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ELECTRICAL POWER LINE WARNING DEVICE
FOR VEHICLES WITH EXTENDED BOOMS
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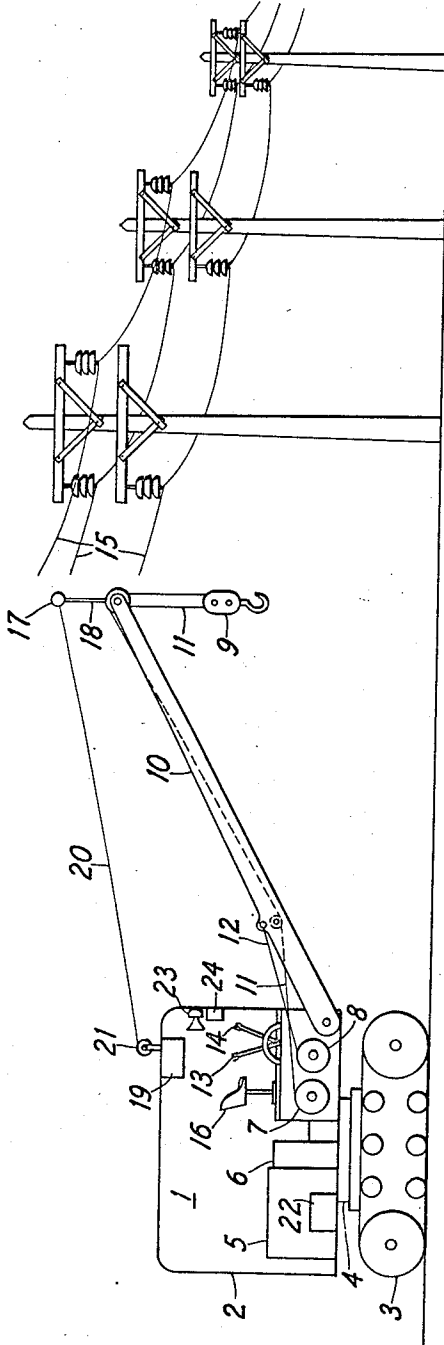


Fig. 1

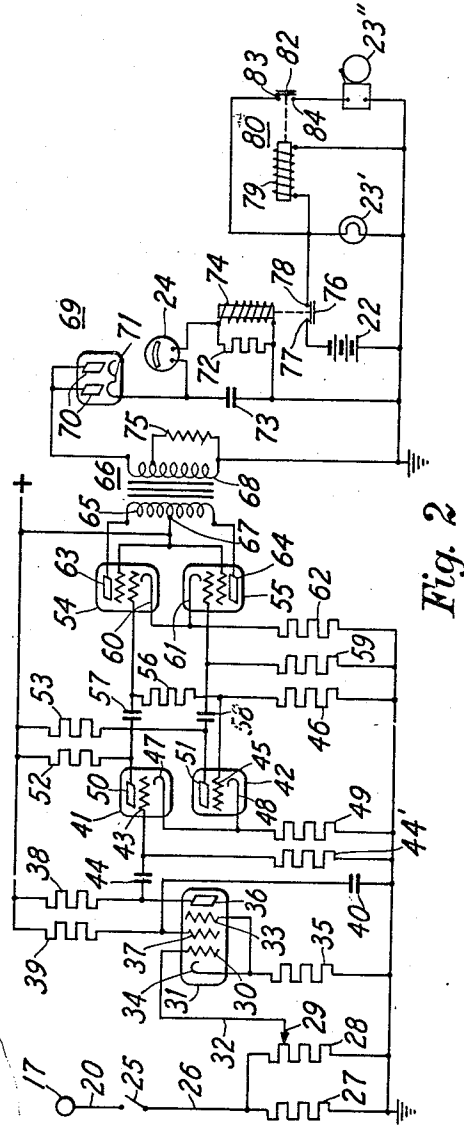


Fig. 2

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ELECTRICAL POWER LINE WARNING DEVICE FOR VEHICLES WITH EXTENDED BOOMS

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1 Claim. (Cl. 177-311)

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The present invention relates to safety devices and, more particularly, to safety devices for vehicles having an extended boom, such as mobile crane units and the like.

In the operation of vehicles having an extended boom, it is customary in moving from one location to another for an operator to drive the machine with the boom in a raised position so that a crane, or the like, will have a substantially shorter turning radius than would be possible with the boom lowered. However, this has been hazardous in the past due to the frequent disregard by the operator of overhead power lines which cross the path of the vehicle. Either due to the inability of the operator to see such lines or the negligence of the operator, the boom is very likely to come in contact with the power line and may cause either failure of the power line or create a very serious hazard for persons in the vicinity. Especially is the hazard severe for the operator, who, in a number of instances, has been killed by electrocution when the boom has contacted high tension lines.

It is, therefore, an object of this invention to provide a safety device to warn the operator of a mobile crane unit and the like of the approach of the boom of the machine to an electric power line so that the vehicle may be stopped and the boom moved before it contacts the power line.

It is a further object of this invention to provide a warning device that may be easily attached to a standard mobile unit having an extended boom for indicating the approach of the boom to a power line at a sufficient distance so that the unit may be stopped and the boom lowered without danger of the boom shorting the power line to ground through the machine.

A still further object of this invention is to provide a warning device for a mobile crane having a sensitive pickup unit capable of indicating the approach of the crane boom to a power line whether the line is loaded or not.

Further objects and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawing.

In the drawing, Fig. 1 is a schematic representation of a mobile crane unit approaching a power line with the side of the crane cut away to show the arrangement of the essential units of a machine which incorporates the present invention.

Fig. 2 is a wiring diagram of a circuit which may be used to operate the warning device in the cab of the crane.

In Fig. 1, I have shown a mobile crane unit of the general type to which the present invention

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is applicable. Crane unit 1 is provided with the usual cab 2 which is rotatably mounted upon an endless-track propelling arrangement 3 by means of a bearing member 4 upon which the cab 2 may rotate with respect to the track 3. An engine 5 and a transmission 6 are provided for both driving the crane unit and for operating the cable drums 7 and 8 which respectively control the operation of the hoisting hook pulley 9 and the crane boom 10 by means of cables 11 and 12. Levers 13 and 14 are provided for the operator for operating the usual clutches between transmission 6 and the hoisting drums 7 and 8.

As shown in Fig. 1, crane 1 is generally moved from one location to another with boom 10 in an elevated position, and in this position the end of the crane boom is liable to contact high tension lines 15 which cross the path of the crane. It will be apparent that the crane boom will be substantially at ground potential through the usual metal cab 2, bearing support 4, and track 3. Likewise, it will be apparent that the seat 16 for the operator is in substantially the conducting path for any current passing from boom 10 to ground. Hence, the operator of the cab is in a very vulnerable position if the boom runs into the power line. In order to warn the operator of the crane of the approach of the boom to the power line, I have provided a warning device capable of indicating the approach of the boom at a distance sufficient to permit the operator to stop the crane and lower the boom. For this purpose, a signal voltage pickup unit 17, which may be of either the inductive type or of the capacitive type, is located upon an insulating rod 18-mounted adjacent the end of boom 10. While signal device 17 may be of either the inductive or capacitive type, in the preferred embodiment, a capacitive type comprising a hollow metal sphere is used since it is possible with this type of device to pick up a signal from the high tension lines 15 whether or not a load current is being carried by the power lines. Signal device 17 is connected to amplifier 19 which is located in the cab by means of conductor 20. An automatic reeling device 21 is provided for conductor 20 to eliminate slack between the amplifier 19 and signalling device 17 when boom 10 is raised or lowered. The usual battery 22 for starting and ignition of the engine 5 which is the prime mover for the crane, provides the operating potential source for amplifier 19, as well as the signalling devices 23 and meter 24, which are conveniently located in cab 2 to warn the operator of the approach of the end of boom 10 to the lines 15.

Referring now to Fig. 2, signal pickup unit 17

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is connected to amplifier 19 through line 20 as described hereinbefore. However, a switch 25 is normally provided between line 20 and the amplifier for disconnecting the signal source from the amplifier. If so desired, switch 25 may be operated as a limit switch by the location of boom 10 in respect to cab 2 of the crane unit so that when the boom is lowered the signal may be automatically interrupted. The signal voltage from pickup unit 17 is then applied to the amplifier through line 26 and resistor 27 which has its other terminal connected to ground. Resistor 27 serves as a leak resistance and is one of the controlling factors determining the amount of potential available from signal unit 17 that may be applied to the amplifier. A potentiometer 28 is connected in parallel across resistor 27 and a movable contact 29 for potentiometer 28 is provided for supplying an operating potential to the control grid 30 of the detector tube 31 by means of line 32. As shown, tube 31 is of the pentode type with a suppressor grid 33 directly connected to cathode 34 of the tube and with a grid biasing resistor 35 directly connected between the cathode terminal and ground. Plate 36 and screen grid 37 are connected to a plate voltage supply (not shown) through resistors 38 and 39, respectively. A screen by-pass condenser 40 is connected between the screen grid and ground. The output of tube 31 is coupled to a pair of triode tubes 41 and 42 which serve as phase inverters for the subsequent push-pull amplifier stage provided by tubes 54 and 55. In a manner well known in the art, grid 43 of triode 41 is connected to the plate of pentode tube 31 through coupling condenser 44 and a load resistor 44'. However, grid 45 of triode 42 is connected to a point intermediate resistors 45 and 56 which are connected to serve as both a load resistor for tube 41 and as a voltage divider circuit. By this arrangement tube 42 is adapted to operate in phase with pentode 31 while tube 41 is substantially 180° out of phase with pentode 31. It will be understood by those skilled in the art that resistors 46 and 56 may be so proportioned that the output voltage from tubes 41 and 42 may be equal with the phase inverted. Cathodes 47 and 48 of triodes 41 and 42 are directly connected to one end of a resistor 49 which in turn is connected to ground and serves as a common grid biasing resistor for both tube 41 and 42. Plates 50 and 51 of the triodes are respectively connected to a plate potential source through resistors 52 and 53.

As stated hereinbefore, a push-pull stage of amplification is provided by a pair of screen grid tubes 54 and 55. The control grid of tube 54 is coupled to the output of tube 41 through coupling condenser 57 and resistors 46 and 56, while the control grid of tube 55 is connected to the output of tube 42 through coupling condenser 58 and load resistance 59. Cathodes 60 and 61 of the screen grid tubes are directly connected to a common grid biasing resistor 62. Plates 63 and 64, respectively, of tubes 54 and 55 are connected across the ends of a primary coil 65 of output transformer 66. In order to provide the required operating potential for the screen grids and the plates of tubes 54 and 55, the screen grids are connected together and a source of positive potential is directly applied to the screen grids and likewise connected to the plates 63 and 64 through center tap 67 on primary coil 65.

In order to provide the desired operating po-

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tential for warning devices 23 and meter 24, secondary coil 68 of transformer 66 is connected to a rectifier, such as double-diode tube 69. As shown, plates 70 of rectifier tube 69 are connected to one end of secondary coil 68 while the opposite end of the coil is directly connected to ground. Cathodes 71 of rectifier 69 are connected to ground through ammeter 24 and through both the coil of relay 74 and resistor 72 which are connected in parallel. Preferably, but not necessarily, a by-pass condenser 73 is provided between cathodes 71 and ground, and likewise, a resistor 75 is provided across a portion of secondary 68 of transformer 66.

With meter 24 connected in the output circuit of rectifier 69, means are provided for continuously indicating the amount of current flowing between pickup unit 17 and resistor 27, and by properly selecting resistor 72 in relation to the coil of relay 74, a predetermined voltage developed across rectifier tube 69 will actuate armature 76 of relay 74. As shown, armature 76 is adapted to close contacts 77 and 78, which are respectively connected between the power battery 22 and the coil 79 of relay 80. While any number of warning devices 23 may be connected to the battery 22, it has been found desirable to connect a lamp 23' directly to the battery 22 through contacts 77 and 78 and armature 76 of relay 74, so that a signal will be present at all times when the current in the output circuit of the amplifier is sufficient to indicate the presence of the crane boom adjacent to the power line. As stated before, coil 79 of relay 80 is in parallel with the lamp 23' and hence the coil is energized at the same time that the lamp is lighted. Armature 82 of relay 80 is designed to close a set of contacts 83 and 84 to place a second warning device, such as bell 23'', directly across the battery. However, relay 80 is of the time delay type and may be arranged to be de-energized after a specified period of time. In this way, both lamp 23' and bell 23'' will be energized as soon as the boom approaches the power line, but after a predetermined time bell 23'' may be de-energized, leaving only the lamp 23' as a warning element.

In operation, the mobile crane unit 1 is generally driven from one location to another with boom 10 in an elevated position and in this position the boom is very likely to come in contact with overhead high tension lines 15. However, with pickup unit 17 installed above the end of the crane boom, and with limit switch 25 in a closed position, the pickup unit 17 is adapted to pick up a signal voltage from the power line 15 upon the electrostatic principle. Under these conditions, unit 17 acts as one plate of a condenser with the wires 15 acting as the opposed plate of the condenser and the intervening space between unit 17 and wires 15 acting as the dielectric of the condenser. In this manner a voltage is impressed upon pickup unit 17 and this in turn is applied to the amplifier 19 through resistors 27 and 28. The movable contact 29 is provided on resistor 28 so that sensitivity of the amplifier may be adjusted and the desired portion of the signal voltage generated in unit 17 applied to the amplifier. In the amplifier the current flow in tube 31 is controlled by grid 30 and the output of tube 31 is applied to tubes 41 and 42, which, as stated hereinbefore, are adapted to serve as a phase inverter circuit to produce equal voltages which are substantially 180° out of phase with each other, with tube 41 being out of phase with

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tube 31, while tube 42 is in phase with tube 31. An amplification stage is then provided for the signal voltage by tubes 54 and 55, which are coupled to the output circuits of tubes 41 and 42. The output of this stage of amplification is then applied to a coupling transformer, which in turn is connected to rectifier tube 69. When the strength of the signal voltage is sufficiently high, the current flow through tube 69 may be adjusted to actuate the coil of relay 74. When the coil of relay 74 has been energized, the contacts 77 and 78 are closed to connect the warning light 23' and bell 23'' to the power source, battery 22. When the operator of the crane is thus warned of the approach of the end of boom 10 to the power line, he may stop the crane and properly adjust the boom to a point where it will not contact the power line.

By the foregoing arrangement, a very effective warning device is provided for the operator of a vehicle having an extended boom so that the life of the operator, as well as other workmen, will not be endangered by the boom contacting a high tension line and shorting the line to ground through the machine.

It will be apparent to those skilled in the art that the electrostatic unit 17 may be replaced by an electromagnetic type of pickup wherein a voltage is generated in a coil by the magnetic lines of force generated in the air space between the coil and the high tension lines. It will also be obvious that numerous changes may be made in the electronic amplifier without departing from the scope of the invention, and that the only requirement of the amplifier is that it convert the signal voltage or current to an operating potential for the warning devices.

Among the modifications that may be made in this system without departing from the scope of the invention is the possibility of interconnecting the ignition system for the internal combustion engine driving the crane with the relay system for the warning devices. Thus, when the signal voltage is sufficient to actuate relay 74, the engine may be stopped. If a gas engine is used in propelling the crane, the relay could operate to open the ignition system or ground the magnetos, or, if a diesel engine is used, the relay may be used to close the fuel line.

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While the warning device is shown in the preferred embodiment to be incorporated in a mobile crane unit, it will be appreciated that this system can be applied to any equipment having an extended boom where there is likelihood of contacting an overhead power line while moving the machine from one location to another.

Other variations and modifications of the invention may be made without departing from the scope of the invention, and I, therefore, intend to limit the invention only within the scope of the appended claim

I claim:

In combination, a vehicle having an extending boom, said boom being continuously in electric contact through said vehicle with the earth so that it is at ground potential, a capacitor pickup unit mounted adjacent the end of said boom and insulated therefrom, an amplifier mounted on said vehicle and connected directly to said pickup unit for amplifying the signal impressed upon said unit, means for continuously energizing said amplifier when either said vehicle or said boom is in motion, and warning means connected to the output of said amplifier for indicating the approach of said boom to an overhead electric power line whereby the operator may stop said vehicle or adjust said boom before said boom contacts said overhead power line.

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