

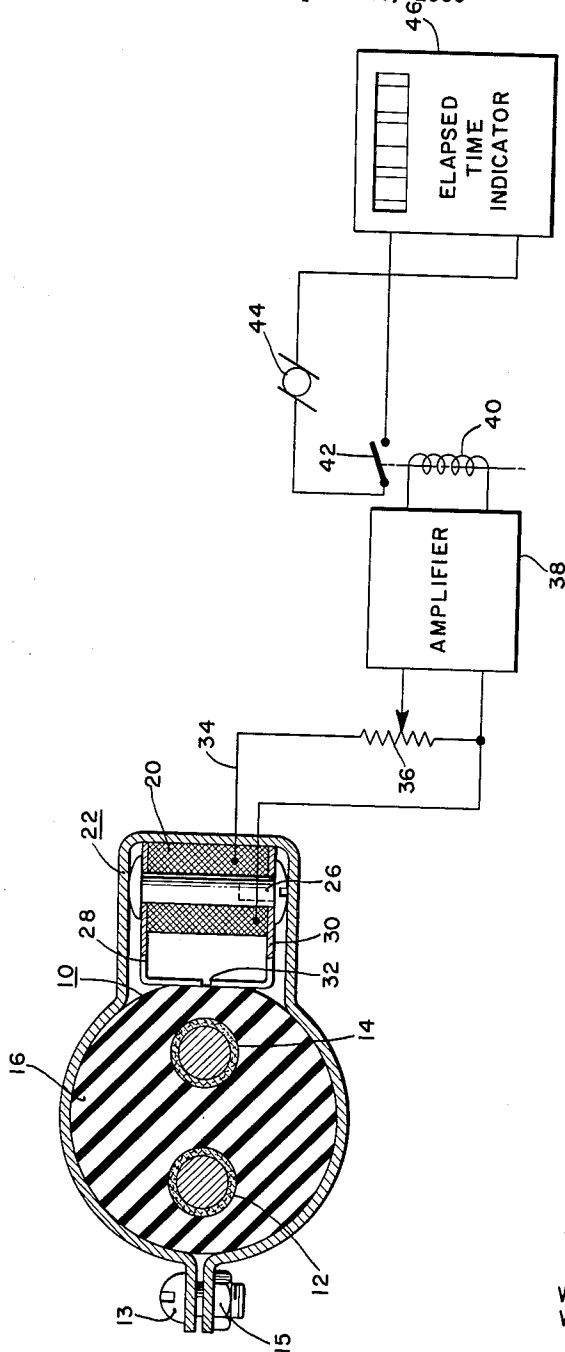
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EXPOSURE TOTALIZER

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EXPOSURE TOTALIZER

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This invention relates to apparatus for determining the length of time equipment has been in operation and, more particularly, to improvements in said equipment.

There is a legal requirement that, for reasons of public health and safety, in medical facilities where X-ray apparatus is employed, a record must be kept of the total amount of X-ray exposure which has occurred over a given interval, say, during a week. These records must be filed with the designated agency. The mode in present use for obtaining this information is rather inaccurate, not because the user intentionally wishes to be inaccurate, but because no accurate X-ray exposure totalizer has been made available to date. As an example of one of the common methods of totalizing the amount of X-ray exposure, it is customary to count the number of X-ray films and multiply this by an average exposure time. Obviously, this is inaccurate, since the range of exposure times employed even for taking dental X-rays varies considerably with the thickness or location of the subject of which an X-ray photograph is desired.

Another approach to the problem of determining the total exposure has been to connect a time totalizer by means of a current transformer to the input power line to the X-ray apparatus. When the X-ray apparatus has power applied thereto, current is induced in the transformer and thereafter applied to the suitable type of totalizing clock which runs as long as current is applied thereto. This arrangement has not found favor for a number of reasons. Amongst these is the fact that in order to couple the current transformer to the input power cord, it is necessary to break into the insulation of the cord and separate the two conductors therein from one another. One of the current transformers then is coupled inductively to one of these conductors. This is more difficult to do than appears at first glance since the power cord for an X-ray machine is heavily insulated and protected. With this type of an arrangement, no distinction occurs between when current is being applied to the X-ray apparatus to heat the filaments and when further current is provided to apply anode potentials to the X-ray tube. As is well known, the actual X-ray exposure occurs only during the time anode potential is applied to the X-ray tube. It therefore appears that none of the presently known arrangements provides the required information as to the actual X-ray exposure time which occurs. Thus at present not only is the law not being complied with, but a hazard to health exists to persons using the X-ray equipment in the absence of knowledge as to the exact exposure they may be subjected to.

An object of this invention is to provide an accurate exposure totalizer of the type indicated.

Another object of this invention is to provide an exposure totalizer which can couple to a line cord to derive information as to the application of power to the apparatus to which the line cord is connected without the necessity of isolating the conductors of the line cord.

Yet another object of the present invention is to provide a novel, simple and accurate X-ray exposure totalizer.

These and other objects of the invention are achieved in an arrangement wherein a pickup head is brought to proximity to a line cord furnishing power to an X-ray device. Output from the pickup head is connected to an

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amplifier, which in turn applies its output to suitable clock apparatus for totalizing the intervals during which output is received from the amplifier.

The pickup includes a coil having a magnetic core extending therethrough. A pair of pole pieces are connected to opposite ends of the core and extend essentially in the form of an L from the core to pole tips which are opposed to one another and define therebetween an air gap. This air gap is made substantially smaller than one of the conductors in the line cord. Preferably the pickup head is made sufficiently small to be substantially shielded by one of the conductors from the magnetic field of the other conductors. Means are provided to attach the pickup head to the line cord with its air gap extending parallel to one of the conductors. Also, preferably, the pickup head is positioned with its air gap on a line which passes through the centers of the conductors in the line cord.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawing, which is a cross section and schematic view of an embodiment of the invention.

Reference is now made to the drawing, illustrating in cross section the pickup head and in schematic form the following circuitry, all of which comprises an embodiment of the invention. In accordance with the previous discussion, it is desired to determine when electrical current flows through a line cord following apparatus, as, for example, X-ray apparatus. It is also desired to find when such current flow increases above a certain level, indicative of the fact, for example, that this current is being provided to actually operate the X-ray tube.

The line cord 10 may include two conductors 12, 14, which are surrounded or wrapped in insulation 16. The exposure totalizer will include a pickup head 20, which is enclosed in a plastic holder 22, which also has a portion for encircling the line cord 10. By means of a screw 13 and nut 15, a means is made for opening the holder 22 to encircle the line cord and to be freely movable until the desired position is attained, at which time the screw and nut, respectively 13 and 15, may be tightened.

The pickup head 20 includes a coil 24, through the center of which there is inserted a magnetic core 26. This magnetic core 26 may be made of iron. A pair of pole pieces 28, 30, which have an L shape, are respectively attached to the ends of the core 26. These pole pieces end in pole tips, which define an air gap 32 therebetween. This air gap is made considerably smaller than the diameter of one of the conductors in the power cord 10. A pair of leads 34 extend from the coil and are connected to a potentiometer 36. The potentiometer is connected to an amplifier 38. The potentiometer 36 may either be external to the amplifier or alternatively may comprise the gain control of the amplifier 38. The output of the amplifier is applied to a relay, having a coil 40 and a pair of contacts 42. When the relay is operated, the contacts 42 apply power from a source 44 to an elapsed-time indicator 46. The potentiometer 36 enables a setting to a desired level for operating the relay 40. Thereby, until such time as the current flowing through the line cord 10 exceeds a value determined by the setting of the potentiometer 36, the relay 40 will not be operated, and the elapsed-time indicator also is not operated. When the current through the power cord increases to provide the required anode potential to the X-ray tube, the amplifier 38 output becomes sufficiently large to operate the relay 40, and the elapsed-time indicator 46 is rendered operative. Thus, in accordance with this invention, an

accurate elapsed-time indicator for apparatus such as an X-ray machine is provided.

The pickup head size can be varied, provided that the air gap 32 be maintained substantially less than the size of one of the conductors of the power cord. However, optimum operation is achieved when the pickup head size is sufficiently small, so that it can be substantially shielded by one of the conductors from the magnetic field of the other. Furthermore, a favored location of the pickup head relative to the conductors is with the air gap on a line which passes through the centers of both conductors. This orientation is shown in the drawing. Effectively, then, the pickup head is in the field of the conductor 14. To find this position for the head, for those line cords where the conductor positions cannot be seen or felt, the head is moved around the line cord, with current flowing therethrough, until two positions are reached where the relay either becomes inoperative or begins to chatter or to become inoperative. The optimum head position is between these two positions on the line cord. It may be necessary to reduce the gain of the amplifier to determine these positions. It should be noted, however, that this invention will operate successfully, even though the head is not in the optimum position. All that is actually required is that the head be in a position on the cord where the relay is operated as soon as current flows in the cord. Almost any position on the cord except where the fields from both wires therein cancel each other satisfies this requirement.

While the above description is directed to the application of the elapsed-time indicator to the problem of determining the total expose of X-ray apparatus, it will be appreciated that this is by way of explanation of the utility of the device, and is not intended to be a limit thereon. It has been found that with this invention it is possible to detect the current flow through one conductor in multiple-conductor cable when the pickup head is closest to that conductor and the air gap extends parallel to the conductor. Furthermore, the indicator which is operated from the output of the pickup head need not be an elapsed-time indicator, but can be an amplitude or frequency indicator, as required.

Accordingly, there has been described and shown hereinabove a novel and useful apparatus for detecting current flow through a conductor in a multiple-conductor cord, and further, for detecting the amplitude of said current flow, whereby an indicator may be driven to indicate the duration of said current flow.

We claim:

1. In apparatus to which electrical current is supplied over a pair of conductors which are wrapped in insulation, each of said conductors establishing a magnetic field upon current flow therethrough, means for indicating the time elapsing during current flow to said apparatus, comprising a pickup head having a coil, said coil having a pair of output terminals, a magnetic material core extending through said coil, a pair of L-shaped pole pieces, one of said pole pieces being attached to one side of said core the other of said pole pieces being attached to the other side of said core, said pole pieces extending from said core to define an air gap between the ends of said pole pieces which is substantially less than the diameter of one of said conductors, means for holding said pickup head against said insulation-wrapped conductors with its air gap extending parallel to one of said conductors and substantially shielded by said one of the conductors from the other conductor, an elapsed-time indicator, and means for connecting said pair of output terminals to said elapsed-time indicator.

2. In apparatus to which electrical current is supplied over a pair of conductors which are wrapped in insulation each of said conductors establishing a magnetic field upon current flow therethrough, means for indicating the time elapsing during current flow to said apparatus comprising a pickup head having a size to be effectively shielded by one of said conductors from the magnetic field of the other when said pickup head is positioned on an axis passing through the centers of said conductors, said pickup head having a coil, said coil having a pair of output terminals, a magnetic material core extending through said coil, a pair of L-shaped pole pieces, one of said pole pieces being attached to one side of said core the other of said pole pieces being attached to the other side of said core, said pole pieces extending from said core to define an air gap between the ends of said pole pieces which is substantially smaller than the diameter of one of said conductors, means for holding said pickup head against said insulation-wrapped conductors with its air gap extending parallel to one of said conductors, an elapsed-time indicator, and means connecting said pair of output terminals to said elapsed-time indicator.

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