

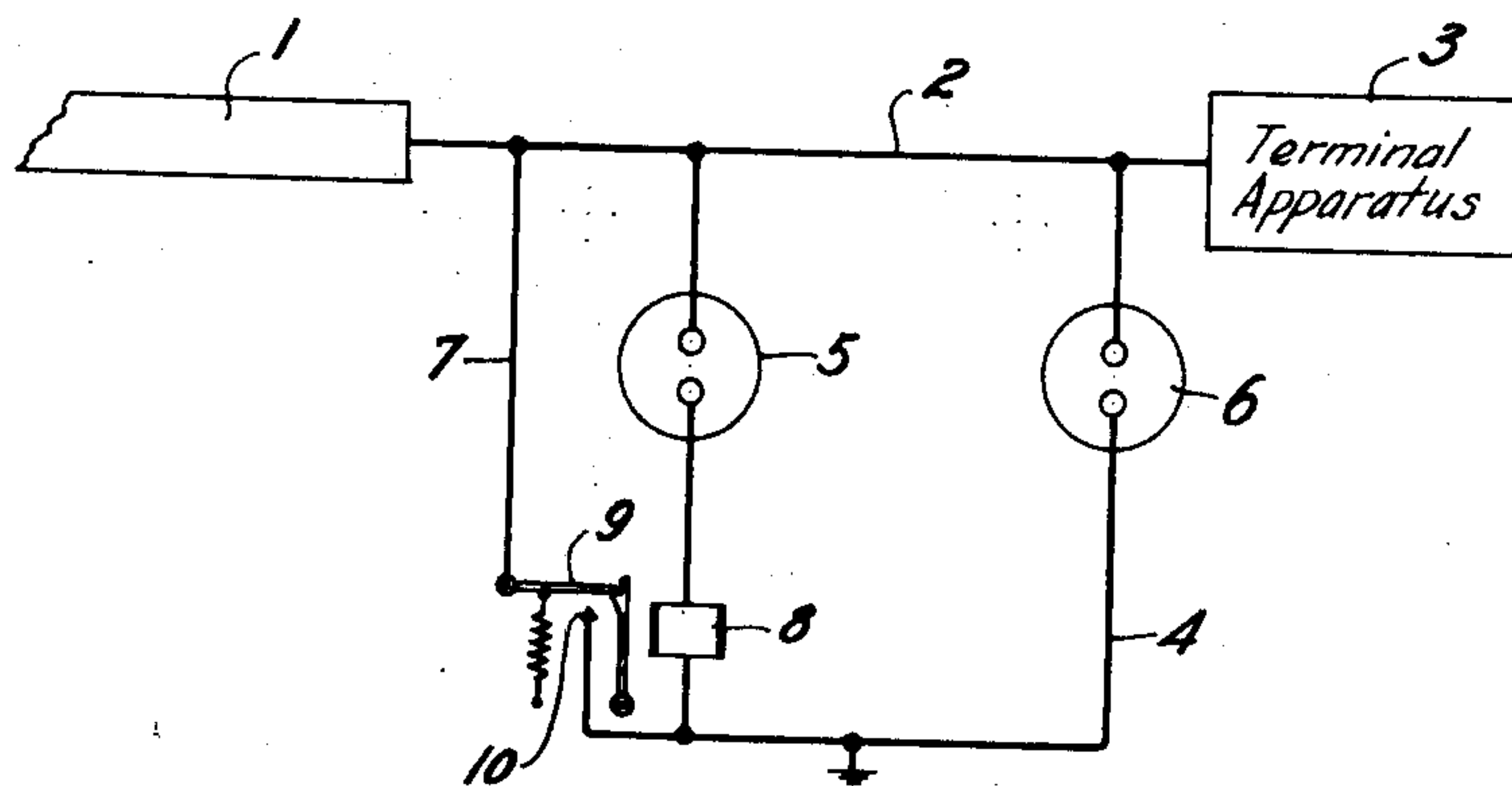
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POTENTIAL LIMITING DEVICE

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UNITED STATES PATENT OFFICE.

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POTENTIAL-LIMITING DEVICE.

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This invention relates to potential limiting means and particularly to means for protecting submarine cables from excess potentials.

It is an object of the present invention to prevent the application of excess potentials to electric circuits and particularly submarine signaling circuits.

Another object of the invention is to dissipate any excess potential applied to a circuit so as to prevent damage thereto.

Electric circuits are frequently subjected to excess potentials, due to short-circuits or to atmospheric discharges in the vicinity of the circuit. When this occurs there is danger of damaging the insulation on conductors or of injuring apparatus, causing expense and delay for the necessary repairs. If an excess potential is applied to a submarine cable so that the insulation is punctured at a point some distance from the terminal station it is necessary to raise the cable before the damage can be repaired. This procedure involves very heavy expense and it is therefore necessary to take every precaution to prevent the application of excess voltages to submarine cables.

At the present time it is usual to ground the cable whenever disturbances due to lightning or other causes are appreciable and the cable is kept grounded until all danger is past. This is done even when lightning arrestors are employed in order to be certain that the cable will not be damaged.

One type of lightning arrestor proposed for use on electrical circuits includes a vacuum spark gap in series with an electromagnetic device, such as a relay, for grounding the circuit whenever a spark passes. In other cases protection is afforded by spark gaps which are connected directly to ground. Each of these two forms of protection is efficient for certain purposes, but the former very often fails to operate in response to voltages of very high frequency or of very short duration and the latter may not be capable of dissipating a heavy induced charge before damage has been done.

In accordance with the present invention these difficulties are overcome by providing a plurality of discharge paths responsive to potentials of either high or low frequency and of either short or long duration for automatically grounding the cable whenever an excess potential is applied thereto. The auto-

matic means must be positive in its operation and is preferably in the form of a vacuum spark arrestor or other potential responsive means which is not subject to variation.

The various features of the invention will be apparent from a consideration of the following description and the accompanying drawing on which the single figure shows a submarine cable protected in accordance with this invention.

Referring to this drawing there is shown the protective apparatus associated with a conductor 2 between the submarine cable 1 and terminal apparatus 3 which may include means for transmitting and receiving signals over the cable. The protective device consists essentially of three paths to ground rendered operative by the application of excess potentials to the cable. Two of these paths include vacuum spark arrestors 5 and 6 and the third path includes the armature 9 and contact 10 of relay 8 which is normally in open position. The path to ground through spark arrestor 5 includes the winding of relay 8 which comprises only a few turns and therefore offers limited impedance to ordinary disturbing voltages. Spark arrestor 6 is connected directly to ground. The spark arrestors 5 and 6 are preferably of the type shown in the copending application of F. Gray, Serial No. 604,152, filed December 1, 1922, and are designed when associated with submarine cables using an operating potential of 50 volts or less, to operate on potentials in excess of approximately 80 volts.

In the operation of the device, arrestor 6 will break down before the arrestor 5 because of the lower time lag of its associated elements but if the excess voltage applied to the conductor is of low frequency or even prolonged high frequency the spark arrestor 5 will also break down permitting the passage of current to ground through the winding of relay 8. With the passage of current through the relay winding the armature 9 will be moved into engagement with the contact 10, grounding the cable and dissipating any excess potential on the cable and apparatus. The relay is preferably so constructed that when operated, the armature will maintain the connection to ground through the contact 10 until manually released. This ordinarily will only be done after making the necessary tests to de-

termine whether the excess voltage has been removed. However, if the relay should be released through accident or mistake or should fail to operate, the arrestors 5 and 6 would again break down under the excess potential grounding the cable and reenergizing the relay.

If the excess potentials applied to the cable have the characteristics of lightning, that is, if the disturbances are of very high frequency or of very short duration the impedance of the path to ground through the winding of relay 8 will be great even though there are very few turns to the winding. Furthermore excess voltages of very short duration if applied to the cable may cause considerable damage before the relay has operated. For this reason there is provided the path to ground, including spark arrestor 6, having very low impedance and operating in response to high frequency disturbances as well as those of low frequency.

This type of potential limiting means is of advantage because of the fact that it is responsive to excessive potentials of every character, for by the operation of the relay 8 the cable will be automatically grounded whenever a continued dangerous potential is applied and at the same time those excess potentials which are of such a nature that they will not operate the relay, will be shunted to ground through the spark arrestor 6. The use of this type of potential limiting means will obviate the need of grounding submarine cables during storm periods since it is readily responsive to all excess potentials.

The invention may, of course, be applied to other electrical circuits besides submarine cables but it is particularly applicable to signaling systems. The break down potential of the spark arrestors may be fixed at a desired potential depending upon the circuit to which

the device is applied. Other changes and modifications may be made to the circuit without departing from the spirit and scope of the invention.

What is claimed is:

1. A protective device for signaling circuits comprising a plurality of paths to ground, each of said paths being other than a normal signaling path to ground, one of said paths comprising a space discharge device associated with elements having substantially no impedance and another of said paths comprising a space discharge device and an impedance element controlling the operation of a third path to ground.

2. A protective device for electric circuits comprising a plurality of paths to ground, each of said paths being other than a normal signaling path to ground, one of said paths being more responsive to excess voltages having the characteristics of lightning discharges than a second of said paths, said second path being responsive to excess voltages of low frequency or of comparatively long duration and controlling the operation of a third path to ground.

3. A protective device for a signaling conductor comprising a plurality of paths connected in shunt between said conductor and ground, each of said paths being other than a normal signaling path to ground, one of said paths comprising a space discharge device, a second path comprising a space discharge device in series with an impedance element responsive to current flow therein, and a third path comprising contacts arranged to be closed by said impedance element in response to current flowing therein.

In witness whereof, I hereunto subscribe my name this 17th day of March, A. D. 1926.

ALLISON A. CLOKEY.