

Sept. 25, 1962

W. W. McKINNEY ETAL

3,055,370

PALLIDOTOMY SURGICAL INSTRUMENT

Filed Nov. 28, 1958

2 Sheets-Sheet 1

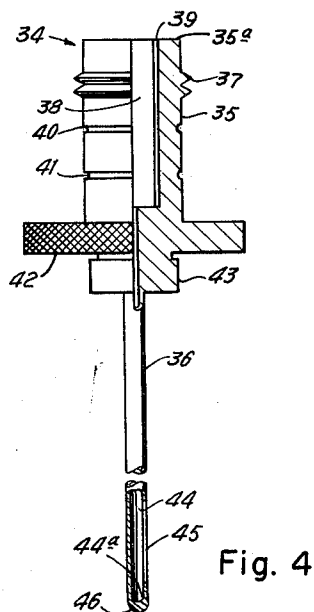


Fig. 4

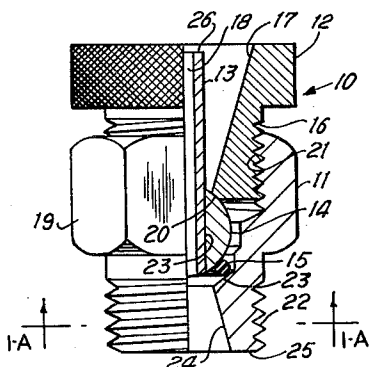


Fig. 1

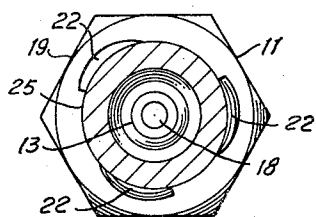


Fig. 1-A

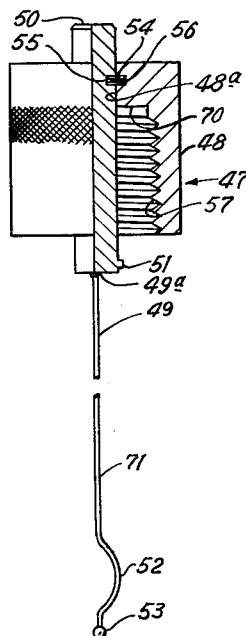


Fig. 5



Fig. 3

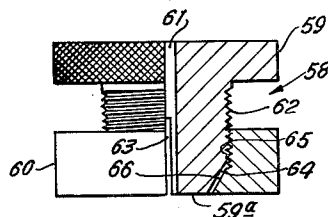


Fig. 6

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2 Sheets-Sheet 2

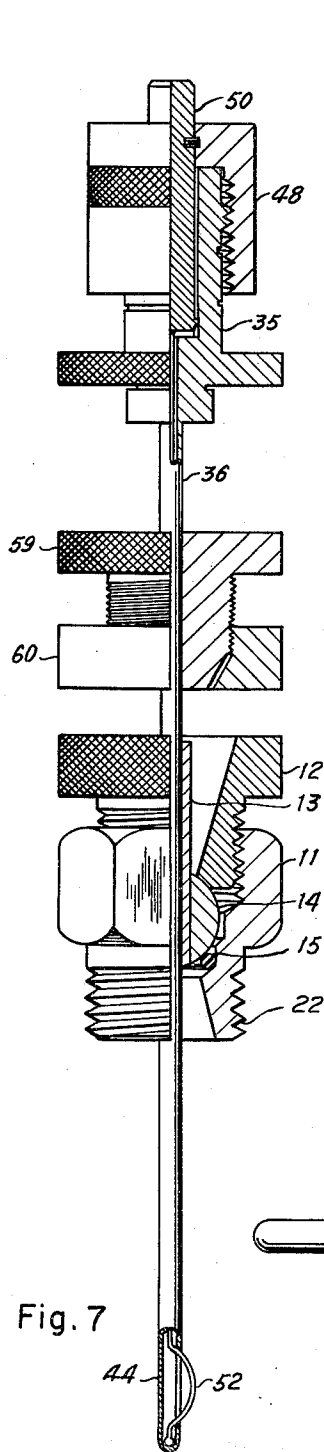


Fig. 7

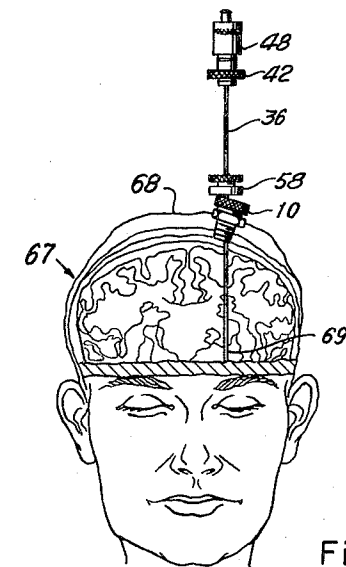


Fig. 8

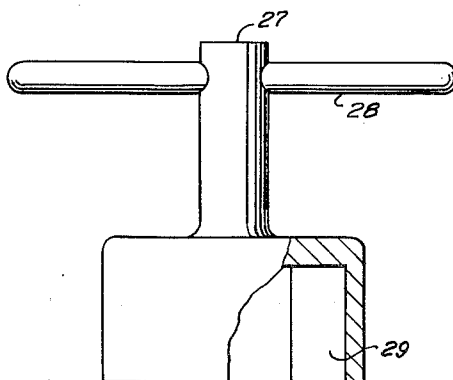


Fig. 2

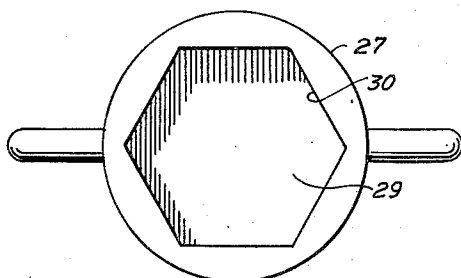


Fig. 2-A

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PALLIDOTOMY SURGICAL INSTRUMENT

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Filed Nov. 28, 1958, Ser. No. 776,992
7 Claims. (Cl. 128-303)

This invention relates to surgical instruments and, more particularly, to such instruments for incapacitating or stimulating a particular portion of a human or animal brain.

In the treatment of some diseases of or defects in the human body, it has been found necessary that a portion of the brain either be rendered ineffective or be electrically stimulated. As a result of his studies concerning and his treatment of people afflicted with Parkinson's disease, Dr. William W. McKinney of Fort Worth, Texas, developed a pallidotomy technique wherein an area approximately one centimeter in diameter in the globus pallidus, or in any other portion of the brain such as the ventrolateral nucleus of the thalamus, is incapacitated by cutting or by using an electrocoagulation technique; also, he developed a similar technique wherein subcortical structures are electrically stimulated. Our invention is concerned with the means by which Dr. McKinney practices these techniques and by which similar or related ones may be practiced.

It is to be emphasized that our invention disclosed and claimed herein is concerned with the means by which Dr. McKinney practices his pallidotomy and stimulation techniques but is not concerned with those techniques per se. While our invention is described with respect to Dr. McKinney's techniques, it is not to be restricted to such usage; rather, in the broadest sense, it is intended that our invention be employed in any case where a portion of a human or an animal brain is to be incapacitated or stimulated.

Accordingly, a principal object of our invention is to provide means for incapacitating or stimulating a particular portion of a brain.

Another object is to provide such means which do not permanently injure any portion of the brain other than the portion desired.

Another object is to provide such means having a first part to be secured to the patient's skull and a second part to be inserted in the patient's brain.

Yet another object is to provide such means which is accurately aligned prior to being inserted in the brain.

Still another object is to provide such means which can be locked in the aligned attitude.

A further object is to provide such means which can neither produce a cutting effect on, nor emit an electrical discharge into, the brain until after it is fully inserted therein.

A still further object is to provide such means which has micrometer-like means for limiting the portion of the brain to be incapacitated or stimulated.

Additional objects will be apparent from a study of the following disclosure and attached claims in conjunction with the drawings, wherein:

FIG. 1 is an elevational view, partially in section, of a needle holder and cranial tap.

FIG. 1-A is a cross-sectional view taken along the plane 1A-1A of FIG. 1.

FIG. 2 is an elevational view of a wrench for manipulating the cranial tap (FIG. 1).

FIG. 2-A is an end view of the wrench.

FIG. 3 is an elevational view of a directional guide bar.

FIG. 4 is an elevational view, partially in section, of a needle.

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FIG. 5 is an elevational view, partially in section, of a stylet.

FIG. 6 is an elevational view, partially in section, of a collet.

FIG. 7 is an elevation view, partially in section, of the assembled stylet, needle, collet, needle holder, and cranial tap.

FIG. 8 is a schematic representation of the means of this invention as it appears when in use.

As shown in FIGS. 1 and 1-A, the needle holder and cranial tap assembly 10, known in combination as the attachment means, is essentially a securing means and an alignment means combined. It is comprised of: cranial tap 11; holder 12 threadedly connected at 21 to tap 11; ball 14 disposed between arcuate surface 20 of the holder, which surface matches the curvature of the ball and O-ring 15 disposed on seat 23 of tap 11; and tubular member 13 which extends through, and is secured at 23 (as by silver soldering) to ball 14 and which has a bore 18. Outwardly and upwardly inclined surface 17 permits the tubular member 13—ball 14 alignment means to be rotated when the force on the ball is diminished by retracting holder 12 from tap 11. This, of course, permits the direction of the longitudinal axis of bore 18 to be changed within the limits imposed by surface 17. In like manner outwardly and downwardly inclined surface 24 permits the direction of the longitudinal axis of an instrument extending through bore 18 to be changed, which would not be the case were the upper and lower ends of surface 24 equidistant from the longitudinal axis of top assembly 10. The tap is externally threaded at 22, the threads being of the interrupted type for ease in securing the tap in a patient's skull, as explained herein-after. Surface 19 of the tap is hexagon-shaped in order that it may be engaged by a wrench, as explained hereinbelow; of course, it could be square or of any other shape provided a wrench is provided for engaging it.

Wrench 27, shown in FIGS. 2 and 2-A, is a conventional lug wrench having arms 28 by which it is rotated. Recess 29 of the wrench, opening downwardly, has a hexagon-shaped wall 30 for engaging surface 19 of the tap and for rotating the tap as arms 28 are rotated.

Directional guide-bar 31 (FIG. 3) is a cylindrical member having a reduced-diameter lower portion 32 and a downwardly-facing shoulder 33. The diameter of portion 32 is such that it can be inserted in tubular member 13. When the guide-bar is so inserted, shoulder 33 abuts the upper end of the tubular member and prevents the lower end of the guide bar from extending below lower end 25 of tap 11.

Needle 34 (FIG. 4) is comprised principally of tubular body 35 and tube 36 connected by a flanged portion 43, which serves to strengthen the connection. (Tube 36 either is fabricated from an electrically non-conductive material or is coated with such material.) Bore 38 of the body communicates with upper end 35A of the body and with bore 44. Longitudinal slot, or keyway, 39 in the internal surface of the wall of the body extends the length of bore 38. The body is externally threaded at 37 near its upper end and has external, annular grooves, such as 40 and 41, accurately located with respect to upper end 35A. Flange 42 serves as a handle for the needle. Bore 44 extends downwardly to the closed lower end 46 of the tube, and communicates with longitudinal slot 45 in the tube wall. This slot has a predetermined length and is accurately, angularly located in the tube with respect to keyway 39. The lower face of the slot is accurately located above lower end 46 of the tube.

Stylet 47 (FIG. 5) is comprised principally of adjusting means 48, cylindrical body 50, and wire, or cutting, means 49. The adjusting means is internally threaded at 57, for engaging threads 37 of needle 34, has a longitudi-

nal bore 48A, and a downwardly-facing shoulder 70. In the wall of bore 48A the adjusting member has an annular groove 56, the purpose of which will be noted subsequently. Cylindrical body 50 is an elongate member having an external, annular groove 55, in which a snap ring 54 may be disposed, and an external key, or boss, 51 integrally connected to it near its lower end. Wire means 49 may be connected either integrally or fixedly (e.g., as by welding) at 49A to body 50. The wire means has a permanent crimp, or curved portion, 52 near its enlarged, lower end 53 to cause it to bend at 52 in a predetermined direction when a longitudinal, compressive load is placed on it. Means 49 may be a highly tempered wire. Curved portion 52, the longitudinal axis of means 49, and key 51 are in the same plane. Wire means 49 may be comprised of two sections (not shown), the first of which is tubular and is secured at 49A to body 50, and the second of which is inserted (at approximately point 71) in the lower end of the first section, which is then crimped to securely connect the two. In this way the second section will not be affected by the heat required to secure the first section to body 50.

To prepare stylet 47 for use, snap ring 54 is held in groove 55 and cylindrical body 50 is inserted in bore 48A to the position shown. At this time the snap ring flexes outwardly until it is contained in both of grooves 55 and 56, its diameter being greater than the depth of groove 56. In this way the cylindrical body is caused to move longitudinally with the adjusting means, but one can be rotated relative to the other when the other is secured in a fixed position. When it is desired to remove body 50 from the adjusting means, the latter is held fixedly and an excessively large force is applied to the body to cause the snap ring either to fail in shear or to be deformed.

In use cylindrical body 50 is inserted in bore 38 of body 35, which action, of course, positions wire 49 in bore 44. At this time, enlarged end 53 of wire 49 is positioned inwardly of slot 45 and cannot escape through the slot since its diameter is greater than the width of the slot. Also, key 51 is positioned in keyway 39 which prevents body 50 from rotating with respect to body 35 when adjusting means 48 is so rotated. When the lowermost thread 57 engages the uppermost thread 37, enlarged end 53 abuts lower end 44A of bore 44. As adjusting means 48 is threaded downwardly on body 35, curved portion 52 commences to be forced outwardly through slot 45, this being due to the fact that key 51 is contained in keyway 39 and that stylet body 50 and wire means 49 cannot rotate with respect to tube 36. The lengths of means 49 and bore 44 are such that the distance from the longitudinal axis of bore 44 to the outermost point of curved portion 52 (extending through slot 45) is a predetermined value when the lower end of adjusting means 48 and groove 40 are indexed; and another predetermined value obtains when said lower end and groove 41 are indexed. (When this latter situation occurs, upper end 35A of needle 34 abuts shoulder 70 of adjusting means 48, and curved portion 52 cannot be forced farther outwardly.) It follows that, when curved portion 52 is fixed in one of these positions and then needle 34 and stylet 47 (termed, in combination, the "operator means") are rotated in unison, the locus of the various positions occupied by curved portion 52 will enclose a volume having a prescribed boundary.

Collet 58 (FIG. 6) is comprised of collet body 59 and nut 60. The nut is internally threaded at 65 for engaging external threads 62 of the collet body and has a longitudinal bore with a wall 66 formed by the removal of a frusto-conical section therefrom. Its upper portion being externally flanged, the collet body has a longitudinal bore 61 and a lower, frusto-conically-shaped external portion 64. A plurality of longitudinal slots 63 spaced around the collet body extends from its lower end upwardly into threaded portion 62 to form a plurality of downwardly extending collet arms 59A which can be forced inwardly

with respect to the main portion of the collet body. After the collet body is threaded into the nut and surface 64 engages surface 66, collet arms 59A will be forced inwardly by the camming action of surfaces 64 and 66 when the collet body is advanced farther into the nut. In this way any member (e.g., tube 36 of needle 34) extending through bore 61 can be secured or locked therein.

In a modification of the invention, cylindrical body 50 (FIG. 5) may be fabricated from an electrically non-conductive material which has properties in tension and compression similar to steel. In this case wire means 49 is lengthened, and its upper end passes upwardly through the center of and is bound securely to body 50. Also, in this case either tube 36 is made from an electrically non-conductive material or the wall of bore 44 is lined with such material. Thus, when curved portion 52 protrudes through slot 45 (as in FIG. 8), an electrical current can be passed from the wire means' upper end, through wire means 49, and out curved portion 52 into the patient's brain.

In practice, after a trephine opening of the desired size is made in the correct location through the patient's skull 68 (FIG. 8) with a D'Errico type drill, or similar instrument, cranial tap 11 is threadedly inserted in the skull with wrench 27. With the flange adjacent the upper end of holder 12 sufficiently small to be inserted in recess 29 of the wrench and with recess 29 sufficiently deep, holder 12 and tap 11 may be assembled to form attachment means 10 prior to insertion of tap 11 in the skull; otherwise, after tap 11 is so inserted, O-ring 15 and the ball 14—tubular member 13 alignment means are inserted in the tap and, then, holder 12 is threaded therein, as previously explained.

After the trephine opening is made but before the tap is secured in the skull, the exposed dura is cut in a stellate manner, the cortical vessels are coagulated, and the arachnoid is nicked to facilitate introduction of tube 36 into the brain.

After the wrench is removed from tap 11, lower portion 32 of the guide bar is placed in tubular member 13 to set the direction and adjustment of the alignment means. Now, the bar is aligned with the inner canthus of the eye and the external auditory canal. Next X-rays are taken in the fore-and-aft (AP) and lateral positions, and the line of the bar is projected downwardly by a ruler both in the fore-and-aft (AP) and lateral positions, so that the direction of the needle (tube 36) can be determined before it is inserted. When the direction of the longitudinal axis of the tubular member is determined to be satisfactory, holder 12 is threaded farther into tap 11 to force surface 20 against ball 14 and ball 14 against O-ring 15, which locks tubular member 13 in the previously determined attitude. Guide bar 31 is removed from the tubular member which is now ready to receive tube 36.

After collet 58 is positioned and locked on tube 36 at a point just below flange 43, wire means 49 and cylindrical body 50 are inserted in bores 44 and 38, respectively, as previously explained, to the point where enlarged end 53 abuts surface 44A and threads 37 and 57 have just engaged. When so assembled, curved portion 52 of member 49 does not protrude through slot 45, although it is aligned with the slot since key 51 is disposed in keyway 39.

Now, tube 36 is inserted in tubular member 13 "until one can feel the resistance of the cortex," as explained by Dr. McKinney. The collet is now unlocked, moved downwardly on the tube, and then locked at the desired position thereon for abutting holder 12, eventually, to prevent the tube from penetrating the brain to a depth greater than desired. (Dr. McKinney states that in his experience this depth is approximately seven centimeters.) The collet is unlocked and locked on the tube, as explained hereinbefore, by decreasing the advance of collet

body 59 in nut 60 and by increasing this advance, respectively.

Following the teachings of Dr. McKinney further, "the needle tube 36 is then inserted into the brain until collet nut 60 is resting on the holder 12. If the needle tube passes through the ventricle, I do not feel that any damage is done, and I do not think this has to be considered. If the position is satisfactory, one may proceed to stimulate by placing an active electrode on body 50 or on the upper end of wire means 49 extending through body 50 (depending on the type of structure being employed, as explained above), or the cutting operation may be performed."

If the cutting technique is to be used, curved-portion 52 is extruded through slot 45 by rotating adjusting member 48 with respect to needle body 35, as explained hereinabove. The exact position of the curved-portion can be determined, after being extruded, by taking X-rays. In practice it has been found more satisfactory to isolate the desired portion as follows: First, extrude curved-portion 52 to the desired extent to produce a radial cut and retract it to its original position in tube 36; secondly, rotate needle 34 (and, hence, stylus 47) 90 degrees, and extrude and, then, return the curved-portion to its original position as in the first step; thirdly, perform the second step at 180 degrees and, then, at 270 degrees from the cut made in the first step; and, fourthly, commencing at the fourth cut with the curved-portion extruded as when these four radial cuts were made, continue rotating needle 34 (and stylus 47) so as to cut each quadrant. It has been found more satisfactory to cut each quadrant twice before proceeding to the next quadrant. Dr. McKinney says: "It is my impression that one is much less apt to produce a hemorrhage if this technique is followed, that is, by making radial cuts. After the radial cuts have been completed, it has been my experience that one can turn the completely extruded curved-portion through a 360 degree turn without any resistance; however, I have found that if I attempt to turn the curved-portion prior to (making) the radial cuts, there is a very definite resistance and I believe that one is much more apt to produce hemorrhage by coring without radial cuts."

If desired, electro-coagulation can be accomplished with the extruded curved-portion, and the only part that will coagulate is the curved-portion, the exterior of tube 36 also being coated with a non-conductive material.

On completion of the cutting or coagulation, the curved-portion is retracted into tube 36 and needle 34 is removed from holder 12. After tap 11 is removed from the trephine opening, a non-toxic burr hole cover (e.g., a polyethylene cover) is placed therein. The incision in the patient's scalp is then closed in the usual manner.

From the foregoing, it is seen that a surgical instrument has been provided for positively incapacitating or stimulating a preselected portion of a human or animal brain, and, furthermore, that the incapacitating operation may be accomplished by either a cutting or an electrical method.

It is seen further that this surgical instrument is comprised of two primary assemblies which operate in unison. The first of these assemblies, an attachment means, is connected to the patient's skull in a prepared opening therein and, then, is aligned relative to the preselected portion of the patient's brain to be incapacitated. The second of these assemblies, the operator means, is inserted into the brain through the attachment means and, then, either is rotated relative to the brain to incapacitate the preselected portion or is incorporated in an electrical circuit to incapacitate or to stimulate the preselected portion.

It is to be understood that the form of the invention shown and described is to be taken as a preferred embodiment of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to

without departing from the spirit of the invention or the scope of the attached claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. Surgical means for use in operating on a human brain, including: tap means to be secured in a prepared opening in the skull enclosing said brain; holder means, secured in said tap means, having tubular alignment means to be locked in a predetermined attitude therein; needle means contained in and engaged by said holder means having tube means, with a longitudinal slot adjacent its lower end, to be inserted in said brain, and having a tubular body, connected to said tube means, with an internal keyway extending the length of its bore and oriented with respect to said slot; and stylet means, connected to and movable longitudinally on said needle means, having wire means disposed in said tube means, said wire means having a curved portion extending through said longitudinal slot for incapacitating a preselected portion of said brain, said stylet means having a key disposable in said keyway for orienting said curved portion with respect to said slot.

2. The surgical means of claim 1 and rotation means on said needle means incapacitating said preselected portion after rotating said needle means relative to said brain.

3. The surgical means of claim 1 including collet means securable on said tube means for limiting penetration of said brain by said tube means.

4. Surgical means for use in operating on a brain enclosed in a skull, including: tap means connectable to said skull in a prepared opening therein; tubular holder means, secured in said tap means, having tubular alignment means to be locked in a predetermined attitude therein when its longitudinal axis is directed toward a preselected portion of said brain; needle means contained in and engaged by said holder means having tube means, with a longitudinal slot adjacent its lower end, to be inserted in said brain through said alignment means, and having a tubular body, connected to said tube means, with an internal keyway extending the length of its bore and angularly oriented with respect to said slot, said tubular body having external threads; and stylet means, having internal threads engaging said tubular body external threads and movable longitudinally on said needle means, having wire means disposed in said tube means, said wire means having a curved portion extending through said slot, when said stylet means is moved downwardly on said needle means, for incapacitating said preselected portion of said brain, said stylet means having a key disposable in said keyway for orienting said curved portion with respect to said slot.

5. The surgical means of claim 3 and rotation means on said needle means incapacitating said preselected portion after rotating said needle means relative to said brain.

6. The surgical means of claim 3 wherein said stylet means has: adjusting means connected to and movable longitudinally of said needle means; a cylindrical body extending through said adjusting means into said tubular body, connected to said adjusting means for longitudinal movement therewith, and having key means extending into said keyway for causing rotation of said cylindrical body with said tubular body; said wire means extending from said cylindrical body and said curved portion being angularly oriented with respect to said key.

7. The surgical means of claim 3 wherein said stylet means has: adjusting means connected to and movable longitudinally of said needle means and internally flanged adjacent its upper end; a cylindrical body extending through said flange into said tubular body, connected to said adjusting means for longitudinal movement therewith, and having key means extending into said keyway for causing rotation of said cylindrical body with said tubular body; said wire means extending from said cylindrical body into said tube means and said curved portion protruding through said slot into said brain, when said

key means is positioned adjacent the lower end of said keyway, for incapacitating said preselected portion of said brain when said needle means is rotated relative to said brain, said curved portion being angularly oriented with respect to said key.

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