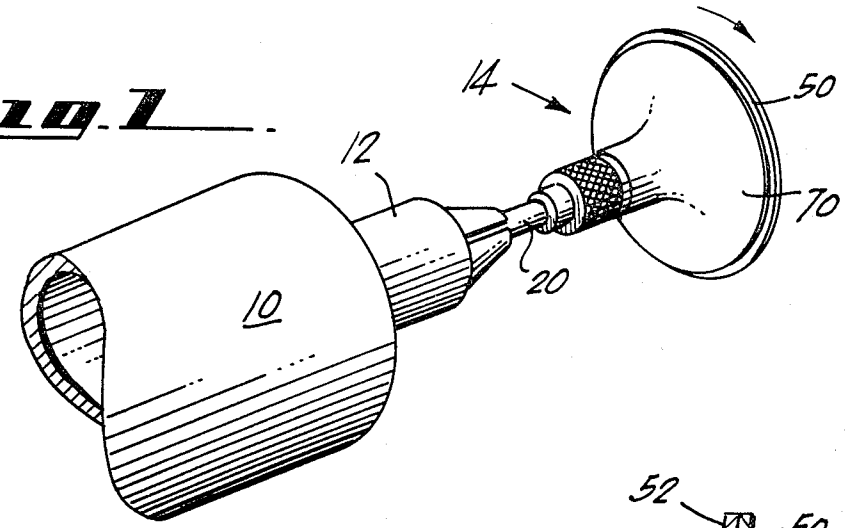
Sept. 1, 1970 J. H. LEE 3,526,065

ROTARY FINISHING TOOL

Filed Sept. 26, 1967 2 Sheets-Sheet 1

Fig. 1



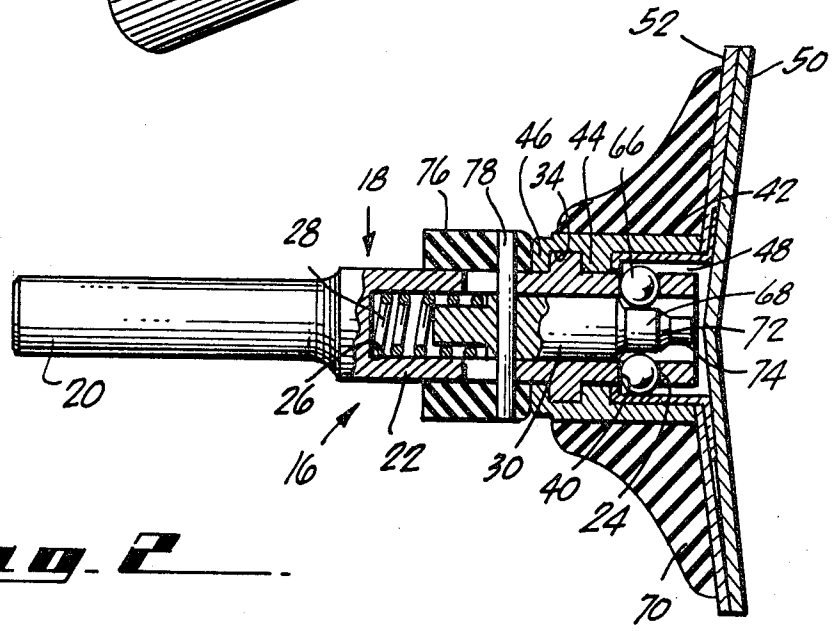


Fig. 2

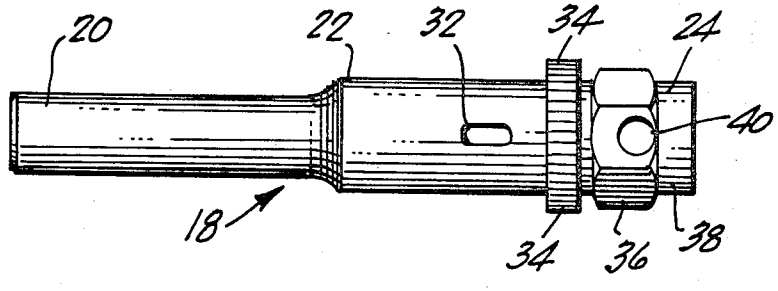


Fig. 3

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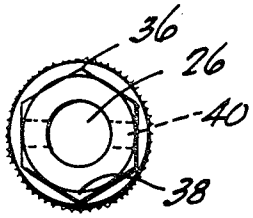

Fig. 4

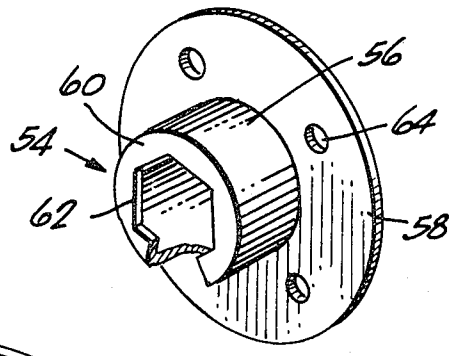

Fig. 6

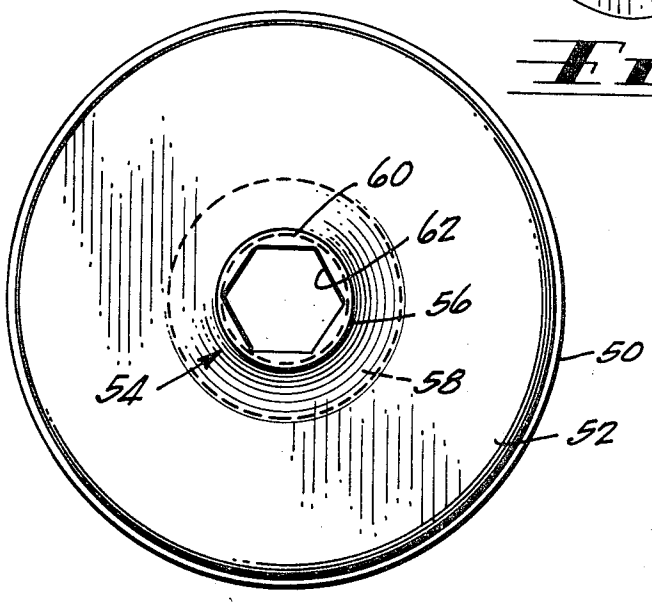

Fig. 5

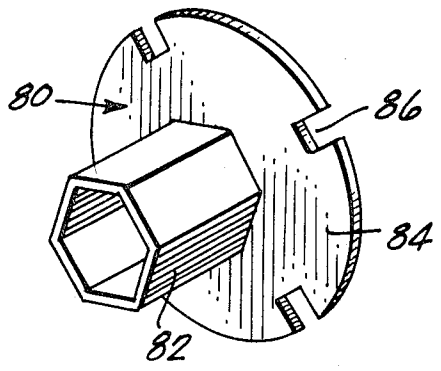

Fig. 7

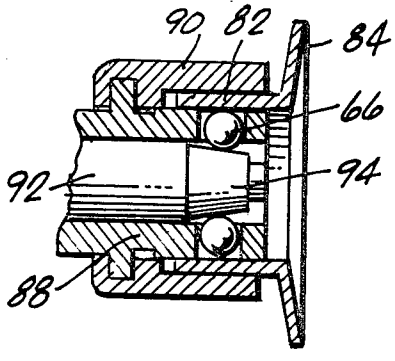

Fig. 8

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3,526,065

ROTARY FINISHING TOOL

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Int. Cl. B24d 13/14
U.S. Cl. 51—358 5 Claims

ABSTRACT OF THE DISCLOSURE

Rotary disk tool for sanding, polishing etc. Rigid metallic driving hub has shank at one end to attach power source and peripheral socket at other end. Disk has connector shell centered on rear face. Shell fits into peripheral socket and has free end shaped to be driven by inner or outer wall of socket. In preferred form, has inward flange of hexagon shape to fit and be driven by center post of socket. Detent balls move radially outward of post to block disengagement of shell and "fly-off." Safety lock is not affected by driving load.

BACKGROUND OF THE INVENTION

This invention lies in the field of rotary finishing tools such as disk type sanders, buffers and polishers, and relates to structure for releasable connection of disposable finishing units to permanent re-usable rotary driving units. It is directed more particularly to driving and driven units of maximum simplicity in which the driving connection is positive in both acceleration and deceleration modes to eliminate any initial "fly-off" tendency, and an independent safety lock is provided which positively prevents inadvertent disengagement and is not affected in any way by driving loads. While the problems encountered are of the same general nature with all types of rotary finishing tools, they are generally most severe with sanding or abrasive disks because of the severe loading in use. Thus, although the description will make reference primarily to rotary abrasive tools, it will be understood that the problems and solutions are basically the same in all cases.

There are various types of rotary abrasive tools presently in use and they all perform their primary functions in a very satisfactory manner. However, they all have disadvantages which are traceable to the type of connection between the permanent driving unit and the disposable abrasive unit.

In one type, the abrasive disk is bonded to the driving pad with a cement which releases when the disk is deliberately peeled away beginning at one edge, or when a suitable solvent is applied. This is a rather inefficient arrangement because it involves a great deal of "down time" for applying and removing each disk when replacement is required. Moreover, the heat of friction often causes the bonding agent to release, and the centrifugal force resulting from the high rotational speed will cause the disk to fly in any direction, often causing injury to personnel and damage to structural elements.

In another type, the disk is provided with slots, holes, or the like at its center for attachment to fingers, hooks, or bosses on the driver. When this type is subjected to conditions of extreme flexing or high torque resistance, the disk frequently fails or tears in the hub area, and flies off with great force to cause injury or damage.

In a third type, the disk has a plastic or flexible metal connector bonded to its rear face and configured to snap into a mating receptacle in the driving pad or hub. The complementary portions serve to drive the disk in rotation and to hold it in the hub by friction. When a large area of the disk is in engagement with a surface being finished, the connection is generally satisfactory. However, it is often necessary to apply high pressure at the extreme

margin of the disk, as in sanding inside radiused surfaces. In such case, the rearward flexing of the disk margin produces tension at the center and the connector frequently snaps out of the hub socket, with the usual dangerous consequences.

In still another type, the disk has a connector portion which may be a part of the disk backing or an attached piece. The connector and the driving hub have interengaging hooks and slots which may be spring loaded to some extent. In any case, they are held in engagement primarily by the rotational torque of the driver. When the power source is turned off, the driver decelerates rapidly but the inertia of the disk tends to cause it to continue to rotate at high speed. The result is that the hooks become disengaged from the slots and the disk flies off in the same way as in the other forms mentioned above.

SUMMARY OF THE INVENTION

The present invention provides a very simple, durable, and completely reliable rotary driver and rotary driven disk together with connecting means, which solve the problems mentioned above. Moreover, it provides for instant and effortless connection and release of the abrasive disk when it is necessary to intentionally make a change.

Generally stated, the tool includes a rotary driver and a rotary abrasive or other finishing disk, the driver having a socket to receive a connector secured to the rear side or face of the disk, and further provided with means to positively lock the parts against inadvertent relase. The driver is similar to prior devices to the extent that it has a central hub member or mandrel of rigid metallic material such as steel having a shank at one end to be gripped by a drill motor or other power source and having a socket at the other end. Surrounding the socket end of the hub is a pressure pad of resilient material such as rubber which tapers to a fairly thin and yieldable annular margin to back up the margin of the abrasive disk.

The center post of the hub serves as a first socket portion, and a sleeve surrounding and spaced from the post serves as a second socket portion. Between them they define an open ended peripheral socket having a closed bottom or inner end. The abrasive disk is provided with a connector in the form of a rigid metallic hollow shell coaxially secured to the rear face of the disk. In the preferred form the free end of the shell is formed with an inward flange defining a hexagon or other non-circular opening. For assembly the free end of the shell is slipped axially into the socket, and the flange opening engages a similar external formation on the post to form a driving connection.

To accomplish positive but releasable locking, the center post is hollow and carries detents in its wall, preferably steel balls, which are adapted to move radially outward in their mounting openings to effectively enelarge the diameter or lateral extent of the post and block removal of the shell by their interference relation. The detents are extended by engagement with a plunger which moves axially in the hollow post in response to spring pressure. The detents, and hence the shell, are released by fingertip movement of an external release collar against the spring action. With this arrangement the locking function is entirely independent of the driving function.

The connector shell may be modified to have a hexagonal or other non-circular cross section throughout part or all of its length, and the first or second socket portions or both may have a similar configuration throughout part or all of their lengths to serve as driving connections. If the shell is formed without an inward flange the detents may be forced into the radial high pressure engagement with the inner wall of the shell by a wedge formation on the plunger. In any of these modifications, the locking function is independent of the driving func-

tion. Therefore, it is not affected in any way by application or cessation of torque loads. Since the lock is positive it readily resists all tension type separating forces such as those resulting from flexing pressure on the disk margin. At the same time it is instantly releasable upon withdrawal of the locking plunger.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other advantages and features of novelty will become apparent as the description proceeds in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view showing the tool of the invention mounted in a drill motor or other source of power;

FIG. 2 is an elevational view, partly in section, of the rotary driver with the rotary finishing disk mounted in place, and the means for locking the parts in assembled relation;

FIG. 3 is a side elevational view of the mandrel portion of the driving hub;

FIG. 4 is an end elevational view of the mandrel;

FIG. 5 is a plan view looking at the rear face of the finishing disk with its connector;

FIG. 6 is a perspective view, partly broken away, of the preferred form of the connector;

FIG. 7 is a perspective view of a modified form of connector; and

FIG. 8 is a partial sectional view of a modified form of driving hub and lock means with a connector mounted in place.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The manner of use of the rotary finishing tool is illustrated in FIG. 1, in which a power tool **20** is provided with a rotatable chuck **12**. The finishing tool **14** is mounted in chuck **12** by its drive shaft and rotates as a unit, usually in a clockwise direction as indicated.

The sectional view in FIG. 2 shows all of the elements making up the total assembly ready for attachment to the power tool as in FIG. 1. The driving hub **16** includes a rigid metallic mandrel **18**, rotatable about its central longitudinal axis, a first end of which is in the form of a solid shank **20** adapted for mounting in chuck **12**. The central portion **22** and second end portion **24** are hollow and define a longitudinal passage **26** which houses a compression spring **28** and a slidable plunger **30** urged by the spring toward the open second end **24**.

The mandrel is shown separately in FIGS. 3 and 4, where it will be seen that the central cylindrical portion **22** is pierced by a pair of radial access holes **32** for a purpose to be described. The second end portion **22** is formed with serrated annular boss or shoulder **34** for positive connection to a second part of the driving hub. The intermediate part of end portion **24** is provided with a hexagonal formation **36** which serves to drive the finishing disk. The hexagon shape is preferred but other non-circular shapes may be used if desired. The free end of portion **24** is formed as a cylinder **38** of the same size or slightly smaller than the distance across flats of hexagon **36**. This cylinder serves as a guide for mounting the finishing disk. A pair of diametrally opposed radial openings **40** are formed in the hexagon section to slidably receive detent means.

Returning to FIG. 2, the mandrel requires an additional member to complete a driving hub having means to receive the connector of a finishing disk. For this purpose a sleeve **42** is provided in the form of a cylinder having an inwardly extending annular shoulder **44** to butt against shoulder **34** and space the sleeve radially from end **24**. The inner end of the sleeve is force fitted over serrated shoulder **34** to lock it against relative rotation and is swaged inwardly at **46** to lock the two parts in assembled relation.

In the relation described, the end **24** of the mandrel constitutes a hollow central post or first socket portion and the forward free end of sleeve **42** constitutes a second socket portion radially spaced from the first portion to define between them a peripheral socket **48** which is open at the free ends of members **24** and **42** and closed at its inner end by shoulder **44**. The outer wall of the socket, formed by sleeve **42**, is cylindrical and the inner end of the inner wall is hexagonal or non-circular as defined by formation **36**. A conventional pressure pad **70** of resilient material such as rubber is bonded to sleeve **42** and yieldingly supports the abrasive disk when it is pressed against the work piece.

The preferred form of finishing disk assembly is shown in FIGS. 2, 5, and 6, where it is seen to comprise a sanding disk **50**, a backing **52**, and a connector **54**. The latter comprises a cylindrical shell **56** having an outwardly directed flange **58** at a first end and an inwardly directed flange **60** at its second, free end. Flange **60** is pierced to provide an opening **62** of hexagon shape to slide over and match the formation **36** to provide a rotary driving engagement. While the two matching forms are preferably hexagonal, they may be any other suitable non-circular shape if desired.

To make up the disk assembly, connector **54** is centered precisely on the back of abrasive disk **50** with flange **58** in facewise relation after a suitable adhesive has been applied to the back of the disk. Backing **52** is apertured to clear shell **56** and coated with cement, after which it is placed in overlying relation with flange **58** and disk **50** and the cement is cured to bond them together permanently. Openings **64** may be formed in flange **58** to be filled with cement which will serve as rotary driving keys. Since the assembly is a "throw-away" item there is no need to use cement which will allow peeling and might separate under the heat of friction. Instead, any one of many suitable cements is used which will not deteriorate at any temperature encountered in use.

To assemble the parts of the tool, connector **54** is brought into juxtaposition with the center of the driving hub and is guided into socket **48** by engagement of the cylindrical end **38** of the hollow post **24** within hexagonal aperture **62**. The connector may then be slipped axially into full engagement with the socket with slight angular adjustment to match the hexagonal parts **36** and **62**. The unit is now in the relation shown in FIG. 2, with the driving elements in engagement and with pressure pad **70** in contact with the back of the disk. Any rotary movement of the mandrel will be applied directly to the disk through the connector and all parts will rotate as a unit.

It will be noted that since flange **60** is directed radially inwardly there is a substantial peripheral gap between hollow post **24** and the inner wall of shell **56**. In order to lock the disk in the driver, detents which are preferably steel balls **66** are mounted for radial movement in openings **40** in the wall of the hollow post. The forward free end of plunger **30** is formed with a first stepped-down cylindrical section **68**, a cone section **72** and a further stepped-down cylindrical section **74**.

When the plunger is fully retracted against spring **28**, section **74** is in radial alignment with balls **66**, allowing them to retract well into the post. As the plunger is extended, the cone section **72** moves them radially out into the gap and cylindrical section **68** holds them positively in this position where they increase the effective lateral dimension of the post and are in interference relation with the shell. Since they block outward movement of flange **60** they serve as a positive lock to prevent inadvertent disengagement of the finishing disk from the driver in the absence of absolute failure of some part. When a change is called for, finger tip release is accomplished by rearward sliding movement of collar **76** which is connected to plunger **30** by pin **78** which is axially movable in radial access holes **32**.

A modified form of connector **80** is shown in FIG. 7, where the shell **82** is formed with a hexagonal cross section and has no inward flange at its inner free end. The outwardly extending flange **84** which is to be bonded to the disk is provided with cutouts or openings **86** to receive cement serving as rotary driving keys.

The hollow center post **88** and sleeve **90** of FIG. 8 are basically similar to the corresponding parts of the driving hub of FIG. 2 but are modified to receive connector **80**. The inner wall of sleevee **90** is preferably hexagonal to snugly receive shell **82** in rotary driving engagement. The outer wall of post **88** may likewise be hexagonal for driving engagement but may be cylindrical if desired. Balls **66** move radially in openings **92** as in the previous embodiment. However, since shell **82** is not provided with an inward flange at its free end, the balls must be pressed forcefully into engagement with the inner wall of the shell to produce an interference relation. To this end, plunger **92** is provided at its free end with a cone surface **94** having a slight slope to give a very high mechanical advantage. When the plunger moves forward the balls are pressed outward with a very high force and their very small area of contact results in a very high unit pressure and binding engagement. The net result is that the locking effect is positive, and inadvertent release is impossible. Those parts of the driver not shown are the same as those of FIG. 2.

Either of the connectors of FIGS. 6 and 7 may be provided with cutouts **64** or **86** or other suitable forms or may have no cutouts whatever in some cases. Shell **56** may be made hexagonal, as shell **82**, and the latter may be formed with holes or depressions in its walls to receive balls **66**, which would provide an even more positive lock. Also, the inner wall of sleeve **42** may be hexagonal the same as sleeve **90**, and post **24** may be hexagonal throughout its length.

It will be apparent to those skilled in the art that various changes may be made in the device as disclosed without departing from the spirit of the invention, and it is intended that all such changes shall be embraced within the scope of the following claims.

I claim:

1. A rotary finishing tool comprising: a rotary driver adapted for connection to a rotatable power source, and a rotary finishing disk adapted to be releasably attached to said driver; said driver including a first rigid metallic socket portion having a central longitudinally extending axis of rotation, and a second rigid metallic socket portion coaxial with and surrounding said first portion in spaced relation to define between them an axially directed peripheral socket; said disk having a first face adapted for rubbing contact with a surface to be finished; and a connector in the form of a rigid metallic hollow shell concentric with the disk and having a first end permanently secured to the second face of the disk and a second free end; said shell being proportioned to slide axially into said socket; at least a portion of said shell being non-circular and at least one of said socket portions having a corresponding formation to provide a rotary driving connection between the driver and the disk; said first socket portion having at least one detent means movable radially outwardly into interference relation with said shell to prevent axial movement of said shell and disengagement from the socket; and means carried by said first socket member and movable in a first direction to move said detent means to interference position and hold it in such position, and movable in a second direction to release said detent means for disengagement of said shell from said socket.

2. A tool as claimed in claim **1**; said first socket portion being in the form of a hollow post defining an axial passage; and a plunger slidable in said passage; one end of said plunger being formed to urge the detent means radially outward in response to axial movement of the plunger.

3. A tool as claimed in claim **1**; the free end of said shell being formed with a radially inwardly directed flange to surround and engage said first socket portion; said detent means in its interference position lying immovably in the path of movement of said flange to prevent disengagement of said shell from said socket.

4. A tool as claimed in claim **1**; the movable means carried by said first socket member being adapted to force the detent means radially outward into high pressure binding engagement with the inner wall of said shell to prevent axial movement of said shell in said socket.

5. A tool as claimed in claim **1**; the free end of said shell being formed with a radially inwardly directed flange to surround and engage said first socket portion; the inner margin of said flange being non-circular; and at least the inner end of said first socket portion having a corresponding formation to provide a rotary driving connection between said shell and said first socket portion.

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