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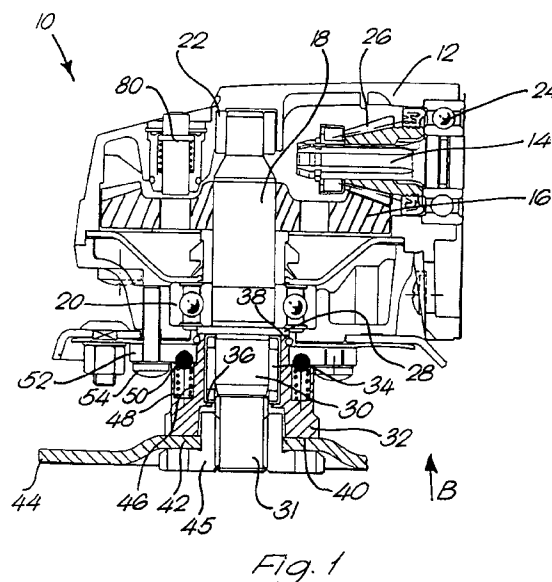
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(54) **A device having a flange lock.**

(57) A device (10) comprises a housing (12), a shaft (18) rotatably mounted in the housing (12), a sleeve (32) around the shaft (18), and a nut (45) for threaded engagement with an end (31) of the shaft (18) to define with the sleeve (32) a flange lock. Drive means (14, 16) rotates the shaft (18). The sleeve (32) is automatically prevented from rotating with the shaft (18) when the drive means (14, 16) is reversed, such that the nut (45) unscrews from the end (31) of the shaft (19) to release the flange lock. The sleeve (32) is automatically prevented from rotating with the shaft (18) by virtue of a ratchet plate (42) fixed to the housing (12).



This invention relates to devices, such as angle grinders, which incorporate a drive means and a flange lock for receiving a flange of an article to be driven.

Angle grinders, which require a flange lock to be released manually whenever an abrasive disc is to be replaced, are well known. Such angle grinders have either in-built motors or facilities for attachment to an external drive. The drive is transferred to the abrasive disc via a rotatable shaft. During release of the flange lock at the end of the shaft, a manually operated abutment is sometimes employed to prevent rotation of the shaft and hence the abrasive disc. This facilitates unscrewing of a nut, at the end of the shaft, which forms part of the flange lock and holds the abrasive disc on the end of the shaft.

Although manual release of a flange lock is acceptable, it is not ideal. Hence, angle grinders have been developed which use the powered drive of the angle grinder to assist in releasing the flange lock. Such an angle grinder is described in EP-A-0235598. In this prior art device, an abrasive disc is clamped between a nut and a sleeve mounted on a spindle of the angle grinder. When it is desired to undo the nut, a knob must be depressed which serves to lock the spindle with respect of the sleeve. Then, when the motor acts to drive the crown wheel, and hence the sleeve, the nut is unscrewed from the threaded portion of the spindle, thereby facilitating removal and replacement of the abrasive disc.

Although the angle grinder of EP-A-0235598 is an improvement over the more basic prior art angle grinders, the present invention provides a device which automatically releases the flange lock without the need for depressing a knob, as in EP-A-0235598. Moreover, unless the motor has sufficient torque to overcome the resistance to unscrewing of the nut from a standing start, the nut cannot be undone. The present invention further provides a novel way of improving release of the flange lock simply by controlling the nature of the drive from the drive means.

With the foregoing in mind, a device according to the present invention comprises a housing, a shaft rotatably mounted in the housing, a sleeve around the shaft, a nut for threaded engagement with an end of the shaft to define with the sleeve a flange lock and drive means for rotating the shaft, wherein the sleeve is automatically prevented from rotating with the shaft when the drive means is reversed such that the nut unscrews from the end of the shaft to release the flange lock.

Although, as will be appreciated, the present invention is particularly applicable to angle grinders, any other appropriate device, incorporating a flange lock, may also take advantage of the invention.

The sleeve preferably includes means biased into contact with the housing to prevent rotation of the sleeve when the drive means is reversed.

The biased means may comprise ball bearings urged towards the housing by springs in blind bores in the sleeve. Other alternative arrangements for achieving the desired result can, of course, also be used.

The housing preferably includes a ratchet or bearing plate against which the sleeve bears, the bearing plate being shaped to allow rotation of the sleeve when the shaft is being driven in the forward direction and to act as an abutment for the sleeve when the drive means is reversed.

The bearing plate may include recesses which each gradually deepen towards an end wall, which acts as the abutment.

The bearing plate may include four recesses, each recess being tear-shaped and lying on the circumference of a circle having its centre on the axis of the shaft.

The drive means preferably supplies a pulsed drive whenever it is reversed. Furthermore, when the flange lock has been released, the drive means can preferably be locked to prevent rotation of the shaft, thereby facilitating manual removal of the nut from the shaft.

The flange lock is preferably used to grip an abrasive disc to enable the device to be used as an angle grinder.

According to another aspect of the present invention, there is provided a device comprising a housing, a shaft rotatably mounted in the housing, a sleeve around the shaft, a nut for engaging an end of the shaft to define with the sleeve a flange lock and drive means for rotating the shaft or the sleeve during normal operation of the device, wherein when the drive means is reversed to loosen the nut on the shaft the drive means provides a pulsed drive to facilitate release of the nut. The use of a pulsed drive provides a marked improvement in efficiency of release of the flange lock.

Preferably the drive means drives the shaft and the sleeve either follows the shaft, during normal operation of the device, or is automatically held by interaction with the housing when the drive means is reversed.

A specific embodiment of the present invention is now described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a sectional side view of an angle grinder according to the present invention;

Figures 2a and 2b are a sectional side view and a plan view of a sleeve incorporated in the angle grinder of Figure 1;

Figures 3a and 3b are a sectional side view and a plan view of a bearing plate incorporated in the angle grinder of Figure 1;

Figure 3c is a bottom surface profile of each groove, or recess, in the surface of the bearing plate of Figures 3a and 3b, and

Figure 4 is a circuit diagram of electrical arrange-

ments to put the present invention into effect.

With reference to the drawings, an angle grinder (10) has a housing (12) mounting a drive pinion (14). A crown wheel (16) is fixed to a stub shaft (18), rotatably supported in the housing (12) between a bearing (20) and a bush (22).

The drive pinion (14) is journaled in bearing (24) in the housing (12), and is rotated by a motor (not shown). The pinion has a pinion gear (26) drivingly fixed thereon which meshes with, and drives, the crown wheel (16).

The stub shaft (18) has a drive flange (28), a bearing surface (30) and a threaded end (31). Mounted on the bearing surface (30) is a sleeve (32), carried on bearing (34). An internal flange (36) of the sleeve (32) supports the bearing (34) against drive flange (28), while a rim (38) of the sleeve (32) bears against the drive flange (28). Sleeve (32) has an annular surface (40) adapted to receive a flange (42) of an abrasive disc (44). A nut (45) is adapted to be screwed onto the threaded end (31) of the shaft (18) and to clamp flange (42) against surface (40).

The sleeve (32) has two blind bores (46), lying parallel to the axis of the stub shaft (18) and each receiving a spring (48) and a ball (50). The spring (48) urges the ball (50) out of bore (46) against a ratchet, or bearing, plate (52) secured to the housing (12) by screws (54).

Figures 3a and 3b show the ratchet plate (52) which has four tear-shaped circumferential grooves (56) disposed on its surface. Figure 3c shows the bottom surface profile of each groove (56). This comprises a long ramp (58) and a substantially vertical end wall (60). The line (62) of the bottom profiles of the grooves (56) lies on a circle whose radius equals the radial distance of the axis of each bore (46) from the axis of the sleeve (32). Thus, the balls (50) urged against the ratchet plate (52) enter the grooves (56). In this regard, it is to be noted that the grooves (56), around their entire arc on the line (62), have a section which is part circular of radius equal to, or slightly greater than, the radius of the balls (50).

It will be understood that rotation of the motor rotates drive pinion (14, 26) to rotate crown wheel (16) and stub shaft (18). The stub shaft (18) rotates the sleeve (32) and the nut (45), and hence the abrasive disc (44, 42) clamped therebetween. The bearing (34) is inoperative. The direction of rotation is such that any slackness of the nut (45) is tightened by the torque applied by the stub shaft (18). That is to say, looking in the direction of the arrow B in Figure 1 the shaft (18) and sleeve (32) rotate in the direction of the arrow A of Figure 3b (Figure 3b is a view in the direction of Arrow B in Figure 1).

Thus, it will be apparent that the balls (50) lying in the grooves (56) of the ratchet plate (52) will ride up a ramp (58) before dropping into the next groove over end wall (60). They offer little resistance to rota-

tion of the stub shaft (18) and, indeed, at the speeds at which angle grinders operate, of the order of 10,000 rpm, the balls (50) do not drop into the grooves (56) at all, but ride over them.

When the motor and shaft (18) are stopped and it is desired to change the disc (44), the circuit shown in Figure 4 comes into operation. Normally, power supply (90) passes through field coils (92) of the motor before entering double pole switch (94). When in the ON position (OFF position shown) power is then directed immediately to the armature (96) of the motor via wires (98). Power to pole A of the switch (94) is directed to brush (a) of armature (96) and likewise for pole B. However, when the tool is switched OFF, wires (98) are isolated and instead, pole B of the switch (94) is connected to brush (a) of armature (96) and pole A is directed to brush (b) through push switch (100) and control circuit (102). When push switch (100) is operated, circuit (102) is energised to produce current pulses to brush (b) of armature (96) which, in view of the inverted connection of brushes (a, b) or armature (96) and non-inverted connection of field coils (92), result in the armature (96) being pulsed in the reverse direction to normal operation when switch (94) is in its ON position. That is to say, brief torques of limited duration are applied in a direction opposite to the Arrow A. The balls (50) drop into two opposite grooves (56) and come up against the end walls (60) over which there is no component of force to lift them. Consequently they become trapped between that wall (60) and a front wall of the bores (46) and effectively prevent rotation of the sleeve (32) with respect to the ratchet plate (52). The sleeve (32) has a large surface (40) in contact with the flange (42) and is tight up against the flange (42) by virtue of the clamping force exerted by the nut (45). Thus the disc (44) can likewise not rotate. By the same token, the nut (45) is also prevented from rotation. However, the sleeve (32) has the narrow rim (38) in contact with the drive flange (28) of the shaft (18). The bearing (34) allows free rotation of the shaft (18) with respect to the sleeve (32). The tightness of the threaded contact between the shaft end (31) and the nut (45) obviously resists relative rotation. However, neither the slim contact between the rim (38) and the drive flange (28) nor the thread contact between the shaft end (31) and the nut (45) are sufficient entirely to prevent rotation of the shaft (18) relative to the nut (45), particularly under the pulsing which is imposed by the motor, so that the threaded end (31) gradually, but increasingly quickly, unscrews itself from the nut (45).

It is feasible that, once the braking effect on the nut (45) is lost through its loosening with respect to the disc (44), the nut (45) may spin with the shaft (18). However the pulsing of the motor should overcome this, but, if not, a conventional push operated locking button (80) can be depressed to engage the crown wheel (16) and prevent rotation of the shaft (18). The

nut (45) can then be manually removed.

It will be of course understood that the present invention has been described above purely by way of example, and that modifications of details can be made within the scope of the invention.

Claims

1. A device comprising a housing, a shaft rotatably mounted in the housing, a sleeve around the shaft, a nut for threaded engagement with an end of the shaft to define with the sleeve a flange lock and drive means for rotating the shaft, wherein the sleeve is automatically prevented from rotating with the shaft when the drive means is reversed such that the nut unscrews from the end of the shaft to release the flange lock. 10
2. A device as claimed in Claim 1, wherein the sleeve includes means biased into contact with the housing to prevent rotation of the sleeve when the drive means is reversed. 15
3. A device as claimed in Claim 2, wherein the biased means comprise balls urged towards the housing by springs in blind bores of the sleeve. 20
4. A device as claimed in any preceding claim, wherein the housing includes a ratchet plate against which the sleeve bears, the ratchet plate being shaped to allow rotation of the sleeve when the shaft is being driven in the forward direction and to act as an abutment for the sleeve when the drive means is reversed. 25
5. A device as claimed in Claim 4, wherein the ratchet plate includes recesses which each gradually deepen towards an end wall, which acts as the abutment. 30
6. A device as claimed in Claim 5, wherein the ratchet plate includes four recesses, each recess being tear-shaped and lying on the circumference of a circle having its centre on the axis of the shaft. 35
7. A device as claimed in any preceding claim, wherein the drive means provides a pulsed drive whenever it is reversed. 40
8. A device as claimed in any preceding claim, wherein the drive means can be locked to prevent rotation of the shaft when the nut is to be manually unscrewed. 45
9. A device as claimed in any preceding claim, which is an angle grinder, the flange lock being used to grip an abrasive disc. 50

10. A device comprising a housing, a shaft rotatably mounted in the housing, a sleeve around the shaft, a nut for engaging an end of the shaft to define with the sleeve a flange lock and drive means for rotating the shaft or the sleeve during normal operation of the device, wherein when the drive means is reversed to loosen the nut on the shaft the drive means provides a pulsed drive to facilitate release of the nut. 55

11. A device as claimed in Claim 10, wherein the drive means drives the shaft, and the sleeve either follows the shaft, during normal operation of the device, or is automatically held by interaction with the housing when the drive means is reversed.

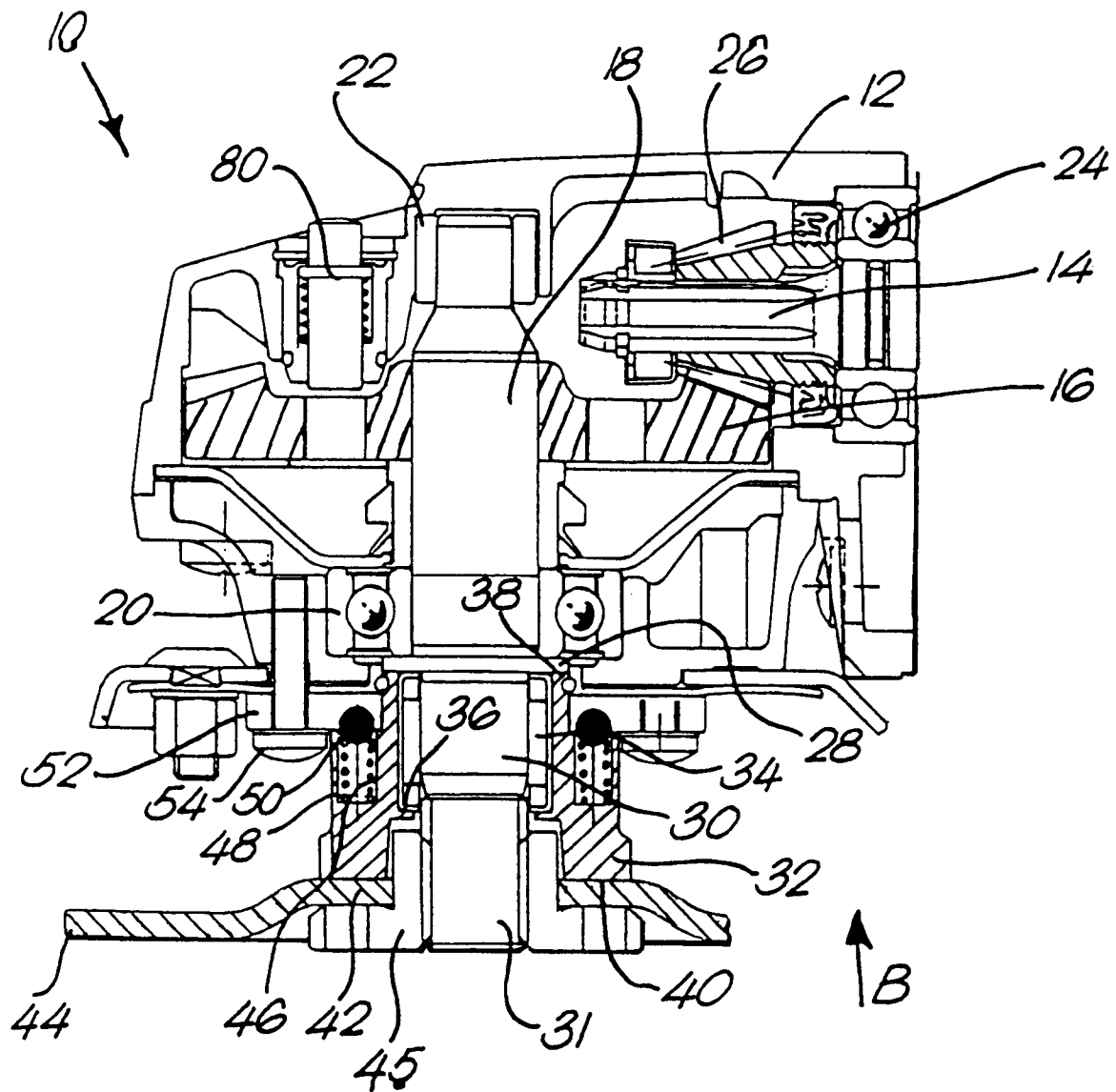


Fig. 1

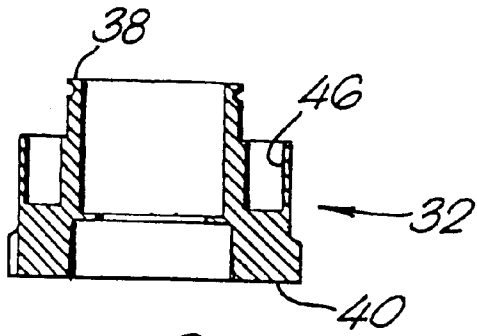


Fig. 2a

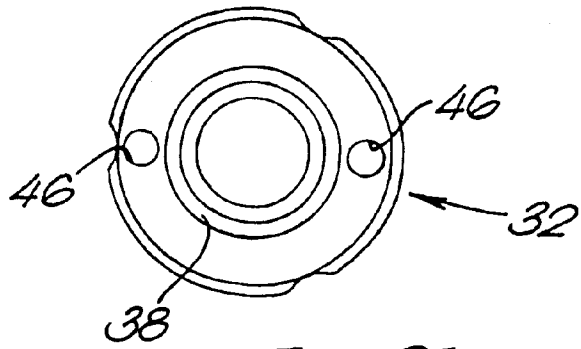


Fig. 2b

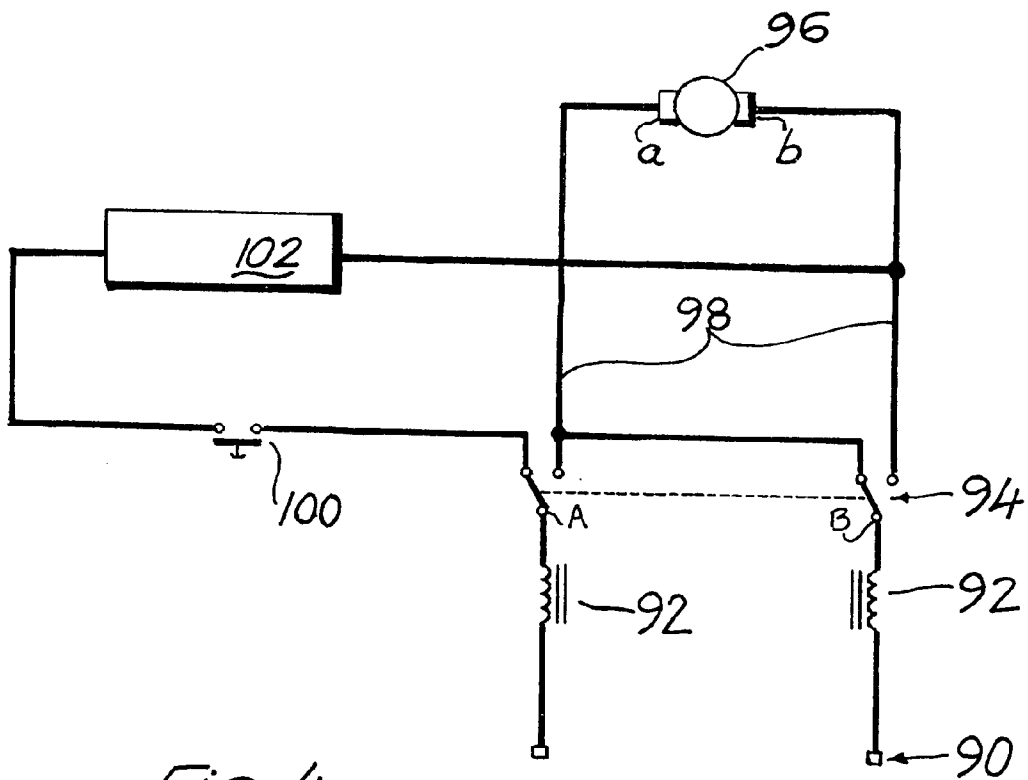


Fig. 4

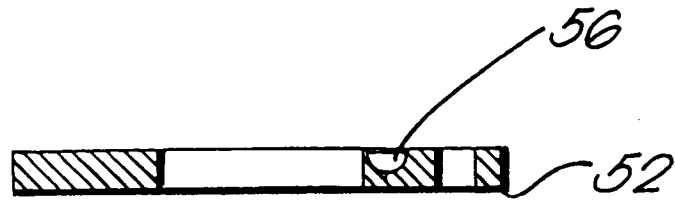


Fig. 3a

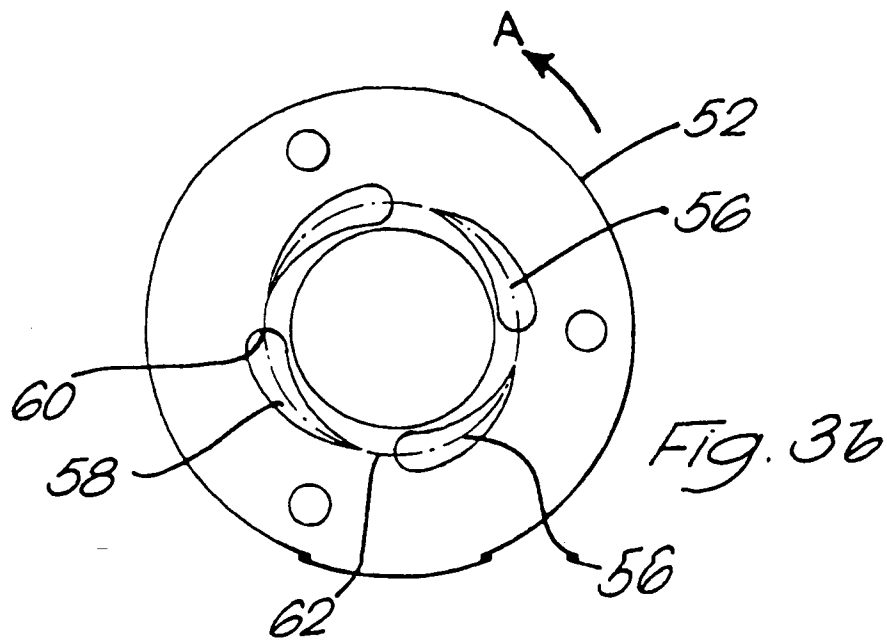


Fig. 3b



Fig. 3c



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 30 1502

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
D,A	EP-A-0 235 598 (METABOWERKE GMBH & CO.) * claims; figures * -----	1,10	B24B45/00 B24B23/02
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			B24B B25F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 30 June 1994	Examiner Eschbach, D
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