

[54] **DRILL LIKE DRIVING DEVICE**

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[51] **Int. Cl.**..... **A64b 17/16, F16h 37/06**

[58] **Field of Search** **74/416, 665 S; 128/305, 128/310, 312**

[56] **References Cited**

UNITED STATES PATENTS

3,515,100	6/1970	Keller	128/310
3,654,911	4/1972	Loge	128/305
3,678,934	7/1972	Warfield et al.	128/310
2,495,691	1/1950	Brennan	74/665 S X

FOREIGN PATENTS OR APPLICATIONS

781,511	8/1957	Great Britain	128/310
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Primary Examiner—Channing L. Pace

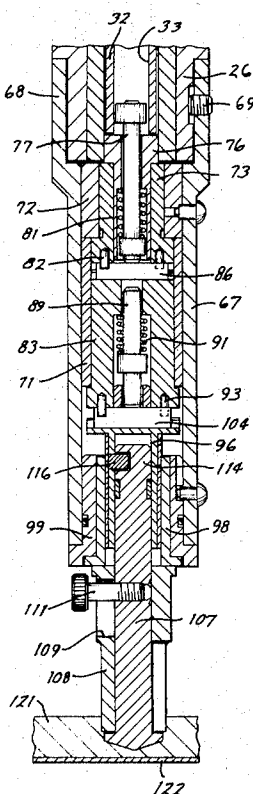
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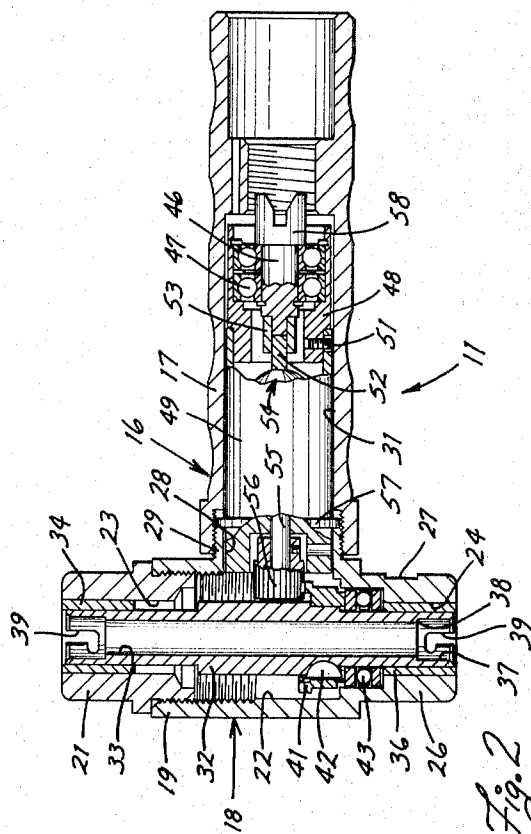
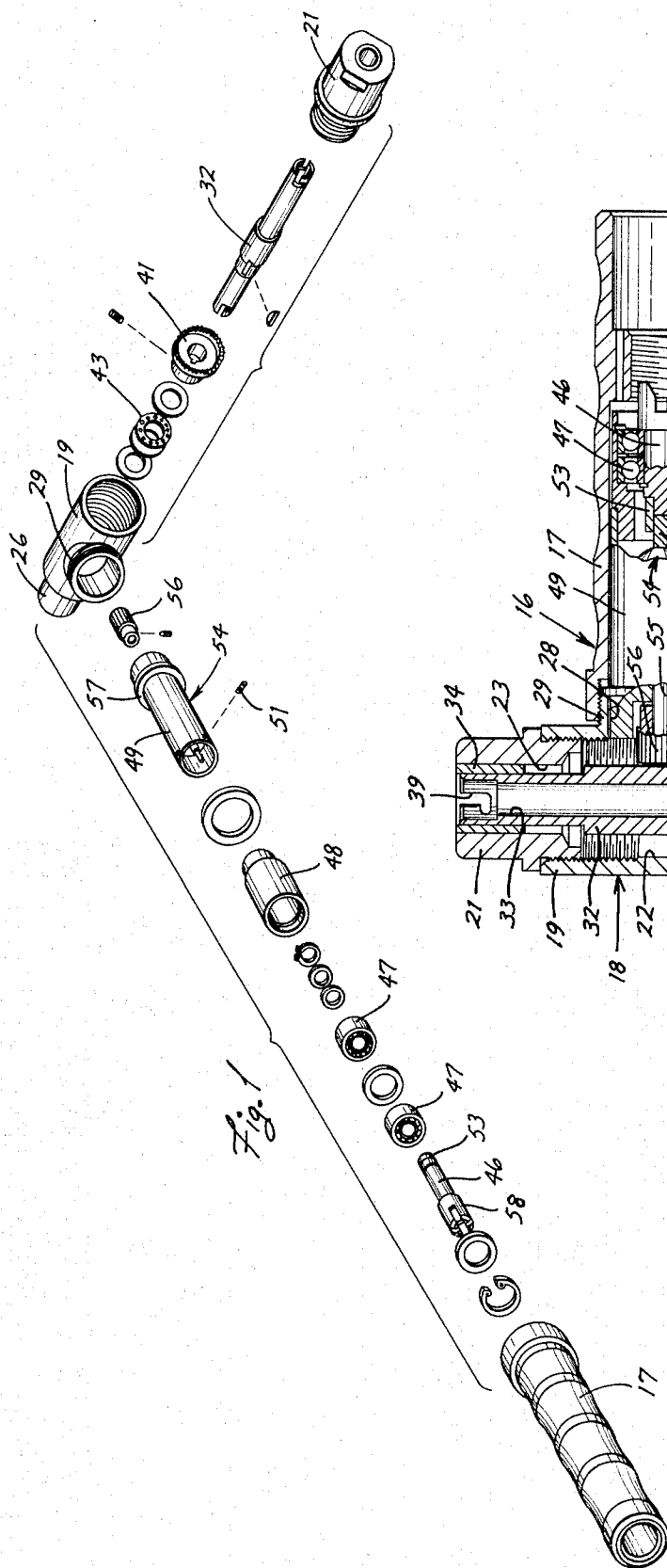
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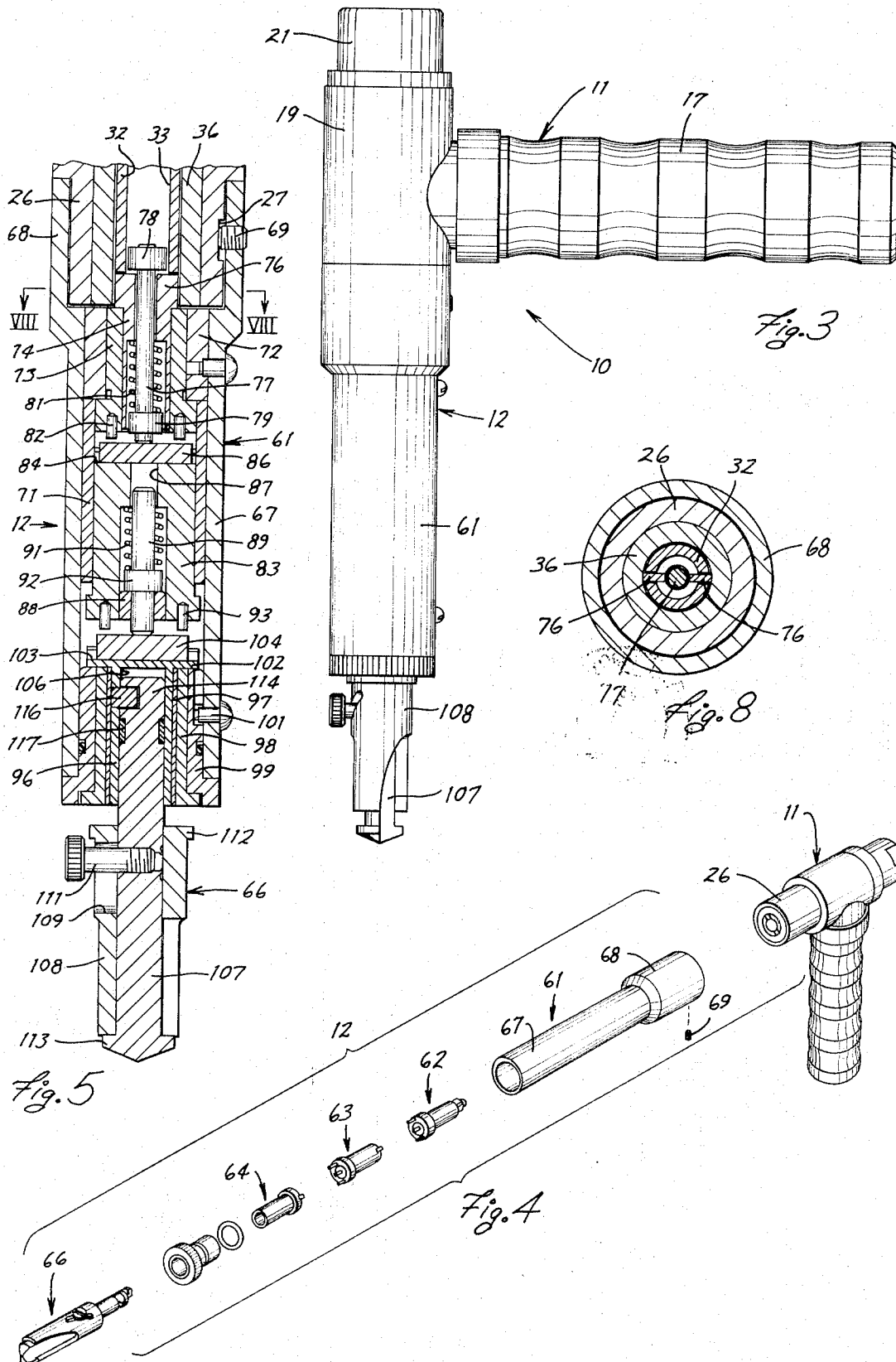
ABSTRACT

A driving device including a right-angle handpiece assembly having a casing containing an input shaft, an output shaft and means drivingly connecting same. A bone drill attachment is connectible to the handpiece assembly and includes a cylindrical extension mountable upon the output end of the casing and concentric inner and outer drill bits which project from said extension. The inner drill bit is connectible to the output shaft by a pair of clutch mechanisms which are normally spring-biased into a disconnected position. The outer drill bit normally rotates with the inner drill bit but is permitted to move axially and angularly relative to the inner drill bit through a predetermined distance. The cutting end of the inner drill bit extends axially beyond the cutting end of the outer drill bit. Alternately, a wire driving attachment can be connected to the handpiece assembly and includes a chuck structure mountable upon the output end of the casing and drivingly connectible to the output shaft. The chuck structure has a continuous opening therethrough which aligns with a through opening in the casing for receiving therein an elongated member, such as a wire.

4 Claims, 9 Drawing Figures







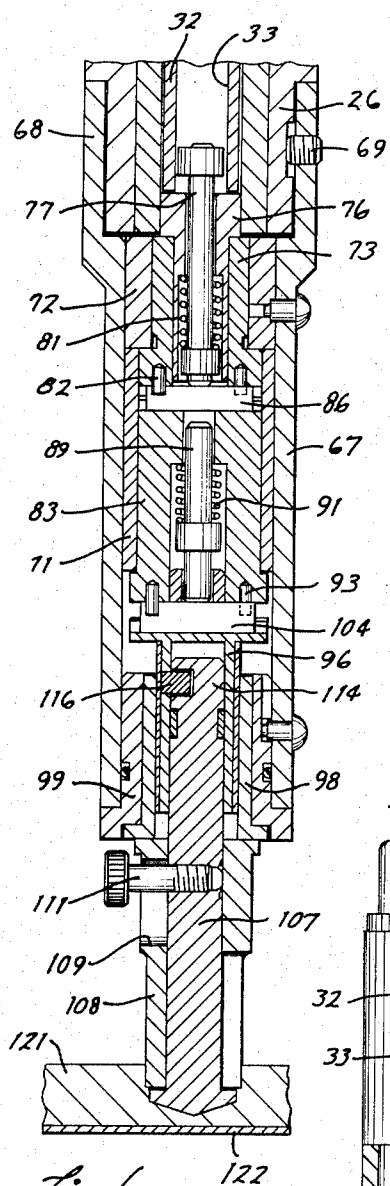


Fig. 6

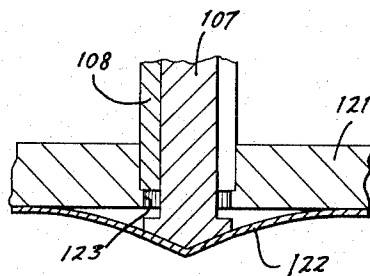


Fig. 7

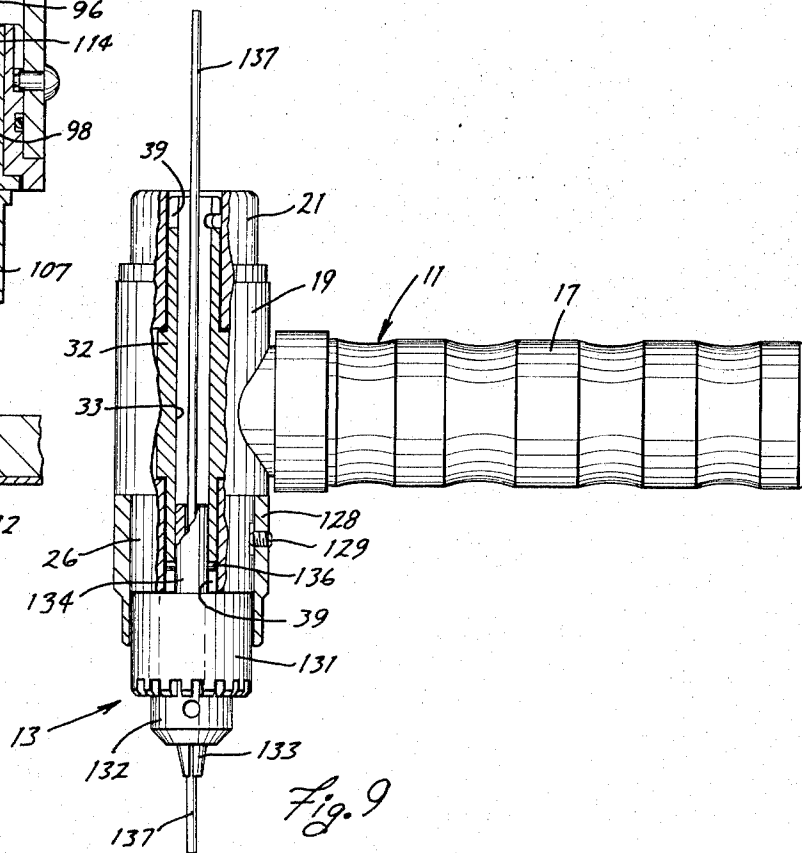


Fig. 9

DRILL LIKE DRIVING DEVICE

FIELD OF THE INVENTION

This invention relates in general to a drill-like driving device and, in particular, to an improved device which includes a right-angle handpiece assembly which can have several different attachments mounted thereon, such as a bone drilling attachment or a wire driving attachment for permitting drilling or perforation of a bone in a human or other animate.

BACKGROUND OF THE INVENTION

A number of drills and drill bits have been developed in the past for the purpose of providing openings in bone structure, such as the skull, and a drill bit construction of this type is disclosed in the U.S. Pat. No. 2,842,131. The purpose of this drill structure is to perform the drilling operation with a minimum of bone damage and without perforating the meninges so that the brain tissues under the meninges will not be contaminated with bone fragments produced during the drilling operation.

Heretofore, however, it has been the common practice to furnish a drill bit assembly, as shown in the aforementioned Smith patent, which is driven by a driver or handpiece, not especially adapted for this type of surgical operation. Moreover, insofar as I am aware, no complete drill assembly has been furnished for easy connection to and operation by a highspeed air motor and having the features of automatically disconnectible clutch means as well as a right-angle drive.

Accordingly, the primary object of this invention is the provision of a drill device having clutch means for automatically disconnecting a pair of concentric drill bits from the source of rotational power and, moreover, having a simple means for disconnecting the extended bits from the handpiece.

A further object of this invention is the provision of a drill device having a handpiece which can be quickly and easily adapted for other uses, such as a wire driver, thereby reducing inventories required for assembling different types of surgical instruments.

Other objects and purposes of this invention will become apparent to persons familiar with this type of equipment upon reading the following descriptive matter and examining the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of the improved handpiece assembly constructed according to the present invention.

FIG. 2 is a central, cross-sectional view of the handpiece assembly.

FIG. 3 is a side elevational view illustrating therein the handpiece assembly of FIG. 2 having a bone drill attachment mounted thereon.

FIG. 4 is an exploded, perspective view of the bone drill attachment of FIG. 3 and illustrating its relationship to the handpiece.

FIG. 5 is a central, sectional view of the bone drill attachment and illustrating the manner in which same is mounted on the output end of the handpiece assembly, the bone drill attachment being illustrated in its released or nondriving position.

FIG. 6 is a central, sectional view similar to FIG. 5 and illustrating the bone drill attachment in its engaged driving condition.

FIG. 7 is a fragmentary, sectional view illustrating the operational position of the bone drill when it breaks through a large bone, such as a cranial bone.

FIG. 8 is a sectional view taken along the line VIII—VIII of FIG. 5.

FIG. 9 is a side elevational view, partially in cross section, illustrating the improved handpiece assembly of FIG. 2 having a wire driving attachment mounted thereon.

For convenience in reference only, the terms "upper," "lower," "rightward" and "leftward" will have reference to the device and parts thereof, particularly as appearing in FIGS. 2, 3, 5 and 9. The terms "output" and "input" will have reference to the lower end and right end, respectively, as appearing in FIGS. 2, 3 and 9. The terms "inner" and "outer" will have reference to the geometric center of the device and designated parts thereof. Said terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

SUMMARY OF THE INVENTION

The objects and purposes of the invention, including those set forth above, have been met by providing a drill-like driving device which includes an improved right-angle handpiece assembly having input and output shafts arranged within a casing at right angles to each other and interconnected by gear means. The input shaft includes a reduction gear assembly therein whereby the input shaft can be connected to a high-speed air motor and the output shaft can be driven at a low rotational speed. The handpiece assembly is connectible to a bone drill attachment which is mountable on the output end of the casing and includes drive shaft means which is drivingly connectible to the output shaft of the handpiece assembly. The drive shaft means of the bone drill attachment includes a pair of normally disconnected clutch assemblies connected in series between the output shaft of the handpiece assembly and a pair of concentric drill bits. The drill bits are normally rotated together but are mounted for permitting limited axial and annular displacement therebetween for permitting the rotation of the drill bits to be stopped under emergency situations wherein the clutch assemblies do not release. Alternately, the handpiece can have a wire driving attachment mounted on the output end thereof, which wire driving attachment in one embodiment comprises a chuck mounted on the casing and having a wire engaging member connected to the output shaft for permitting rotation of an elongated wire, which wire extends through the chuck and the casing for permitting driving of a wire of substantial length.

DETAILED DESCRIPTION

FIGS. 1 and 2 illustrate therein the improved right angle handpiece assembly 11 of the present invention, which assembly is designed to permit its use with several different drill-like attachments. The handpiece assembly 11 particularly the like, suitable for use with a bone drill attachment 12, as illustrated in FIG. 3. However, the handpiece assembly 11 can also be utilized with a wire driving attachment 13 as illustrated in FIG. 9.

Considering first the handpiece assembly 11, as illustrated in FIGS. 1 and 2, same includes a substantially T-shaped casing 16 having an elongated tubular handle 17 fixedly connected to an elongated tubular gear housing 18. The gear housing 18, for purposes of convenience, is constructed of two pieces and includes a main housing part 19 and an end cap 21 which is fixedly, here threadedly, connected to the upper end of the main housing part 19. The gear housing 18 has a coaxial cylindrical opening 22 extending therethrough, which opening has cylindrical portions 23 and 24 of reduced diameter at the opposite ends thereof. The end of the housing 18 opposite the end cap 21 is also formed with a reduced cylindrical hub 26 on the exterior thereof which is formed with a flat 27 thereon. Gear housing 18 also has a further opening 28 provided in the side thereof and partially defined by an outwardly extending circular boss 29 which, in the illustrated embodiment, is threaded to permit same to be fixedly connected to the handle 17. The opening 28 is thus substantially aligned with a central opening 31 which extends longitudinally of the handle 17.

The gear housing 18 has a drive or output shaft 32 supported for rotation therein by bushings 34 and 36 disposed adjacent the opposite ends of the gear housing. The drive shaft 32 is of tubular construction and has a central opening 33 extending axially throughout the complete length thereof. The opposite ends of the tubular drive shaft 32 are provided with enlarged internal recesses 37 which result in the formation of an axially facing shoulder 38. The tubular drive shaft 32, in the region of each recess 37, is provided with a pair of diametrically opposite slots 39 which are of a substantially L-shaped configuration and extend axially inwardly from the free ends of the shaft. The enlarged recesses 37 and slots 39 thus function as half of a conventional bayonet-type coupling for permitting either end of the drive shaft 32 to be drivingly coupled to a further shaft or member.

A driven face gear 41 is concentrically disposed within the opening 22 of the gear housing 18, which face gear 41 is positioned in surrounding relationship to and is nonrotatably connected to the drive shaft 32 by any conventional means, such as a key 42. The face gear 41 is rotatably supported on the gear housing 18 by means of an intermediate thrust bearing 43.

Considering now the handle 17, same includes an input shaft assembly rotatably supported therein and provided for drivingly connecting the output shaft 32 to an external power source, such as an air motor. The input shaft assembly includes an input shaft 46 substantially coaxially disposed within the opening 31 and rotatably supported within the handle 17 by conventional anti-friction bearings 47. The ball bearings 47 are supported on an annular bearing retainer 48 which has one end thereof fixedly connected to a speed reducer housing 49 by a conventional set screw 51. The housing 49 contains therein a conventional planetary gear-type speed reducer which has a rotatable drive shaft 52 drivingly connected to the input shaft 46 by means of an intermediate coupling 53. A conventional speed reducer 54 is drivingly connected between the shaft 52 and a driven shaft 55. The driven shaft 55 has a spur gear 56 nonrotatably secured thereto. Gear 56 has axially elongated teeth formed on the periphery thereof and functions as a drive gear, being disposed in continuous meshing engagement with the driven face gear 41.

The speed reducer housing 49 has an annular shoulder or flange 57 formed thereon, which flange is clampingly held between the boss 29 and an internal shoulder formed in the handle 17 for fixedly securing the speed reducer housing 49 in position within the handle. The input shaft 46 is provided with a conventional slotted coupling portion 58 on the free end thereof adapted to engage the output end of a suitable drive mechanism or power source, such as a flexible drive member connected to an air motor, not illustrated.

Considering now the bone drill attachment 12, as illustrated in FIG. 4, same includes a housing assembly 61 which is adapted to be connected to the handpiece assembly 11. The housing assembly 61 has disposed therein first and second clutch assemblies 62 and 63 connected in series with one another, with the second clutch assembly 63 in turn being drivingly connectible to a clutch drive shaft assembly 64. The latter in turn is drivingly connected to a cutter assembly 66.

Referring now to FIGS. 5 and 6, the housing assembly 61 includes a cylindrical extension sleeve 67 having an enlarged upper section 68 of sufficient inside diameter to telescope over the cylindrical hub 26. The extension sleeve 67 is releasably connected to the handpiece casing by a set screw 69 which engages the flat 27 formed on the casing. An elongated cylindrical bushing 71 is secured within the central portion of the extension sleeve 67, as by means of a press fit, and a further annular bushing 72 is secured within the upper end of the extension sleeve 67. The bushings 71 and 72 respectively rotatably support the second and first clutch assemblies 63 and 62.

The first clutch assembly 62 includes a sleeve-like rear clutch element 73 rotatably supported within the bushing 72 and having a tubular shaft 74 fixedly secured, as by being press-fitted, within the interior thereof. The upper end of shaft 74 extends upwardly beyond the clutch element 73 so as to be insertable into the internal recess 37 formed in the end of the drive shaft 32. The upper end of the tubular shaft 74 has a pair of diametrically opposed flanges or ribs 76 extending radially outwardly therefrom and adapted to be slidably received within the elongated straight portions of the slots 39 formed within the drive shaft 32. An ejector pin 77 is slidably supported within and extends through the tubular shaft 74 and has an enlarged stop or abutment 78 fixedly secured to the upper end thereof, with a further abutment 79 being fixedly secured to the lower end thereof. A conventional compression spring 81 is disposed in surrounding relationship to the ejector pin 77 and is confined between the tubular shaft 74 and the lower abutment 79 for normally urging the ejector pin 77 in a downward direction.

The rear clutch assembly 62 also has a pair of clutch projections, namely a pair of diametrically opposed pins 82, fixedly secured to and projecting downwardly from the lower end of the clutch element 73. The pins 82 are adapted to coast with the second clutch assembly 63 for permitting same to be clutchably engaged with and drivingly connected to the first clutch assembly 62. The second clutch assembly 63 includes a sleeve-like front clutch element 83 rotatably supported within the bushing 71 and having a slot 84 extending diametrically across the upper axial end face thereof. An elongated key 86 of substantially rectangular cross section is fixedly positioned, as by being press-fitted,

within the slot 84 and is disposed so as to be normally abuttingly engaged by the lower end of the ejector pin 77 associated with the first clutch assembly 62. The front clutch element 83 has a central opening 87 extending therethrough, the lower end of which is enlarged. A retainer sleeve 88 is disposed within the lower end of the opening 87 and is fixedly secured to the front clutch element 83. An elongated ejector pin 89 is disposed within the opening 87 and is slidably supported by the retainer sleeve 88 and the clutch element 83. Ejector pin 89 is resiliently urged downwardly by a compression spring 91 and projects beyond the retainer sleeve 88. The spring 91 is disposed within the enlarged portion of the opening 87 and is confined between the clutch element 83 and a collar 92 which is fixedly secured to the ejector pin 89 intermediate the ends thereof.

The second clutch assembly 63 also has clutch projections, namely a pair of diametrically opposed clutch pins 93, fixedly secured to and projecting axially downwardly from the lower end of the front clutch element 83. The clutch pins 93 are disposed for clutching engagement with the clutch drive shaft assembly 64.

The clutch drive shaft assembly 64 includes a sleeve-like drive shaft 96 on which is press-fitted a surrounding sleeve 97, which sleeve is rotatably supported within an annular bushing 98. Bushing 98 is stationarily disposed within a surrounding cuplike end cap 99 which is disposed within the lower end of the cylindrical extension sleeve 67 and is fixedly secured thereto, as by a pin 101.

The clutch drive shaft 96 has an annular flange 102 adjacent the upper end thereof, which flange has a slot 103 extending diametrically across the upper axial end face thereof. An elongated key 104 of substantially rectangular cross section is fixedly disposed within the slot, as by being press-fitted therein, and is positioned so as to be abuttingly engaged by the lower end of the ejector pin 89. The clutch drive shaft 96 also has a central opening 106 formed therein, which opening permits reception therein of a portion of the cutter assembly 66.

Considering now the cutter assembly 66, same includes an inner cutter or drill bit 107 and an outer tubular cutter or drill bit 108 rotatably supported on the inner cutter 107. The outer cutter has a small helical slot 109 formed in the sidewall thereof and through which extends a pin, namely a screw 111. The screw 111 is fixedly secured to the inner cutter 107 and extends radially outwardly thereof. The slot-and-pin connection provides the only direct driving connection between the cutters, while it also permits the outer cutter 108 to have a limited rotational and axial displacement relative to the inner cutter 107.

The outer cutter 108 has an annular flange 112 at the rearward end thereof which is adapted to move into abutting engagement with the lower end of the bushing 98, whereas downward movement of the outer cutter 108 is limited by an annular flange 113 which is provided on the lower end of the inner cutter 107, which inner cutter projects axially downwardly beyond the lowermost end of the outer cutter 108. The lower axial end faces of the inner and outer cutters are both provided with cutting edges and surfaces which are conventional and thus further description thereof is not believed necessary.

To permit the cutter assembly 66 to be drivingly connected to the clutch drive shaft assembly 64, the inner cutter 107 is provided with an elongated shank portion which is adapted to be slidably inserted into the opening 106 formed within the clutch drive shaft 96. The upper free end of the inner cutter 107 has a substantial flat formed thereon which results in the formation of an upwardly extending projection 114 having a cross section approximating or slightly greater than half of a cylinder. This projection 114 is adapted to align with and axially overlap a key 116 which is fixedly secured to the drive shaft 96. The key 116 has a cross sectional profile which is substantially equal to or slightly less than half of a cylinder, so that the key 116 and the projection 114 thus substantially comprise a cylinder when overlapped to thus provide a rotatable driving relationship between the shaft 96 and the inner cutter 107. The cutter 107 also has a friction ring 117 disposed in surrounding relationship therewith and positioned for frictionally engaging the inner periphery of the drive shaft 96 for holding the shank of the inner cutter 107 within the drive shaft 96.

OPERATION

The operation of the drilling device 10, particularly when the bone drill attachment 12 has been attached to the handpiece assembly 11, will be briefly described to insure a complete understanding thereof.

Prior to operational use, the bone drill attachment 12 is secured to the handpiece assembly 11 by positioning the large end 68 of the cylindrical extension sleeve 67 over the cylindrical hub 26, the bone drill attachment being secured to the handpiece by the set screw 69. A suitable power source is drivingly connected, as by a flexible power transmitting element, to the coupling portion 58 of the handpiece input shaft 46. This thus provides a power transmitting drive connection between the input shaft 46 of the handpiece and the rear clutch element 73 of the bone drill attachment 12.

After the bone drill attachment 12 has been secured to the handpiece 11, the cutter assembly 66 is disposed in a disengaged or nonrotatable position since all of the clutches in the bone drill attachment are released, being in the position illustrated in FIG. 5. The spring 81 of the first clutch assembly causes the ejected pin 77 to be resiliently urged downwardly so that the lower end of the pin engages the key 86, whereby the ejector pin 77 pushes the second clutch assembly 63 downwardly within the bushing 71 so that the clutch pins 82 are axially spaced and disengaged from the key 86. The ejector pin 89 of the second clutch assembly is also resiliently urged downwardly by the spring 91 so that the lower end of the pin 89 engages the key 104 and pushes the clutch shaft assembly 64 downwardly so that the key 104 is also axially spaced and disengaged from the clutch pins 93. The downward movement of the clutch shaft assembly 64 also causes the inner cutter 107 to be in its lowermost or fully extended position, as illustrated in FIG. 5. The outer cutter assembly 108, being connected to the inner cutter 107 solely by the pin and slot connection 109 and 111, will be disposed adjacent the flange 113 or adjacent the bushing 98, depending upon the orientation of the overall drilling assembly, since the cutter 108 will move axially of the cutter 107 due to the effect of its own weight. The initial position of the cutter 108, when the device is inoperative, is im-

material to the successful operation of the drilling apparatus.

When a drilling operation is to be performed, the drill assembly 10 is positioned, as shown in FIG. 6, so that the lower end of the inner cutter 107 engages the surface of a bone 121, such as a cranial bone. The drive shaft 32 of the handpiece assembly may now be rotated by energizing the external power source which is attached to the coupling portion 58. By pressing downwardly on the handle 17, the cutter assembly 66 is moved upwardly until the outer cutter 108 substantially engages the lower end of the bushing 98. This upward movement of the cutter assembly also causes the clutch shaft assembly 64 to be slidably moved upwardly in opposition to the urging of the spring 91, whereby the ejector pin 99 is depressed in an upward direction so that the key 104 thus moves into a position wherein it is disposed between and axially overlaps the clutch pins 93. This thus results in the second clutch assembly 63 and the clutch shaft assembly 64 being substantially nonrotatably interconnected. Downward pressing on the handle 17 also causes the second clutch assembly 63 to be moved upwardly toward the first clutch assembly 62 in opposition to the urging of the spring 81, whereby ejector pin 77 is thus depressed to permit the key 86 to be positioned between and in axially overlapping relationship with the clutch pins 82. This thus results in the first clutch assembly being nonrotatably and drivingly connected to the second clutch assembly. Since the first clutch assembly is in turn nonrotatably connected to the drive shaft 32 due to the engagement of the flanges 76 within the bayonet slots 39, the rotation of the drive shaft 32 is thus transmitted to the inner cutter 107 causing rotation of same. The pin 111 secured to the cutter 107 in turn causes a corresponding rotation of the outer cutter 108.

When the drilling operation is being performed on the bone 121, the bone drill attachment is disposed in driving engagement substantially as illustrated in FIG. 6. Since the inner cutter 107 extends below the outer cutter 108, the inner cutter performs the initial cutting operation and results in the formation of a hole of a predetermined diameter, which hole is then subsequently enlarged by the rotation of the outer cutter 108. The hole is thus drilled in a two-step sequence due to the axial spacing between the inner and outer cutters. The drilling will continue, due to the urging of the operator, until the inner cutter 107 cuts through the bone, as illustrated in FIG. 7. However, the outer cutter 108 has not yet fully cut through the bone 121 and is thus supported on a narrow annular shelf of bone 123. Due to the downward pressure of the operator on the handle 17, and due to the engagement of the outer cutter 108 with the bone shelf 123, a substantial frictional torsional resistance is imposed on the outer cutter 108, whereas substantially no torsional resistance is imposed on the cutter 107 since it has passed through the bone 121. Accordingly, the driving torque imposed on inner cutter 107 causes the pin 111 to engage the side of the slot 109, thereby causing the inner cutter 107 to be cammed downwardly into the position illustrated in FIG. 7, which downward camming of the inner cutter 107 also permits the two clutch connections to be disconnected due to the resilient urging of the springs 81 and 91. The transmission of torque to the inner cutter is thus substantially instantly terminated. Further, since the outer drill bit 108 is still supported on the bone

shelf 123, this thus prevents the inner and outer cutters from being pressed inwardly, thereby preventing an inadvertent puncturing of the meninges 122 which covers the brain.

While the operation as described above results in the disconnection of the inner cutter 107 due to the camming action created by the pin and slot 109 and 111, nevertheless the termination of torque transmission to the inner cutter 107 may also occur due to the urging of the springs 81 or 91. Particularly, when the inner cutter 107 initially cuts completely through the bone 121, the springs 81 or 91 may then possess sufficient force to cause the inner cutter 107 to be extended to thus drivingly disconnect one or both of the clutch connections. Whether the springs cause the actual initial disconnection of the clutch assemblies, or whether the initial downward movement of the cutter 107 is caused by the pin-and-slot arrangement, depends upon the size of the springs and the amount of friction possessed by the overall device. However, it will be readily apparent that the pin-and-slot connection and the clutch springs effectively function as backup systems for one another so that one or the other will initially release, whereupon failure of one of the devices to release will in turn result in the release of the other. Further, while only a single clutch could be provided, the provision of two clutch devices also provides a safety feature in that if one clutch device fails to release, the other clutch device will release to insure stoppage of the drill. The present invention thus provides three disconnectible couplings connected in series to positively insure that the cutting bits will be positively stopped as soon as the inner cutter penetrates the cranial bone to thus prevent puncturing of the meninges which covers the brain.

MODIFICATION

FIG. 9 illustrates therein a modification of the present invention wherein the handpiece assembly 11 of FIGS. 1 and 2 is provided with a wire driving attachment 13 mounted thereon. Particularly, in the illustrated embodiment, the wire driving attachment 13 substantially comprises a conventional Jacobs chuck which has a chuck body 131 rotatably mounted within a sleeve-like body 128 which is mounted on and secured to the cylindrical hub portion 26 of the handpiece casing by a set screw 128. The chuck body 131 supports therein an annular jaw actuating member 132. A plurality of circumferentially spaced and radially movable jaws 133 are mounted within the member 132 and are actuated in a conventional manner for permitting the jaws to be radially moved into clamping engagement with an elongated member, such as an elongated wire 137. The chuck body 131 also has a hollow shaft portion 134 extending from the rearward end thereof, which shaft portion is adapted to extend into the end of the drive shaft 32 and is provided with one or more radially projecting pins 136 thereon which extend into the bayonet slots 39 for nonrotatably connecting the chuck body 131 and the jaws 133 to the drive shaft 32.

In operation of the wire driving device illustrated in FIG. 9, the wire 137, which is generally of an elongated length, is extended through the opening 33 formed in the drive shaft 32 and is clamped by the jaws 133 so that a predetermined length of wire extends outwardly from the jaws. Upon operation of the device, whereupon the rotation of the drive shaft 32 is transmitted to the jaws 133, the wire is operated substantially as a drill

and is rotatably drilled into a bone. After the predetermined length of wire has been drilled into the bone, the chuck is released and the overall device lifted upwardly to permit a further amount of wire to pass through the chuck, whereupon the chuck is then again retightened onto the wire and a further length of wire is then drilled into the bone. This procedure is repeated until the desired length of wire has been inserted into the bone.

Thus, as is apparent from the above-described structure and operation, the handpiece 11 of the present invention, as illustrated in FIGS. 1 and 2, is highly desirable since it can be utilized interchangeably with many different types of attachments, such as the bone drill attachment and the wire driving attachment. Further, while the above description has illustrated the attachments as mounted on one end of the drive shaft 32, it will be readily apparent that all of the attachments could likewise be secured to the handpiece so as to be drivingly connected to the opposite end of the drive shaft 32 (the upper end in FIG. 2), thereby permitting rotation of a tool or driven element in the opposite direction. The desirable handpiece thus is interchangeable in that the attachments can be attached to the opposite ends of the drive shaft to thus permit a driven element to be rotated in opposite directions.

Although a particular preferred embodiment of the invention has been disclosed in detail for illustrative purposes, it will be recognized that variations or modifications of the disclosed apparatus, including the rearrangement of parts, lie within the scope of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a drill assembly having casing means, input shaft means rotatably supported within said casing means, and output shaft means rotatably supported within said casing means and connected to said input shaft means for rotation thereby, the combination comprising:
 a tubular, cylindrical extension on said casing means coaxial with said output shaft means;
 outer cylindrical bit means having a coaxial cylindrical opening extending therethrough, said outer bit means being rotatably supported relative to said extension;
 inner bit means snugly but slidably disposed within said outer bit means, said inner bit means having a workpiece engaging end extending axially beyond the corresponding end of said outer bit means;
 cooperating stop means on said inner and outer bit means permitting limited relative axial movement therebetween;
 engageable clutch means coacting between said inner bit means and said output shaft means and adapted, when engaged, to rotate said inner and outer bit means in response to rotation of said output shaft means; and

said clutch means including first and second disengageable clutch devices drivingly connected in series and each including resilient means normally maintaining same in a released condition, whereby engagement of both of said clutch devices is necessary to permit said inner and outer bit means to be rotated in response to rotation of said output shaft means, engagement of said clutch devices being effected when said end of said inner bit means is pressed firmly against a workpiece.

2. A drill assembly according to claim 1, wherein said casing means includes first and second tubular portions fixedly connected together at right angles to one another, and wherein said input and output shaft means are respectively rotatably supported within said first and second tubular portions and are interconnected by gear means.

3. A drill assembly according to claim 1, wherein said stop means comprises an elongated helical slot in one of said bit means and a pin rigidly secured to and extending radially from the other of said bit means into said slot for permitting only limited axial and rotational movement between said inner and outer bit means, said helical slot being oriented in a direction relative to the rotational direction of said inner bit means for causing said inner bit means to be moved axially for causing disengagement of said clutch means when the external load on said inner bit means is removed but an external load is still present on said outer bit means.

4. A drill assembly according to claim 1, wherein at least one of said clutch devices includes a first annular sleeve member rotatably supported within said cylindrical extension, said first sleeve member having an ejector pin slidably supported thereon for axial movement thereof in a direction substantially parallel with the longitudinal direction of said cylindrical extension, and said resilient means associated with said one clutch device comprising spring means coacting between said first sleeve member and said pin for normally urging said pin outwardly from one end of said first sleeve member, said one end of said sleeve member also having projection means extending axially outwardly thereof; and

said one clutch device also including a second sleeve member rotatably supported within said cylindrical extension and spaced axially of said first sleeve member, said second sleeve member having rib means formed thereon which extends both axially and radially thereof, said rib means extending axially in a direction toward said one end of said first sleeve member, whereby relative axial movement of said first and second sleeve members toward one another in opposition to the urging of said spring means causes said projection means to axially overlap said rib means for providing a torque transmitting connection therebetween.

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