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(54) **ARBOR ARRANGEMENT**

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(57) **ABSTRACT**

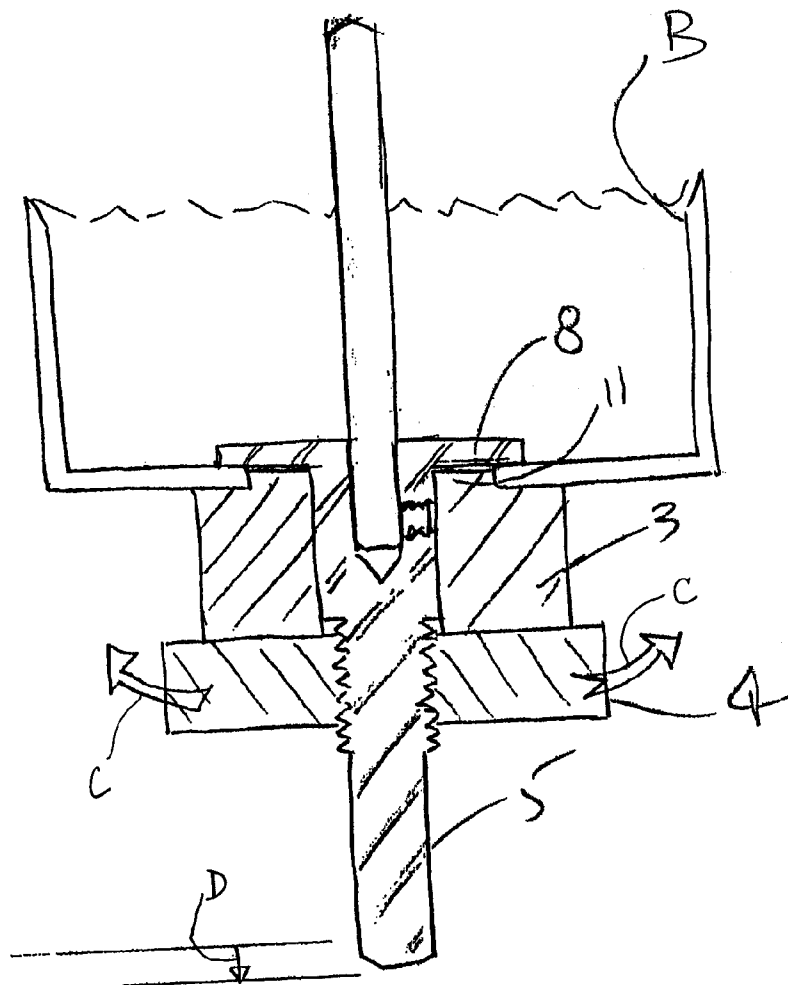
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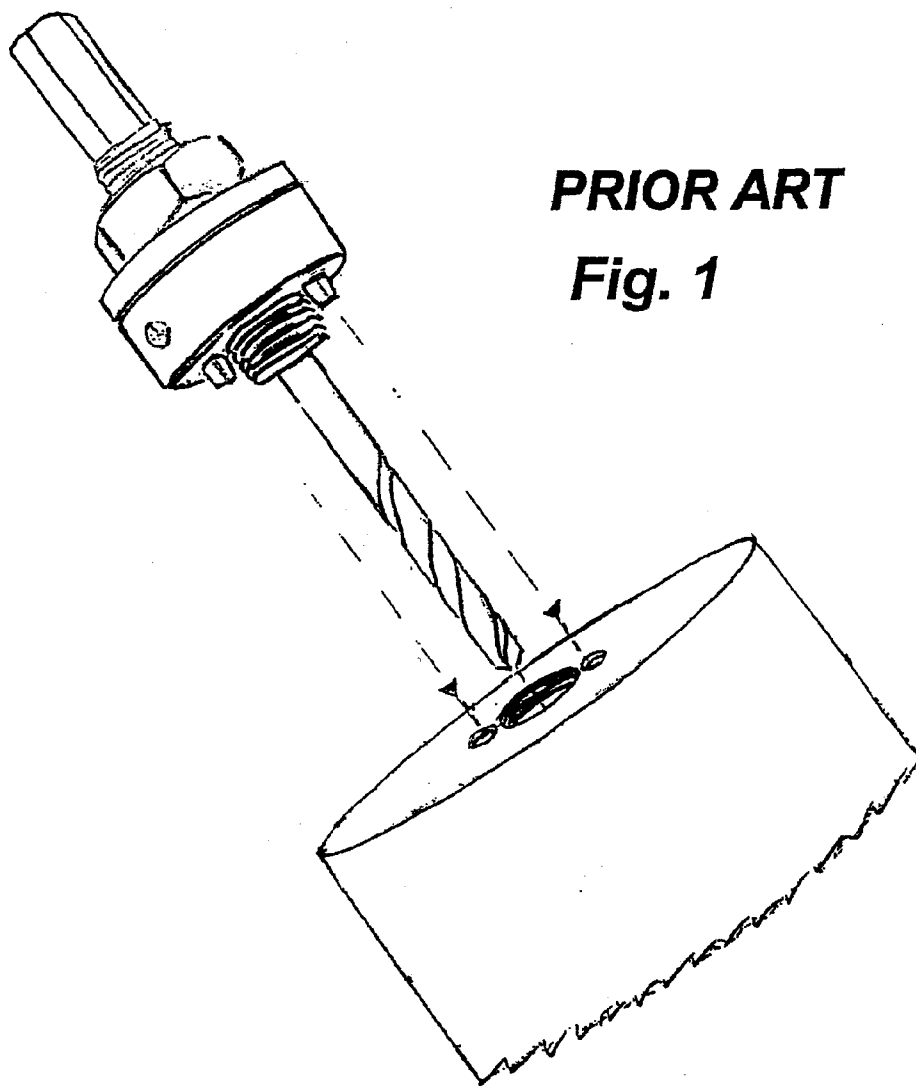
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An arbor assembly for mounting an attachment, such as a cup saw blade to a rotary drive, comprising a mandrel that has a spindle for coupling to a rotary drive, a drive shaft and a locking plate; a boss with a drive head that rotationally engages the cup saw blade and with a bore that rotationally engages the drive shaft of the mandrel, and a means for reversibly locking the cup saw blade between the locking plate and the boss, in rotational engagement with the drive head and the mandrel. The arbor assembly is robust and easy to use, for example with conventional electric drills.





PRIOR ART

Fig. 2a

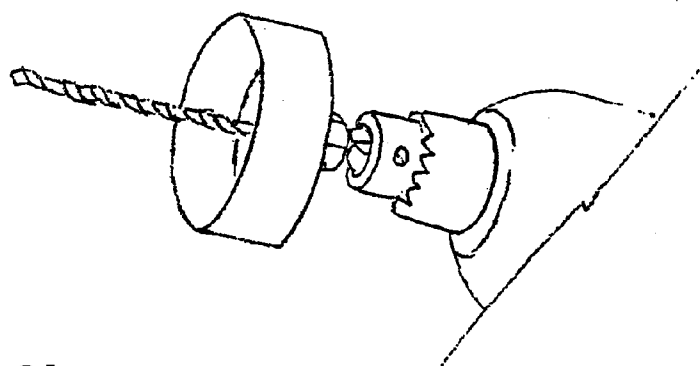
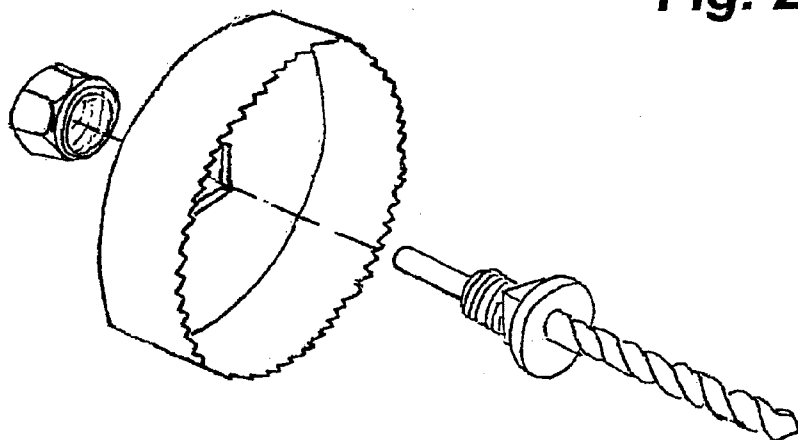
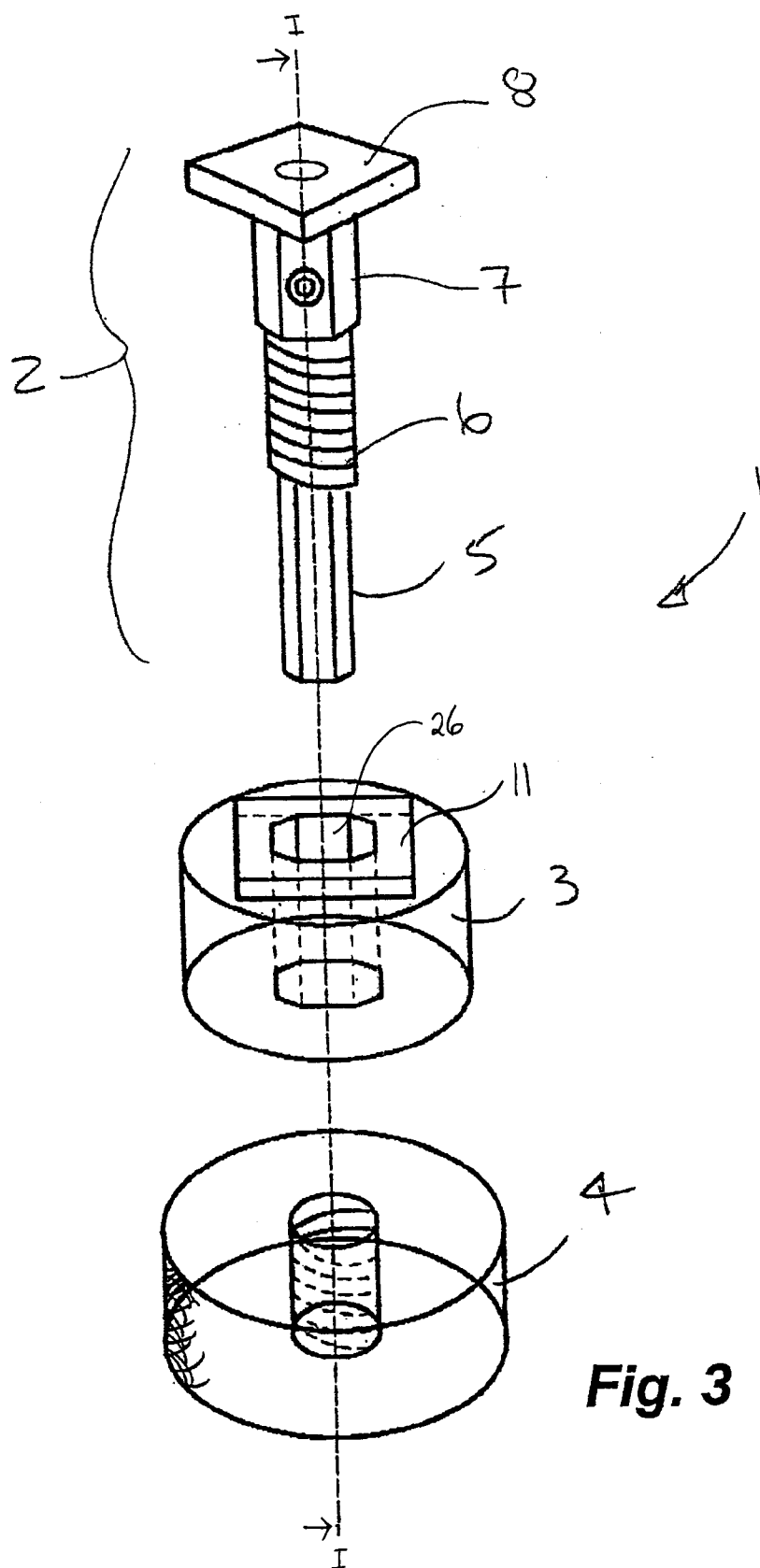
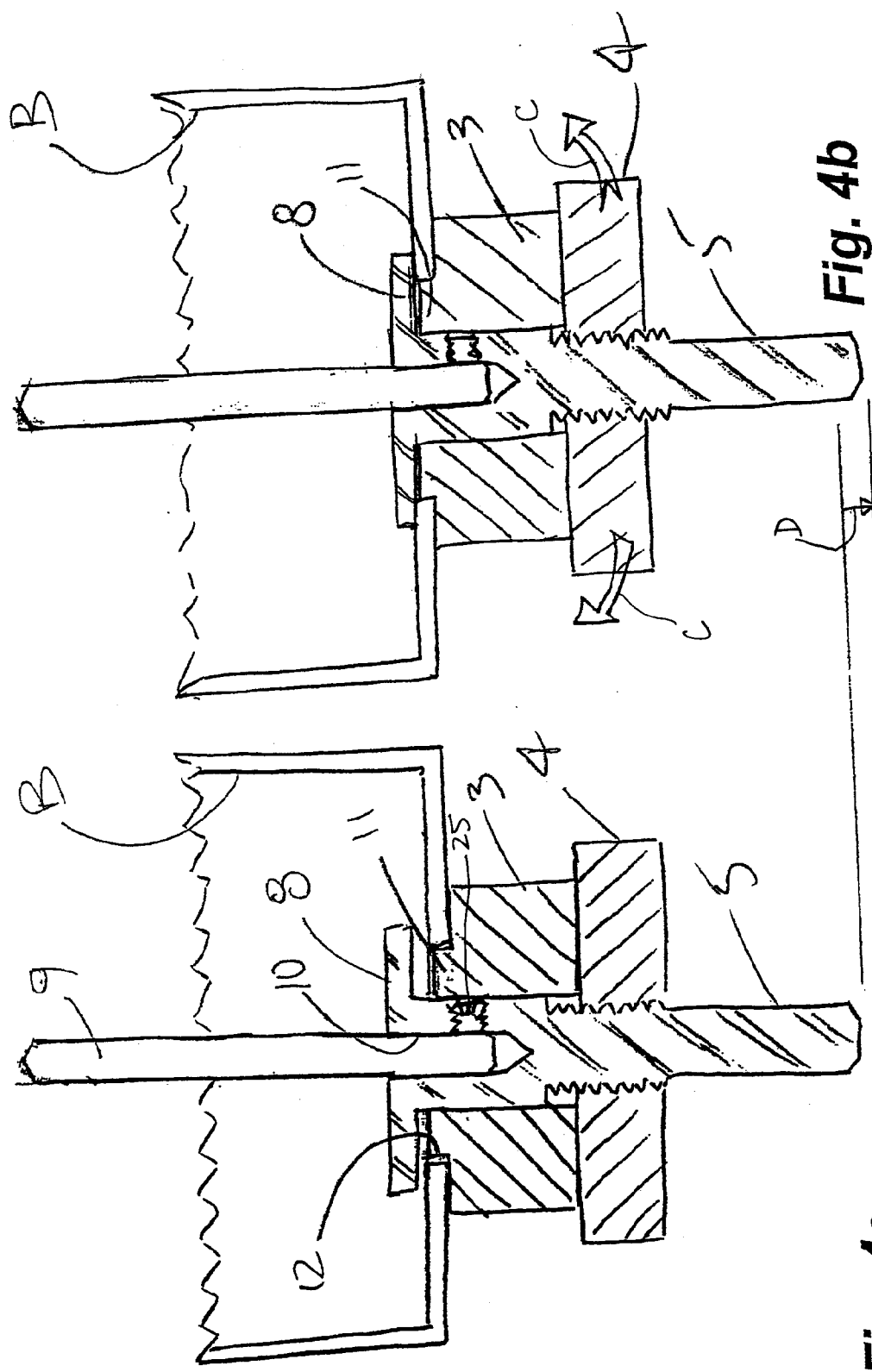


Fig. 2b

PRIOR ART





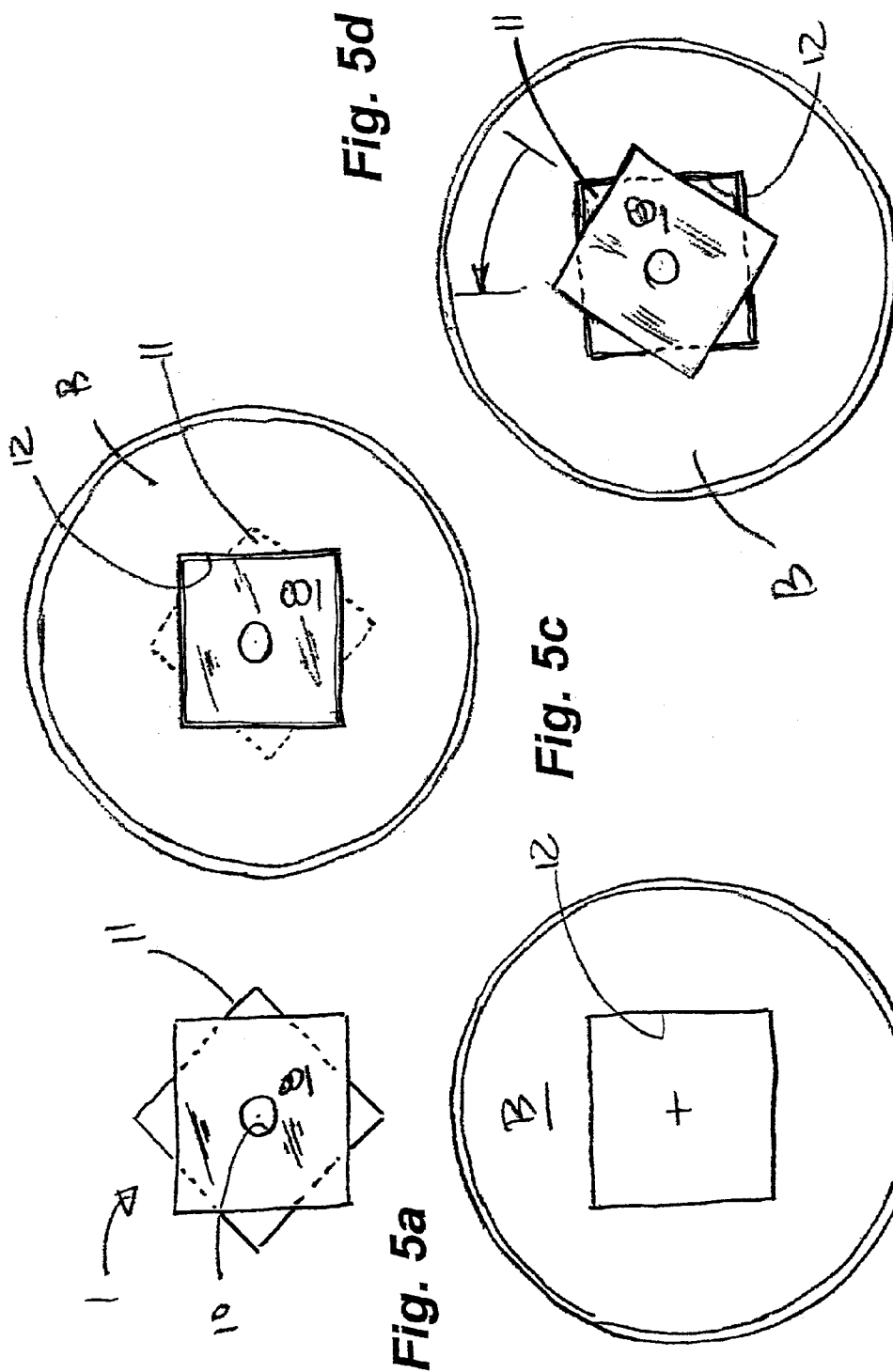


Fig. 6

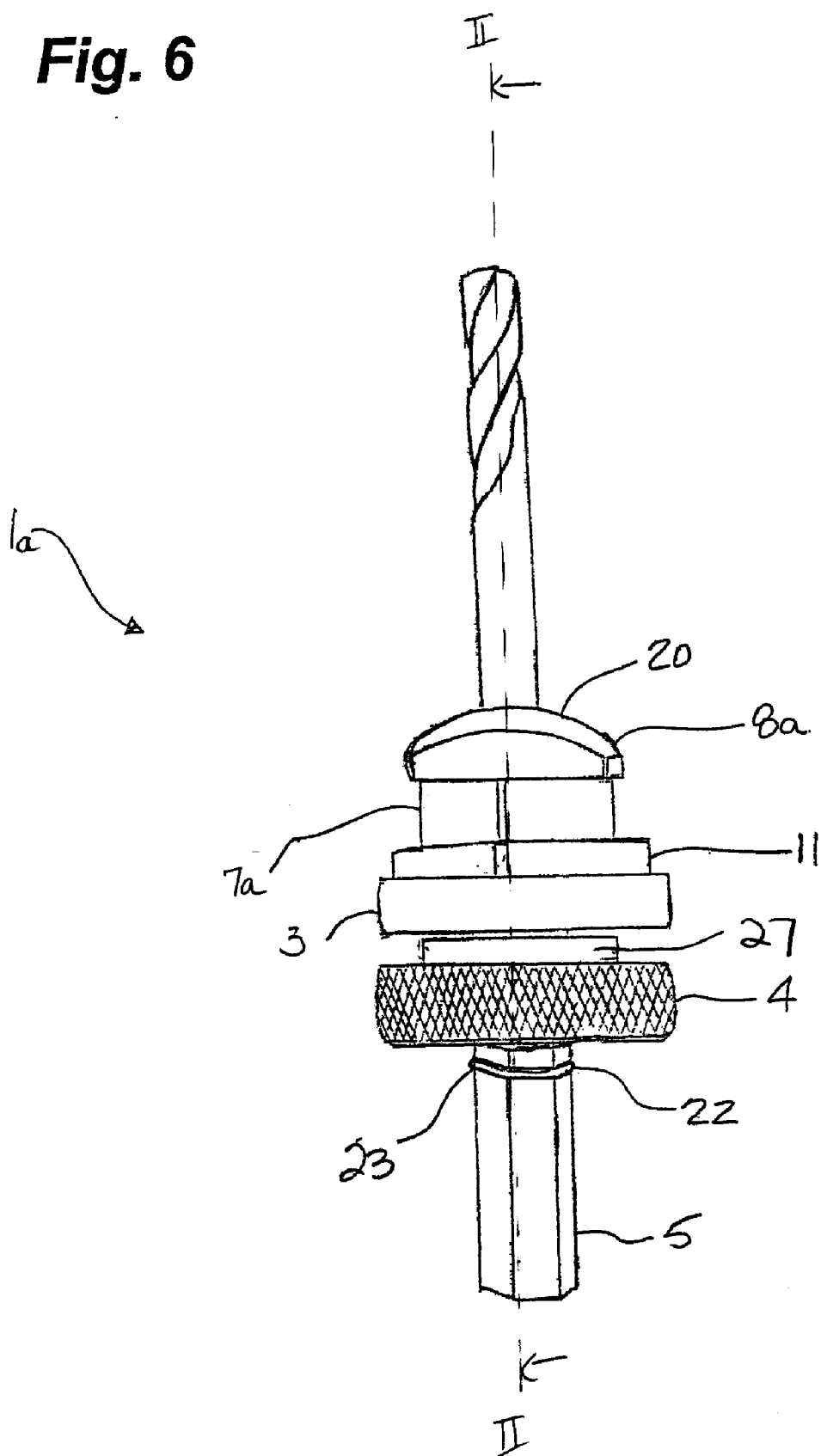
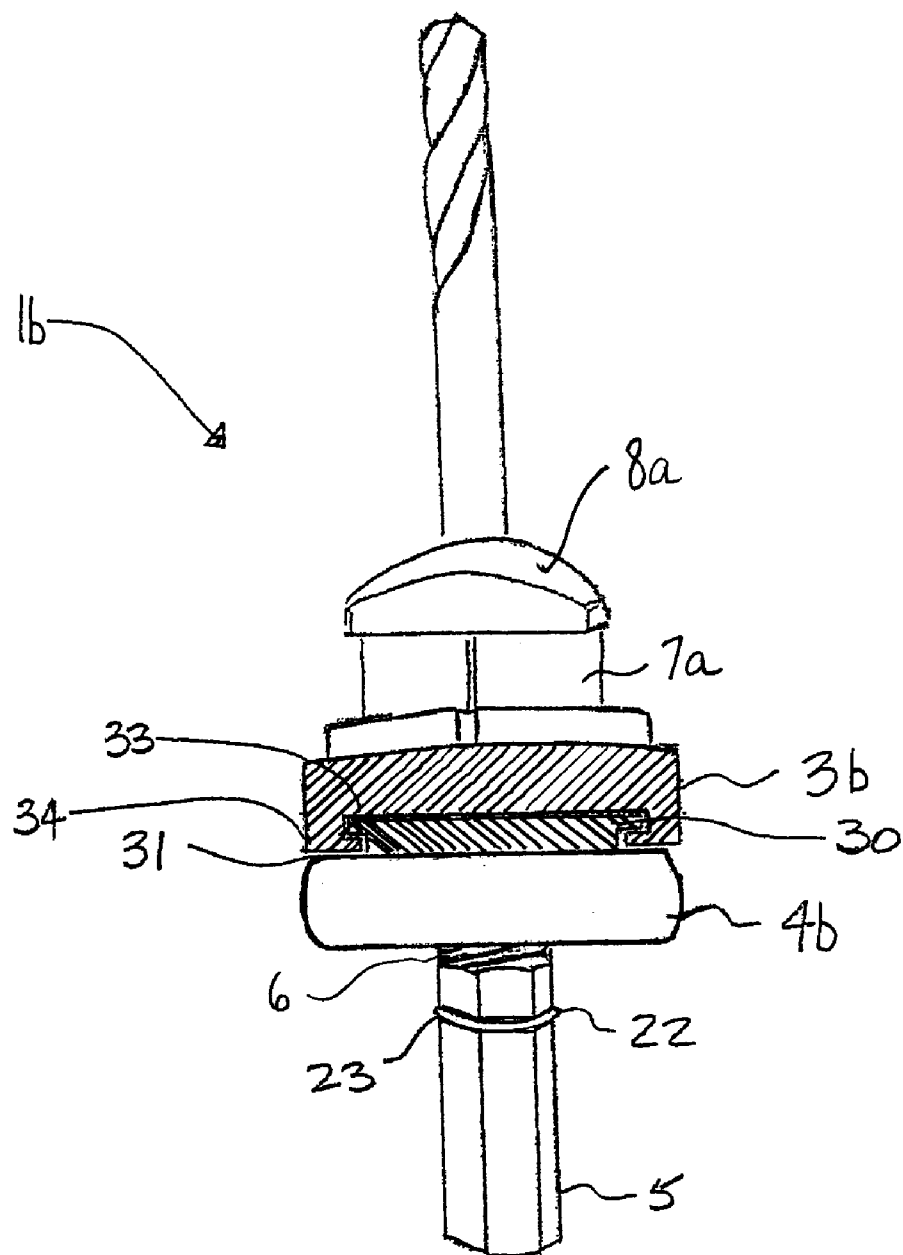


Fig. 7



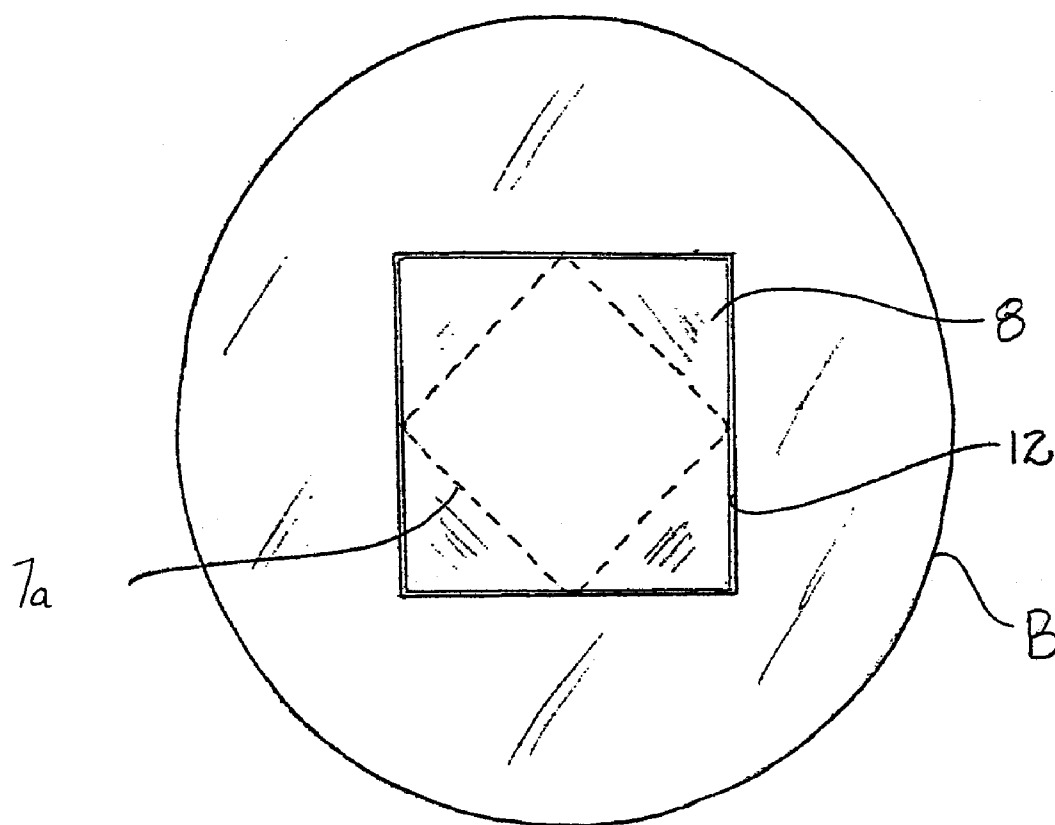


Fig. 9

ARBOR ARRANGEMENT

FIELD

[0001] The present invention relates to the field of arbor arrangements for connecting attachments, such as cup saw blades, to rotary tools.

BACKGROUND

[0002] It is known to attach various attachments to rotary tools. One such attachment is a circular cup-shaped saw blade attached to a power drill or the like for cutting holes in a variety of materials. An arbor arrangement is used to affix the saw blade to a pilot bit, positioned in the center of the cup saw blade, and to permit the blade and pilot bit to be locked into the chuck of the power drill.

[0003] Prior art arbor arrangements comprise a body through which the pilot bit extends. The pilot bit extends through a hole in the center of the cup saw blade. A threaded end of the arbor is secured to the body using a nut. Typically, at least one pair of pins extend from the top of the body for engaging corresponding holes in the base of the cup saw blade to transfer torque to drive the saw blade. Should the blade jam up during cutting, the pins are particularly susceptible to breakage.

[0004] Further, in most cases, the hole in the base of the saw blade is threaded for engagement with a threaded portion on the top of the arbor body. The relatively small number of threads are easily stripped, particularly if uneven force is applied to the drill during cutting. Further, uneven force by the user and wobble, as a result of worn threads, may cause the pins to wear the corresponding holes resulting in greater instability and wear.

[0005] Alternatively, other have attempted to improve the transfer of torque to the cup saw blade by replacing the pins with a square opening which corresponds to a square body fixed adjacent the chuck end of the pilot bit. A washer is fixed above the square portion of the pilot bit to sandwich the blade between the pilot bit and a nut. The chuck end of the pilot bit is then inserted into the chuck of the drill. While improving the transfer of torque to the cup saw blade, this prior art arrangement requires a wrench to lock the blade and does not provide any additional locking aspects to ensure that the nut does not back off which can result in loosening of the saw blade relative to the pilot bit.

SUMMARY

[0006] The arbor arrangement of the present invention overcomes some of the limitations noted above in the prior art devices, and is a robust and easy to use device that transmits high torque to an attachment, such as a cup saw blade.

[0007] In one aspect, this invention is an arbor assembly for mounting an attachment to a rotary drive, the arbor assembly comprising:

[0008] (a) a mandrel comprising a spindle, a drive shaft and a locking plate;

[0009] (b) a boss comprising a drive head, and forming a bore for rotational engagement with the drive shaft, and

[0010] (c) means for driving the boss towards the locking plate and for reversibly locking the boss at a selected position on the mandrel.

[0011] In various embodiments of this aspect, the locking plate, the drive shaft, and/or the drive head are square, the locking plate is rotationally offset from the drive head and/or the drive shaft is rotationally offset from the locking plate, and is sized to extend radially substantially to the smallest extent of the locking plate.

[0012] In yet other embodiments the means for driving the boss and for reversibly locking the boss, is a locking nut threadably connected to the mandrel to effect the movement of the boss axially along the mandrel toward the locking plate.

[0013] In another aspect, this invention is an arbor assembly for mounting an attachment with an opening, to a rotary drive, the arbor assembly comprising:

[0014] (a) a mandrel, further comprising:

[0015] (i) a spindle,

[0016] (ii) an advancing portion,

[0017] (iii) a drive shaft, and

[0018] (iv) a locking plate sized and shaped to fit through the opening in a first orientation, but not in a second orientation that is rotationally offset from the first orientation;

[0019] (b) a boss slidably disposed on the drive shaft and co-rotating therewith, and further comprising a drive head sized and shaped to engage the opening in the second orientation, and

[0020] (c) a locking nut coupled to the advancing portion.

[0021] In various embodiments of this aspect, the locking plate, the drive shaft, and/or the drive head are square, the locking plate is rotationally offset from the drive head and/or the drive shaft is rotationally offset from the locking plate, and is sized to extend radially substantially to the smallest extent of the locking plate.

[0022] In one embodiment the locking nut is threadably coupled to the advancing portion.

[0023] In one embodiment one of the locking nut and the boss comprises a flange, and the other of the locking nut and the boss comprises a groove that cooperates with the flange.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. 1 is an exploded perspective view of a prior art arbor arrangement and a cup saw blade, the arbor having pins for transferring torque;

[0025] FIGS. 2a and 2b are an exploded perspective view and an unexploded perspective view fit to a drill, respectively, of an alternate prior art arbor arrangement having a square drive for transferring torque;

[0026] FIG. 3 is an exploded isometric view illustrating an embodiment of the arbor arrangement of the present invention;

[0027] FIG. 4a is a sectional view of the assembled arbor arrangement according to FIG. 3, taken along line I-I, shown having a locking nut in a loosened position;

[0028] FIG. 4b is a sectional view of the assembled arbor arrangement according to FIG. 3, taken along line I-I, shown having the locking nut in a tightened position;

[0029] FIG. 5a is a plan view of the arbor arrangement according to FIG. 3 illustrating a square drive head below the offset square locking plate;

[0030] FIG. 5b is a plan view of a cup saw blade illustrating a square opening in the cup saw blade, for accepting the square drive head according to FIG. 5a;

[0031] FIG. 5c is a plan view of the cup saw blade positioned over the arbor arrangement and having the rotationally offset locking plate aligned with the square opening of the cup saw blade;

[0032] FIG. 5d is a plan view of the cup saw blade according to FIG. 5c, the arbor arrangement and offset locking plate having been rotated to position the square drive head in alignment with the cup saw blade's square opening—equally applicable being rotation of the cup saw blade relative to the locking plate offset, both of which enable alignment of the blade with the drive head;

[0033] FIG. 6 is a perspective view of an embodiment of the invention having a square portion that engages and drives the boss and is sized substantially the same as the opening in the blade for ease of removal from the blade;

[0034] FIG. 7 is a perspective view, in partial cross-section, of an embodiment of the invention wherein the locking nut is flanged for co-operation with a grooved boss so as to cause the boss and locking nut to move together axially along the mandrel, for ease of manipulation thereon;

[0035] FIG. 8 is a sectional view according to FIG. 6 along line II-II; and

[0036] FIG. 9 is a plan view according to FIG. 6.

DETAILED DESCRIPTION

[0037] As shown in FIGS. 1 and 2, prior art arbor arrangements comprise pins or square drives for transferring torque to a cup saw blade attached to a power drill or the like.

[0038] Reference will now be made to the Figures, which show various embodiments of the arbor arrangement of the present invention. In one embodiment, shown in FIG. 3, the arbor arrangement 1 of the present invention comprises a mandrel 2, a boss 3 and a locking nut 4.

[0039] The mandrel 2 is adapted to be rotationally coupled with a rotary drive such as a conventional electric drill having a chuck or collet connection (not shown). Further the mandrel 2 is adapted to be rotationally coupled with an attachment B, such as a cup saw blade (FIGS. 4, 5, 8 and 9). Other attachments that may be used with the arbor arrangement include cutting grinding or polishing wheels and blades, sanding disks, buffers, paint scrapers, brushes such as a wire or nylon brushes, rotary shapers and hemispherical attachments.

[0040] The mandrel 2 comprises a spindle 5, an advancing portion 6, a drive shaft 7 and a locking plate 8. Spindle 5

may be adapted for engagement in the chuck of a drive, such as a power drill, and is preferably polygonal in cross section for engagement of the jaws of a chuck, as known in the art. The advancing portion 6 provides a means for axial progression of the locking nut 4 along the mandrel, preferably both towards and away from the locking plate 8. In one embodiment, the advancing portion is threaded. The drive shaft 7 acts to engage and drive the boss 3.

[0041] It may be polygonal in cross section, with square and hexagonal shapes being preferred, the hexagonal embodiment being shown in FIG. 3. The locking plate 8 acts to reversibly lock the attachment B to the arbor arrangement 1.

[0042] The mandrel 2 may be formed from readily available commercial stock, for example of hexagonal or square cross section, the advancing portion 6 of the mandrel being a continuation of drive shaft 7 turned to a smaller diameter and threaded as shown in the examples. The spindle 5 may be machined to provide longitudinal grooves or edges, for engagement by the jaws of a chuck. Locking plate 8 may be welded onto the end of drive shaft 7. Alternatively, mandrel 2 may be formed as a unitary body from readily available commercial stock.

[0043] As shown in FIGS. 4a and 4b, a pilot bit 9 may be releasably secured into a central axial bore 10 of mandrel 2. Therefore mandrel 2 may be provided with a bore 10 for receiving the pilot bit 9, which bit may be secured within the bore by a conventional set screw 25, that may be positioned, for example, in the body of drive shaft 7.

[0044] The boss 3 comprises a drive head 11 and a central axial bore 26. The drive head 11 acts to engage a complementary opening 12 of the attachment B, to thereby rotationally drive the attachment B. In one embodiment the drive head 11 is square and therefore the complementary opening 12 of the attachment B is also square. The central axial bore 26 acts to engage the drive shaft 7 of mandrel 2, such that boss 3 and also therefore an attachment B, are rotationally driven thereby.

[0045] Locking nut 4 engages advancing portion 6, for example by a threadable coupling, to move boss 3 axially towards locking plate 8, and to reversibly lock (as by tightening) boss 3 in position so that arbor arrangement 1 is then assembled for operation. In one embodiment the advancing portion is reverse-threaded, so that the action of the rotary drive does not loosen the locking nut. Locking nut 4 may be knurled to facilitate gripping for rotation, or may be polygonal in cross section. As is apparent, other means for driving the boss towards locking plate 8 and to reversibly lock boss 8 in position for operation may be used.

[0046] FIGS. 4a and 4b are sectional views of the assembled arbor arrangement according to FIG. 3, with a saw blade positioned therein, having the locking nut 4 in open (non-operating) position and in a closed (operating) position, respectively. With reference to FIG. 4a, the boss 3 is inserted over the mandrel 2 and retained thereon with the locking nut 4. The mandrel 2, boss 3 and drive head 11 are operatively connected for co-rotation, by interaction and engagement of the drive shaft 7 with the central axial bore 26 of the boss. At least a portion of the boss 3 has a radial extent greater than the drive head 7 and the complementary opening 12 of the saw blade. Therefore, when locking nut 4

advances boss 3 towards the saw blade and locking plate 8, at least a portion of the saw blade around the edge of complementary opening 12 is sandwiched and trapped between locking plate 8 and boss 3, as is demonstrated in FIG. 4b. The rotation of locking nut 4 around mandrel 2 in this embodiment is indicated by arrow C, and the movement of locking plate 8 towards boss 3 is indicated by arrow D.

[0047] The insertion of a saw blade into arbor arrangement 1 and its positioning between locking plate 8 and boss 3 is disclosed next, for one embodiment of the invention. As shown in FIG. 5a, in plan view, the locking plate 8 may be square and may be rotationally offset from the drive head 11, which may also be square. The locking nut 4 is rotationally positioned on the advancing portion 6 to axially space the locking plate 8 somewhat from the square drive head 11, for example as demonstrated in FIG. 4a. The locking plate 8 is then inserted through the complementary opening 12 in the saw blade so that the drive head 11 can then be positioned to co-rotationally engage the opening 12. Relative rotation of the arbor arrangement 1 and the saw blade enables rotational alignment of the drive head 11 and opening 12, after the saw blade has successfully passed the locking plate 8. Therefore, drive head 11 and the saw blade are connected for co-rotation, by interaction and engagement of the drive head with the complementary opening 12 in the saw blade.

[0048] With reference to FIGS. 5a-5d, the ease of insertion of the locking plate 8, using square shaped locking plate 8, drive head 11 and complementary opening 12, as an example, is demonstrated. The locking plate 8 is arranged so as to be rotationally offset from the drive head 11, as shown in FIG. 5a, where the boss 3 is omitted for clarity and to emphasize the relationship between the locking plate 8 and square drive head 11. The locking plate of FIG. 5a and the complementary opening 12 of the saw blade are then oriented for coupling, as shown in FIG. 5b. Once the locking plate 8 is aligned and inserted axially through the complementary opening 12 (FIG. 5c), the arbor arrangement 1 and/or the saw blade are rotated, as indicated by arrow D in FIG. 5d, to offset the locking plate 8 from the opening 12, and to align the square drive head 11 with the complementary square opening 12. The locking nut 4 is actuated to drive the locking plate 8 towards the saw blade and boss 3 and thereby to secure the arbor arrangement 1 to the saw blade in preparation for operation of arbor arrangement 1.

[0049] A robust and high torque solution is achieved.

[0050] The square shapes for the locking plate 8 and drive head 11 disclosed in the embodiments herein, can be replaced with other irregular or regular shapes, such as polygonal shapes, as long as there is a radial overhang when the drive head 11 engages opening 12 in attachment B (i.e., after the drive head is rotated into engagement with the opening), so as to extend over the attachment B, so as sandwich and trap the attachment B between the locking plate 8 and the boss 3. Further, the shape of locking plate 8 may be the same, or different, than the shape of drive head 11, provided again that there is a radial overhang when the drive head 11 engages opening 12 in attachment B (i.e., after the drive head is rotated into engagement with the opening), so as to extend over the attachment B, so as sandwich and trap the attachment B between the locking plate 8 and the boss 3.

[0051] After the locking plate is inserted through complementary opening 12 in attachment B, the arbor arrangement

1 is rotated relative to attachment B (by rotating the attachment, the boss or the mandrel), in order to align the opening 12 and the drive head 11. In the embodiments disclosed herein, the rotation is approximately 45 degrees. However, as is apparent, the degree of rotation required can be different than 45 degrees, depending upon the respective shapes, sizes and orientations of the locking plate 8, the drive head 11 and the drive shaft 7. Therefore, the arbor arrangement of this invention includes embodiments in which rotation of the arbor arrangement, from the orientation in which the locking plate is inserted through the opening 12 of the attachment B (the "first orientation") to the orientation in which the drive head 11 engages the opening (the "second orientation"), is other than 45 degrees.

[0052] FIGS. 6 and 8 show another embodiment 1a of the invention, in which the locking plate 8a is profiled for ease of insertion into the complementary opening 12 of the attachment. In this embodiment, the locking plate 8a is rounded on a leading surface 20 so as to substantially remove any angular edges and facilitate insertion into the complementary opening 12.

[0053] In this embodiment, shown in FIGS. 6-8, the drive shaft 7a, which acts to engage and drive the boss 3, is square in cross section. The drive shaft 7a is substantially the same size as the smallest extent of the square drive 11 and the complementary opening 12, so as to remove excess play between the mandrel 2 and the attachment, and thereby ease engagement and removal of the square drive 11 from the attachment.

[0054] As best seen in FIG. 9, the drive shaft 7a extends radially substantially to the smallest extent of locking plate 8 and further, is sized to be substantially the size of the complementary opening 12 in a saw blade. Therefore, in this embodiment, when the locking nut is backed off from the saw blade and the mandrel 2 is to be removed from the saw blade, the locking plate 8 is substantially centered in the complementary opening 12 and is easily removed when the locking plate 8 is rotated to match the orientation of the opening 12.

[0055] In one embodiment shown in FIG. 6, a snap ring or retainer clip 22 may be fit within a groove 23 formed on the spindle 5 to prevent complete removal of the locking nut 4 from the mandrel 2. The groove 23 may be positioned on the spindle 5 sufficiently removed from the locking plate 8 to permit rotation of the locking nut 4 for loosening and tightening of the attachment onto the arbor arrangement.

[0056] In yet another embodiment 1b of the invention, as shown in FIG. 7, a flange 30 may be formed on a leading edge 31 of the locking nut 4b for co-operating with a groove 33 formed on an adjacent edge 34 of the boss 3b. Thus, the non-rotating boss 3b can be readily retained and driven axially on the spindle 5 by the rotating locking nut 4b, speeding up the process of locking and unlocking the attachment to arbor arrangement 1. As is apparent, the flange 30 may also be formed on boss 3b, and the groove 33 may accordingly be formed on locking nut 4b.

[0057] In yet another embodiment, as shown in FIG. 6, a protrusion 27 on locking nut 4a may act as a spacer, to space the locking nut from the boss, to thereby facilitate grasping the locking nut independently of the boss, to facilitate rotation. Alternatively, protrusion 27 may be sized and

shaped to fit within a complementary space (not shown) on the adjacent face of boss **3** to facilitate centering of locking not **4a**.

[0058] While the invention has been described in conjunction with the disclosed embodiments, it will be understood that the invention is not intended to be limited to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Various modifications will remain readily apparent to those skilled in the art.

What is claimed is:

1. An arbor assembly for mounting an attachment to a rotary drive, the arbor assembly comprising:

- (a) a mandrel comprising a spindle, a drive shaft and a locking plate;
- (b) a boss comprising a drive head, and forming a bore for rotational engagement with the drive shaft, and
- (c) means for driving the boss towards the locking plate and for reversibly locking the boss at a selected position on the mandrel.

2. The arbor assembly of claim 1, wherein the locking plate is square.

3. The arbor assembly of claim 1, wherein the drive shaft is square in cross section.

4. The arbor assembly of claim 2, wherein the drive shaft is square in cross section.

5. The arbor assembly of claim 2, wherein and the drive head is square.

6. The arbor assembly of claim 4, wherein and the drive head is square.

7. The arbor assembly of claim 5, wherein the locking plate is rotationally offset from the drive head.

8. The arbor assembly of claim 6, wherein the locking plate is rotationally offset from the drive head.

9. The arbor assembly of claim 4, wherein the drive shaft is rotationally offset from the locking plate, and is sized to extend radially substantially to the smallest extent of the locking plate.

10. The arbor assembly of claim 1, wherein the means for driving the boss and for reversibly locking the boss, is a locking nut threadably connected to the mandrel to effect the movement of the boss axially along the mandrel toward the locking plate.

11. The arbor assembly of claim 2, wherein the means for driving the boss and for reversibly locking the boss, is a locking nut threadably connected to the mandrel to effect the movement of the boss axially along the mandrel toward the locking plate.

12. The arbor assembly of claim 4, wherein the means for driving the boss and for reversibly locking the boss, is a locking nut threadably connected to the mandrel to effect the movement of the boss axially along the mandrel toward the locking plate.

13. The arbor assembly of claim 6, wherein the means for driving the boss and for reversibly locking the boss, is a locking nut threadably connected to the mandrel to effect the movement of the boss axially along the mandrel toward the locking plate.

14. An arbor assembly for mounting an attachment with an opening to a rotary drive, the arbor assembly comprising:

(a) a mandrel, further comprising:

- (i) a spindle,
- (ii) an advancing portion,
- (iii) a drive shaft, and

(iv) a locking plate sized and shaped to fit through the opening in a first orientation, but not in a second orientation that is rotationally offset from the first orientation;

(b) a boss slidably disposed on the drive shaft and co-rotating therewith, and further comprising a drive head sized and shaped to engage the opening in the second orientation, and

(c) a locking nut coupled to the advancing portion.

15. The arbor assembly of claim 14, wherein the locking plate is square.

16. The arbor assembly of claim 14, wherein the drive shaft is square in cross section.

17. The arbor assembly of claim 15, wherein the drive shaft is square in cross section.

18. The arbor assembly of claim 15, wherein and the drive head is square.

19. The arbor assembly of claim 17, wherein and the drive head is square.

20. The arbor assembly of claim 18, wherein the locking plate is rotationally offset from the drive head.

21. The arbor assembly of claim 19, wherein the locking plate is rotationally offset from the drive head.

22. The arbor assembly of claim 17, wherein the drive shaft is rotationally offset from the locking plate, and is sized to extend radially substantially to the smallest extent of the locking plate.

23. The arbor assembly of claim 14, wherein the locking nut is threadably coupled to the advancing portion.

24. The arbor assembly of claim 10, wherein one of the locking nut and the boss comprises a flange, and the other of the locking nut and the boss comprises a groove that cooperates with the flange.

25. The arbor assembly of claim 14, wherein one of the locking nut and the boss comprises a flange, and the other of the locking nut and the boss comprises a groove that cooperates with the flange.

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