Dec. 16, 1958 R. M. VAUGHN 2,864,418

SCREW DRIVER

Filed Feb. 21, 1957

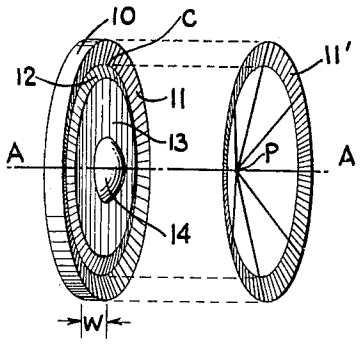


FIG. 1

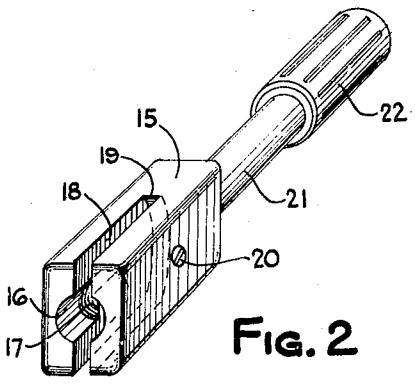


FIG. 2

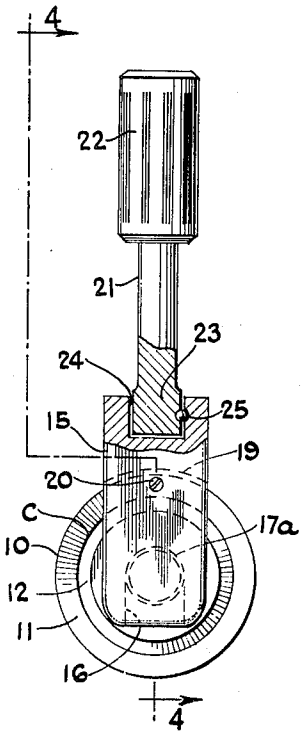


FIG. 3

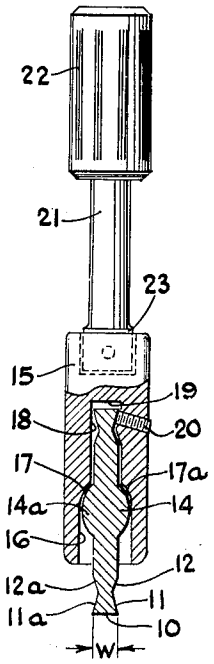


FIG. 4

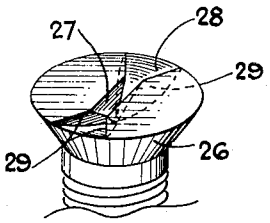


FIG. 5

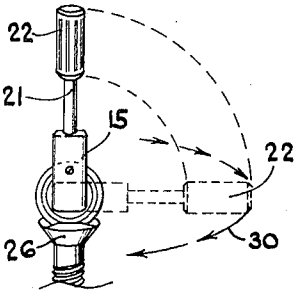


FIG. 6

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SCREW DRIVER

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3 Claims. (Cl. 145—50)

This invention relates generally to screw drivers, and more particularly to an improved screw driver by which an extremely high torque may be applied to slotted screw heads.

This invention constitutes a continuation in part of my co-pending U. S. application, Serial No. 525,007, filed July 18, 1955 and entitled Screw Driver, now U. S. Patent No. 2,808,087, which application is in turn a divisional application from my then co-pending application Serial No. 395,199, filed November 16, 1953, and entitled Method of Milling an Undercut Slot in a Screw Head, now U. S. Patent No. 2,745,120 dated May 15, 1956. This latter patent is a division of another of my applications, then co-pending Serial No. 104,333, filed July 11, 1949, and entitled Slotted Screw Head, now U. S. Patent No. 2,677,985, dated May 11, 1954.

The present continuation-in-part invention is primarily concerned with a screw driver for engaging the walls of a slot described in my above referred to issued Patent Numbers 2,745,120 and 2,677,985.

In the case of the ordinary type of slotted screw head incorporating straight slot walls to receive the screw driver, the driving end of the driver must ordinarily have a certain amount of clearance within the slot to enable it readily to be inserted. Accordingly, the driver has a substantial amount of angular play within the slot in its two directions of turning. This angular play results in point contacts between the driver and the walls of the screw slot while driving, the two opposite forward points or edges of the driver being in contact with corresponding surfaces of the slot. This type of point contact tends to wear down and round off the driving edges and points on the driver and results in a component of force tending to push the driver out of the slot.

Attempts have been made to overcome this usual tendency of a driver to be forced out of a slot while driving. One expedient, for example, has been to undercut the slot somewhat to overcome the effect of an outward component of force pushing the driver out. Such undercutting, however, has not overcome the undesired point contacts of the driver within the slot walls. An attempt has even been made to make the base of the slot arcuate so that the deepest part of the slot is at the center of the screw head and the shallowest is at the sides. This expedient, however, even when combined with ordinary undercutting at the center, does not provide more than point contact.

As fully set forth in the aforementioned U. S. patents, the disadvantages of the previous types of slotted screw heads have been overcome by the provision of a unique form of slot wherein contact between the driver and the slot walls is had over a substantial surface area of the slot walls, rather than merely at points or edges.

This novel slot has an arcuate base and diverges outwardly from the center. Furthermore, it is undercut at the sides where the driving torque is applied, though not at the center. As also set forth in the aforementioned patents, the slot can conveniently be made with a milling

cutter having diverging peripheral edges by twisting or turning the milling cutter about a diametric axis through a slight angle from either side of the longitudinal axis of the slot. It follows that in order to provide substantially full surface contact between such a slot and a screw driver to be used therewith, the peripheral driving edge of the driver should have opposite side surfaces of similar geometric configuration to the milling cutter employed in initially making the slot.

Accordingly, the present invention has as its primary object the provision of a screw driver in which full surface contact is attained between the slot walls and the opposite side driving surfaces of the driver.

Another important object is to provide a screw driver in the form of a driving disc having a three hundred sixty degree peripheral edge of given transverse width, any circumferential edge portion of which is adapted to fit into the slot in a screw head whereby after one portion of a peripheral driving edge has become worn or damaged, another circumferential portion may be employed by simply rotating the disc slightly.

Still another object is to provide a screw driver employing a driving disc of the above type including, in combination, a holding means having one end secured to the disc and the other end extending radially away therefrom whereby the holding means may be swung ninety degrees from a vertical position in the plane of the disc to a horizontal position whereby turning of a screw with very high torque may be effected by then rotating the entire holding means in a horizontal plane about a vertical diametric axis of the disc.

Still another object is to provide a holding means for a disc driver such as set forth above including a retaining head which may be interchanged whereby different diameter discs may be employed for different slot dimensions and in which different circumferential peripheral driving edges may be brought into position for easy cooperation with the slotted portion of a screw head.

These and many other objects and advantages of the present invention are attained by providing a driving portion terminating in a peripheral edge having opposite side surfaces which diverge from each other towards said edge, these side surfaces being conical surfaces of revolution. In a preferred embodiment, the driving portion is in the form of a driving disc having a three hundred sixty degree peripheral edge of given transverse width, the opposite side surfaces of the disc adjacent the peripheral edge diverging radially outwardly towards the edge from a circumferential line spaced radially inwardly from the edge to define the referred to conical surfaces of revolution. Thus, the transverse thickness of the disc at the circumferential line is less than the transverse width of the disc at its outer edge. An elongated holding means is arranged to co-operate with the disc and secure the disc at one end, the other end of the holding means extending radially away from the disc so that the disc may be rotated about one of its diametric axes after a peripheral portion of its edge has been inserted in the slot of the screw head.

The holding means itself includes a retaining head having an axial bore passing from one face thereof and terminating within the head. After this bore has been formed in the head, there is cut a slot passing into the same face and diametrically through the bore in a plane including the axis of the bore. This slot extends beyond the termination point of the bore so that this bore termination defines end shoulders. The slot is of a width sufficient to receive the transverse width of the driving disc such that its opposite sides are straddled by the portions of the retaining head separated by the slot. The disc itself is provided with a central hub on each side adapted to seat against the end shoulders defined by

the termination point of the bore within the retaining head, and a set screw or the like may be provided to bear against a peripheral portion of the disc to secure it within the slot. By this arrangement, the disc may be rotated within the retaining head by simply loosening the set screw and resetting the same whereby a new peripheral driving edge portion may be readily positioned for use.

Preferably, the holding means also includes an elongated shaft having a square block at one end adapted to be received in a square socket in the retaining head, the other end of the shaft terminating in a handle. The shaft and handle extend radially away from the disc such that the conventional type rotation of the handle will rotate the disc about one of its diametric axes. Alternatively, the handle may be swung downwardly in the plane of the disc through an angle of ninety degrees whereby a peripheral portion of the disc ninety degrees displaced from the original slot engaging peripheral portion will now engage the slot in the screw head. Swinging of the handle in a horizontal plane may then be effected to provide a greatly increased torque for driving the screw. The feature of a simple socket receiving connection for the retaining head with the shaft enables other retaining heads and discs of different dimensions to be readily used with the same shaft and handle.

A better understanding of the invention will be had by referring to the accompanying drawings, in which:

Figure 1 is a perspective view of the basic screw driving disc of the present invention including a schematic projected surface portion useful in explaining the configuration of the driving disc;

Figure 2 illustrates in perspective a preferred holding means for securing the driving disc of Figure 1;

Figure 3 is a side elevational view partly cut away showing the holding means and driving disc assembled for use;

Figure 4 is another elevational view of the driver, partly cut away, taken in the direction of the arrows 4—4 of Figure 3;

Figure 5 is a perspective view of a slotted screw head with which the screw driver of the present invention is employed; and,

Figure 6 is a schematic illustration of one manner of operating the screw driver of this invention.

Referring to Figure 1, there is illustrated a basic component of the screw driver in the form of a driving disc having a peripheral edge **10** extending completely around in a circle for three hundred sixty degrees. The transverse width of the edge **10** is indicated in Figure 1 at *w* and is dimensioned to be received within the slot of a screw head with which the driving disc is employed. As shown in Figure 1, the opposite side surfaces of the disc adjacent the peripheral edge **10**, such as the surface **11**, diverge radially outwardly towards the edge from a circumferential line indicated at *c* spaced radially inwardly from the peripheral edge, to define non-planar conical surfaces of revolution. From the circumferential line *c*, the side surfaces diverge to the normal thickness of the disc merging into flat face surfaces such as indicated at **13** at the center portion of which are provided hubs such as hub **14**. The transverse thickness of the disc at the circumferential line *c* is therefore less than the given transverse width *w*.

The reason why the side surfaces, such as the surface **11**, are defined as non-planar conical surfaces of revolution will be apparent by referring to the projected portion of this surface along the disc axis A—A of Figure 1 as indicated at **11'**. Note that if radially directed lines are drawn at an inclination defined by the diverging characteristic of the surface, such lines will intersect the A—A axis at the point P which constitutes the apex of a cone. The surface **11'** is thus a conical surface of revolution and is non-planar since the various radially directed lines converging at the point P do not lie in a single plane yet

constitute straight lines which lie on different portions at the surface **11'**.

As mentioned heretofore, the slot in the screw head with which the present invention is employed is generated by means of a milling cutter having diverging peripheral opposite side surfaces in the form of conical surfaces of revolution, as fully set forth in applicant's aforementioned Patent Number 2,745,120. Thus, by making the opposite side surfaces, such as the surface **11**, of the driving disc of the same geometric configuration, the side walls of the slot structure will be fully engaged by the driver.

Referring to Figure 2, a holding means for enabling convenient manual operation of the driving disc is illustrated as comprising a retaining head **15** having a bore **16** passing from one face into the head and terminating within the head as at **17**. The retaining head **15** is also provided with a slot passing from the same front face as the bore **16** and extending into the head in a plane including the axis of the bore to terminate at a point **19** beyond the termination point **17** of the bore. The retaining head **15** also includes a locking means in the form of a set screw **20** passing into a side face thereof to intersect the slot **18** adjacent its termination point **19**, as will become clearer with reference to Figures 3 and 4. The remaining portion of the holding means of Figure 2 comprises an elongated shaft **21** secured to the retaining end **15** at one end and terminating in a handle **22** at its other end.

Referring to Figure 3, the holding means of Figure 2 and driving disc of Figure 1 are shown in assembled side view. Preferably, the end of the elongated shaft **21** secured to the retaining head **15** terminates in a square block **23** receivable in a square socket **24** formed in the retaining head **15**. A conventional spring biased detent ball **25** may be provided in the block **23** for temporarily securing the shaft **21** with respect to the socket **24**. In Figure 3 the extent of the bore **16** is indicated in dotted lines.

In the broken away portion of the elevational view of Figure 4, the manner in which the driving disc is secured within the retaining head **15** is clearly illustrated. As shown, the termination portion of the bore **17** has a corresponding portion **17***a* against which the hub **14** seats. The other side hub **14***a* of the disc is shown seated against the bore termination part **17**. Also shown in Figure 4 are the opposite side surfaces **11***a* for the surface **11** and **12***a* for the surface **12**. It will be noted in Figure 4 that the set screw **20** passes into the side of the retaining head **15** at a slight angle such that the end of the set screw will be substantially flush with the diverging surface **11** adjacent the periphery of the disc. This set screw **20** will lock the disc against inadvertent rotation within the slot **18** of the retaining head. In the event, however, it is desired to provide a fresh peripheral driving portion for engagement with the slot in the screw, it is a simple matter to loosen the set screw **20** and rotate the disc a few degrees and then re-tighten the set screw.

In Figure 5 there is shown in perspective a slotted screw head **26** having a transverse slot **27** with slot edges diverging towards the periphery of the screw head. The bottom of the slot **27** is arcuate as indicated at **28**, the radius of curvature of the arc **28** corresponding to the radius of the driving disc portion of the screw driver. Also shown in Figure 5 are the undercut side walls **29** for the screw head. A more complete description of this slotted screw head is set forth in applicant's aforementioned Patent Number 2,677,985 wherein the undercut side walls **29** are defined as non-planar conical surfaces of revolution. It will be evident, therefore, that the opposite peripheral side surfaces **11** and **11***a* will engage in complete surface contact the undercut side walls **29** of the screw when the driving disc is inserted therein as indicated in Figure 6.

Referring to Figure 6, one manner of actually driving the screw head **26** is illustrated in dotted lines at **22'** wherein the elongated holding means constituting the

handle **22** and shaft **21** has been swung ninety degrees in the plane of the disc to a horizontal position whereby it may then be turned in a horizontal plane as indicated by the arrows **30** to enable a very high torque to be applied to the screw head.

The operation of the improved screw driver of this invention will be evident from the foregoing description with respect to the accompanying drawings. The width of the slot in the screw head corresponds to the transverse width *w* of the driving disc peripheral edge **10** such that any circumferential portion of the disc may be readily inserted in the slot **27** of the screw as shown in Figure 5. After a peripheral edge portion has been inserted in the slot, a slight rotation of the disc by rotating the handle **22** to turn the disc about one of its diametric axes will cause the non-planar conical surfaces of revolution **11** and **11***a* to engage the undercut sidewalls **29** in complete surface contact so that the edge of the driving disc cannot now be lifted out of the slot. As continued turning torque is applied to the driving disc about one of its diametric axes, the undercut design of the slot in co-operation with the diverging opposite side surfaces of the disc tend to cam the driving edge of the disc into even tighter engagement in the slot whereby very high torques may be applied to the slotted screw head without possibility of disengagement of the driving disc from the slot. By initially inserting a side portion of the peripheral portion of the disc in the slot with the driving handle **22** in the horizontal position **22** shown in Figure 6, or alternatively by simply rotating the disc edge within the slot ninety degrees to the position shown in dotted lines in Figure 6, and then rotating the entire handle assembly in a horizontal plane as described heretofore, an extremely high torque may be applied to the screw head.

It will also be clear that any circumferential portion of the entire periphery of the disc may be employed for engaging the slot and thus if some portions become worn, other new unused portions may be positioned by loosening the set screw as described heretofore and repositioning the disc in the retaining head **15**. Additionally, other sized discs with correspondingly designed retaining heads, all provided, however, with the same sized socket, may be readily substituted for use with the same shaft **21** and handle **22**.

Many modifications falling within the scope and spirit of the screw driver of this invention will readily occur to those skilled in the art. The invention is, therefore, not to be thought of as limited to the particular embodiment disclosed in the drawings for illustrative purposes.

What is claimed is:

1. A screw driver comprising, in combination: a driving disc having a three hundred and sixty degree peripheral edge of given transverse width, the opposite side surfaces of said disc adjacent said peripheral edge diverging radially outwardly towards said edge from a circumferential line spaced radially inwardly from said edge to define non-planar conical surfaces of revolution, the transverse thickness of said disc at said circumferential line being less than said given width; an elongated holding means including at one end a retaining head having an axial bore passing from one face thereof and terminating within said head, said head including a slot passing into said face diametrically through said bore in a plane including the axis of said bore, said slot terminating at a point in said head spaced beyond the termination of said bore, whereby the termination point of said bore defines end shoulders, said slot having a width sufficient to receive said transverse width of said driving disc; said driving disc including hub portions extending transversely from the opposite center surface portions of said disc, adapted to abut against said end shoulders when said disc is positioned in said slot; and set screw means passing transversely into a side face of said retaining head to intersect said slot adjacent its point of termination and bear against a side of said disc to retain said disc in said head, the other end of said holding means extending radially away from said disc, whereby said disc may be rotated about one of its diametric axes.

2. A screw driver according to claim 1, in which said retaining head includes a square socket on its face opposite said one face, said holding means including an elongated shaft terminating at one end in a square block receivable in said socket, and at its other end in a handle.

3. A screw driver comprising, in combination: a driving disc having a three hundred sixty degree peripheral edge of given constant transverse width, the opposite side surfaces of said disc adjacent said peripheral edge diverging radially outwardly towards said edge from a circumferential line spaced radially inwardly from said edge to define non-planar conical surfaces of revolution, the transverse thickness of said disc at said circumferential line being less than said given transverse width; an elongated holding means including at one end a retaining head, said retaining head having a slot extending in a plane including the longitudinal axis of said elongated holding means, said slot terminating within said head and having a width sufficient to receive the transverse width of said driving disc; and set screw means passing transversely into a side face of said retaining head to intersect said slot adjacent its point of termination and bear against a side of said disc between said circumferential line and said edge to retain said disc in said head.

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