M. G. DIAZ & A. AZAROLA Y GRESILLON.

CURRENT LIMITING DEVICE.

APPLICATION FILED AUG. 22, 1908.

1,001,737. Patented Aug. 29, 1911.

Fig. 1.

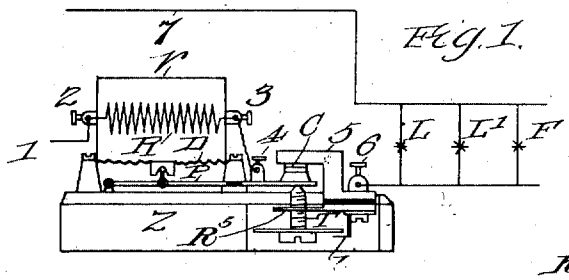


Fig. 2.

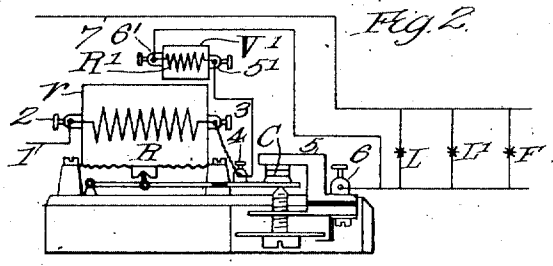


Fig. 3.

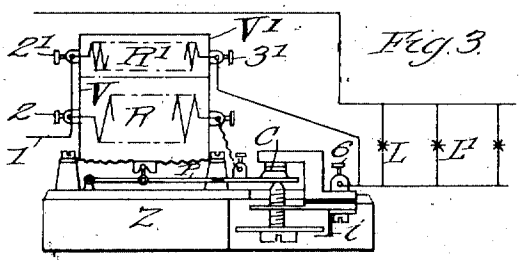


Fig. 4.

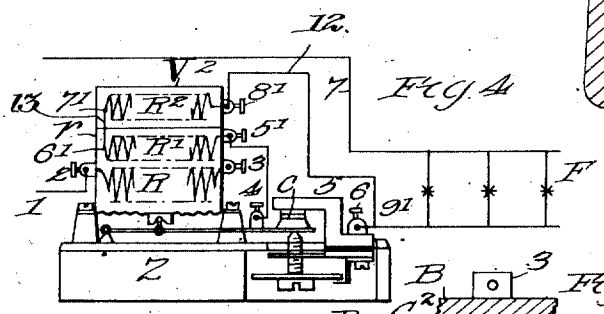


Fig. 5.

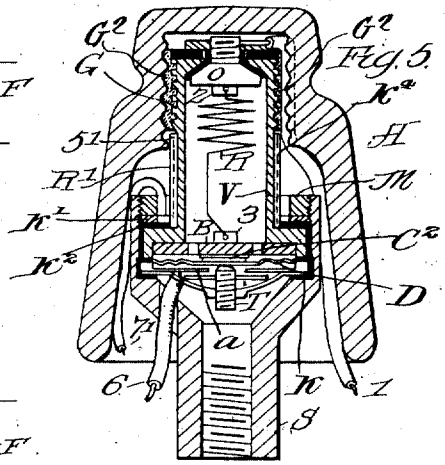


Fig. 6

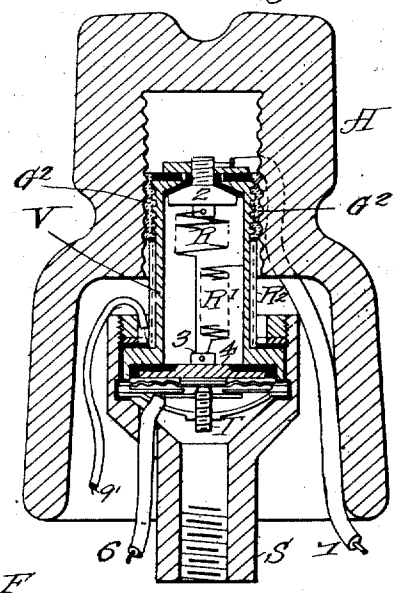
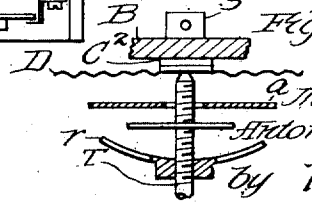


Fig. 5a



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UNITED STATES PATENT OFFICE.

MANUEL GARCIA DIAZ AND ANTONIO AZAROLA Y GRESILLON, OF MADRID, SPAIN.

CURRENT-LIMITING DEVICE.

1,001,737. Specification of Letters Patent. Patented Aug. 29, 1911.

Application filed August 22, 1908. Serial No. 449,871.

To all whom it may concern:

Be it known that we, MANUEL GARCIA DIAZ and ANTONIO AZAROLA Y GRESILLON, subjects of the King of Spain, residing at Madrid, Spain, have invented new and useful Improvements in Current-Limiting Devices, of which the following is a specification.

The present invention has reference to an apparatus or instrument intended to prevent the theft of electricity, and has particular reference to means whereby the circuit is broken and the lights thereof extinguished for a certain length of time when a user fraudulently attempts to introduce an extra lamp or otherwise uses current beyond the limit contracted for.

The invention is shown in the accompanying drawing, in which—

Figure 1 represents diagrammatically a simple embodiment of the device and arrangement of circuits; Fig. 2 represents one form of the apparatus employing an auxiliary resistance; Fig. 3 represents another modified form employing an auxiliary resistance; Fig. 4 represents a form of the apparatus employing two supplementary resistances; Fig. 5 represents an embodiment of the device employing an insulating housing or casing for the apparatus; Fig. 5^a is a detailed view of the portion of the structure represented in Fig. 5; and Fig. 6 is a modification of the form shown in Fig. 5.

Referring particularly to Fig. 1, V is a closed airtight vessel, the sides or walls of which conduct and radiate heat, which vessel is suitably placed on a base Z. One of the walls of V consists of a flexible diaphragm D which can be distended by the pressure from within. R is an electric resistance of a certain value arranged in such a form as to have substantially no self-induction. Surrounding the resistance R and filling the vessel which contains the same is a gas of any suitable kind which may be either air or vapors of any suitable liquid, or partly of liquid and partly of gas or vapor. This confined atmosphere may have a pressure equal to or greater than atmospheric pressure, which pressure increases under the conditions hereinafter set forth. The diaphragm D is mechanically connected with a lever P and the end of this lever at the point C makes or breaks electric contact with a part fixed to the base Z when the lever turns around its pivot. The lever P, and therefore the said diaphragm, has to act against the action of a spring R^5, suitably attached to a portion of the frame or base Z, in which spring a screw T turns more or less, its position being determined by means of an index *i*, and the said screw making contact with the end of lever P.

If the apparatus be arranged in series in a consumer's circuit, which we will assume is to work at a rate of 0.4 amperes, the electric current will take its course from conductor 1 through terminal 2, resistance R, terminals 3, and 4 on lever P, make-and-break contact C on insulated end of lever bracket 5, terminal 6, and the lamps L, L^1 to the other conductor 7. If now the spring R^5 be suitably set by means of the screw T, the contact C can be kept fixed or closed notwithstanding the initial heating or radiation from resistance R which dilates the gas and sets up pressure on the diaphragm, which will correspond to a given equilibrium of temperatures between the ordinary atmosphere and that of the apparatus and the latter will remain in equilibrium.

If the fraudulent user introduces an extra lamp F, or one of a larger consumption in place of L or L^1, or takes extra energy in any other form, the increase in the heat of the resistance R destroys the equilibrium which is maintained by the spring and the circuit is opened almost instantaneously. The circuit being thus broken, no calorific energy is produced by resistance R and the apparatus cools by radiation to the temperature of the surrounding air and closes the circuit afresh, as the action of the spring reëstablishes the contact C. Thus as these phenomena recur successively, there is produced an interrupting action.

Referring now particularly to Fig. 2, a non-inductive auxiliary resistance R′ connected around 4 and C, through 5′ and 6′ is arranged in shunt between the two points of the contact C. This resistance if of a certain predetermined value and arranged in a receptacle V^1, more or less close to the vessel V, will answer two conditions, one being that of taking up the spark of rupture if the contact works in the open air, and the other being that of communicating

by radiation from the vessel V^1 to the vessel V a quantity of heat during the opening of the contact C, which will cause these openings to be of longer duration by rendering the cooling of vessel V more difficult. If the vessel V^1 be brought into greater proximity to V, it will be possible to permit the transfer of heat from V^1 to V in such a way as to sustain the dilation within the vessel V, and the oscillations gradually become slower or more deliberate so that the contact C will remain open, and the circuit will have a great resistance so long as the user does not interrupt it, the apparatus which was improperly heated being thus caused to cool down. The circuit connections are hereinafter mentioned.

Referring now particularly to Fig. 3 a suitable auxiliary resistance R^1 may be provided in shunt, with regard to the main resistance and contact, between 2 and 6, through 2′, 3′ and 4′ which resistance is placed in a chamber or compartment V′ next to the main vessel or chamber V, the arrangement being such that the heat which is produced after the first opening of the circuit by the action of the partition wall, is transmitted from V^1 to V by conductivity, the heat created by the resistance R ceasing and that produced by R^1 being taken up in an increasing quantity, which is limited only by the radiation from the apparatus, thus producing the effect of at first lengthening slightly and then indefinitely, the period of rupture, since while current passes to the lamps it is insufficient to cause them to light up brightly but sufficient to support the internal radiation thus restricting the fraud or theft. The user, having had the inconvenience of a variable or intermittent light which marks the fraud or theft he has been committing, is obliged to leave the apparatus to cool for a certain time.

Referring to Fig. 4 we provide two supplementary resistances R^1 R^2 one of which is inside the main vessel V and the other in a compartment V^2 these resistances being in series with each other and so calculated and arranged that if fraud be committed, the resistance R′ from the time of first opening the circuit supplements the diminished action of R, dilating the atmosphere in the vessel V in such a way that the circuit is opened at once; the resistances R′ and R^2 are high resistances, R′ being connected through post 5′ to post 4, said resistances being connected to each other by wire 13 which connects post 6′ and 7′, and resistance R^2 is connected at 8′ to wire 12. The resistance R^2 by its radiation of heat into vessel V, acts as an additional compensating influence against too rapid radiation of heat from vessel V.

The two distinct devices described above may be fitted to an impervious casing either in the air or underground or be let into a wall or a flooring.

Figs. 5 and 6 represent vertical diametrical sections of the device fitted for the purpose of being used, within insulators A for heavy currents. They are shown in the drawings in their natural dimensions, but can be made of any suitable size, according to the requirements to be fulfilled. They each consist of a vessel or metallic receptacle V to the upper part of which an insulated conductor 1 runs which is lodged in a groove formed vertically inside the circular wall of the insulator. In the figures all the heavy portions in black represent insulating washers or devices. From the terminal *o* the current reaches R and flows through the contact holder plate or perforated disk B, in front of which is a yielding diaphragm or plate D suitably insulated from V. The letters for these parts will be more clearly followed on the small detail key diagram Fig. 5^a. The plate D supports in its center the lower contact of the make-and-break device C^2 (the lever P being dispensed with). This lower contact may be put in or out of engagement with that attached to the disk B by the movements of the corrugated diaphragm D. Below the plate is fitted a protecting washer *a* and below the latter is a spring-plate or the like *r* by which more or less pressure may be applied to the diaphragm by moving the micrometer screw T. A conducting wire 6 soldered to the washer *a* passes through an opening in the support or base of the device and delivers the current to the user. The entrance for this conducting wire may be made airtight and if a suitable washer and screw are fitted in the base of the socket S, an airtight chamber is created below the diaphragm. Air may be provided over and below the diaphragm at the same initial pressure in order to make the device absolutely independent of widely ranging external changes of pressure and temperature. The spring *r* rests on an insulating lining *k* interposed between it and the base of the sockets and the whole arrangement described forms a single piece held in place in socket S by a thick screw threaded fixing ring M, a washer *k′* below it, and an interposed insulating ring k^2. The metal socket or holder S is insulated from all the metallic pieces with the exception of the said ring M and its washer *k′* and it may be screwed to a support and fixed where desired.

In the upper outer surface of the vessel V are grooves G whereby through the medium of a suitable cement G^2, the vessel can be fixed to the insulator A, and its other or lower outer part is occupied by a wide annular recess k^4 into which is wound the calculated resistances R^1 in Fig. 5 or R^2 in Fig. 6.

The device represented in Fig. 6 does not differ from that represented in Fig. 5 except as regards the cross plate or disk B, which in Fig. 6 is insulated from V by ring k^6 while in Fig. 5 it makes electrical contact with the said vessel V.

The arrangement of the circuits is as follows:—Referring to Fig. 5:—1st, interior radiation circuit through 1, resistance R, 3, C^2, D, and 6 corresponds with circuit 1, 2, 3, 4, C, 5, 6, in Fig. 1.

The external radiator circuit is through 3, B, V, 5′, resistance R′, and wire 7′, thus connecting the point 7′ with 6. It corresponds to circuit 4, 5′, 6′, 7′ in Fig. 2. The apparatus being thus arranged, with the external radiation circuit near the vessel, at the expiration of a certain number of oscillations occasioned by the fraud, the light goes out and compels the user to take off the fraudulent lamps and to wait till the device cools again.

If the external radiation circuit be removed somewhat from the vessel V the oscillating period increases with respect to the previous condition, and if it be further removed its heating effect will cease altogether, the resistance R′ then only serving to reduce the arcing or spark, although this is not really necessary.

Referring to Fig. 6 the auxiliary resistance R′, corresponding to the resistance R′ of Fig. 4, is introduced into the vessel V, being connected to post 3 and to the resistance R^2, the latter being situated exterior to the vessel V, and corresponding to the resistance R^2 of Fig. 4. The resistance R^2 is connected to wire 9′, which latter may be connected to wire 6. Except as to the member B, the structure of the device is otherwise the same as in Fig. 5, and the resistances R, R′ and R^2 have the same effect as in Fig. 4.

We claim:—

1. A current limiting device comprising an electric circuit, an expansible vessel included within said circuit, a resistance for heating said vessel, an adjustable contact controlled by the expansion of said vessel and controlling said circuit, a shunt circuit containing an auxiliary resistance adapted to convey current when said contact is broken, and a vessel in close proximity to said expansible vessel containing said auxiliary resistance adapted to be heated thereby, said second-named vessel being of substantially the same width as said expansible vessel.

2. A current limiting device, comprising an electric circuit, an expansible vessel included within said circuit, a resistance for heating said vessel, an adjustable contact controlled by the expansion of said vessel and controlling said circuit, a shunt circuit containing two auxiliary resistances adapted to convey current when said contact is broken, one of the said auxiliary resistances being arranged in said expansible vessel, and a vessel in close proximity to said expansible vessel containing the other of said auxiliary resistances and adapted to be heated thereby.

3. A current limiting device, comprising an electric circuit, an expansible vessel included within said circuit, a resistance for heating said vessel, an adjustable contact controlled by the expansion of said vessel and controlling said circuit, a shunt circuit containing two auxiliary resistances adapted to convey current when said contact is broken, one of the said auxiliary resistances being arranged in said expansible vessel, and the other of said auxiliary resistances being located outside said expansible vessel and adapted to impart heat thereto.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

MANUEL GARCIA DIAZ.
ANTONIO AZAROLA Y GRESILLON.

Witnesses:
E. DE MORA,
JACINTO HENAREJO.