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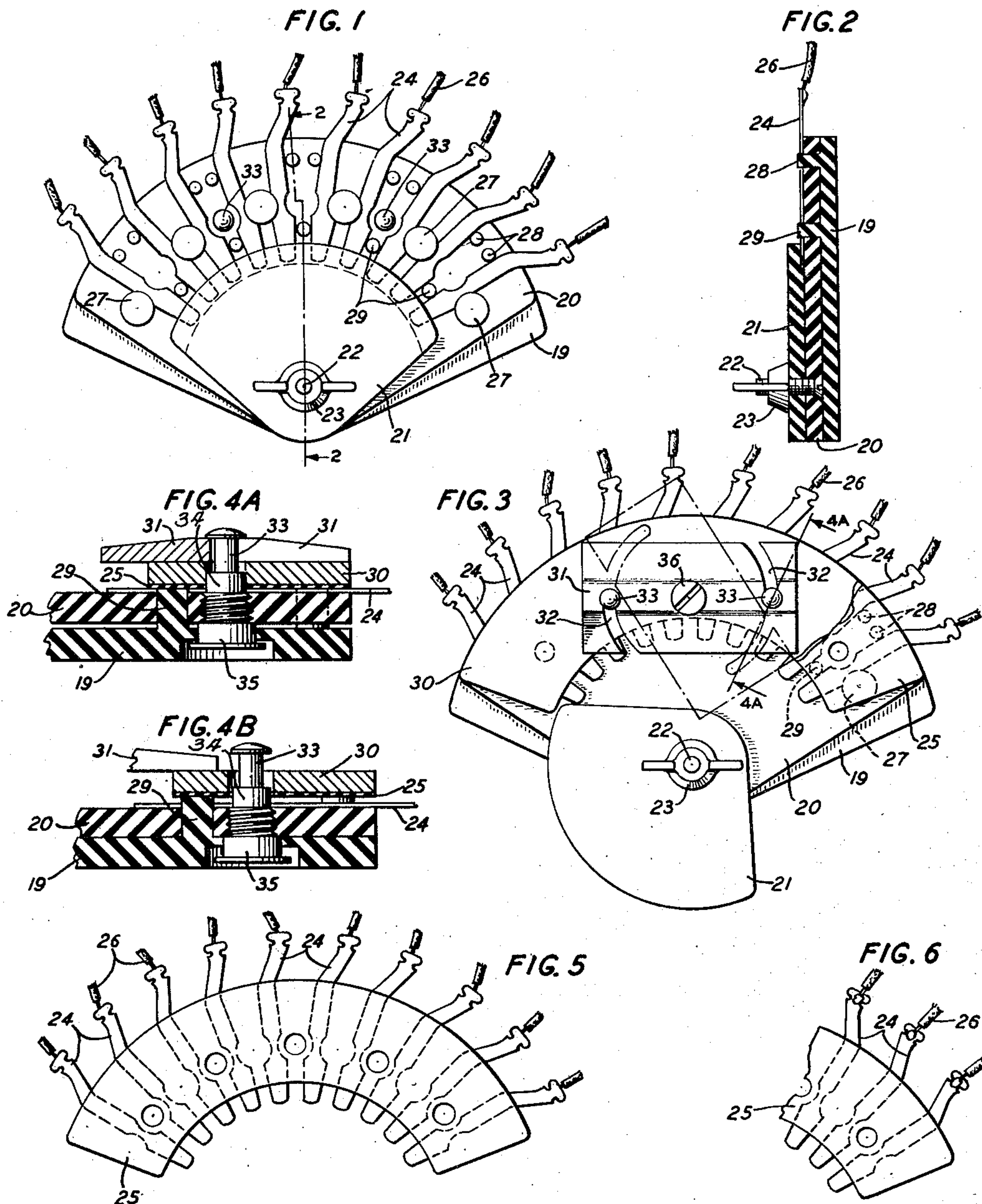
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2,528,424

TOOL FOR USE IN REPLACING INSULATORS IN SWITCH BANKS

Filed Aug. 4, 1948

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

FIG. 7

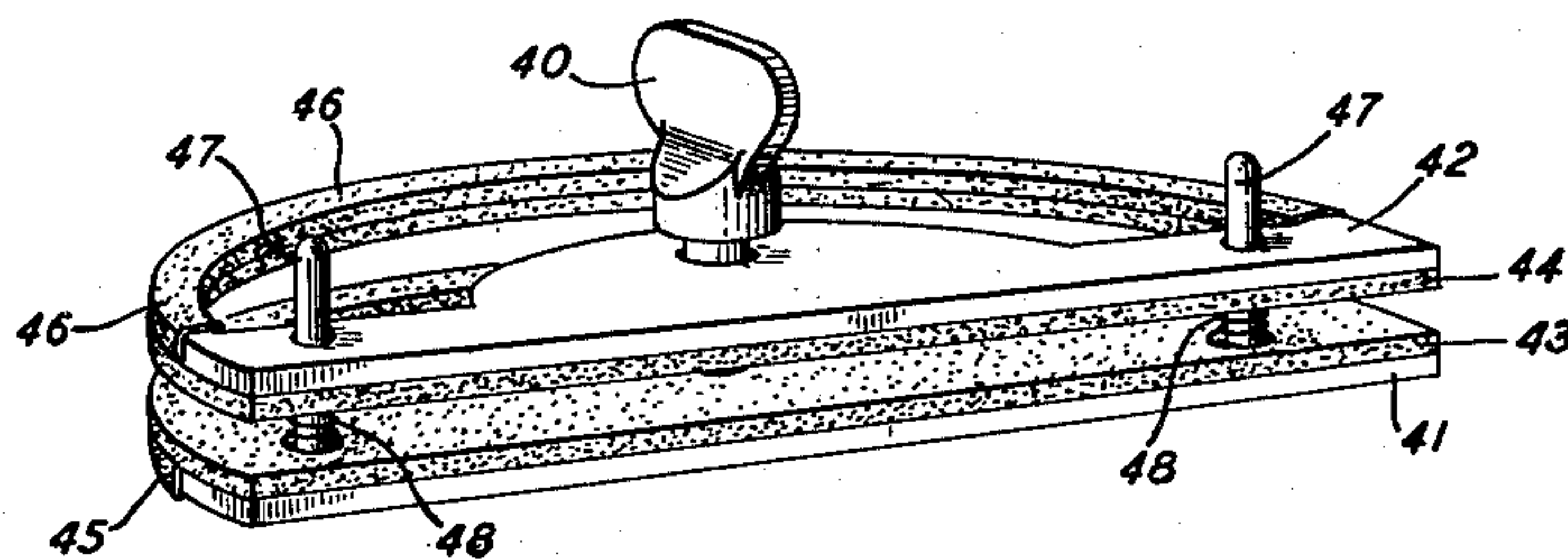


FIG. 8

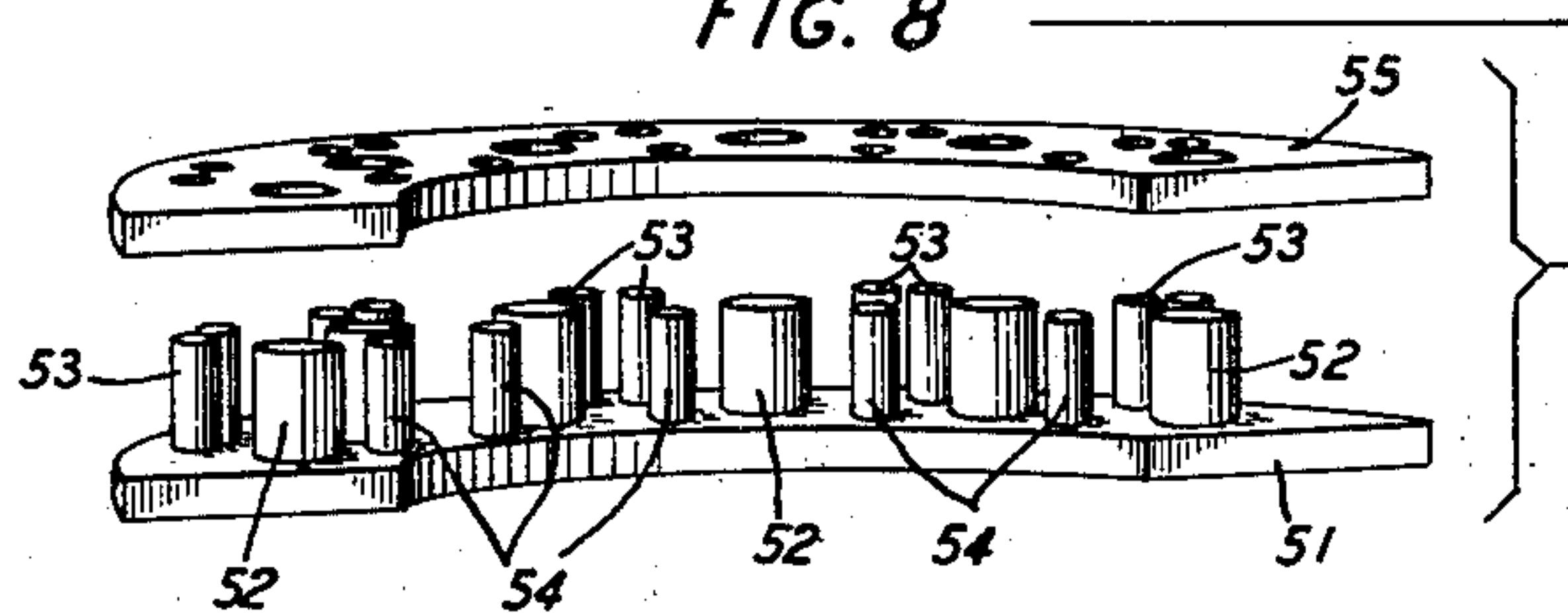
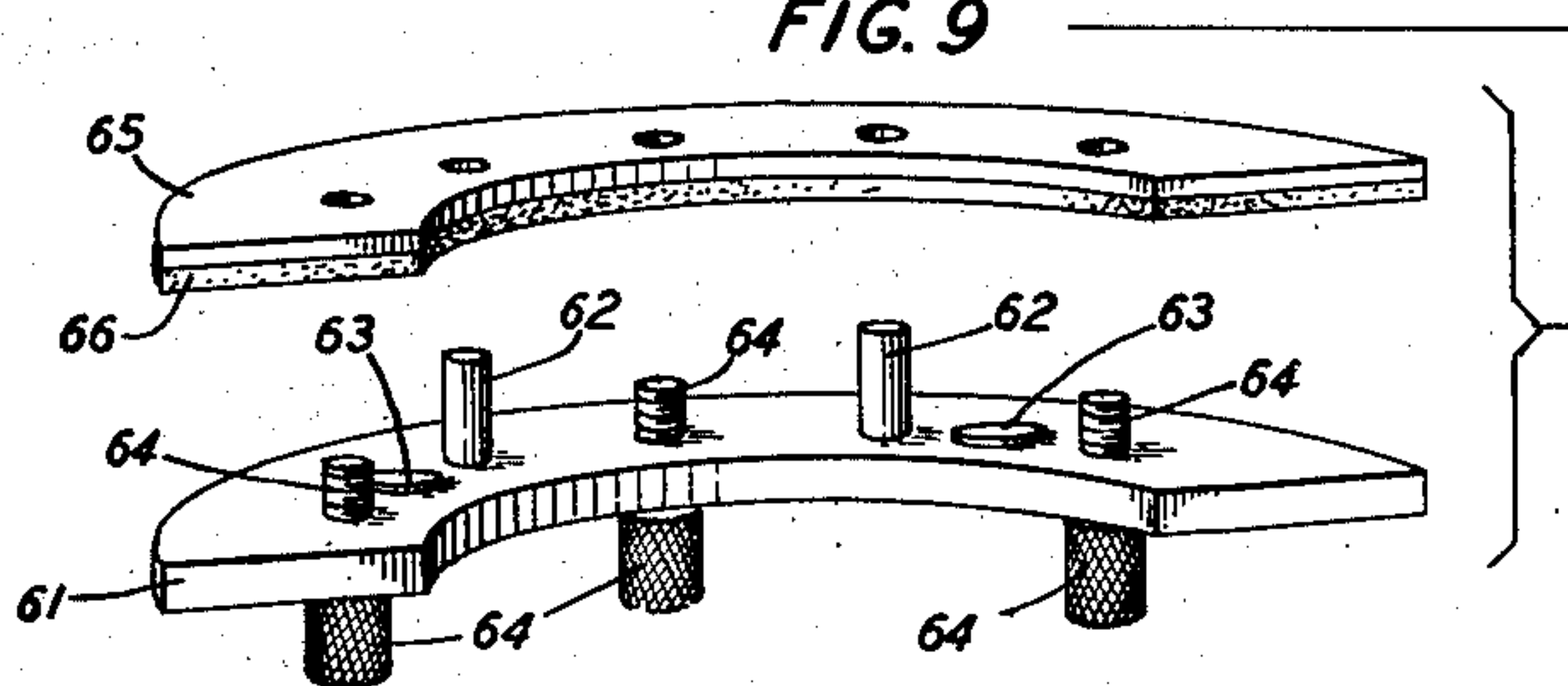


FIG. 9



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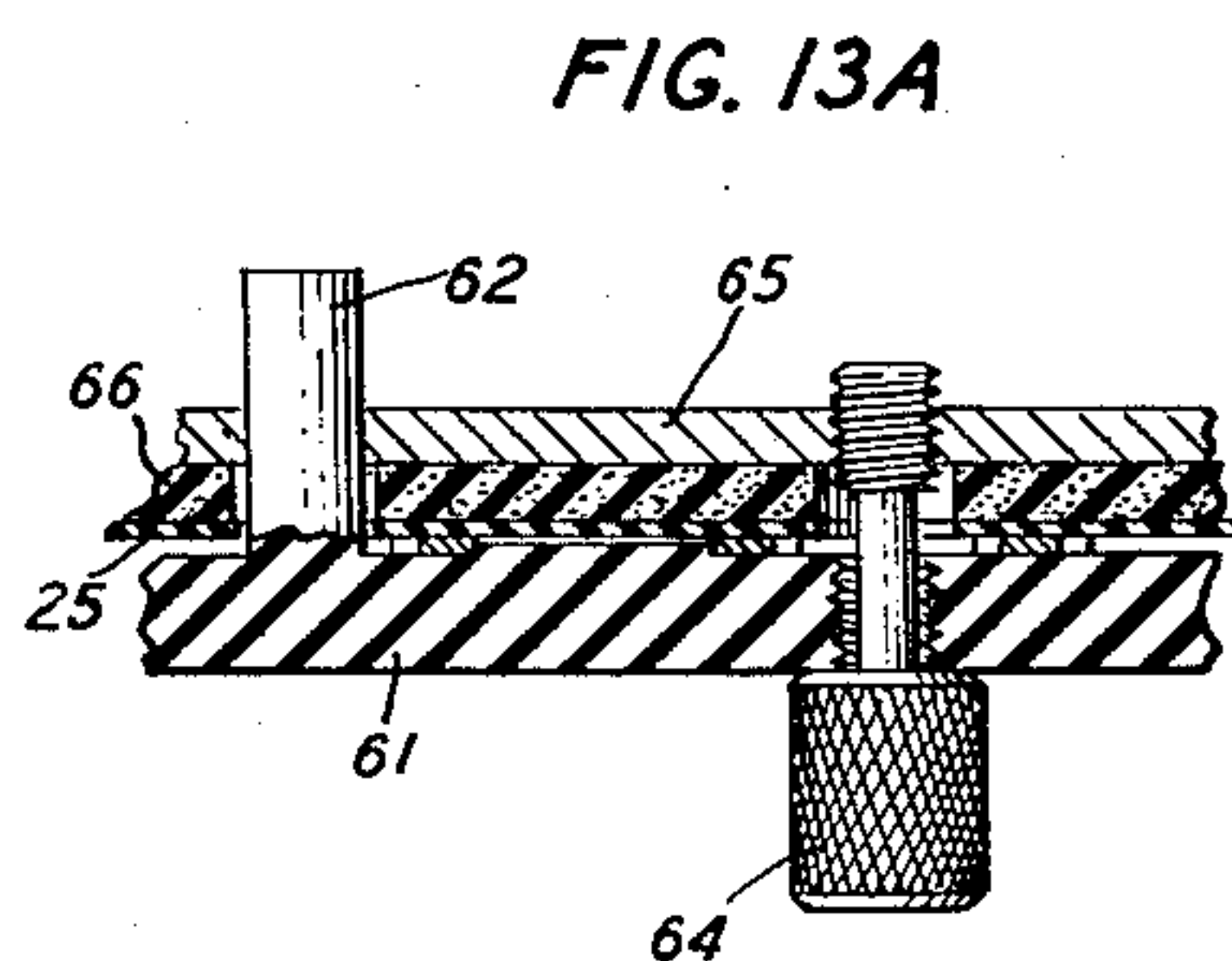
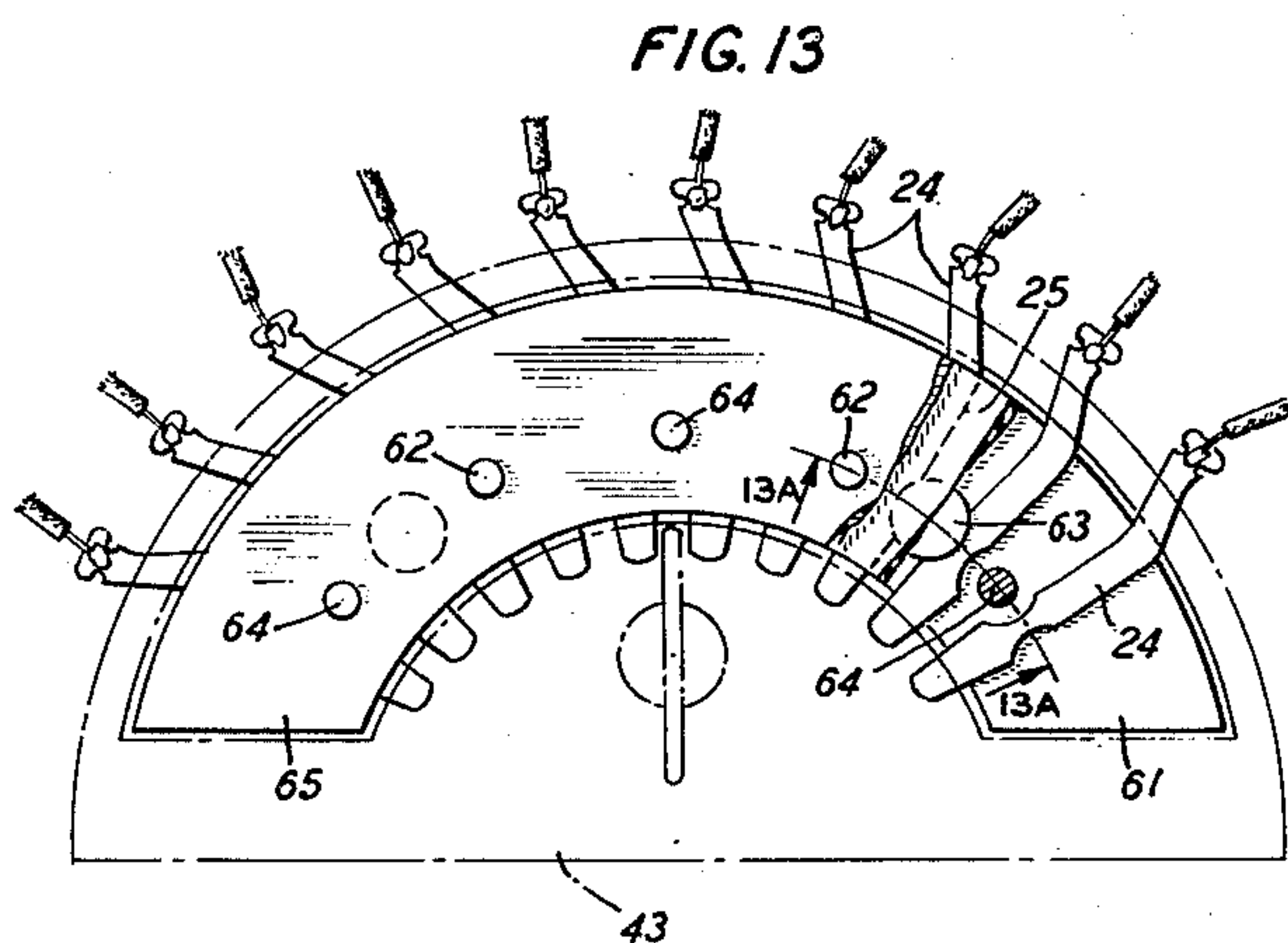
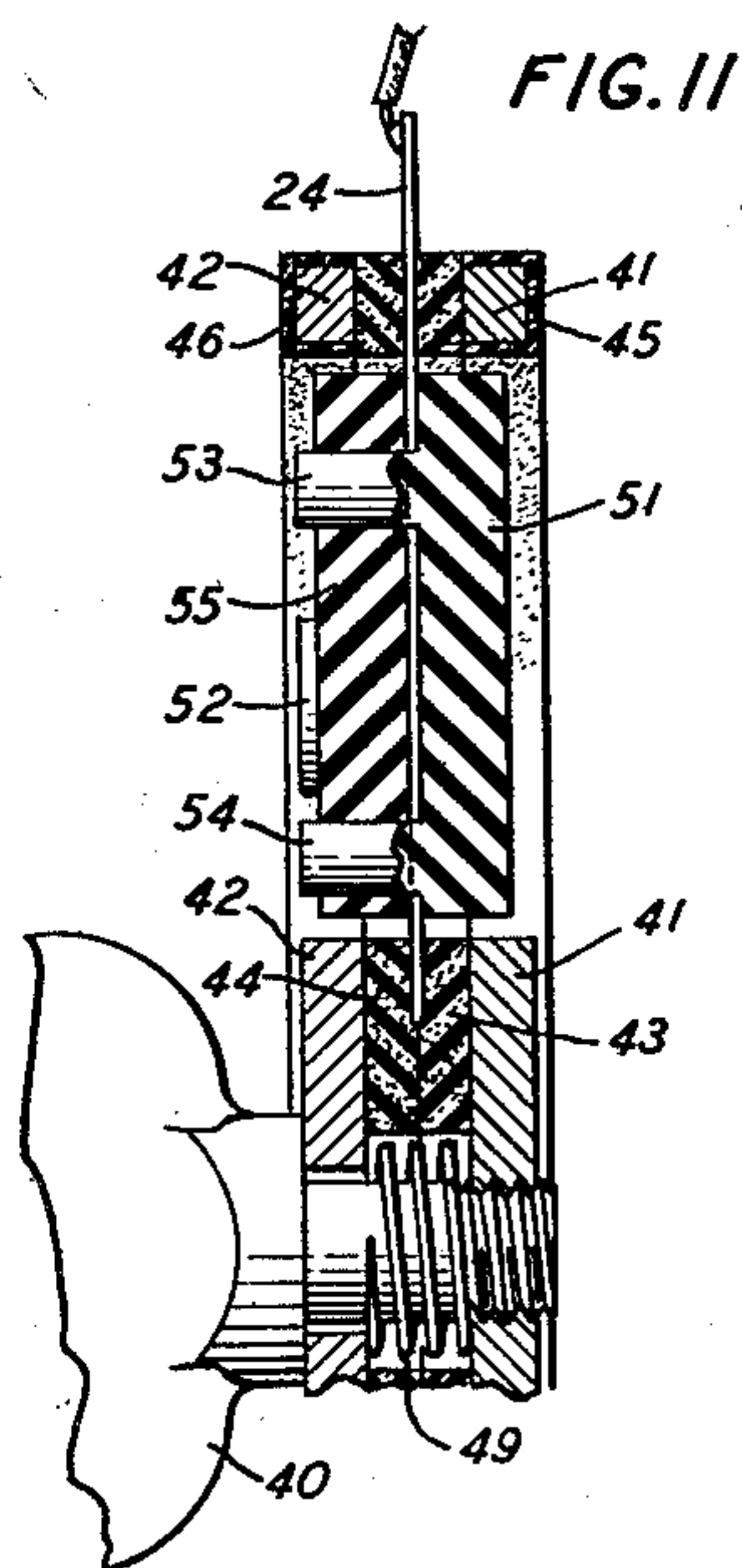
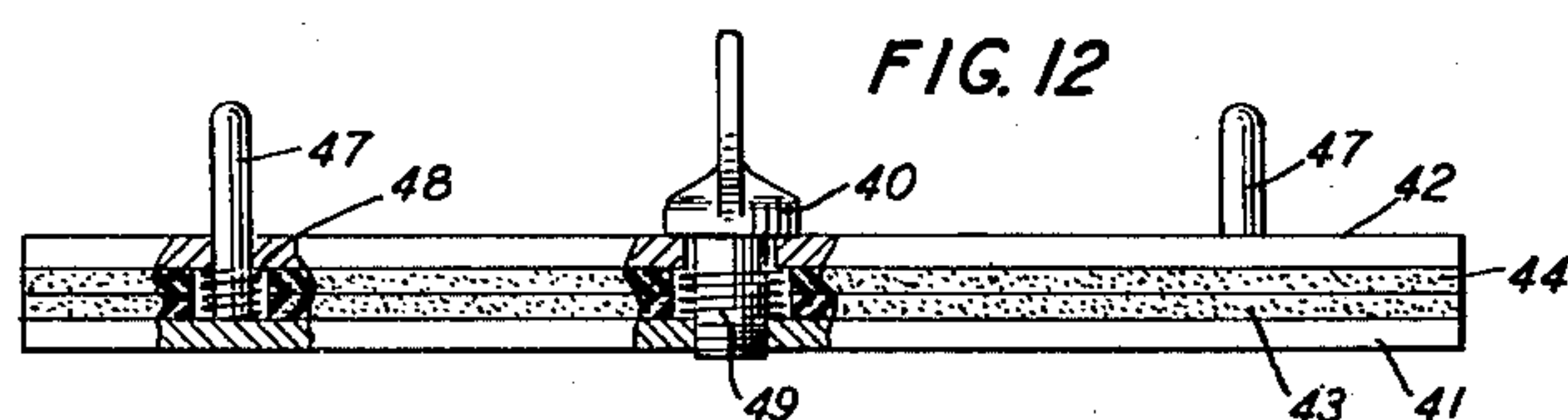
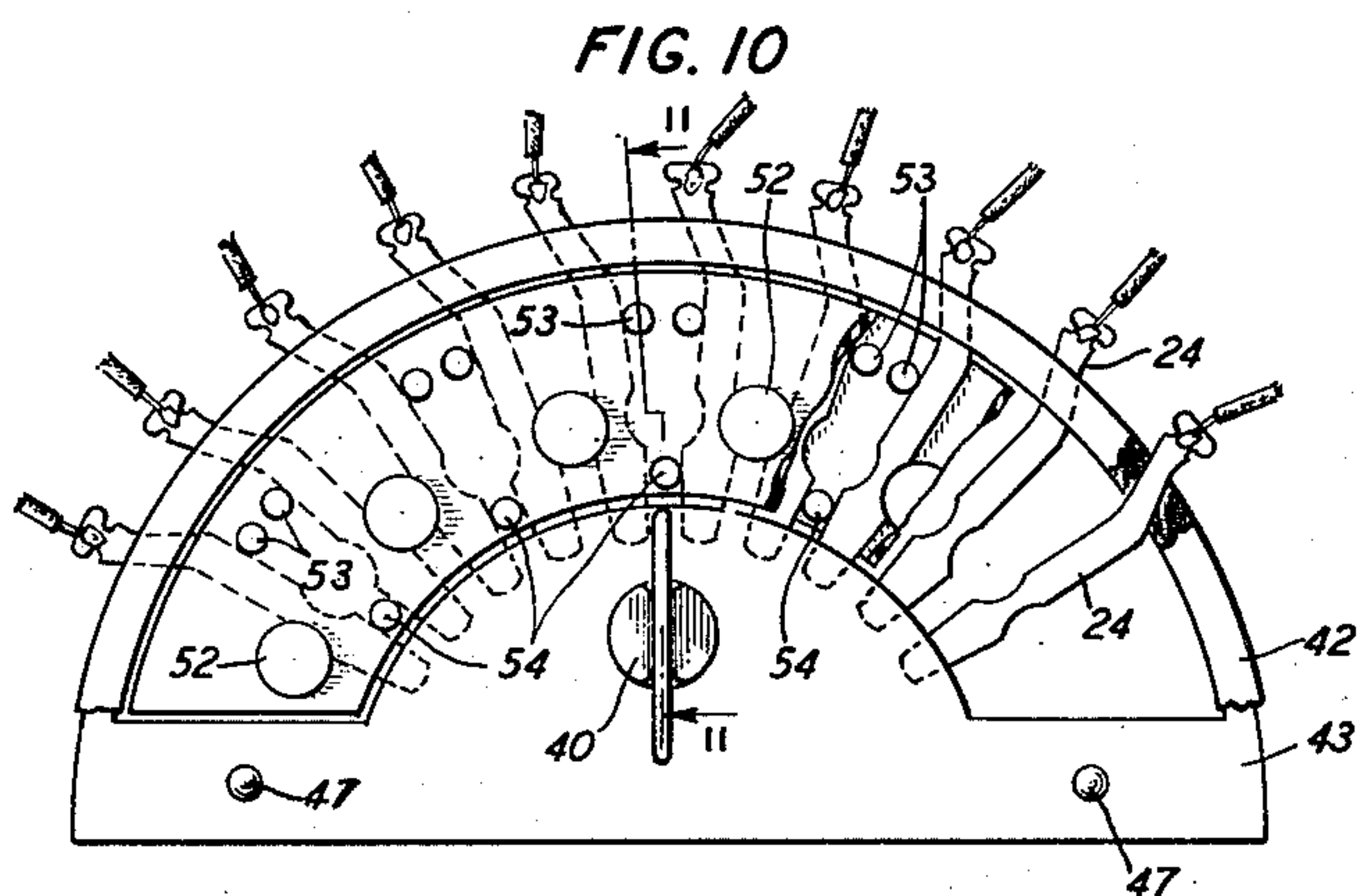
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TOOL FOR USE IN REPLACING INSULATORS IN SWITCH BANKS

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4 Sheets-Sheet 3



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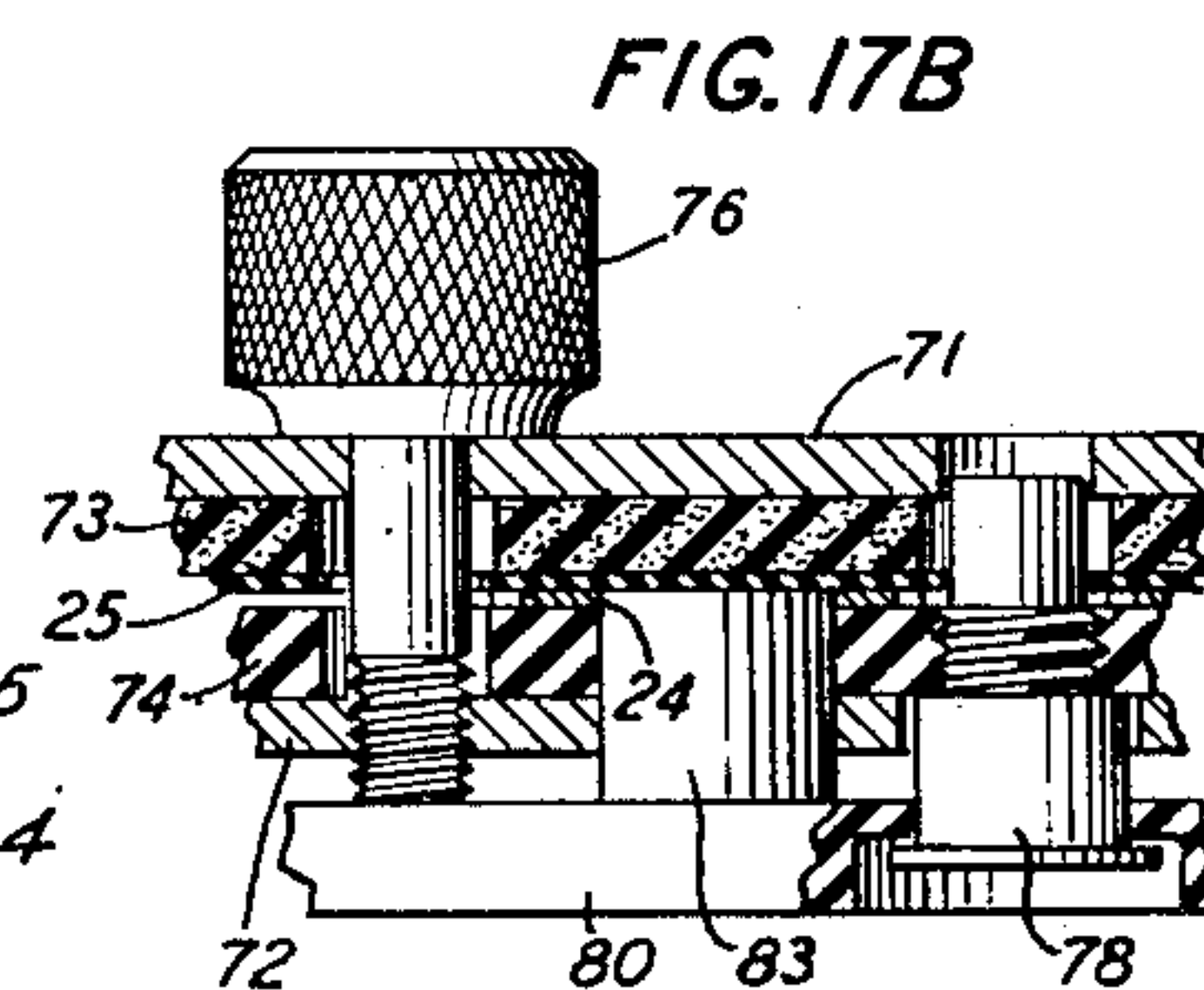
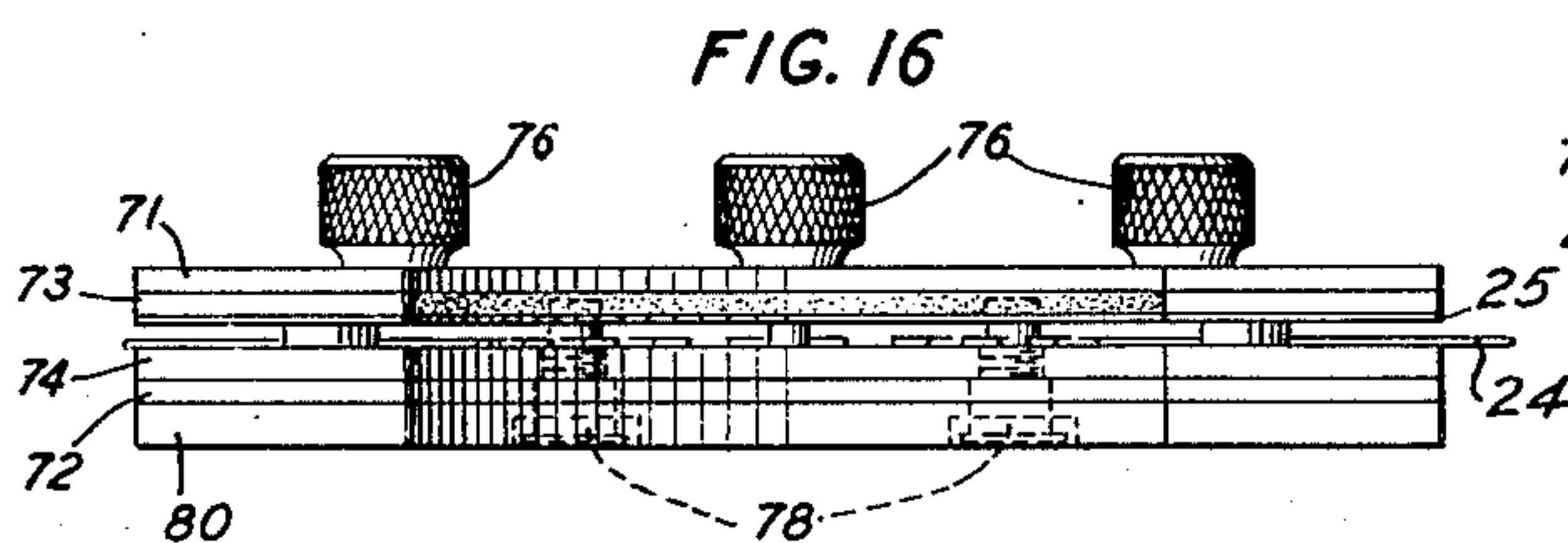
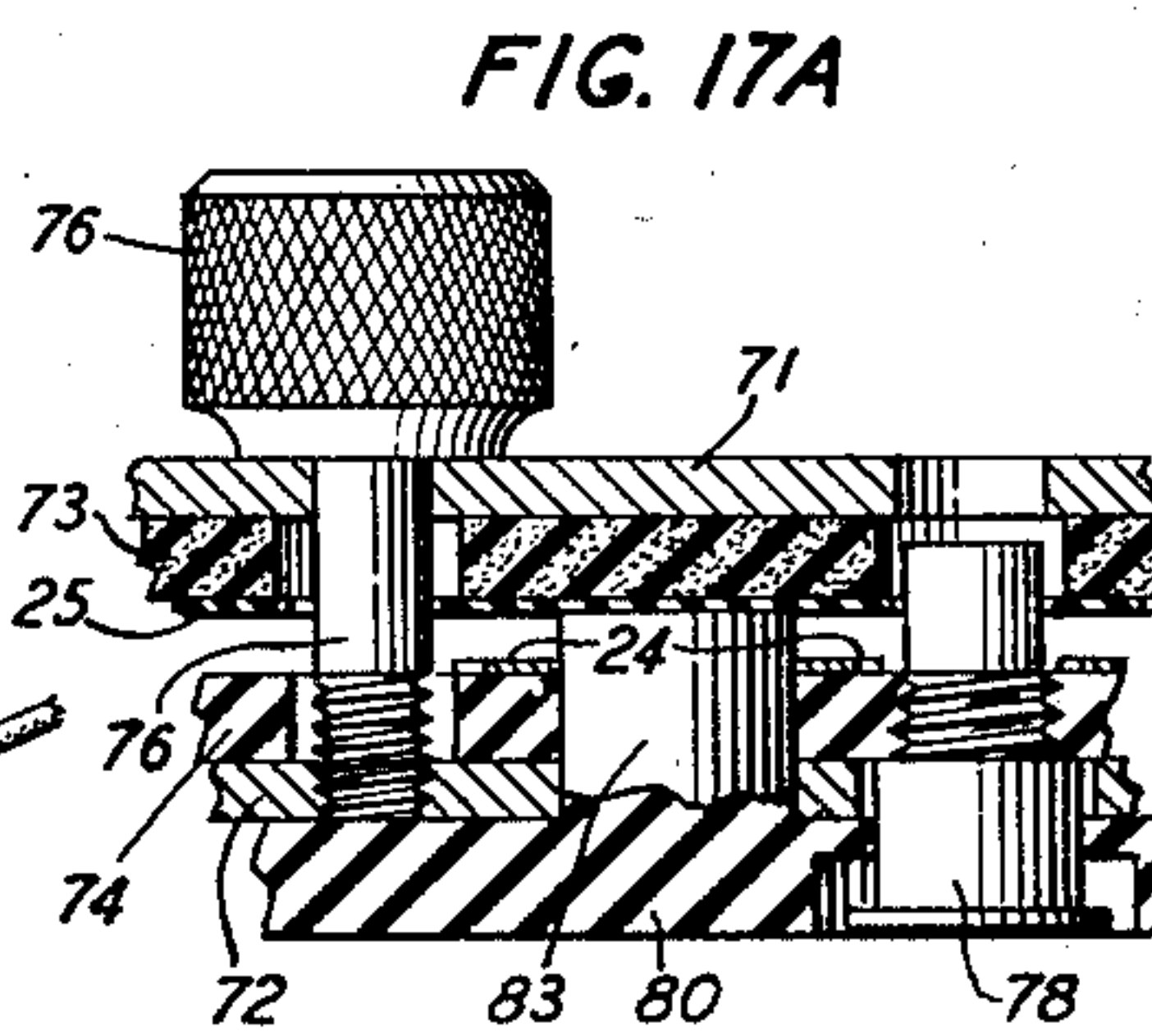
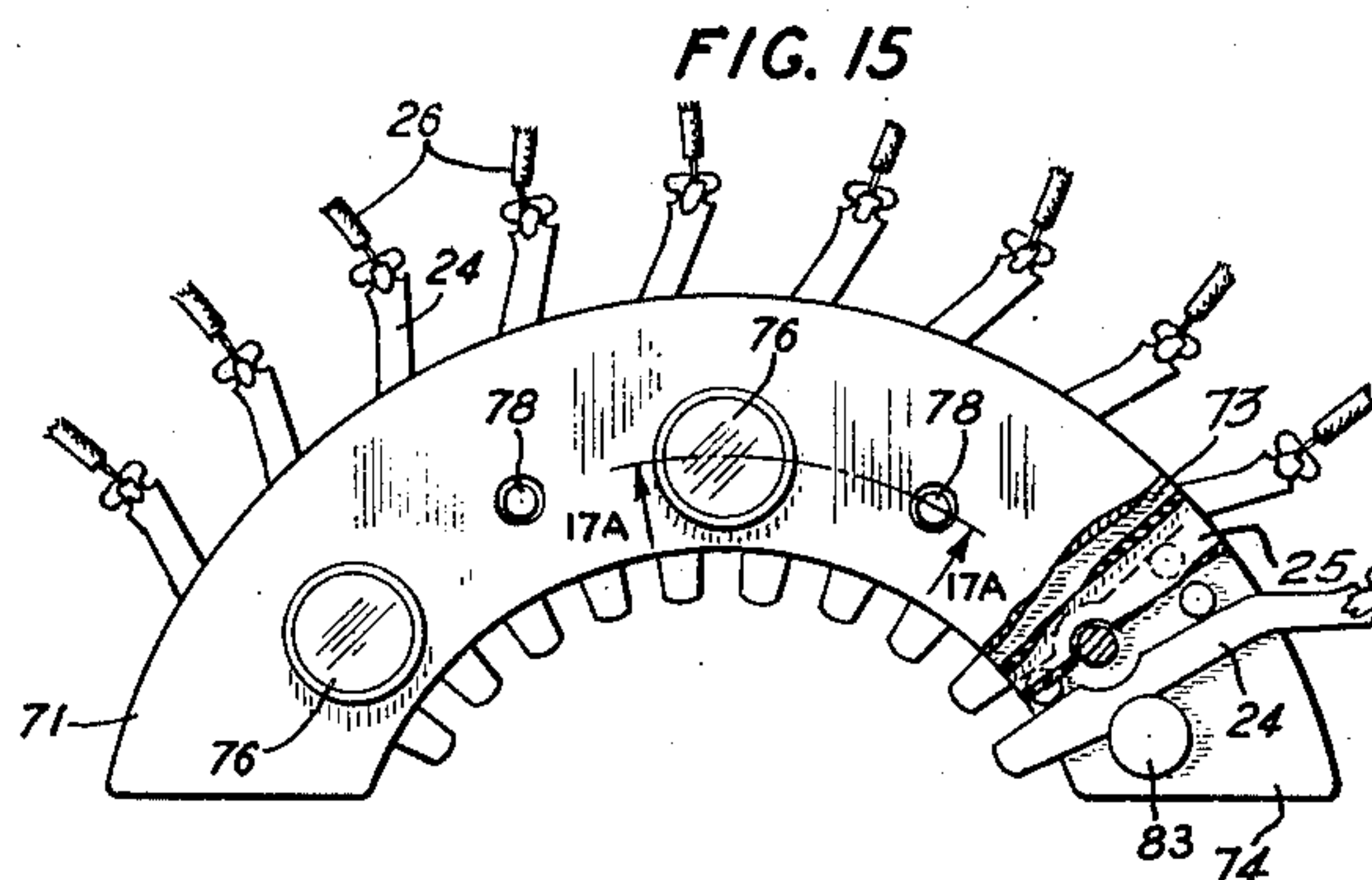
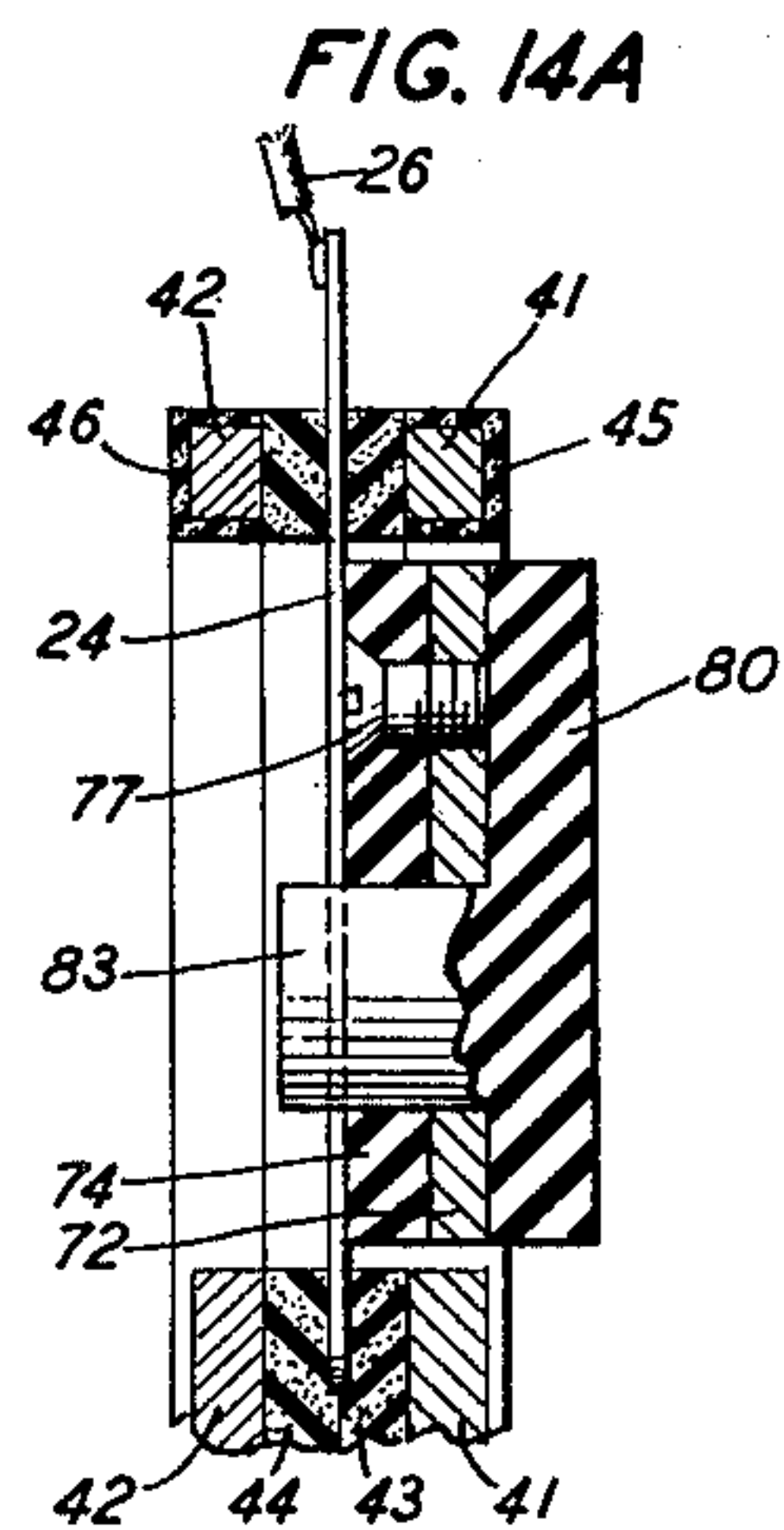
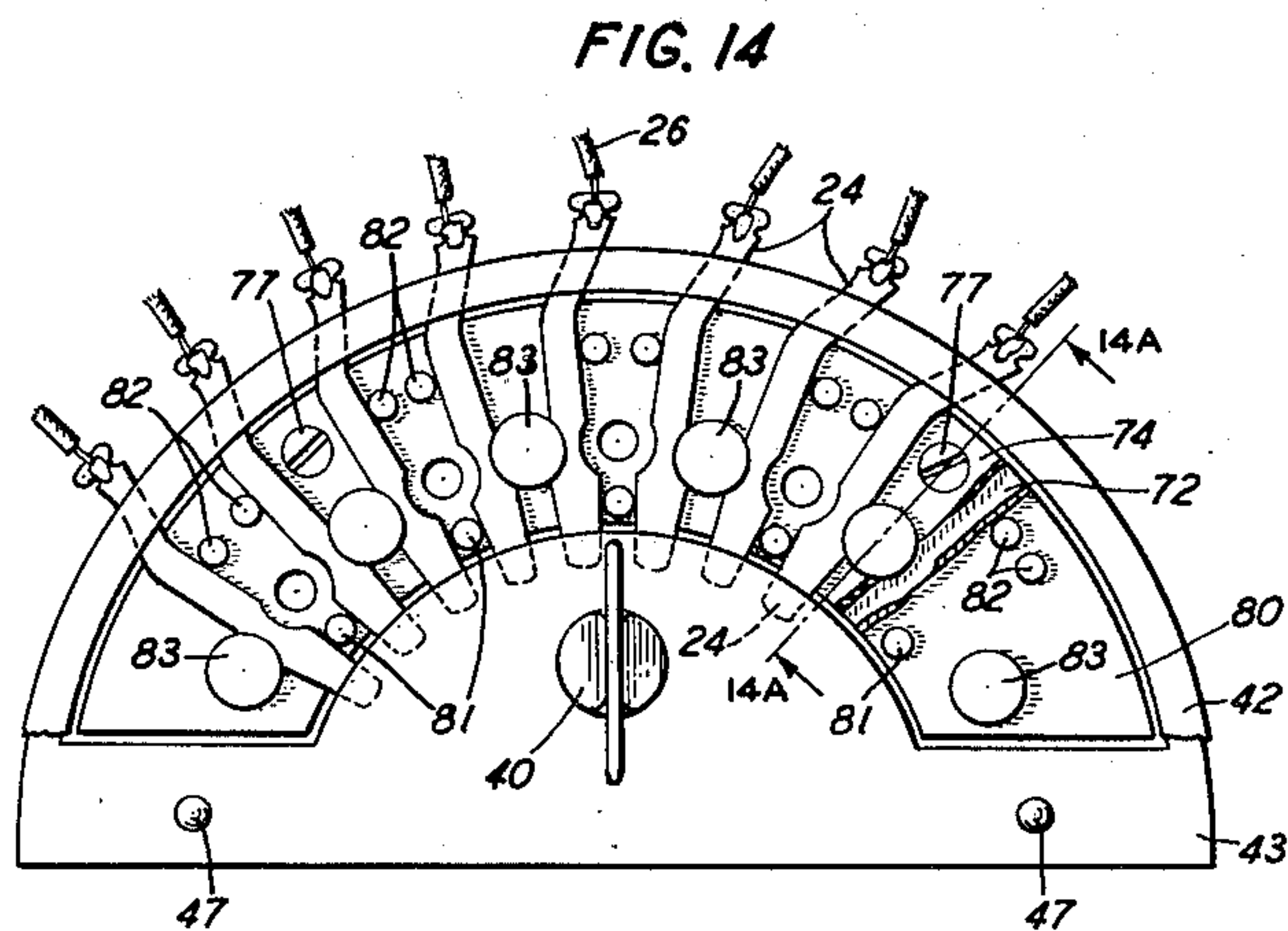
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TOOL FOR USE IN REPLACING INSULATORS IN SWITCH BANKS

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4 Sheets-Sheet 4



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## UNITED STATES PATENT OFFICE

2,528,424

TOOL FOR USE IN REPLACING INSULATORS  
IN SWITCH BANKS

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7 Claims. (Cl. 154—1.6)

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This invention relates to selective rotary switch banks in telephone systems and particularly to a tool for use in replacing defective insulators without unsoldering and disconnecting any of the bank wires from the bank terminals.

Objects of the invention are the provision of means for enabling and facilitating the replacement of defective insulators in multi-level rotary switch banks without unsoldering and disconnecting any of the bank wires from the bank terminals and without interfering, while an insulator is being replaced, with telephone connections established through the banks of other switches to which the terminals of the switch in question are multipled.

According to this invention a tool is provided for use in replacing defective insulators in multi-level rotary switch banks with new insulators without disconnecting the bank wires from the terminals, one part of the tool being arranged to clamp the terminals of a row and hold these terminals in normally separated positions, while the defective insulator is being separated from the terminals and while the terminals are being coated with an adhesive and the new insulator is being placed in proper position with respect to the clamped terminals and another part being arranged to clamp the new insulator and terminals until the adhesive has dried and the terminals are thus fixed in proper position on the insulator.

A feature of the invention is a tool according to the preceding paragraph comprising a terminal locating plate with guide pins between which the terminals of a row may be placed either before or after separation from the defective insulator, and comprising clamping plates whereby the terminals may be clamped in normally spaced relation and thus prevent the terminals from coming in contact with each other or with other terminals of the bank or with any other conductors while the associated defective insulator is being removed and a new one put in its place.

Another feature of the invention is a tool of the above-described character in which additional clamping means is provided for clamping the new insulator to the row of terminals while adhesive spread on the surface of these terminals is drying so as to fix the terminals in proper position on the insulator after the clamping means is removed.

Another feature of the invention is a tool according to the preceding paragraph in which the terminal locating plate is removably associated with the clamping devices.

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Another feature of the invention is a tool of the above-described character comprising a clamping device for clamping a defective insulator with its attached terminals without unsoldering the wires from the terminals, the clamp being so arranged that the defective insulator may be removed from the terminals while fixed in the clamp, the clamp being made of insulating material or being surfaced with insulating material to prevent electrical connection between the different terminals.

Another feature of the invention is a tool of the above-described character comprising a clamping device according to the preceding paragraph and further comprising another clamping device for clamping a new insulator to the terminals after adhesive has been applied while the terminals are held by the first clamping device, the terminal locating plate being removable and the two clamping devices being separable so that the first clamping device may be used to clamp another row of terminals while the adhesive between the terminals and new insulator held by the last-mentioned clamping device is drying.

According to another feature of the invention a tool of the character described in the next preceding paragraph consists of two unitary parts, the terminal positioning plate being attached to the lower plate of the last-mentioned clamping device by studs which allow the positioning plate to move out of engagement with the terminals when the clamping screws are tightened to press the new insulator against the terminals. These studs also constitute insulator positioning lugs when the new insulator is being placed over the clamped terminals.

An understanding of the invention and its various features including those above mentioned will be facilitated by describing tools shown in the drawing.

Figs. 1 to 6 show a tool of the above-described character;

Figs. 7 to 13A show an alternative tool structure; and

Figs. 14 to 17B show a modification of the alternative structure.

The tool shown in Figs. 1 to 6 consists of two separable parts, one of which comprises a terminal locating plate 19, a lower clamp plate 20 and a rotatable clamp plate 21 as shown in Figs. 1 and 2. The rotatable clamp plate 21 is rotatably attached to the upper side of the lower clamp plate 20 by a screw 22 and wing nut 23. The terminal locating plate 19, which is loosely attached to the lower side of the lower clamp plate 20 by two screws 35, has terminal locating



pins 27, 28 and 29 extending through corresponding holes in plate 20, as shown particularly in Figs. 1 and 2. The heads of screws 35 are recessed in the lower side of plate 19 and permit a limited movement of plate 19 toward or away from plate 20, as shown in Figs. 4A and 4B. The other part of the tool comprises an upper clamp plate 30, a lock plate 31, and a screw 36 rotatably attaching the lock plate to the upper clamp plate as shown in Figs. 3, 4A and 4B. The screws 35, which attach locating plate 19 to the lower clamp plate 20, extend upwardly to form locking studs 33 for engaging the lock plate 31. In order that there will be no electrical connection between terminals while the terminals are held in the tool, the locating pins 27, 28 and 29 and plates 19, 20 and 21 are made of hard rubber, phenol fiber or other suitable electrically non-conductive material. Since the terminals 24 do not come into electrical contact with the upper clamp plate 30 and lock plate 31, these plates may be metal plates.

Fig. 1 shows the terminal locating plate 19, lower clamp plate 20 and rotatable clamp plate 21 with a row of terminals 24 positioned by the guide pins 27, 28 and 29 which extend through the lower clamp plate, the inner ends of the terminals 24 being clamped between the rotatable plate 21 and the lower plate 20. As shown, the bank wiring has not been disconnected from the ends of the terminals 24. In Fig. 1, the defective insulator has been separated from the terminals and is not shown. Fig. 2 is an enlarged section of the terminal locating plate and clamp assembly taken on the line 2—2 in Fig. 1.

Fig. 3 shows the terminal locating plate 19, lower clamp plate 20, terminals 24, and rotatable clamp plate 21 as in Fig. 1 except that the plate 21 is positioned out of engagement with the inner ends of the terminals. In Fig. 3, an insulator 25 lies over the terminals 24, the insulator and terminals being clamped between the upper clamp plate 30 and the lower clamp plate 20 by the engagement of lock plate 31 and studs 33. The insulator 25 is located in proper position by the extending shanks 34 of screws 35, the engagement of an insulator 25 with one of these extensions being shown particularly in Figs. 4A and 4B, which are partial sections taken on line 4A—4A in Fig. 3. The lock plate 31 has arcuate slots 32 which engage the heads of studs 33 and the turning of plate 31 on screw 36 loosens or tightens the clamping of the terminals and insulator between the upper and lower clamp plates, depending upon the direction in which the lock plate is rotated. Fig. 4A shows the lock plate in engagement with studs 33 and Fig. 4B shows the lock plate when not in engagement with studs 33.

The insulator 25 shown in each of Figs. 3 to 6 represents either a defective insulator or a new insulator with terminals 24 adhesively held in proper position thereon, the terminals being shown with the bank wires connected thereto. Since the wiring ends of the terminals of adjacent layers in a switch bank curve to the right and left, respectively, to provide greater separation between like positioned terminals, Fig. 5 shows an insulator and associated row of terminals with the outer ends extending to the right and Fig. 6 shows an insulator and associated terminals with the outer ends extending to the left. It is apparent that the tool is adapted to clamp the terminals in proper position with respect to the terminals of any layer of a switch

bank irrespective of whether the soldering ends of the terminals curve to the right or to the left.

When a defective insulator in a switch bank of the well known two-motion step-by-step switch is to be replaced, the screws holding the insulators and terminals as a bank unit are removed. For illustration of a switch bank, reference may be had to Automatic Telephony, by Smith and Campbell, 2nd edition, Figs. 55, 56 and 57. Without unsoldering the conductors from the terminals, the defective insulator with the adhesively attached row of terminals is separated from adjacent insulators, and the terminals of this row are broken loose from the insulator and placed on the lower clamp plate of the tool between the guide pins 27, 28 and 29 of the terminal locating plate. The rotatable clamping plate 21 is then rotated into engagement with the inner ends of the terminals, and the wing nut 23 is tightened to clamp the terminals in proper position as shown in Fig. 1.

Instead of first separating the terminals from the defective insulator, the terminals may be positioned between the guide pins 27, 28 and 29 while the insulator is attached; and, after the rotatable clamp plate is swung into position to clamp the inner ends of the terminals, the insulator may be loosened from the terminals and removed. If some of the terminals become loosened from the insulator while being removed from the bank assembly, it will be necessary to separately place each terminal on the lower clamp plate between the corresponding set of guide pins. Although in the above description, the tool is described with the terminal locating plate below the lower clamping plate, the tool may be used in inverted position to replace insulators which have the terminals adhesively attached to their lower surfaces.

After the terminals are clamped in position by the rotatable plate 21 and the defective insulator has been removed, liquid adhesive is applied to the new insulator; or the liquid adhesive may be applied to the terminals, in which case the rotary plate prevents its application to the end surfaces with which the switch wiper makes contact. Then the new insulator is placed over the terminals, being accurately located by the insulator positioning hubs 34 of the two locking studs 33; the upper clamp plate 30 is placed over the new insulator; and the attached lock plate is rotated to engage the locking studs 33 as shown in Figs. 3 and 4A. When the clamping device is thus locked, the guide pins 27, 28 and 29 and plate 19 are pushed downward into position shown in Fig. 4A, so that pressure applied by engagement of the locking plate and locking studs squeezes the insulator and terminals between clamp plates 20 and 30. After the adhesive has had time to dry, the locking plate is rotated to release the upper clamp plate 30, the rotatable clamp plate 21 is rotated to disengage the inner ends of the terminals, the upper clamp plate 30 is removed, and the new insulator and attached terminals are replaced in the bank.

The alternative tool structure shown in Figs. 7 to 13A provides a tool which consists of three parts, a terminal clamping fixture, a terminal locating fixture and an insulator clamping fixture. The terminal clamping fixture, which is shown in Figs. 7, 10, 11 and 12 consists of two semicircular metal plates 41 and 42, each with a cut-out section of the same shape and only slightly larger than the separating insulators of switch banks with which the tool is designed for



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use. The two plates are loosely held together by a thumb screw 40, alignment of the plates being effected by metal pins 47 fixed in plate 41 and extending into corresponding holes in plate 42 as shown in Figs. 7 and 12. The adjacent surfaces of the plates 41 and 42 are covered with layers of sponge rubber 43 and 44 and the ring segments 45 and 46 of each plate are also coated with soft rubber, so that terminals clamped in this fixture are electrically insulated from each other. A spiral spring 49 on screw 40 and spiral springs 48 on pins 47 normally tend to separate the two plates so that a defective insulator and attached terminals may be positioned between the plates and the terminals clamped therein by tightening screw 40 as illustrated in Figs. 10, 11 and 12. After clamping the terminals, the defective insulator may be loosened therefrom and removed. The terminal locating fixture, which is shown in Figs. 8 and 11 consists of two plates 51 and 55 each made of hard rubber, phenol fiber or similar insulating material and of the same shape and only slightly smaller than the cut-out sections of the plates 41 and 42 of the terminal clamping fixture. The plate 51 has hard rubber pins 52, 53 and 54 set therein perpendicular to one of its major surfaces and the plate 55 has holes therein corresponding to the pins in plate 51, the pins being spaced so that a row of terminals may be accurately positioned by the pins between the plates, as shown in Figs. 11 and 13. The insulator clamping fixture, which is shown in Figs. 9, 13 and 13A, also consists of two plates, 61 and 65, each of the same size and shape as plates 51 and 55 of the terminal locating fixture. The plate 61 is made of hard rubber, bakelite or other similar insulating material and set therein are two short hard rubber pins 63 for locating the fixture with respect to the terminals of a row held in the terminal clamping device and two longer hard rubber pins 62 for locating the new insulator, to which the terminals are to be adhesively attached. The plate 65 is a metal plate surfaced on one side by sponge rubber 66 and has threaded holes positioned corresponding to unthreaded holes in plate 61; and an insulator and row of terminals may be clamped between the plates 61 and 65 by turning the screws 64 into the threaded holes of plate 65 as shown in Figs. 13 and 13A.

When a defective insulator is separated from a terminal bank without unsoldering the wiring, the insulator with the terminals attached is inserted between the plates 41 and 42 of the terminal clamping fixture and the thumb screw 40 is then tightened to clamp the terminals. The defective insulator is then loosened from the terminals and removed. The locating plate 51 is then brought up under the clamping fixture and the thumb screw 40 is loosened just enough to allow a slight movement of the terminals as the locating pins are pushed between the terminals; and the plate 55 is then placed over the pins so that the terminals are accurately positioned by the pins between the plates 51 and 55, as shown in Fig. 11. The thumb screw is then again tightened after which the locating plates 51 and 55 are removed. The next step is the application of liquid adhesive to the upper surface of the terminals, following which the plate 61 of the insulator clamping device is placed below the clamped terminals, the pins 63 serving to accurately locate the plate with respect to the terminals. The new insulator is placed over the terminals, being accurately positioned by pins

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62. The plate 65 is then placed over the insulator and screws 64 are turned into the threaded holes in plate 65, so that the insulator and terminals are clamped together, as shown particularly in Fig. 13A. The thumb screw 40 of the terminal clamping fixture is now loosened to permit the clamping plates 61 and 65 with the clamped insulator and terminals to be removed from the terminal clamping fixture. While the adhesive between the new insulator and terminals is drying the terminal clamping and locating fixtures may be used to replace another insulator. A number of insulator clamping devices are provided so that each new insulator and terminals may be held in a clamping fixture until the adhesive has dried; whereupon the insulator and attached terminals are replaced in the bank.

A further modification of the tool shown in Figs. 7 to 13A may be made as shown in Figs. 14 to 17B so that the terminal locating and insulator clamping fixtures are combined. The same terminal clamping device shown in Figs. 7, 10, 11 and 12 is provided to clamp the terminals. The terminal locating and insulator clamping device comprises two steel clamping plates 71 and 72 and a terminal locating plate 80. The top clamping plate 71 is surfaced on its lower side with a layer 73 of sponge rubber; and the plate 72 is surfaced by a layer of hard rubber 74 attached by screws 77 to the steel plate 72. The top plate 71 is separable from the plate 72 and has holes therein corresponding to the holes in a separating insulator. Screws 76 are provided for clamping a row of terminals and insulator between plates 71 and 72. The terminal locating plate 80 which is made of hard rubber or similar insulating material is loosely attached to clamping plate 72 by two screws 78, as shown in Figs. 16, 17A and 17B. The plate 80 has hard rubber locating pins 81, 82 and 83 set therein, extending vertically upward; and when the lower clamping plate 72 with the attached locating plate 80 are placed below the terminals in the clamping device and raised against the lower side of the terminals while thumb screw 40 is slightly loosened, the terminals are accurately positioned by the locating pins 81, 82 and 83. Fig. 14 is a top view of the terminal clamping device with the row of terminals therein positioned by pins 81, 82 and 83 of the terminal locating plate 80. Fig. 14A is an enlarged partial cross-section of the lower clamping plate 72 and attached terminal locating plate 80 taken on line 14A—14A of Fig. 14. After the terminals are accurately located, the thumb screw 40 is again tightened, liquid adhesive is applied to the terminals 24 and a new insulator 25 is placed over the terminals, the insulator being properly positioned by the unthreaded upwardly extending ends of the screws 78. The top clamping plate 71 is then placed over the insulator and screws 76 are turned into the threaded holes of plate 72, thereby clamping the insulator and terminals. Then the screws 76 are tightened, the tops of the locating pins come into contact with the insulator but the edges of these pins continue to engage the edges of the terminals to insure that the terminals remain in proper position while the adhesive is drying. Figs. 15 and 16 show an insulator 25 and row of terminals 24 between the clamping plates. In Fig. 16 the screws have been loosened as is the case after the adhesive has dried and the insulator with attached terminals is ready for placing in the terminal bank. Figs. 17A and 17B are partial



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enlarged cross-sections taken on line 17A—17A of Fig. 15, Fig. 17A with screws 76 loosened and Fig. 17B with screws 76 tightened.

What is claimed is:

1. A tool for use in replacing insulators in switch banks without disconnecting the bank wiring from the terminals attached to an insulator which is to be replaced and without interfering with the use of other switches to which the bank wiring is connected, comprising means for localizing and clamping a row of terminals with multiple bank wiring connected thereto in proper relative positions without electrically interconnecting any of said terminals and without clamping the insulator to which the terminals are attached, means for localizing an insulator in proper position with respect to a clamped row of terminals, and additional means for clamping said insulator and terminals together without electrically interconnecting any of said terminals.

2. A tool for use in replacing insulators in switch banks without disconnecting the bank wiring from the terminals attached to an insulator which is to be replaced and without interfering with the use of other switches to which the bank wiring is connected, comprising a terminal locating plate of insulating material having guide pins between which the terminals of a row with multiple bank wiring connected thereto may be placed either before or after separation from a defective insulator and comprising clamping plates for clamping the terminals in normally spaced relation without clamping the insulator to which the terminals are attached so as to facilitate the separation of a defective insulator from the terminals and the adhesive attachment of a new insulator to the terminals without electrically interconnecting any of said terminals.

3. A tool for use in replacing insulators in switch banks without disconnecting the bank wiring from the terminals attached to an insulator which is to be replaced and without interfering with the use of other switches to which the bank wiring is connected, comprising a fixture for clamping a row of terminals with multiple bank wiring connected thereto while attached to an insulator which is to be replaced without clamping the insulator and without electrically interconnecting any of said terminals, a terminal locating plate of insulating material having guide pins for accurately positioning the terminals of a row in normally spaced relation after separation of the insulator from the clamped terminals, and means for clamping an insulator to a row of terminals held by said clamping fixture without electrically interconnecting any of said terminals.

4. A tool for use in replacing insulators in switch banks without disconnecting the bank wiring from the terminals attached to an insulator which is to be replaced, comprising a fixture for clamping a row of terminals with multiple bank wiring connected thereto while attached to an insulator which is to be replaced without electrically interconnecting any of said terminals and without clamping the insulator so that the insulator may be separated from the terminals and removed, a terminal locating plate of insulating material having guide pins for accurately positioning the terminals of a row in normally spaced relation after separation from an insulator, said terminal clamping means and locating plate being shaped so that the locating plate may be placed in position to accurately localize the terminals in said clamping fixture and then

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be removed, and means for clamping an insulator to a row of terminals held by said clamping fixture after application of adhesive between the terminals and insulator, said clamping fixture and clamping means being shaped and arranged to permit the removal of said terminals from the clamping fixture while clamped to an insulator by said clamping means.

5. A tool for use in replacing insulators in switch banks without disconnecting the bank wiring from the terminals attached to an insulator which is to be replaced, comprising three separate fixtures, a terminal clamping fixture, a terminal locating fixture and an insulator clamping fixture; said terminal clamping fixture comprising two aligned semicircular metal plates and a thumb screw for forcing one plate toward the other, each of said plates having a cut-out section of the same shape and only slightly larger than said insulator, the hub portions of said plates being adapted to clamp the wiper contact ends of a row of terminals and the outside ring portions being adapted to clamp the wiring ends of the terminals without clamping the insulator to which the terminals may be attached, the adjacent surfaces of said hub portions and all surfaces of the ring portions being coated with rubber or similar insulating material to prevent the electrical interconnection of any terminals clamped between said plates; said terminal locating fixture comprising two plates of insulating material and of the same shape and size as said insulator; the bottom plate having guide pins set therein and extending perpendicular to the surface and the upper plate having corresponding holes into which the guide pins may extend, whereby said lower plate may be placed immediately below, and the upper plate immediately above a row of terminals loosely clamped in said clamping fixture to accurately position said terminals in said clamping fixture before the thumb screw is turned to fixedly clamp the terminals therein; and said insulator clamping fixture comprising two plates of the same shape as said insulators, the upper plate being a steel plate the lower surface of which is coated with a layer of sponge rubber, and the lower plate being a hard rubber plate having short terminal locating pins extending upwardly for localizing the plate with respect to a row of terminals clamped in said clamping fixture, having longer pins extending upwardly for positioning an insulator placed above the terminals and having screws extending through the plate to engage corresponding threaded holes in the upper plate, whereby an insulator and a row of terminals which are clamped in said terminal clamping fixture may be clamped between the plates of said insulator clamping fixture, said insulator clamping fixture with the clamped insulator and terminals being separable from the terminal clamping fixture by loosening the thumb screw of said terminal clamping fixture.

6. A tool for use in replacing insulators in switch banks without disconnecting the bank wiring from the terminals attached to an insulator which is to be replaced, consisting of a terminal locating and clamping fixture for clamping a row of terminals in normally spaced relation after being separated from the insulator which is to be replaced, and an additional clamping plate assembly for cooperation with a clamping plate of said fixture for clamping an insulator against said terminals; said terminal locating and clamping fixture comprising a lower clamping



plate, a rotatable clamping plate pivotally attached by a thumb screw to the upper surface of the lower clamping plate, and a terminal locating plate having guide pins set therein extending upwardly through corresponding holes in said lower clamping plate positioned so as to localize a row of terminals in normally spaced relation on the upper surface of the lower clamping plate, the inner ends of a row of terminals being clamped against the lower clamping plate by rotating the rotatable plate over these ends and then tightening said thumb screw, all of said clamping and locating plates being made of hard rubber or other suitable insulating material to prevent electrical interconnection between any terminals while clamped in said fixture; said additional clamping plate assembly comprising an upper clamping plate of hard rubber or similar insulating material and of the same shape as said insulators and a metal locking plate pivotally attached to the upper surface of said upper clamping plate; said terminal locating plate being loosely attached to the lower surface of said lower clamping plate by screws which allow a small separation between said plates, the upper ends of said screws extending upwardly to form locking studs for engaging slots in said locking plate whereby an insulator placed over a row of terminals held in said clamping fixture may be clamped against the terminals by rotation of the locking plate.

7. A tool for use in replacing insulators of switch banks without disconnecting the bank wiring from the terminals attached to an insulator which is to be replaced, comprising a terminal clamping fixture and a terminal locating and insulator clamping fixture; said terminal clamping fixture consisting of two aligned semi-circular metal plates and a thumb screw for forcing one plate toward the other, each of said plates having a cut-out section of the same shape and only slightly larger than said insulators, the hub portion of said plates being adapted to clamp the wiper contact ends of a row of terminals and the outside ring portion being adapted to clamp the wiring ends of the terminals without clamping the insulator to which the terminals may be attached, the adjacent surfaces of said

hub portions and all surfaces of said ring portions being coated with rubber or similar insulating material to prevent the electrical interconnection of any terminals clamped between said plates; said terminal locating and insulator clamping fixture consisting of a lower clamping plate made of steel and having a layer of hard rubber attached to its upper surface, a terminal locating plate of insulating material such as hard rubber having guide pins extending upwardly through corresponding holes in said lower clamping plate, said pins spaced to localize a row of terminals in normally spaced relation, and an upper clamping plate made of steel and having a coating of sponge rubber or like insulating material over its lower surface and having screws for engaging threaded holes in the lower clamping plate, said terminal locating plate being loosely attached to said lower clamping plate by screws which allow a small separation between said plates, the upper ends of said screws constituting locating pins for localizing an insulator to which a row of terminals is to be adhesively attached, the turning of said screws in the upper clamping plate into threaded holes in the lower clamping plate effecting the clamping of the insulator and terminals between said plates, the loosening of the thumb screw of said terminal clamping fixture enabling removal of the clamped insulator and terminals therefrom.

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