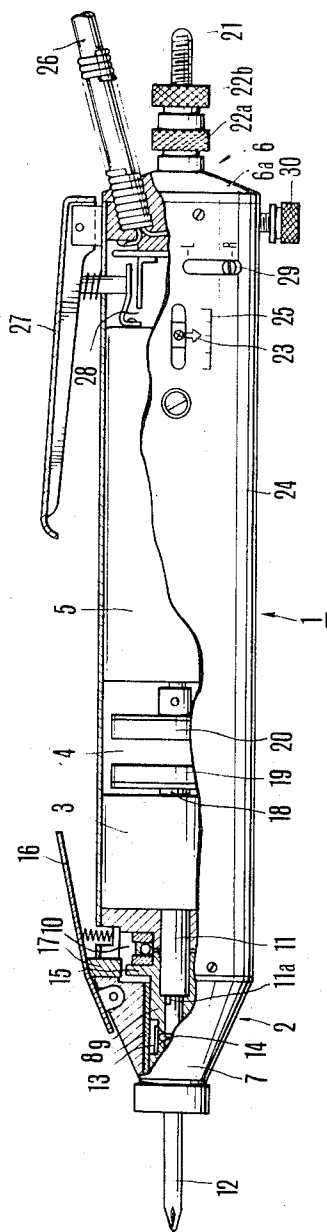
In a tool device of the type comprising rotary driving means, a working tool and a clutch adapted to couple the working tool with the rotary driving means, the clutch comprises a first magnetized disc driven by the rotary driving means and a second magnetized disc confronting the first magnetized disc and connected to the working tool and wherein means is provided for varying the spacing between the first and second magnetized discs whereby to adjust the torque applied to the working tool.

6 Claims, 1 Drawing Figure



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TOOL DEVICES OF THE VARIABLE TORQUE TYPE

BACKGROUND OF THE INVENTION

This invention relates to a working tool device whose torque can be varied over a wide range.

In the assembly and adjustment of various articles such as photographic cameras, telephone sets or the like various types of working tools have been used such as motor driven screw drivers and pneumatic screw drivers which apply a torque to the screw being driven. In such tools, working heads such as screw drivers or wrenches are coupled to the rotary shafts of small electric motors or pneumatic motors connected to a source of pressurized air and these tools are used to drive screws or nuts. Adjustment of the working torque of such tools is provided by the adjustment of the electric power or air pressure supplied to the driving motor or by means of mechanical means.

However, since the adjustment provided by prior art torque adjusting means is generally rough, such tools have not been used in the assemblage of precise machines, such as watches, photographic cameras or the like. Furthermore, the mechanical torque adjusting means are not advantageous in that they are complicated in construction, liable to be damaged and difficult to operate.

SUMMARY OF THE INVENTION

It is, therefore an object of this invention to provide a working tool of variable torque wherein the working torque can be precisely and finely adjusted over a wide range.

A further object of this invention is to provide an improved working tool of the variable torque type which is simple in construction and operation.

According to this invention there is provided a tool device of the variable torque type comprising rotary driving means, a working tool, a clutch adapted to couple the working tool with the driving means, the clutch including a first magnetized disc driven by the rotary driving means and a second magnetized disc confronting the first magnetized disc and connected to the working tool, and means for varying the spacing between the first and second magnetized discs whereby to adjust the torque applied to the working tool.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing, a single FIGURE shows a side view, partly in section, of a screw driver embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The screw driver 1 embodying the invention and shown in the accompanying drawing comprises a chuck 2, a speed reducer 3, a clutch 4, a micro-electric motor 5 and a torque adjuster 6 which are arranged coaxially in a casing 24 in the order mentioned. Chuck 2 comprises a bracket 7 secured to one end of the driver 1 and chuck elements 9 supported at the center of bracket 7 by means of a nylon bearing 8. The chuck elements 9 are supported by a thrust bearing 10 and one end of the chuck elements is secured to the output shaft 11 of the speed reducer 3. The inner end of a plus screw driver 12 is received at the center of the chuck elements 9. Steel balls 14 urged radially inwardly by

leaf springs 13 are received in the grooves formed on the periphery of driver 12 to removably hold the same. A portion of the inner end of screw driver 12 is notched to form a key way to receive a longitudinal key 11a formed on the outer end of output shaft 11. A gear 15 is secured on the outer periphery of the chuck elements 9. On the outside of gear 15 is disposed a pin 17 which is urged to engage gear 15 by means of a lever 16 for preventing the gear from rotating.

Clutch 4 comprises a second magnetized disc 19 mounted on an input shaft 18 of the speed reducer 3 and a first magnetized disc 20 coaxially confronting the second magnetized disc 19. These magnetized discs 19 and 20 are magnetized to have four poles, for example, on their opposed surfaces so that they are coupled with a coupling force inversely proportional to the square of the distance their between.

Torque adjuster 6 comprises a bracket 6a secured to the rear end of the tool 1 and a threaded shaft 21 extending through the center of bracket 6a and secured to the micro-motor 5. Although not shown in the drawing, a compression spring is interposed between bracket 6a and micro-motor 5 and double nuts 22a and 22b are threaded on the outer end of shaft 21. Accordingly, when the double nuts 22a and 22b are turned in one direction shaft 21 is pulled outwardly to move to the right the micro-motor 5 connected to shaft 21, and magnetized disc 20 secured to the rotary shaft of micro-motor 5. A pointer 23 is secured to micro-motor 5 to extend outwardly through a window of the casing 24 of the tool, the pointer 23 cooperating with a scale 25 graduated on the outer periphery of casing 24 to indicate the axial position of micro-motor 5 and hence the spacing between magnetized discs 19 and 20. A cable 26 is connected to casing 24 to supply DC power to micro-motor 5 through a switch 28 operated by a hinged lever 27 and a polarity reversing switch 29. A screw 30 is provided to extend through casing 24 for holding shaft 21 against axial movement.

The screw driver of this invention operates as follows.

First, polarity reversing switch 29 is operated to the position R of righthand rotation so as to connect the inner end (not shown) of cable 26 to switch 28 with a polarity that causes righthand rotation of micro-motor 5. Then, the operator causes the outer end of screw driver 12 to engage the crisscross groove of a screw to be driven. Thereafter, the operator depresses handle 27 toward casing 24 to close switch 28. Accordingly, micro-motor 5 is started to rotate magnetized disc 20 in the righthand direction thereby rotating magnetized disc 19 in the same direction by magnetic force. The speed of disc 19 and its shaft 18 is reduced at a ratio of 10:1, for example, by speed reducer 3 to drive the screw (not shown) at a low speed.

As the screw is driven, the torque applied to screw driver 12 increases and when the torque exceeds the pull acting between magnetized discs 19 and 20, these discs slip relatively until magnetic poles of the opposite polarity oppose each other at which time a repulsive force will be created between the magnetic poles of these discs, thus increasing the load current flowing through micro-motor 5. In response to this over current, an over-load relay, not shown, operates to interrupt the micro-motor from the source. Deenergization of the micro-motor means that the torque applied to the screw being driven has reached a predetermined

value which is determined by the spacing between magnetized discs 19 and 20 and the magnitude of their magnetic forces. Consequently, it will be clear that it is possible to apply a predetermined driving torque to the screw by adjusting the torque acting between magnetized discs 19 and 20.

To adjust the driving torque, set screw 30 is loosened and then double nuts 22a and 22b are rotated in one direction to move micro-motor 5 to the right. On the other hand, when these nuts are rotated in the opposite direction, micro-motor 5 is moved to the left, whereby the spacing between magnetized discs 19 and 20 is varied thus varying the attractive force between these discs and hence the driving torque applied upon the screw in inverse proportion to the square of the spacing between two magnetized discs. This driving torque and hence the spacing between two magnetized discs is indicated by pointer 23 cooperating with scale 25.

When the operator manually actuates lever 16 to engage pin 17 with gear 15 secured to chuck elements 9, the screw driver 12 is locked against rotation. Under these conditions it is possible to use the driver as an ordinary screw driver.

To exchange screw driver 12, it is pulled to the left thus disengaging steel balls 14 from recesses normally receiving them against the force of leaf springs 13 and then a new tool is inserted into chuck 2 to establish a driving connection with the output shaft 11 of speed reducer 3.

When polarity reversing switch 29 is switched to a position L for the lefthand rotation, the micro-motor 5 and hence driver 12 is rotated in the lefthand direction to loosen the screw. After setting the torque to a desired value by turning double nuts 22a and 22b the set screw 30 is tightened to hold shaft 21 in the set position thus preventing the set torque from varying. As above described, since the torque applied upon screw driver 12 is adjusted by varying the spacing between magnetized discs 19 and 20 comprising clutch 4 it is possible to precisely and finely adjust the torque applied upon the screw driver over a wide range from an extremely small value to a substantial value. Assuming a torque of 100 g of the micro-motor 5 and a magnetic force of 70 gauss between magnetized discs 19 and 20, the torque can be adjusted from 30 to 1,000 g.cm. By increasing the number of magnetic poles of magnetized discs 19 and 20, even a slight overload causes a slip between these discs. For this reason, the novel tool can be used safely for the assemblage of such precise articles as photographic cameras and watches.

Although in the foregoing embodiment the invention has been described as applied to a plus screw driver driven by a micro-motor, it will be clear that the invention is not limited to these particular tool and driving means and that another tools such as boxes, reamers, taps, and wrenches and another driving means such as

pneumatic motors can also be used.

As above described according to this invention, it is possible to readily adjust the torque of the tool over a wide range by merely varying the spacing between magnetized discs. Since the value of the torque is determined by the spacing between the magnetized discs, it is possible to precisely set the maximum value of the torque, so that the novel tool is especially suitable for the assemblage of precise articles. When the torque exceeds a predetermined maximum value, slip is created between the magnetized discs so that it is not only possible to prevent excessive torque from being applied to the workpiece but also to prevent overloading of the driving means.

What is claimed is:

1. A tool device of the variable torque type comprising rotary driving means, a working tool, a clutch adapted to couple said working tool with said driving means, said clutch including a first magnetized disc driven by said rotary driving means and a second magnetized disc confronting said first magnetized disc and connected to said working tool, and means for varying the spacing between said first and second magnetized discs whereby to adjust the torque applied to said working tool.

2. The tool device according to claim 1 wherein a speed reducer is interposed between said second magnetized disc and said working tool.

3. The tool device according to claim 1 wherein said first and second magnetized discs are magnetized to have the same number of poles so that these discs slip relative with each other when a predetermined set value of the torque is exceeded.

4. The tool device according to claim 1 wherein said last mentioned means comprises a threaded shaft secured to said rotary driving means coaxially therewith, a nut mating said threaded shaft to axially move said rotary driving means thereby varying the spacing between said first and second magnetized discs, and a set screw for holding said threaded shaft in an adjusted position.

5. The tool device according to claim 1 wherein said rotary driving means and said clutch are coaxially contained in a cylindrical casing, said casing is provided with a longitudinal slot, and a pointer extending through said slot is secured to said rotary driving means to cooperate with a scale graduated on the peripheral surface of said casing for indicating the spacing between said first and second magnetized discs.

6. The tool device according to claim 1 wherein said rotary driving means and said clutch are coaxially contained in an elongated casing and indicator means responsive to the axial position of said rotary driving means for indicating the spacing between said first and second magnetized discs.

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