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(54) Plug-in power supply adapter.

(57) A power supply adapter (10) for plug-in connection to a standard AC power supply socket (17) to provide a DC voltage to an associated electronic instrument. The adapter (10) comprises a relatively compact case having an end face (38) with a plurality of conductive pins ((40) for plug-in connection to one socket (17), of a standard multi-point wall outlet. An AC adapter (32) assembly including a transformer (34), a capacitor (42) and a rectifier (44) is mounted within the adapter case with these components arranged generally in-line between the pins (40) and a power cord (16) adapted for connection to the associated electronic instrument. The adapter case further includes a mounting clip (64) for convenient removable connection to the associated electronic instrument when the power supply adapter (10) is not in use.

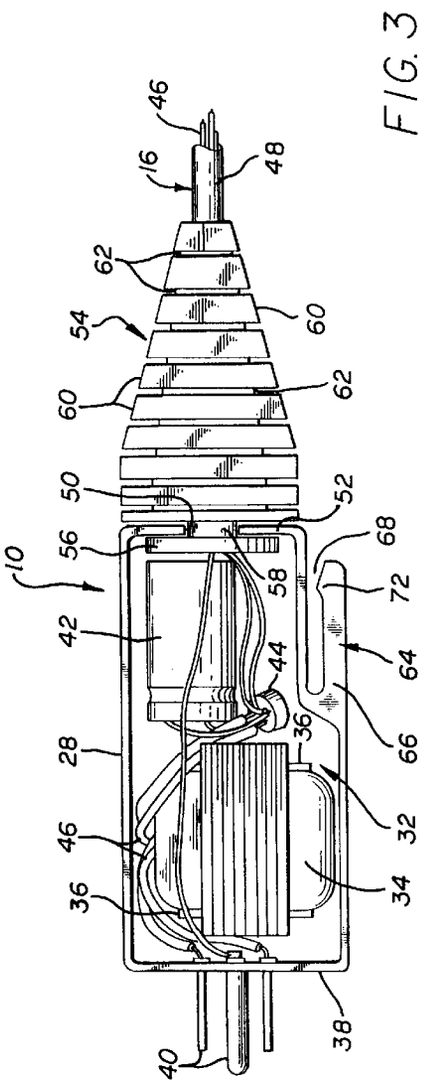

FIG. 3

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This invention relates to an AC adapter of the type used to provide a DC voltage to an associated electronic instrument from an AC supply voltage. The invention is particularly designed for use with electronic instruments in a medical environment.

Modern medical treatment facilities employ a variety of sophisticated electronic instruments in the course of patient diagnosis and treatment. As one common example, electronically operated medication infusion pumps are commonly used for administering one or more selected medical fluids to a patient at a prescribed flow rate and time schedule. Such fluid medication infusion pumps and other electronic equipment require a source of electrical power to maintain the instrument in a desired operational state.

In this regard, many electronic instruments designed for medical as well as non-medical uses are constructed to operate on a DC power supply which can be obtained in the alternative from batteries or by use of an appropriate transformer and rectifier connected to a standard AC power source. In this latter case, the AC adapter frequently comprises a power supply adapter designed for direct plug-in connection to an AC power supply outlet, with a cord extending between the plug-in adapter and associated electronic instrument, to supply DC to the instrument.

In the past, plug-in power supply adapters have included a relatively compact housing or case having the components of an AC adapter mounted therein. Conductive prongs associates with the transformer components have protruded from the adapter case for plug-in connection in the manner of a standard electrical plug with an associated AC power supply receptacle, such as one socket of a standard double or multi-point wall outlet, or a multisocket strip, or the like.

Accordingly, the adapter case essentially comprises the body of an electrical plug for manual grasping in the course of plug-in and unplugging movements. However, the physical size and shape of the adapter case has typically exceeded the width and height of a conventional electrical plug, such that the adapter case partially overlies and therefore obstructs access to adjacent electrical sockets. For example, in a conventional double or quad wall outlet, plug-in connection of a single AC/DC power supply adapter to one of the electrical sockets normally obscures and thus precludes access to all of the remaining electrical sockets in the wall outlet. Additional electrical devices which may be desired or necessary, especially in a medical treatment facility must therefore be plugged into a different wall outlet.

Moreover, in a medical treatment environment, it is often necessary to transport electronic medical instruments from one place to another. For example, fluid infusion pumps are often transported with patients throughout different areas of a hospital or the like, or from one patient room to another for use with different patients as the need arises. While such instruments may be battery powered for short term operation in a mobile environment, it is important that the electrical power cord and associated power supply adapter remain with the instrument so that normal operation can be resumed quickly and easily by merely plugging the adapter into a power supply outlet.

However, transport of the power supply adapter and associated cord with the instrument poses particular problems in that the adapter is relatively heavy and thus difficult to transport with the instrument in a secure and stable manner and/or can become easily separated from the instrument and is thus relatively easily misplaced.

There exists, therefore, a significant need for an improved power supply adapter of the plug-in type which can be plugged into a standard electrical socket without interfering with access to adjacent sockets. The adapter should preferably also include means for convenient and stable mounting in a stored position in association with an electrical instrument for transport purposes.

According to the present invention, there is provided a power supply adapter for plug-in connection to an electrical socket connected to an AC power supply, the adapter comprising an adapter case having a plurality of conductive pins protruding from a first end for plug-in connection to the electrical socket and an AC adapter electrical assembly having a plurality of components mounted with the case characterised in that the said components are in an arrangement disposed generally in-line with the pins.

Preferably, a power cord coupled to the case, preferably at a second end which is opposite to the first end. Preferably, the AC adapter electrical assembly includes a transformer mounted within the case generally adjacent the first end and preferably also at lest one filter capacitor and a rectifier.

There is preferably a mounting clip located on the case, the mounting clip preferably being formed integrally with the case. Preferably, the case comprises a wider front portion and a narrow rear portion, the transformer being mounted within the front portion, and the mounting clip comprising a clip leg projecting rearwardly as a continuation at one side of the front portion but in spaced relation with the rear portion to define a rearwardly open slot. Preferably, the clip leg comprises a ramped lock tooth at its inboard free end.

In one variant, the case is formed from two interfitting case members which together define a hollow interior in which this said plurality of components are located. Preferably, a strain relief fitting connected between the power cord and the case.

Alternatively, the case may be formed of a distal half and a proximal half and includes a strain relief located between the distal and proximal halves of the case. In either case, preferably, the strain relief fitting

comprises an alternative sequence of relatively wide plate members and comparatively narrow neck members.

In a preferred form, the invention may comprise an adapter case formed from first and second interfitting case members co-operatively defining a hollow case interior, the case having a front end wall and a rear end wall; a plurality of conductive pins or prongs protruding from the front end wall of the case; an AC adapter electrical assembly having a plurality of components mounted within the case in an arrangement generally in-line with the prongs, the components including a transformer disposed generally adjacent to the front end wall; and a power cord coupled to the rear end wall of the case.

Alternatively, the invention may be considered to provide a power supply adapter for plug-in connection to an electrical socket connected to an AC power supply, the power supply adapter comprising: an adapter case having a distal end and a proximal opposite end; a plurality of conductive prongs protruding from the distal end of the case, the plurality of conductive prongs for plug-in connection to the electrical socket; a transformer located inside the adapter case near its distal end, the transformer being electrically connected to the conductive prongs; a filter capacitor and a rectifier electrically connected to the transformer, the filter capacitor and rectifier being located proximal to the transformer whereby the components mounted within the case are disposed in generally in-line fashion with the prongs; and a power cord electrically connected to the rectifier and mechanically connected to the proximal end of the case.

The invention also extends to a method of making a power supply adapter for plug-in connection to an electrical socket connected to an AC power supply,the method comprising: supplying an adapter case having first and second opposite ends; mounting a plurality of conductive prongs in protruding fashion from the first end of the case for plug-in connection to the electrical socket; and installing a plurality of components within the case in an arrangement disposed generally in-line with the prongs.

In accordance with the invention, an improved power supply adapter is provided for plug-in connection to a standard AC power supply receptacle to provide a DC voltage to an associated electronic instrument. The power supply adapter is designed with an AC adapter assembly mounted within a compact adapter case having an end face with conductive plug pins or prongs protruding therefrom. The components of the transformer assembly are arranged generally in-line between the conductive prongs and a power cord, so that the case can be constructed with a narrow width and low profile height to avoid obstructing the adjacent sockets of a standard multisocket wall outlet.

The case of the power supply adapter preferably further includes means for the relatively simple removable mounting in a stored position on or in close association with the electronic instrument when the power supply adapter is not in use. In a preferred form, the mounting means comprises a mounting clip formed integrally with the adapter case for secure yet removable mounting onto a bracket arm or some other support structure associated with the electronic instrument.

The invention may be carried into practice in various ways and some embodiments will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of an electronic medical instrument with an associated power cord and a plug-in power supply adapter in accordance with the invention;

Figure 2 is an enlarged rear perspective view of the power supply adapter;

Figure 3 is an enlarged top plan view of the power supply adapter, with a portion of the adapter case removed,

Figure 4 is an exploded perspective view of the power supply adapter;

Figure 5 is a perspective view illustrating the mounting of the power supply adapter in a stored in association with the electronic instrument of Figure 1; and

Figure 6 is a sectional view housing an alternative form of power supply adapter according to the invention.

As shown in Figure 1, an AC power adapter 10 is provided for use with an electronic instrument 12, such as a fluid medication infusion pump. The adapter 10 is designed for quick and easy plug-in connection to a standard AC power supply unit, and to provide a DC voltage via a power cord 16 to the electronic instrument 12. The adapter 10 is constructed with an elongated geometry having a relatively narrow width and low profile height, so that it does not obstruct or otherwise interfere with access to adjacent electrical sockets 17 of multisocket outlet 14.

Although the power supply adapter 10 of the present invention may be used with a wide range of electrical and/or electronic instruments, the illustrative drawings show the adapter 10 in a preferred environment of use, namely, in association with an electronic instrument 12 in a medical environment. The instrument 12 in Figure 1 is a fluid medication infusion pump, specifically the MiniMed III fluid infusion marketed by MiniMed Technologies of Sylmar.

The infusion pump 12 is a relatively compact instrument adapted for mounting onto a conventional portable medical equipment pole 18 by means of an appropriate clamp fixture 20, such as the adjustable clamp fixture described in US Patent 4832299, which is incorporated by reference herein. The infusion pump 12 is shown to include multiple parallel pumping

systems for independent programming and control to regulate the administration of multiple medical fluids from appropriate reservoirs 22 to the patient (not shown) via suitable tubing 24.

The electronic control components and associated electronically powered pumping devices are integrated into the housing of the infusion pump 12. The infusion pump 12 is designed for normal operation by connection to an appropriate AC power supply outlet 14 by means of the AC adapter 10 and the power cord 16, with the AC adapter 10 supplying a selected DC voltage to the infusion pump 12.

As shown best in Figures 2 to 4, the AC adapter 10 includes a relatively compact housing or case as defined by a lower base 28 and an upper cap 30. These case components, in the preferred form, are constructed from a relatively lightweight and high impact moulded plastics material, such as glass-filled nylon. The base 28 and cap 30 have a generally concave or shell-shaped configuration and together define a hollow case interior for receiving and supporting the components of an AC adapter electrical assembly 32.

The AC adapter electrical assembly 32 includes a transformer 34 securely seated within the base 28 in a nested or cradled relation with respect to a plurality of short locator tabs 36. The transformer 34 is positioned in close proximity to a forward end wall 38 from which a plurality of conductive pins 40 protrude in a conventional three-pin array for plug-in connection to the AC outlet 14. In the preferred form, these conductive prongs 40 are securely mounted near their rear ends within the end wall 38 by insert moulding or the like.

The remaining components of the AC adapter electrical assembly 32 are mounted within the adapter case is generally in-line configuration with respect to the transformer 34 and the conductive prongs 40. Figures 3 and 4 shown these remaining components in the form of a filter capacitor 42 and a rectifier 44. All of these components are appropriately coupled electrically by means of suitable conductive wires 46.

A selected trio of the wires 46 are assembled within a protective outer sheath 48 to define the power cord 16 connected to the associated electronic instrument 12. These conductive wires 46 are suitably collected for passage through a notch 50 formed in a rear end wall 52 of the base 28. A strain relief fitting 54 is mounted at the rear end wall 52, providing a flexible structural member connected between the base 28 and the power cord 16 to anchor the power cord 16 securely to the adapter 10.

The strain relief fitting 54 has a mounting head plate 56 at one end for seated reception against the inboard side of the rear end wall 52 of the base 28, with a narrow neck 58 adjacent the head plate 56 and dimensional to fit closely in the open notch 50. From the neck 58, the strain relief fitting 54 includes an alternating sequence of plate and neck segments 60 and 62 which define a flexible structure to retain the associated end of the power cord 16 securely.

It is important to note that the strain relief fitting 54 is designed to permit and flexure (Figure 2) at the adapter case that may be required for use in close clearance locations. Moreover, the fitting 54 is designed to prevent or resist cord breakage at the adapter which may otherwise occur, for example, when the adapter is unplugged by pulling on the power cord 16.

With the AC adapter electrical assembly 32 installed within the lower base 28 and the strain relief fitting 54 mounted in position, the adapter case is closed by mounting the cap 30 onto the base 28. The mounting may be achieved by snap-fit connections, ultrasonic welding, and/or adhesive, with a permanently closed adapter case construction being desired.

The resultant AC adapter 10 includes the components of the AC adapter electrical assembly 32 in a substantially in-line arrangement between the conductive pins 40 and the power cord 16. The adapter 10 thus has an elongate shape which can be easily grasped and/or manipulated manually for plug-in connection to and unplugging from an AC power supply.

The elongate AC adapter electrical assembly 32 also presents a relatively narrow width and a low profile height conforming generally with the dimensions of a standard electrical power plug, so that the plug-in connection of the AC adapter 10 to an electrical socket 17 (Figure 1) does not interfere with or otherwise obstruct access to adjacent electrical sockets 17 of a typical multi-point or strip outlet 17. As a result, the adjacent sockets 17 remain available for easy access and plug-in connection with other electronic instruments as may be necessary or desirable.

Although the specific size and shape of the AC adapter 10 of the present invention may vary according to a range of design criteria, it should be noted that the width and height of the adapter case are predominantly a function of the size and shape of the transformer 34. In this regard, through the use of a compact transformer such as that available from ISL Products International, Ltd, of Syosset, New York, under model designation EI 41, it has been possible to construct an AC adapter 10 with a low profile height of about 1.5 to 1.6 inch (38.1 to 40.6mm) and a narrow width of about 1.7 to 1.8 inch (43.2 to 45.7mm).

The assembled adapter case defines a rearwardly projecting mounting clip 64 for convenient removable mounting of the AC adapter 10 in a stored position with respect to the associated electronic instrument 12. The clip 64 is shown in the form of a rearwardly projecting clip leg 66 formed integrally with the base 28 and cap 30 at one side of the case. Conveniently, to prevent any undesired increase in the case width or height, the clip leg 66 is formed as a continuation of a wider frontal portion of the case within which the transformer core 34 of the case within which

the transformer core 34 is mounted, but in spaced relation with a narrower rear case portion which houses the filter capacitor 42 therein.

In the preferred form, the clip leg 66 co-operates with the narrow rear portion of the case to define a rearwardly open slot 68 dimensioned to receive a bracket arm 70 of the clamp fixture 20, as shown in Figure 5. That is, the clip 64 permits the adapter 10 to be removably mounted quickly and easily onto the bracket arm 70 in close stored association with the medical instrument 12. A lock tooth 72 at the inboard free end of the clip leg 66 includes tapered leading and trailing edges for facilitating secure clip-on mounting and subsequent removal of the adapter 10 from the bracket arm 70.

A support strap 74 having loop and hook Velcro-type fasteners may be mounted on the bracket arm 70 for releasably supporting the power cord 16 in a coiled or other suitably compact configuration.

An alternative preferred form of the power supply adapter is shown in Figure 6, with components corresponding generally with those shown in Figures 1 to 5 being identified by common primed reference numerals. Thus, the modified adapter 10′ includes a transformer 34′ mounted within a compact case in in-line relation with a plurality of conductive plug pins 40′. The remaining components of the AC adapter 10′ include one or more filter capacitors 42′ and a rectifier 44′, which are inserted moulded within a separate case portion 78 spaced rearwardly from the transformer 34′.

A strain relief fitting 54′ is positioned between the transformer 34′ and the capacitors 42′ and rectifier 44′, with all of the components again positioned in a generally in-line configuration between the pins 40′ and the power cord 16′.

Claims

1. A power supply adapter (10) for plug-in connection to an electrical socket (17) connected to an AC power supply, the adapter (10) comprising an adapter case having a plurality of conductive pins (40) protruding from a first end (38), the electrical socket (17); and an AC adapter electrical assembly (32) having a plurality of components mounted within the case, characterised in that the said components are in an arrangement disposed generally in-line with the pins (40).

2. An adapter as claimed in Claim 1, characterised by a power cord (16) coupled to the case, preferably at a second end (52) which is opposite to the first end (38).

3. an adapter as claimed in any preceding Claim, characterised in that the AC adapter electrical assembly (32) includes a transformer (34) mounted within the case generally adjacent the first end (38), and preferably also at least one filter capacitor (42) and a rectifier (44).

4. An adapter as claimed in any preceding Claim, characterised by a mounting clip (64) located on the case, the mounting clip (64) preferably being formed integrally with the case.

5. An adapter as claimed in Claim 4, characterised in that the case comprises a wider front portion and a narrow rear portion, the transformer (34) being mounted within the front portion, and the mounting clip (64) comprising a clip leg (66) projecting rearwardly as a continuation at one side of the front portion but in spaced relation with the rear portion to define a rearwardly open slot (68).

6. An adapter as claimed in Claim 5, characterised in that the clip leg (66) comprises a ramped lock tooth (72) at its inboard free end.

7. An adapter as claimed in any preceding Claim, characterised in that the case is formed from two interfitting case members (28,30) which together define a hollow interior in which the said plurality of components are located.

8. An adapter as claimed in Claim 7, characterised by a strain relief fitting (54) connected between the power cord (16) and the case.

9. An adapter as claimed in any of Claims 1 to 6, characterised in that the case is formed of a distal half and a proximal half (78) and includes a strain relief (54) located between the distal and proximal halves of the case.

10. An adapter as claimed in Claim 8 or Claim 9, characterised in that the strain relief fitting (54,54′) comprises an alternating sequence of relatively wide plate members (60) and comparatively narrow neck members (62).

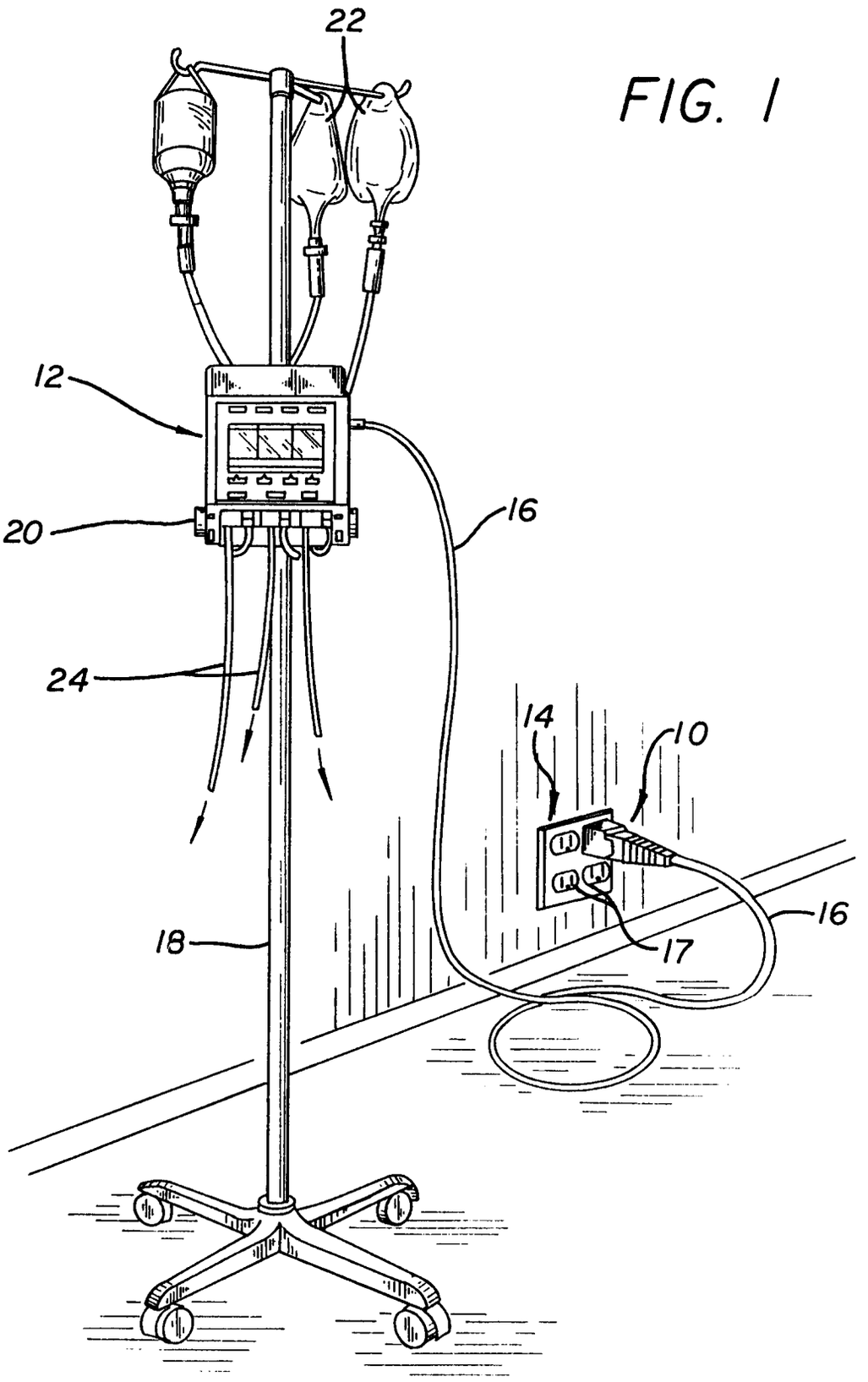
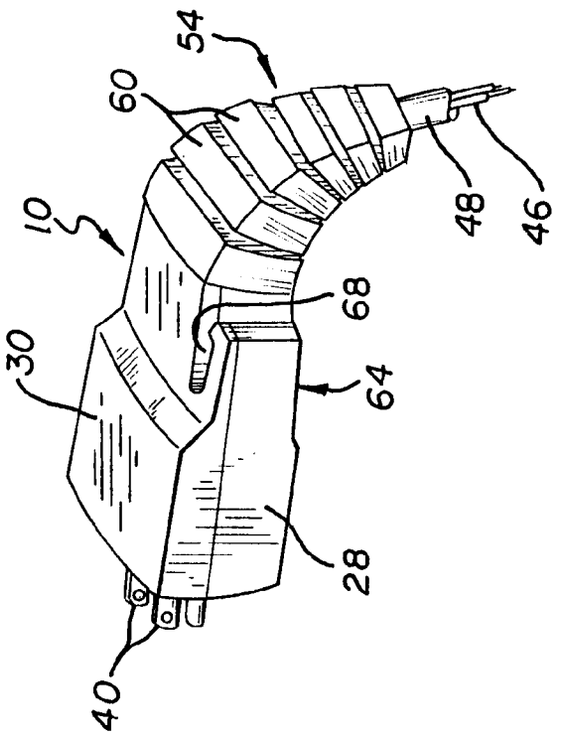


FIG. 1


54
60
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48
46
68
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64
28
40

FIG. 2

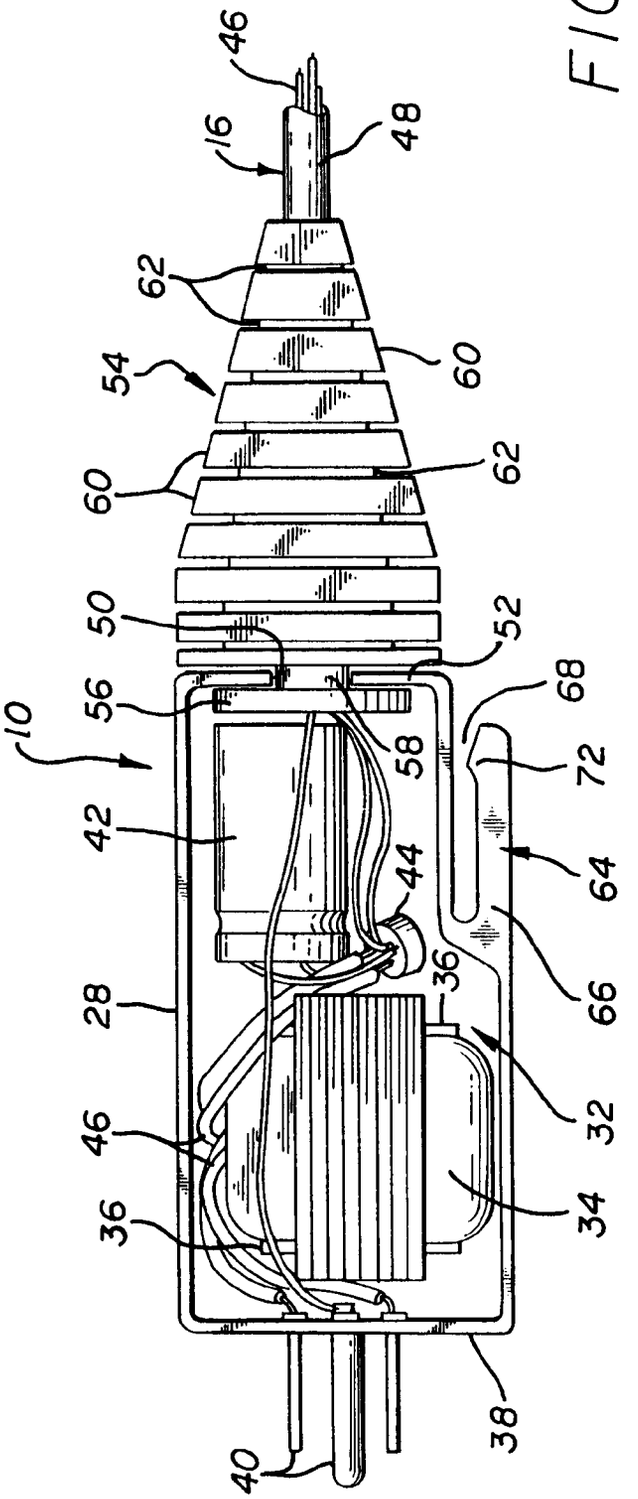
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FIG. 3

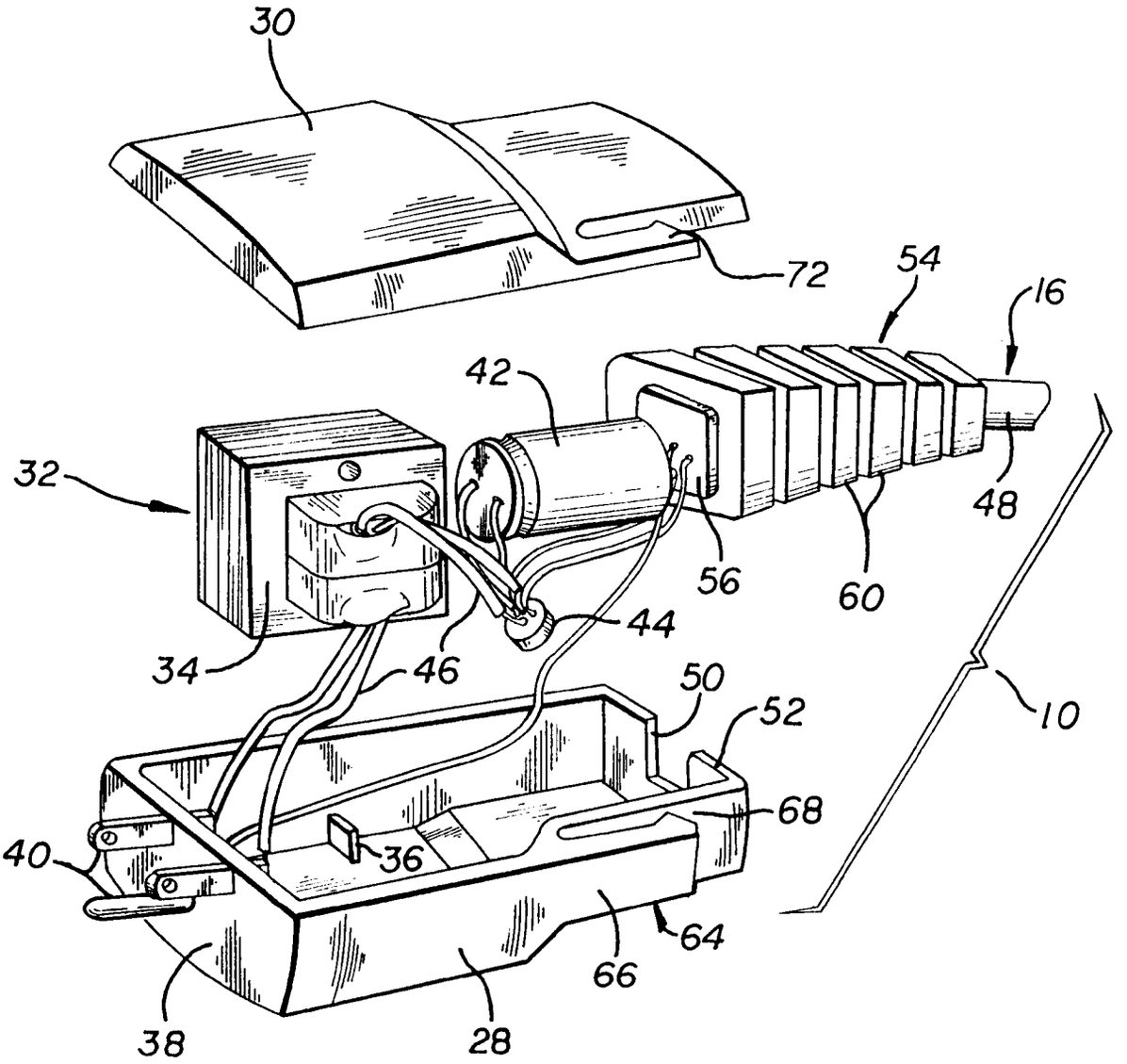

FIG. 4

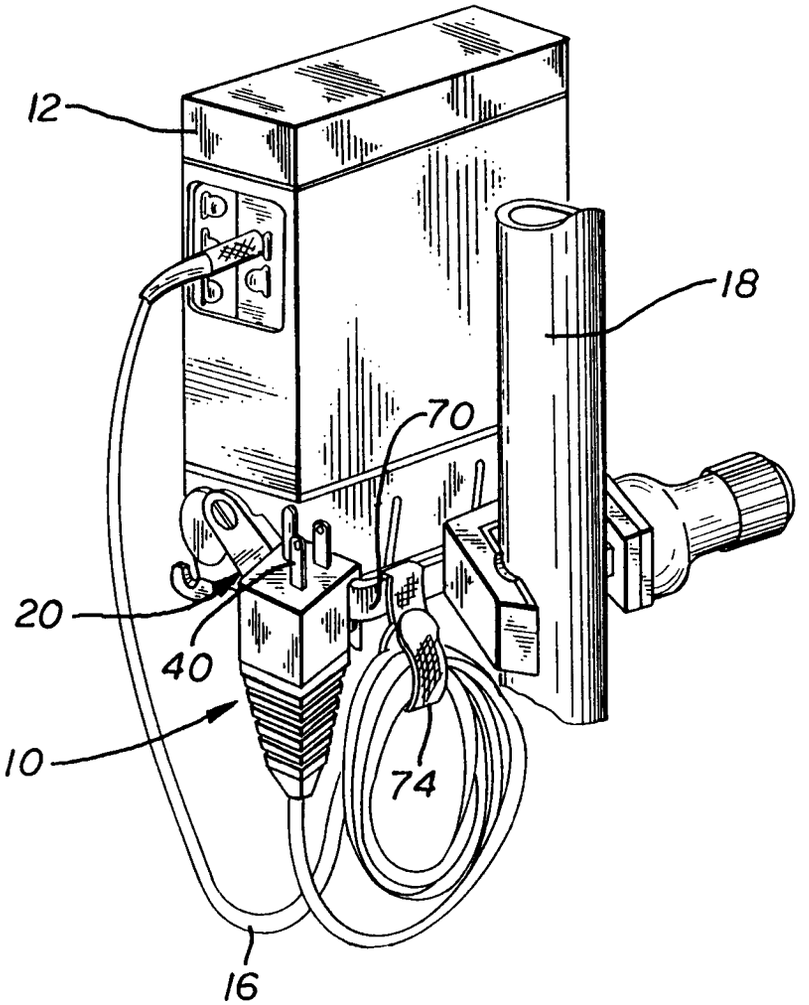

FIG. 5

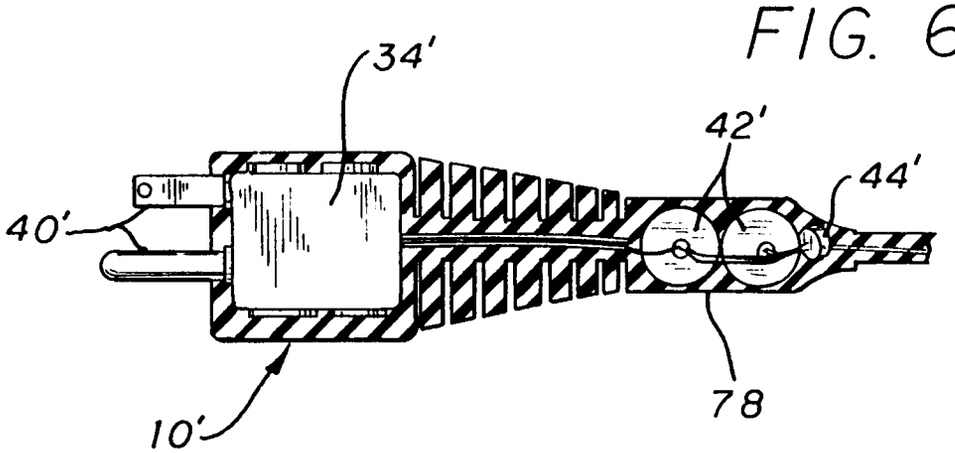

FIG. 6