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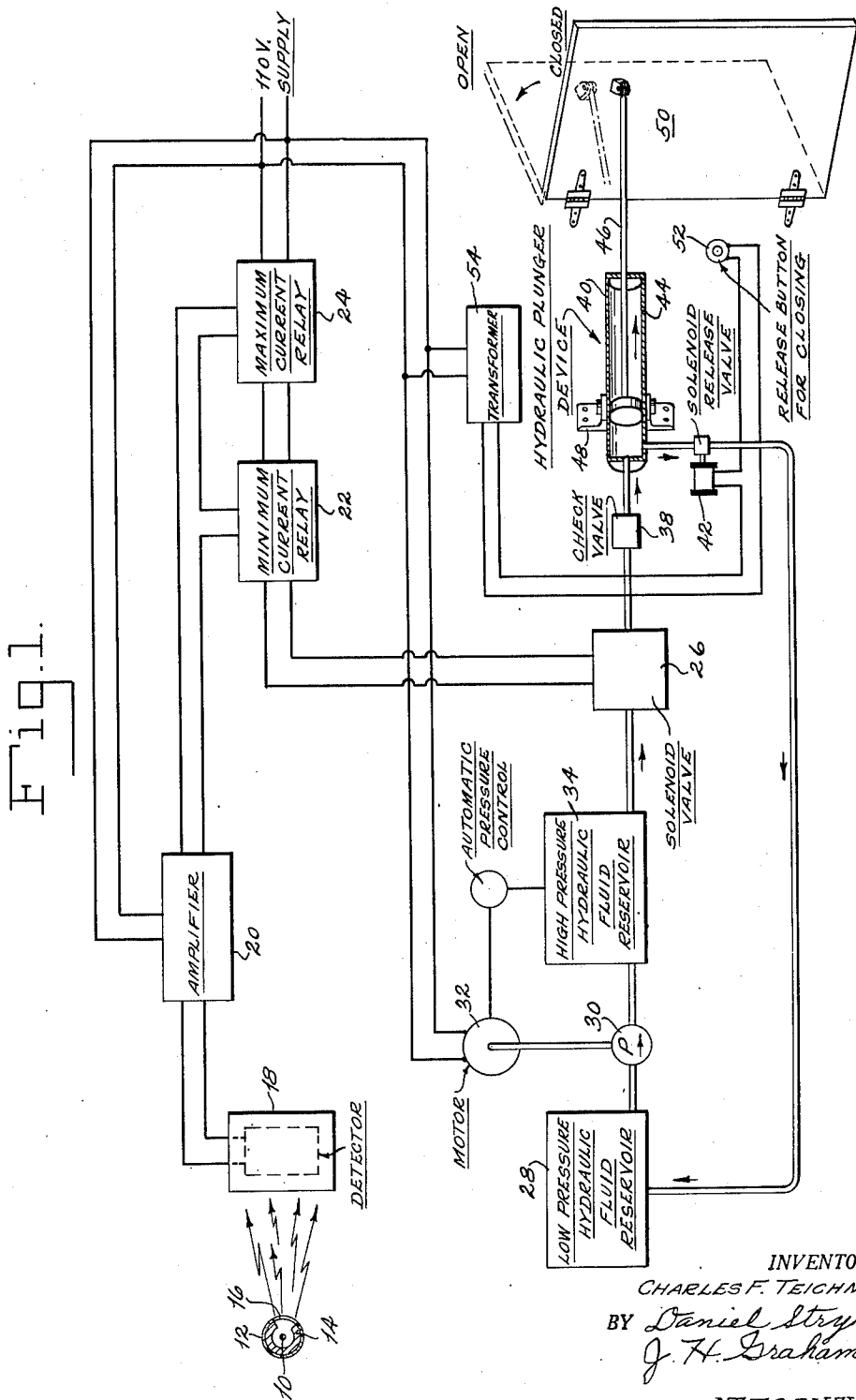
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2,665,153

CONTROL SYSTEM FOR LOCKING MEANS

Original Filed May 30, 1945

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

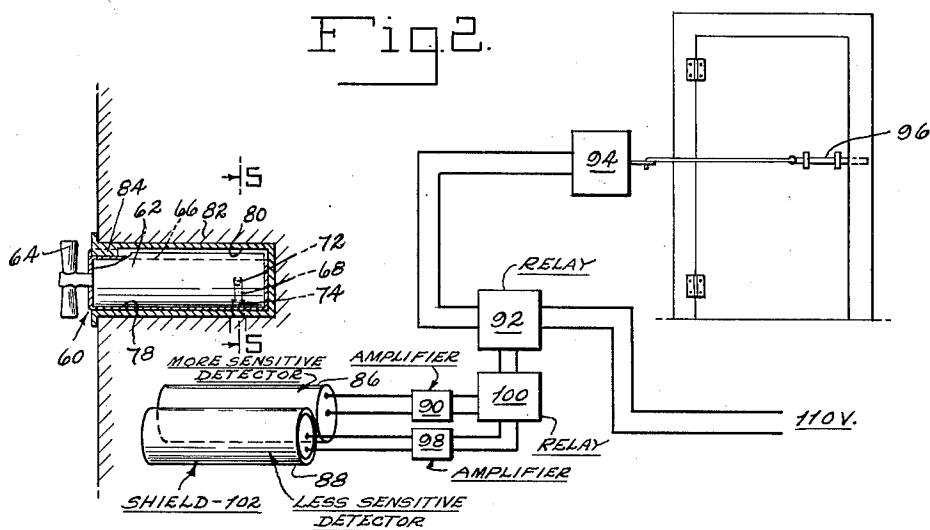


Fig. 3.

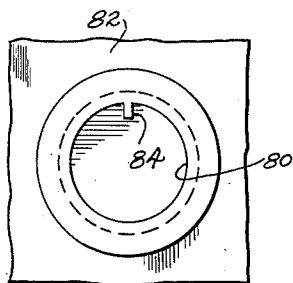


Fig. 5.

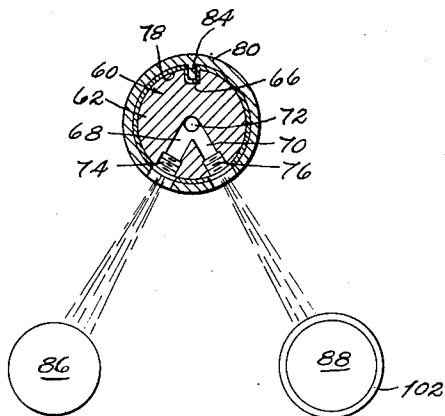
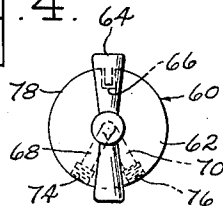


Fig. 4.



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CONTROL SYSTEM FOR LOCKING MEANS

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1, 1950, Serial No. 147,020

4 Claims. (Cl. 292-144)

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This invention deals with automatic actuating mechanisms, and more specifically relates to the actuation of locking mechanisms by means of penetrative radiation.

This is a division of my co-pending application Serial Number 596,795 filed May 30, 1945, in which the actuation of closure mechanisms is claimed. The claims in the present application are directed to the actuation of locking mechanisms.

The object of the present invention is to provide means for the actuation, through the use of penetrative radiation, of locking mechanisms, such for example as the locking mechanisms of bank vaults.

The use of radiant energy for the actuation of mechanisms is well known. Both visible light and invisible light have been employed for this purpose by directing a beam of visible or invisible light to fall on a photocell or photoelectric tube, commonly known as an electric eye. The photocell or photoelectric tube converts the radiant energy of the beam of light into electric current, which in turn is employed to actuate mechanisms for opening and closing doors and for other similar applications. Photocells and photoelectric tubes are sensitive to radiant energy of the infrared, visible light, and ultra-violet regions of the spectrum.

It also is known to employ radio waves for actuating various types of mechanisms. For example it is known to install an oscillator on an automobile for generating high frequency radio waves. These waves are picked up by radio receiving apparatus and converted into electric current for actuating a mechanism which will open the door of a garage and permit the driver to enter the garage without getting out of the car to open the doors. This is merely an example of the use of radio waves for actuating driving or control mechanisms. It is well known that they also have been used for operating airplanes, ships, and land vehicles by remote control as well as for numerous other applications of a similar nature. The use of radio waves for such purposes also has certain disadvantages. For example, they are non-discriminatory except as to wave length and any transmitter operating on the wave length to which the receiver is tuned will cause the operating mechanism to function. Thus if one man driving into his driveway turns on his transmitter to open his garage doors he would also open the doors of a neighbor's garage in the next block if both of their receivers happened to be tuned to the same wave length.

In accordance with the present invention I em-

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ploy penetrative radiation as the actuating medium. As used herein, the term penetrative radiation is intended to mean both electromagnetic radiation, such as gamma rays and x-rays, an high-speed particles of matter, such as those emitted from radioactive materials and those emitted from substances subjected to radioactive emanations, for example, alpha particles or helium atom nuclei, beta particles or electrons, neutrons, protons or hydrogen atom nuclei, positrons or "positive electrons" and mesotrons. The term penetrative radiation may also be defined as radiation which will pass through one-thousandth of an inch thickness of iron without appreciable loss in intensity. The preferred source of penetrative radiation is natural or artificially radioactive substances. For example natural radioactive materials such as radium, uranium, thorium, actinium, their ores, and their salts may be employed. Artificially radioactive substances such as radioactive sodium also may be employed. The radioactive materials may be used either in their pure state or in dilute mixtures with inert substances, for example as in the luminescent radium paint used on the dials of clocks and watches. It is contemplated that the source of radiation may be of any quantity and may be either fixed or stationary, but in order to provide for discriminatory actuation of the locking mechanism it is preferred that the amount of radiation be correlated with the actuating circuit so that the locking mechanism will not function unless the detector is exposed to a definite quantity of penetrative radiation.

A detector sensitive to penetrative radiation is employed for converting the energy of the penetrative radiation into electrical energy for actuating the locking mechanism. This detector may be either an ionization chamber, a proportional counter, a Geiger-Muller type of counter, or any other suitable device depending on the particular type of penetrative radiation employed. For best results, however, I prefer to use a highly sensitive radiation detector of the type described in U. S. Letters Patent No. 2,397,071 to D. G. C. Hare, issued March 16, 1946. The electric current or pulses of current created in the detector may be amplified by means of any suitable type of amplifier and the amplified current employed to actuate a relay or an electronic control device, thereby activating the power circuit of the mechanism which operates the lock.

Any type of electrical, hydraulic, or other suitable mechanism, or any combination thereof may be employed for operation of the lock. For

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example, I may choose to use an electric motor geared as a driver, or an electrically heated vapor pressure motor, or I may prefer to employ an electromagnetic solenoid and a hydraulic system, depending on the specific type of operation and conditions involved.

For a further understanding of the principles of my invention reference is made to the accompanying drawings, it being understood that these drawings are illustrative of a few applications of my invention and I do not consider my invention to be restricted to the specific embodiments herein illustrated and described.

Figure 1 is a diagrammatic illustration of an arrangement for opening hinged type doors.

Figure 2 is a diagrammatic illustration of an arrangement for actuating locking mechanisms.

Figure 3 is a front view of receptacle or keyway 80 shown in Figure 2.

Figure 4 is a front view of key member 60 shown in Figure 2.

Figure 5 is a sectional elevation on the line 5—5 of Figure 2, looking in the direction of the arrows.

In the embodiment illustrated in Figure 1, a radioactive source 10, such as radium, is enclosed in a container 12, formed of any suitable material, such as steel, which will permit penetrative radiation to pass through its walls and which may be portable or may be fastened to an automobile or other movable object. An absorptive shield 14, composed of sufficient thickness of a substance, such as lead, lies between the wall of the container 12, and the radioactive source 10, said shield being continuous except for an opening 16 on one side which permits the passage of penetrative radiation. In order to cause the door opening mechanism to function, radiation from the radioactive source 10, is directed to fall on the detector 18, where bombardment of the elements of detector 18 creates electric current or pulses of current. This current or pulses of current is amplified by means of a suitable amplifier 20 and the amplified current is employed to operate a minimum current relay 22 and a maximum current relay 24 connected in series. The minimum current relay 22 is set to make contact at a definite predetermined amount of current, for example 100 microamperes, and the maximum current relay 24 is set to break contact at a definite predetermined amount of current, for example 125 microamperes. Both relays are connected in series in both the detector circuit and the power circuit which operates solenoid valve 26, so that current is supplied to solenoid valve 26 only when both relays are closed. This is the case only when the amplified current from the detector is within the specific minimum and maximum limits for which relays 22 and 24 are set to operate.

Solenoid valve 26 forms part of a hydraulic type door opening mechanism which consists of a low pressure hydraulic fluid reservoir 28, a pump 30 operated by an electric motor 32, a high pressure hydraulic fluid reservoir 34, an automatic pressure control device 36, for maintaining the desired pressure in the high pressure hydraulic fluid reservoir 34, the solenoid valve 26, a check valve 38, a hydraulic plunger device 40 operated by the hydraulic fluid, and a solenoid release valve 42 for releasing the hydraulic fluid from the plunger device 40 back to the low pressure reservoir 28. One end of the casing 44 of the hydraulic plunger device 40 is

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pivotaly attached to a stationary object, such as the wall of the garage, by means of support 48, and the plunger or sliding element 46 is connected to a hinged door 50 in such a manner that movement of the plunger from the normal position causes the door 50 to open. A release button 52, is provided for operating the solenoid release valve 42 in order to release the fluid from the plunger device 40 and allow it to return to its normal position, thereby closing the door. A transformer 54 may be employed to reduce the main line voltage for the current supplied to the solenoid release valve 42.

The operation of the embodiment illustrated in Figure 1 is as follows: penetrative radiation from the portable radiation source 10 is directed so as to fall on detector 18, which is responsive to said penetrative radiation and functions to convert the penetrative radiation into electrical energy. The electric current or pulses of current created in the elements of detector 18 are amplified to a predetermined degree by means of amplifier 20. Minimum current relay 22 and maximum current relay 24 are connected in series with the output from amplifier 20 and in series with the power supply for the door opening mechanism in such a manner that power for operating the door opening mechanism is supplied only when the amount of current output from the amplifier is of sufficient magnitude to operate the minimum current relay and is not of sufficient magnitude to operate the maximum current relay. When power is supplied to the door operating mechanism through the above-mentioned relay arrangement solenoid valve 26 opens and permits the flow of hydraulic fluid from high pressure reservoir 34 to the hydraulic plunger device 40. The fluid forces the plunger or sliding element 46 of the plunger device from its normal position causing door 50 to open. In order to close the door the fluid is released from the hydraulic plunger device by pushing button 52 to open solenoid release valve 42. The released fluid flows to low pressure reservoir 28. Pump 30, driven by electric motor 32, is provided to pump the fluid from the low pressure reservoir 28 to the high pressure reservoir 34. The fluid pressure in the high pressure reservoir is controlled by automatic pressure control valve 36.

In the embodiment of the invention shown in Figure 2, a portable key member 60 is comprised of a cylindrical member 62 having a handle 64 attached thereto to facilitate handling and manipulation. Cylindrical member 62 is provided with a linear slot 66 and two holes 68 and 70 drilled radially in such a manner that they meet at the axis of the cylinder. A radioactive substance 72 placed at the point of juncture of holes 68 and 70 provides a source of penetrative radiation. Plugs 74 and 76, which are permeable to said penetrative radiation, are placed in the openings of the holes at the surface of the cylinder. Except for the area covering the openings of holes 68 and 70 the surface of cylindrical member 62 is covered by a shield 78 of a material impenetrable by the penetrative radiation. Cylindrical member 62 is adapted to conform to the contour of receptacle or keyway 80 which is affixed to and supported by wall 82 and which has a linear projection 84 adapted to cooperate with slot 66. A more sensitive detector 86 and a less sensitive detector 88 are positioned in the path of the penetrative radiation. The more

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sensitive detector 86 is connected through an amplifier 90 to operate an on-and-off type relay 92 which is set to make contact at a definite specified current intensity and close the circuit which supplies power to mechanism 94 which operates lock 96. The less sensitive detector 88 is connected through an amplifier 98 to operate a circuit breaker type relay 100. Both relay 92 and relay 100 are designed to respectively make and break contact at substantially the same current intensity. Detector 88, however, is made less sensitive to the penetrative radiation by a thin shield 102 of material which reduces the amount of radiation passing into the detector. Relay 100, operated by the less sensitive detector 88, is connected into the output circuit of the more sensitive detector 86 between amplifier 90 and relay 92 and controls the flow of current operating relay 92. If the amplified current supplied to relay 100 exceeds that required to trip this relay, the output circuit of the more sensitive detector 86 will be opened and relay 92 will not be actuated. Under these conditions no current will be supplied to the mechanism 94 which operates lock 96.

The operation of the embodiment illustrated in Figure 2 is as follows: the portable key member 60 is inserted into keyway 30 and thereby penetrative radiation emanating from radioactive substance 72 is directed by means of openings 68 and 70 so as to fall on detectors 86 and 88 which are responsive to said penetrative radiation. When the amount of electrical energy created in the elements of detector 86 is above a definite predetermined value relay 92 is actuated, thereby closing the power circuit of the locking mechanism and causing it to function. Detector 88, which is shielded to make it less sensitive to the penetrative radiation, is connected to relay 100 in such a manner that when the amount of penetrative radiation exceeds a predetermined value the electrical energy created in the detector, when amplified, is sufficient to cause relay 100 to be actuated. Actuation of relay 100 interrupts the output circuit of detector 86 and prevents the actuation of relay 92. Therefore, when the amount of penetrative radiation is in excess of a definite predetermined value the locking mechanism will not function. The operation of the device is dependent, therefore, upon the amount of penetrative radiation emanating from the radioactive source in the key. If the amount of penetrative radiation is less than that required to actuate relay 92 or greater than that required to actuate relay 100 the locking mechanism will not operate. The difference between the lower and upper limits of the amount of penetrative radiation which will cause the locking to operate is dependent upon the amount of penetrative radiation absorbed by shield 102 of detector 88 and may be varied at will by varying the material of construction or the thickness of shield 102.

In addition to discriminatory action based on the intensity of the penetrative radiation, the shape of the key and keyway may be varied to permit further discrimination. For example, the location, size, and cross sectional shape of the linear slot 66 and projection 84 may be varied and a multiplicity of conforming slots and projections may be used. The cross sectional shape of the cylindrical member 62 may be varied by making it an oval, rectangle, hexagon or any other shape desired. The length and thickness of the key and keyway also may be varied as desired. In addition the geometrical location of the key

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and detectors may be varied by altering the direction of holes 68 and 70. Obviously other methods of obtaining discrimination may be employed without departing from the scope of this invention.

Figure 3 is a front view of receptacle 80 showing linear projection 84.

Figure 4 is a front elevation of key member 60 showing the position of slot 66 and holes 68 and 70.

Figure 5 shows a geometric arrangement for the key member 60 and receptacle 80 with respect to detectors 86 and 88.

As hereinbefore stated this invention is not limited to the exemplary illustrations given above and numerous modifications falling within the scope of this invention are evident.

Any source of penetrative radiation may be employed as previously mentioned. This source may be contained in any suitable container and preferably may be portable so as to be carried around by hand.

The detector may be located in any convenient position where it can be exposed to the penetrative radiation. Since penetrative radiation is employed as the actuating medium the present device has the advantage of permitting complete concealment of the component parts if so desired. For example, the detector may be placed in the door itself or in a position remote from the door and connected to the locking mechanism of the door by suitable electrical connections.

Any suitable system for obtaining discriminatory action may be employed. For example, in addition to the methods described in the foregoing examples a contact type current indicator may be used to measure the output from the detector in such a manner that a relay will be actuated when the current supplied to the indicator is equal to that required to make contact in the indicator.

The locking mechanism may be any of the conventional types normally used or any type of mechanism capable of adaptation for the operation of locking mechanisms.

In addition to the actuation of closure and locking mechanisms the device described herein, and obvious modifications and extensions thereof, can be employed for numerous other purposes, for example, for actuating safety devices on machinery, for actuating railway block signals, for automatic floor leveling of elevators, for automatic selection of various wave lengths in radio communications, and for any other application where an operating mechanism can be controlled and actuated by means of penetrative radiation.

Obviously many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. A device for actuating locking mechanisms and the like which comprises a receptacle, a portable key-like member comprising a source of a definite predetermined quantity of penetrative radiation, contained in a housing shaped to conform to the shape of said receptacle, a detector concealed from view and adjacent to said receptacle for converting said penetrative radiation into electrical energy, the magnitude of which is proportional to the intensity of said penetrative radiation, a substance opaque to visible light disposed between said detector and

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said receptacle, control means responsive only to a predetermined quantity of electrical energy generated by said detector, and locking means actuated by said control means, the arrangement being such that when said container with said source of predetermined quantity of penetrative radiation is placed in said receptacle the electrical energy generated by said detector is of such magnitude as to operate said controlling means thereby actuating said locking means.

2. A device for actuating locking mechanisms and the like which comprises a receptacle, a source of penetrative radiation of definite predetermined intensity having a shape conforming to the shape of said receptacle and adapted to be inserted manually into said receptacle, a detector of penetrative radiation concealed from view and positioned in proximity to said receptacle for converting said penetrative radiation into electrical energy, said detector being non-responsive to visible light, amplifying means for increasing the electrical output of said detector, discriminating means electrically connected to the output of said amplifying means, control means actuated by said discriminating means, and locking means actuated by said control means, the arrangement being such that said locking means is actuated only when a source of said definite predetermined intensity is inserted into said receptacle, a normally open minimum current relay and a maximum current normally closed relay connected in series to the output of said amplifying means, a power supply controlled by said relays, and a locking mechanism operated by said power supply.

3. A locking system or the like, comprising a radioactive substance emanating a definite predetermined quantity of penetrative radiation, a key-like container for said radioactive substance adapted to direct said radiation in two predetermined directions, a receptacle for said key-like container adapted to conform to said container, two detectors responsive to said radiation and

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capable of converting said radiation into electrical energy, one of said detectors being more sensitive to said radiation than the other, a substance opaque to visible light disposed between each of said detectors and said receptacle, amplifiers electrically connected to the output of each of said detectors, a first relay electrically connected to the output of the amplifier of the more sensitive detector, a locking mechanism controlled by said first relay, a second relay electrically connected to the output of the amplifier of the less sensitive detector and adapted to control the electrical connection between said amplifier for the more sensitive detector and said first relay, the arrangement being such that both relays are actuated simultaneously only when a radioactive substance emanating a definite predetermined quantity of penetrative radiation is inserted in said receptacle.

4. A device for actuating locking mechanisms and the like which comprises a receptacle, a portable key-like member comprising a source of a definite predetermined quantity of radiation contained in a housing shaped to conform to the shape of said receptacle, a detector adjacent to said receptacle for converting said penetrative radiation into electrical energy, the magnitude of which is proportioned to the intensity of said penetrative radiation, control means responsive only to said predetermined quantity of electrical energy, and locking means actuated by said control means.

CHARLES F. TEICHMANN.

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