

Nov. 12, 1946.

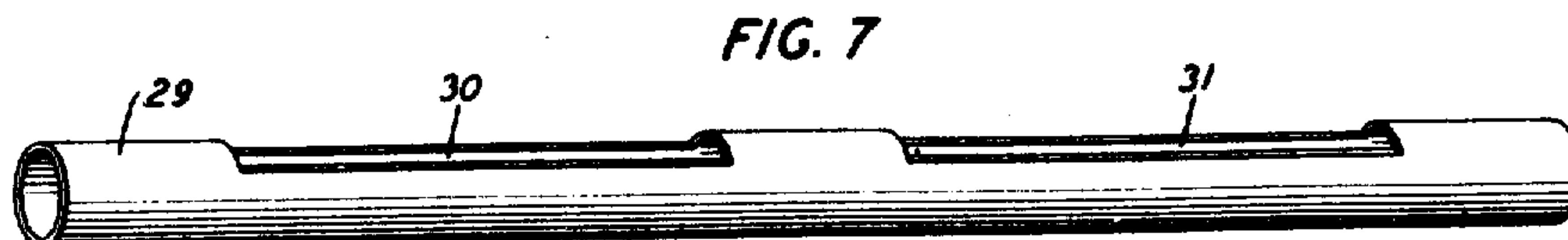
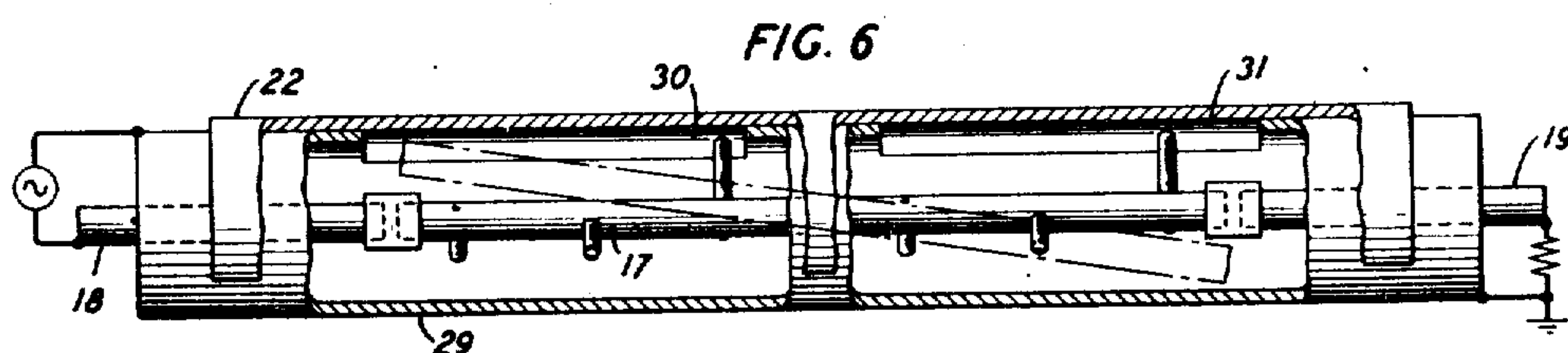
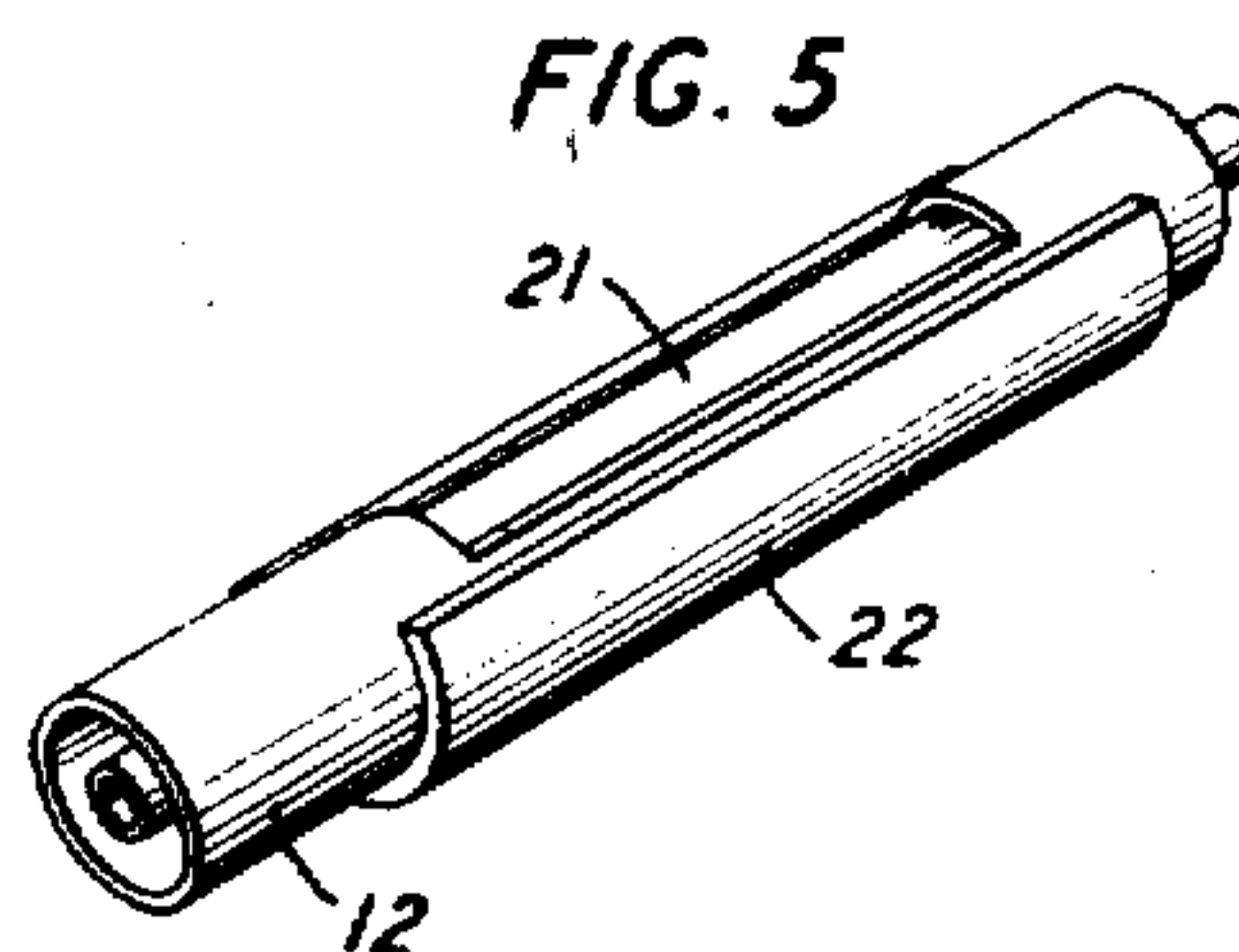
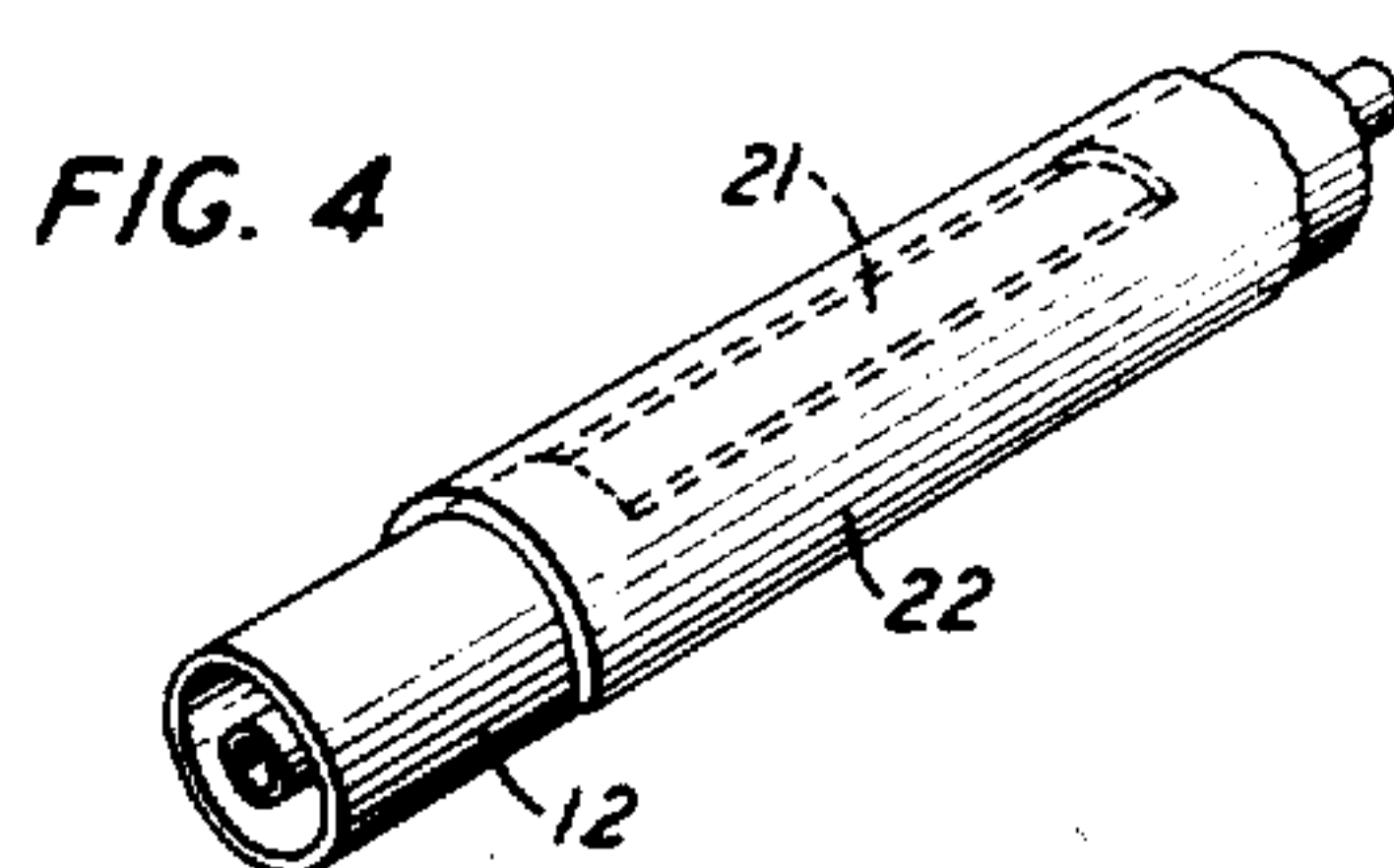
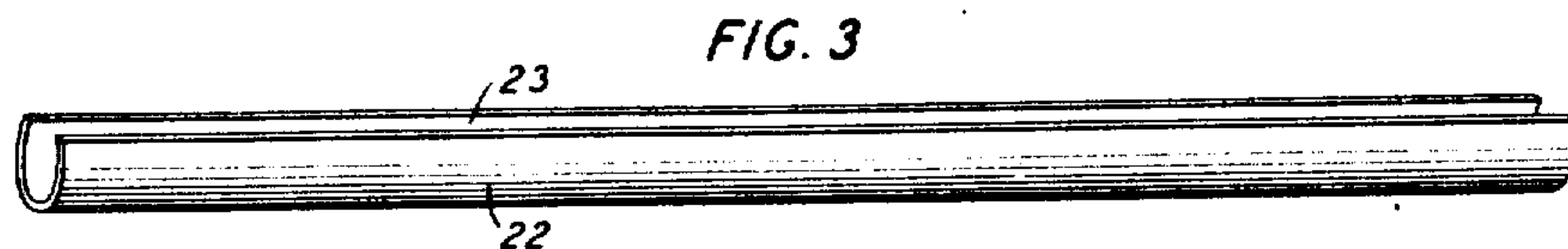
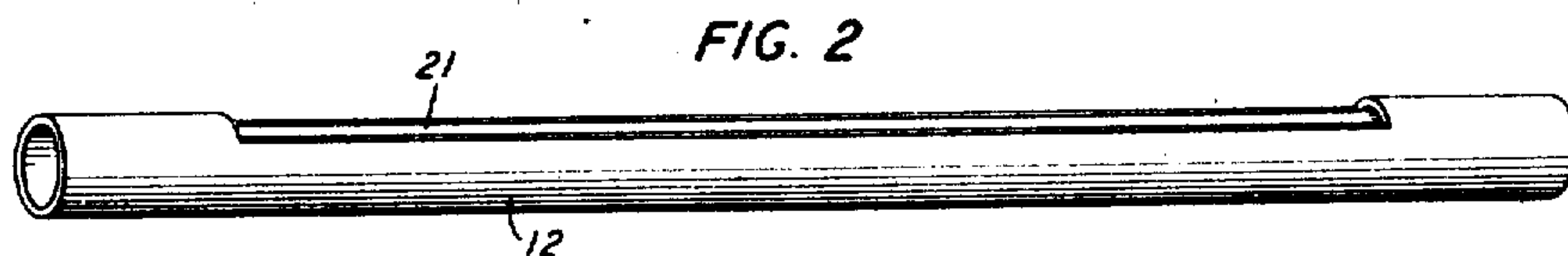
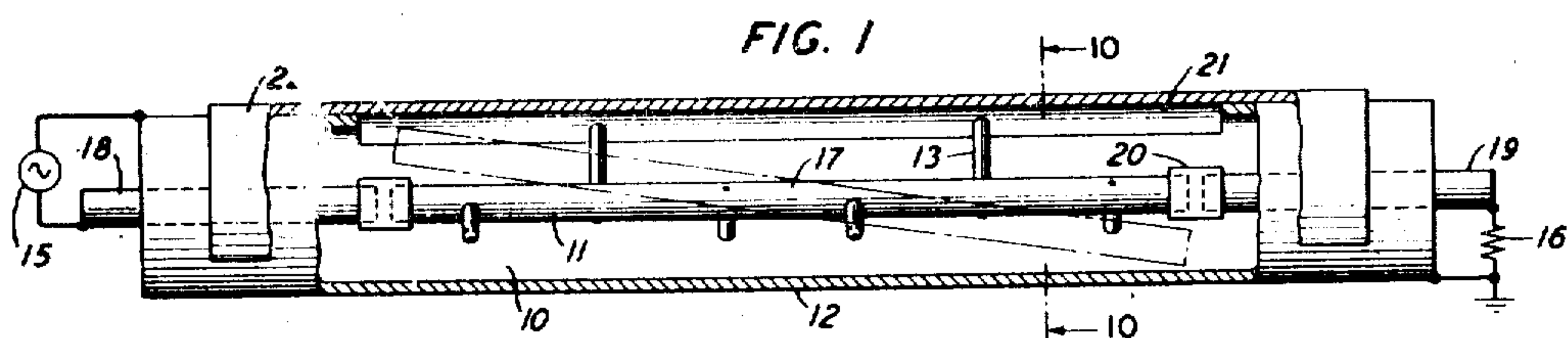
J. C. BAIN

2,410,802

CONCENTRIC CONDUCTOR TRANSMISSION LINE

Filed May 5, 1943

2 Sheets-Sheet 1



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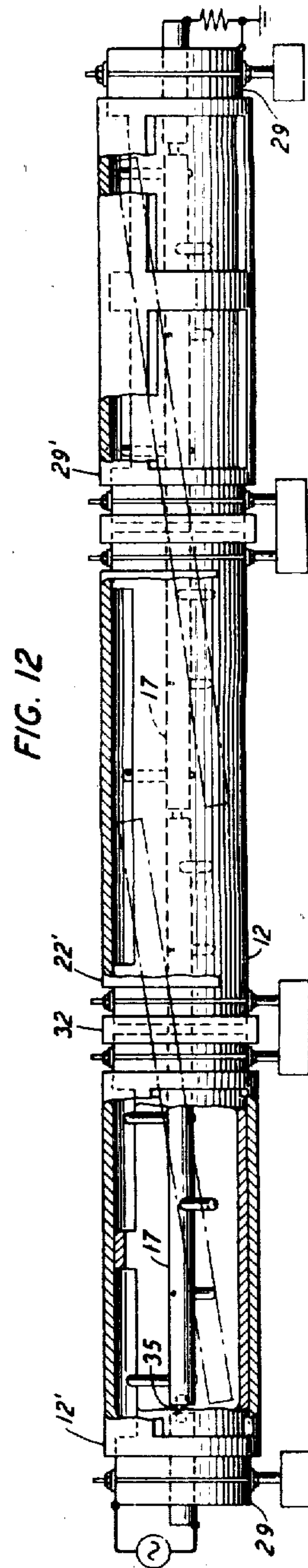
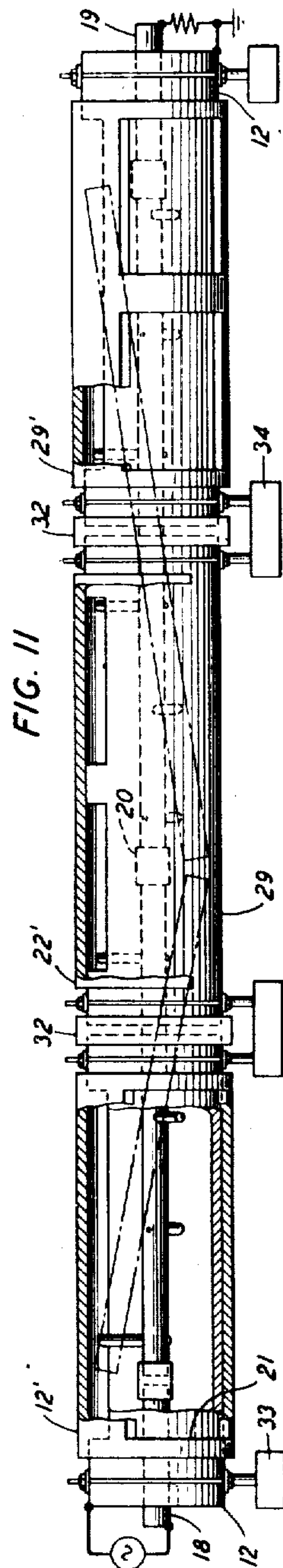
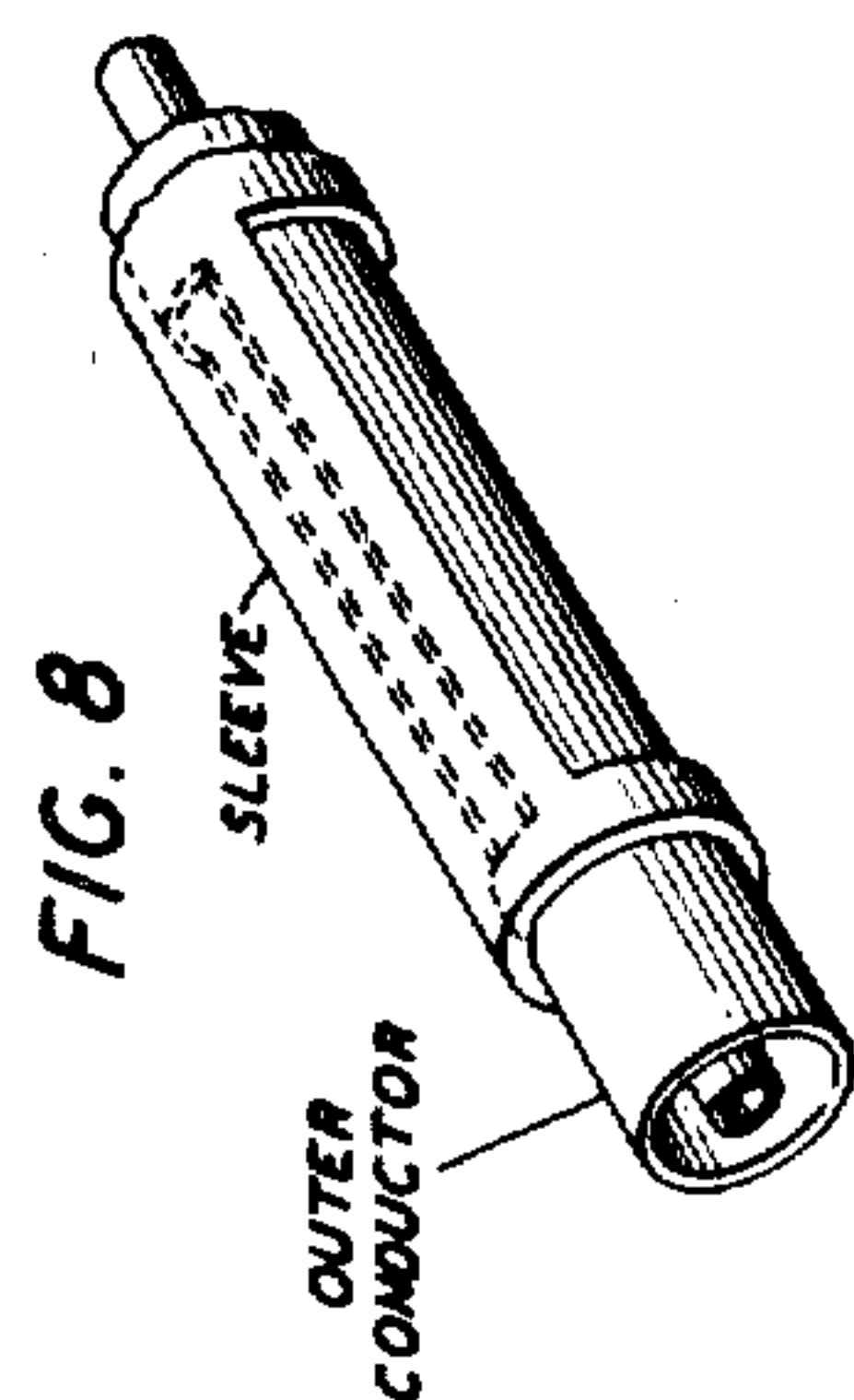
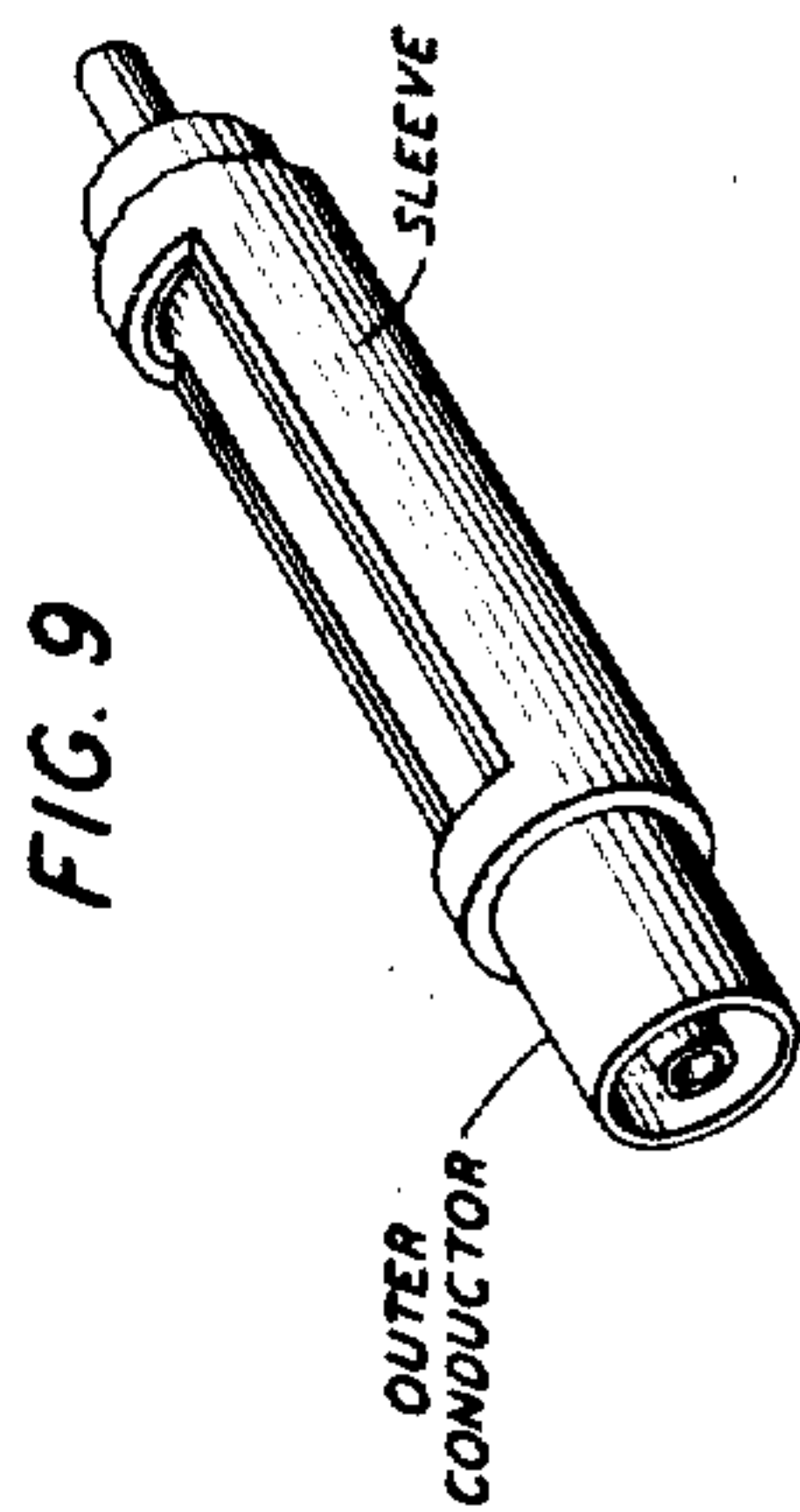
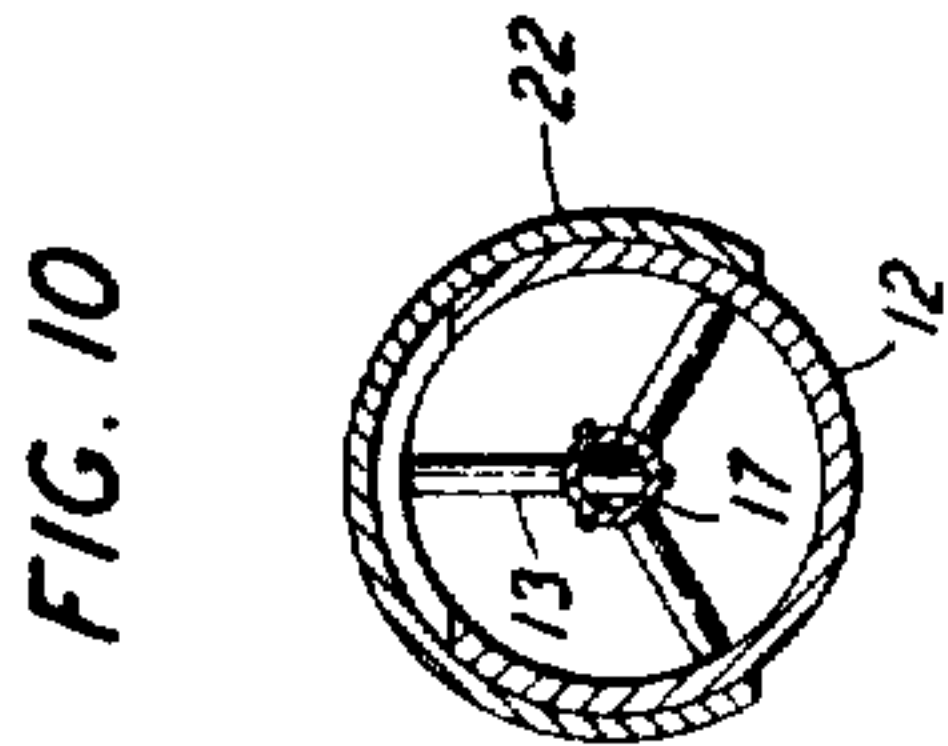
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CONCENTRIC CONDUCTOR TRANSMISSION LINE

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2 Sheets-Sheet 2



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2,410,802

CONCENTRIC CONDUCTOR TRANSMISSION
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Application May 5, 1943, Serial No. 485,743

2 Claims. (Cl. 174—28)

1

This application is a continuation in part of my application Serial No. 362,392 filed October 23, 1940, and relates to a signal transmission system embodying a concentric conductor line comprising an inner conductor and an outer conductor. More particularly, it relates to an arrangement for so adapting such line that the inner conductor can be expeditiously inspected, and replaced if desired without disassembling the outer conductor of such line.

In a familiar type of concentric conductor line including an inner conductor and an outer conductor for transmitting signal waves, it is frequently necessary to remove the outer conductor in order to inspect the inner conductor, or to replace a faulty section thereof, when the associated antenna has been subjected to a lightning discharge. As such disassembly of the line necessitates the removal of the line from service, an auxiliary concentric conductor line would be required in order to enable continuous signal transmission during the replacement of the inner conductor. In a relatively long transmission line such technique would involve a substantial amount of time and expense. Accordingly, the present invention is concerned with inspecting the inner conductor of a concentric conductor line and replacing faulty individual sections of the inner conductor without disturbing the assembly of the outer conductor of such line.

The present invention contemplates an arrangement for enclosing the inner conductor within the outer conductor during periods of normal use, and for substantially exposing the inner conductor through the outer conductor during periods of inspection such that individual sections of inner conductor can be replaced through the outer conductor without disassembling the latter conductor.

An object of the invention is to provide easy access to the inner conductor of a concentric conductor line.

Another object is to inspect or replace individual sections of the inner conductor of a concentric conductor line without interfering with the assembly of the outer conductor of the line.

In a specific embodiment, the present invention comprises a concentric conductor line including an outer conductor provided with one or more spaced longitudinal openings for exposing one section of inner conductor, the insulators mounted thereon, and the connectors attached thereto. Disposed exteriorly of the outer conductor in concentric relation therewith is a sleeve formed with one or more spaced longitudinal

2

openings, each of which is substantially coextensive with one of the openings of the outer conductor. This sleeve is movable to one position to cover the openings of the outer conductor and to another position to register the openings of the sleeve with corresponding openings of the outer conductor whereby the inner conductor, insulators mounted thereon, and connectors attached thereto are exposed for inspection. A section of inner conductor may be removed by detaching the connectors from the opposite ends thereof and withdrawing the insulators therefrom, the particular section of inner conductor being rotated as may be necessary to permit such withdrawal. Thereafter, the particular section of inner conductor is tilted and then removed through one pair of registered openings. A section of inner conductor can be inserted by following the procedure above mentioned, in the reverse order. The same procedure is followed when the concentric conductor line embodies a plurality of discrete sections.

The invention will be readily understood from the following description taken together with the accompanying drawings in which:

Fig. 1 is a schematic circuit diagram of a signal transmission system embodying a specific embodiment of the invention;

Fig. 2 is a perspective view of another conductor or a sleeve used in Figs. 1, 11 and 12;

Fig. 3 is a perspective view of a sleeve used in Figs. 1, 6, 11 and 12;

Figs. 4 and 5 are partial perspective views of operations obtainable in Figs. 1, 6, 11 and 12;

Fig. 6 is a schematic circuit diagram of a signal transmission system embodying another embodiment of the invention;

Fig. 7 is a perspective view of an outer conductor or a sleeve used in Figs. 6, 11 and 12;

Figs. 8 and 9 are partial perspective views of operations obtainable in Figs. 11 and 12;

Fig. 10 is a cross-sectional view taken along the line 10—10 of Fig. 1;

Fig. 11 is a schematic circuit diagram of a signal transmission system embodying a plurality of discrete sections which are similar to Figs. 1 and 6; and

Fig. 12 is a schematic circuit diagram of a signal transmission system including a plurality of discrete sections which are substantially identical with Figs. 1 and 6.

The same reference numerals are employed to designate identical elements appearing in the several figures of the drawings.

Fig. 1, which illustrates a concentric conductor

3

system to which the present invention is applicable, shows a concentric conductor line 10 comprising an inner conductor 11, a hollow outer conductor 12, and a plurality of pin insulators 13 disposed helically in spaced relation on the inner conductor 11 for maintaining the latter conductor in concentric relation with respect to the outer conductor 12, Fig. 10. A source 15 of signal waves is applied to one terminal of the concentric conductor line while a load 16 is connected to the opposite terminal thereof. The inner conductor 11 comprises a middle section 17 carrying the insulators and two terminal sections 18 and 19, the abutting ends of which sections are joined by connectors 20. These connectors comprise a sleeve disposed over the abutting ends of two adjacent sections of inner conductor, although a plug inserted into the abutting ends of the adjacent two sections of inner conductor, assuming the latter to be hollow, would serve equally as well as will be hereinafter pointed out.

The outer conductor 12, Fig. 1, is provided with a longitudinal opening 21, Fig. 2, whose dimensions are proportioned to permit the accomplishment of a purpose which will be hereinafter disclosed. In this connection, it is to be noted in Fig. 1 that the longitudinal length of the opening 21 is such as to expose the middle section 17 of the inner conductor 11, the insulators mounted thereon, and both connectors joining the three sections of inner conductor. Disposed exteriorly of the outer conductor 12, Fig. 1, in coaxial relation therewith, is a sleeve 22 which embodies a slot 23 extending the length thereof as illustrated in Fig. 3. This sleeve is rotatably mounted on the outer conductor 12, Fig. 1, such that in one position the opening 21 of the latter conductor is covered by the sleeve 22 as shown in Fig. 4 and such that in another position the slot 23 of the sleeve 22 registers with the opening 21 of the outer conductor 12 as illustrated in Fig. 5. This registration of the slot and opening of the sleeve and outer conductor, respectively, exposes the middle section 17 of the inner conductor, Fig. 1, together with the insulators and connectors attached thereto, for inspection.

If desired, the middle section can be replaced without disturbing the assembly of the remainder of the system, in a manner that will now be explained. Assuming the opening 21 to be in registration with the slot 23 as hereinbefore mentioned, the two connectors 20 associated with the opposite ends of the middle section 17 are detached therefrom. The insulators are next withdrawn from the middle section 17, the latter being rotated as may be necessary to permit such withdrawal. Thereafter, the middle section 17 is tilted and then withdrawn as indicated by the dot-dash representation thereof in Fig. 1, or it can be lifted out directly. A new middle section can be inserted in the same manner, in the reverse order. In the foregoing respects, it is to be understood that the dimensions of the opening 21 of the outer conductor 12 and of the slot 23 of the sleeve 22 are so proportioned as to allow expeditiously such replacement of the middle section 17 of the inner conductor.

Fig. 6 shows an embodiment which is similar to that of Fig. 1 except the outer conductor 29 is provided with two longitudinal openings 30 and 31, Fig. 7. These openings have substantially the same dimensions, and are proportioned to expose the insulators and connectors associated with the middle section 17 of the inner conductor, Fig. 6. The latter section can be both inspected and re-

4

placed in accordance with the procedure hereinbefore explained with reference to Fig. 1. In Fig. 6 the dot-dash representation of the middle section 17 indicates that it can be tilted and withdrawn and inserted endwise through the opening 30; and it is to be understood that the middle section 17 can be so tilted as to be withdrawn and inserted through the opening 31. It is understood that the openings of both the outer conductor and sleeve associated therewith are so proportioned as to permit expeditiously such replacement of the middle section 17 of inner conductor.

Also, it is to be understood that sleeves having structures similar to those of the conductors 12 and 29, respectively, may be individually employed in each of Figs. 1 and 6. In this connection it is to be understood that such sleeves are so proportioned as to be mounted exteriorly of the respective outer conductors in coaxial relation therewith. In such case, Fig. 8 shows the sleeve rotated to the position where the opening in the outer conductor is covered; and Fig. 9 shows the sleeve rotated to the position where the openings in both the sleeve and outer conductor are in registration. The middle section of inner conductor may be both inspected and replaced in the manner explained previously regarding Figs. 1 and 6.

Fig. 11 illustrates a concentric conductor line embodying a plurality of sections of both inner and outer conductors, each of which sections is similar to the structure of Figs. 1 and 6 except in the respects which will be hereinafter pointed out. Thus, the inner conductor comprises terminal sections 18 and 19 and a plurality of intermediate sections 17, joined by connectors 20; and the outer conductor includes a plurality of sections 12, Fig. 2 and one section 29, Fig. 7. Disposed exteriorly of and in coaxial relation with the left-hand section 12 of outer conductor is the sleeve 12' whose configuration is identical with that of section 12 of outer conductor, Fig. 2; mounted exteriorly of and in coaxial relation with the intermediate section 29 of outer conductor, Fig. 7, is a sleeve 22' whose structure is illustrated in Fig. 3; and positioned exteriorly of and in coaxial relation with the right-hand section 12 of outer conductor is a sleeve 29' which has a configuration according to Fig. 7. The several sections 12 of outer conductor are connected by a plurality of suitable couplings 32. The extreme left-hand and right-hand terminals of the concentric conductor line, Fig. 11, are mounted on suitable supports 33, while its intermediate portions are mounted on suitable supports 34. The sleeves on the respective sections of outer conductor can be rotated to cover and uncover the corresponding openings of the latter sections as described hereinbefore with reference to Figs. 1, 4, 5, 6, 8 and 9.

Assuming both intermediate sections 17 of the inner conductor, Fig. 11, are to be inspected, the sleeves 12', 22' and 29' are rotated until the openings therein register with the corresponding openings of the respective sections of outer conductor. Such registration exposes the two sections 17 of inner conductor together with the insulators and connectors associated therewith. Let it be supposed now that the left-hand section 17 of inner conductor is to be replaced. The two connectors 20 are detached from the opposite ends of the left-hand section 17 of inner conductor, and the insulators are then withdrawn therefrom, the left-hand section 17 of inner conductor being rotated as may be necessary to allow such withdrawal. Thereafter, the left-hand section 17 of inner conductor can be tilted and with-

5

drawn endwise through the registered openings of the left-hand section of outer conductor and the sleeve mounted thereon in the manner indicated by the dot-dash representation of this section of inner conductor, Fig. 11. It is obvious that the left-hand section 17 of inner conductor could also be removed by utilizing the registered openings of the middle section of outer conductor and the sleeve positioned thereon. A new section can be inserted by following the same procedure, in the reverse order. The right-hand section 17 of inner conductor, Fig. 11, can be replaced by repeating the replacement procedure described previously with reference to the left-hand section 17 of inner conductor.

Fig. 12 illustrates a concentric conductor line embodying a plurality of sections of both inner and outer conductors, each of which sections is similar to the structure shown in Figs. 1 and 6 except in the respects which will be hereinafter identified. Thus, the inner conductor comprises terminal sections 18 and 19, and a plurality of intermediate sections 17 joined by connectors 35, each of which has its opposite ends disposed interiorly of the abutting ends of the sections of inner conductor and sweated thereto. Obviously, connectors similar to connectors 20 would serve equally as well as hereinbefore mentioned. The outer conductor comprises a plurality of sections 29, Fig. 7; and a section 12, Fig. 2.

Mounted exteriorly of and in coaxial relation with the left-hand section 29 of outer conductor is sleeve 12' whose configuration is illustrated in Fig. 2. Positioned exteriorly of and in coaxial relation with the intermediate section 12, Fig. 2, of outer conductor is a sleeve 22' whose structure is illustrated in Fig. 3. Disposed exteriorly of and in coaxial relation with the right-hand section 29 of outer conductor is a sleeve 29' whose configuration is identical with that of section 29 of outer conductor, Fig. 7. The several sections 29 of outer conductor are connected by the couplings 32. The assembled line is mounted on supports in the manner of Fig. 11. The sleeves on the respective sections of outer conductor can be rotated to cover and uncover the corresponding openings of the latter sections as mentioned hereinbefore regarding Figs. 1, 4, 5, 6, 8 and 9.

Assuming both sections 17 of the inner conductor, Fig. 12, are to be inspected, the sleeves 12', 22' and 29' are rotated until the openings therein register with the corresponding openings of the respective sections of outer conductor. Such registration exposes the two sections 17 of inner conductor together with the insulators and connectors associated therewith. Let it be supposed now that the right-hand section 17 of inner conductor is to be replaced. The two connectors 35 are heated and then detached from the opposite ends of the right-hand section 17 of inner conductor, and the insulators are withdrawn therefrom, the right-hand section 17 of inner conductor being rotated as may be necessary to permit such withdrawal. Thereafter, the right-hand section 17 of inner conductor can then be withdrawn endwise through the registered openings of the right-hand section of outer conductor and the sleeve mounted thereon in the manner indicated by the dot-dash representation of this section of inner conductor. It is apparent that this section of inner conductor could also be removed by utilizing the registered openings of the middle section of outer conductor and the sleeve disposed thereon. A new section of inner con-

6

ductor can be inserted by following the same procedure, in the reverse order. The left-hand section 17 of inner conductor can be replaced by repeating the replacement procedure described above concerning the right-hand section 17 of inner conductor.

What is claimed is:

1. A concentric conductor line arranged to transmit signal waves, comprising an outer conductor and an inner conductor including a plurality of sections, a pair of connectors on one section for joining its opposite ends to the adjacent ends of the remaining sections and a plurality of insulators spaced on said one section intermediate its opposite ends for maintaining concentric spacing between said one section and said outer conductor, said outer conductor having one or more axial openings for exposing substantially the entire length of said one inner conductor section together with said connectors and insulators thereon, and a sleeve positioned on said outer conductor in coaxial relation therewith and having one or more axial openings which are substantially coextensive with said openings in said outer conductor, said sleeve being movable to one position for covering said openings in said outer conductor, and to another position for registering its openings with said openings in said outer conductor and thereby exposing said one section of inner conductor together with said connectors and insulators thereon, such registered openings allowing the removal and replacement therethrough of the connectors and insulators associated with said exposed inner conductor section and of said last mentioned inner conductor section itself.

2. A concentric conductor line arranged to transmit signal waves, comprising an outer conductor including a plurality of sections joined end to end, an inner conductor including a plurality of sections, a plurality of connectors for joining the adjacent ends of said sections of inner conductor, and a plurality of insulators positioned on each of said sections of inner conductor intermediate its opposite ends for maintaining concentric spacing between said outer and inner conductors, each section of outer conductor having one or more axial openings and the openings of two adjacent sections of outer conductor exposing substantially one entire section of inner conductor together with the connectors and insulators thereon, and a plurality of sleeves, each of which is positioned on one of said sections of outer conductor in coaxial relation therewith and embodies one or more axial openings which are substantially coextensive with the openings of the associated section of outer conductor, said sleeves being rotatable to one position for enclosing said inner conductor together with the connectors and insulators thereon, and to another position for registering their openings with the openings of the associated sections of outer conductor, such registered openings of two adjacent sleeves and two adjacent sections of outer conductors exposing substantially one section of inner conductor together with the connectors and insulators thereon, and at least one pair of such registered openings allowing the removal and replacement therethrough of the connectors and insulators associated with the exposed inner conductor section and of the last-mentioned inner conductor section itself.

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