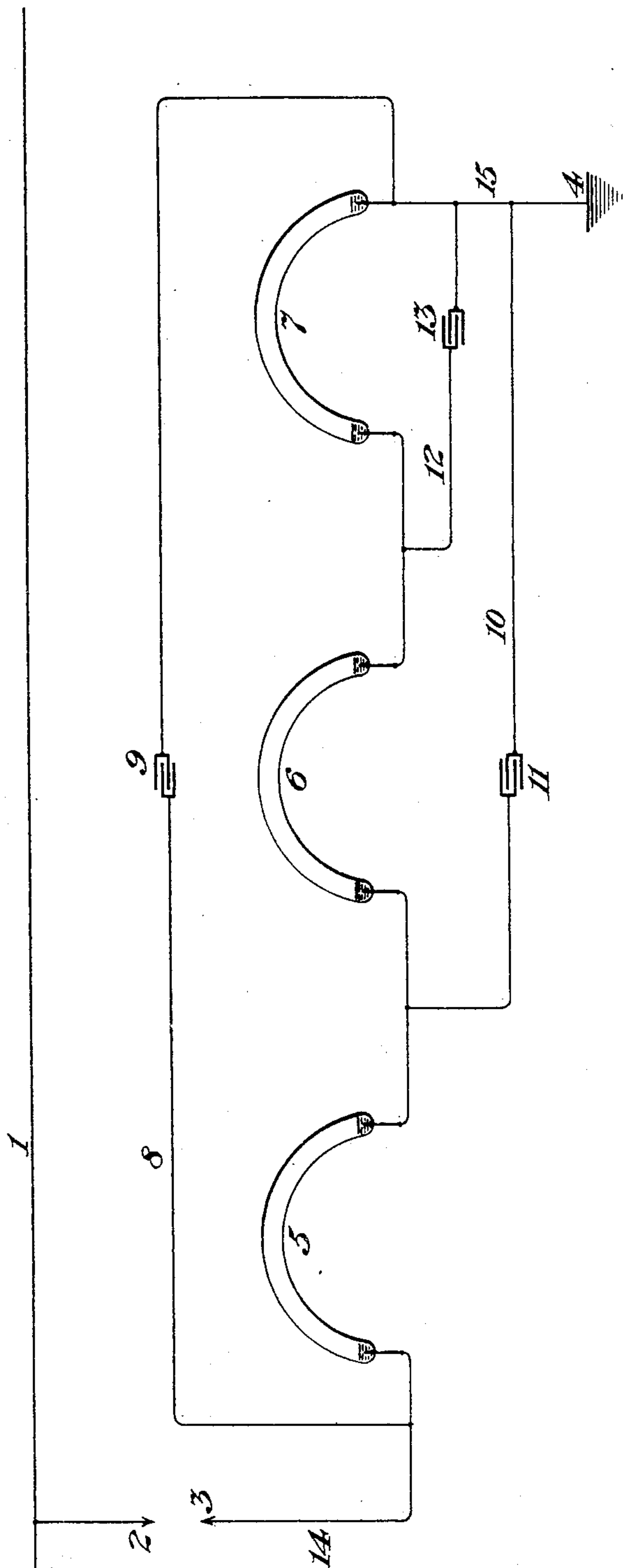


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946,080.

Patented Jan. 11, 1910.



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LIGHTNING-ARRESTER.

946,080.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, PERCY H. THOMAS, a citizen of the United States, and resident of Montclair, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

The present invention relates to improvements in lightning arresters.

10 It is well understood that the lightning arrester should be adapted in the first instance to resist the normal line voltage and to place the lines in connection with the earth upon a rise of potential on the line to an abnormal or dangerous limit. This function is very well performed by an air gap or a number of small air gaps placed between the line and the ground. There is, however, another function which should belong to a successful lightning arrester and that is the function of interrupting the current which tends to follow a discharge to ground, such current being supported by the generator itself. This last named function is only in-
15 differently performed by many types of lightning arrester and the danger always exists of a leak being established between the line and the ground by a discharge of abnormally high potential.

30 It has been proposed to utilize as a lightning arrester, particularly in the case of alternating current circuits, a vapor apparatus such as is typified by the well known mercury vacuum vapor device. In utilizing this device, however, by simply interposing it between the line and the ground, it is found that the device is somewhat lacking in adaptability by reason of the difficulty of adjusting it reliably to a variety of line
40 voltages. That is to say, it is not readily possible to adapt the vapor device mentioned to the function of permitting an earth discharge on the occurrence of a predetermined increase of voltage on the line. On the other hand, the capacity of the mercury vapor device for preventing the maintenance of a current from line to ground through the vapor apparatus belongs to the device by virtue of one of its marked characteristics. The characteristics of an air-
50 gap are so well-known that a properly chosen gap may be relied upon to determine the voltage at which the line shall discharge.

I propose to make use of the advantages of both the air gap and the mercury vapor de-

vice by connecting such devices in series between the line and the ground. In connection with such a combination, I have found that there is a considerable number of useful adjuncts which render the apparatus more adaptable to commercial circuits as will be fully described hereinafter.

In an application filed June 7, 1905, Serial Number 264,057, I have described a system of lightning protective apparatus in which is utilized one or more vapor electric devices usually in connection with an air-gap. Among the various modifications shown in that application is included the use of a plurality of vapor devices in series giving a more stable apparatus or an apparatus adapted to higher potentials. In these cases as disclosed it is sometimes desirable to utilize condensers, inductances or resistances, or combinations thereof, for the purpose of causing a more ready discharge of the line.

The subject-matter of the present application is an improvement applicable to the above in certain cases and utilizing condensers, resistances or inductances connected in a different manner, which manner of utilization is shown in the drawing. For convenience I have illustrated condensers to the exclusion of the other devices mentioned as capable of being utilized for the same purpose, but it will be understood that I do not limit myself to the use of condensers alone.

The drawing illustrates a system of circuits in which my invention is adapted to be utilized and the salient feature thereof is the connection of the condensers or other devices in such a manner that there is a number of shunts around varying numbers of the vapor devices, the same being so related that current through one does not pass through another.

In operation the more comprehensive of the shunts shields the others initially in virtue of its great capacity to pass alternating current relative to the air-gap which results in practically all the initial discharge potential being concentrated on the air-gap. Only after the initial break down of this gap is potential thrown upon this condenser and consequently then only upon the other apparatus and connections inclosed within this shunt. Similarly, the next comprehensive shunt protects initially the connections and apparatus inclosed within it, since no voltage will be impressed upon its condenser

until the break down of the vapor device not shunted, and so on. In operation, the break down thus occurs step by step, the several shunts determining which step shall be taken first.

Referring to the drawing, 1 is the line, and a spark-gap is represented at 2—3 as being located between the line and the ground at 4. In the circuit between the line and ground are interposed vapor devices, 5, 6 and 7, it being understood that the number of these devices may be varied to suit different conditions. In shunt to the three vapor devices shown in the drawing is a circuit, 8, containing a condenser, 9; in shunt to the vapor devices 6 and 7 is a circuit, 10, containing a condenser, 11, and in shunt to the vapor device 7 is a circuit, 12, containing a condenser, 13. For the condensers illustrated, inductances or resistances may be substituted under proper conditions.

The operation of the system may be described as follows: During an abnormal rise of potential on the line by virtue of the circuit 8 and the condenser 9, the potential of the terminal 3 of the spark-gap 2—3, remains at the earth potential while the potential of the terminal 2 of the spark-gap 2—3 shows substantially the potential upon the line. Should this abnormal potential be of sufficient magnitude, a discharge will pass across the gap 2—3 and as a result a potential will be impressed upon the circuit containing the vapor devices, 5, 6 and 7 and the shunt circuits 10 and 12 and also upon the shunt circuit 8. In view of the fact that the shunt circuit 8 can absorb only a limited quantity of energy by virtue of the device 9 a condition will soon be reached, provided the original discharge be of sufficient magnitude, when a high potential will be impressed upon the circuit including the devices 5, 6 and 7 and circuits 10 and 12. In view, however, of the shunt circuit 10 and the device 11 the connection between the devices 5 and 6 will remain at the earth potential while the other terminal of the device 5 will be at the potential which has been transferred from the line. Here again, if the original discharge be of sufficient energy, the device 5 will discharge as before transferring the full remaining potential strain upon the devices 6 and 7 connected with the circuits 10 and 12. As before a condition will arise in which the one terminal of the vapor device 6 is at the earth potential while the other has attained the full potential remaining in the discharge which may cause its breakdown and so on until all the vapor devices have discharged, furnishing a free path for the abnormal charges on the line to earth, after which the original condition is restored in view of the circuit interrupting power of the vapor devices. Thus, the least comprehensive shunt including the condenser

13 is in parallel with the device 7, the next comprehensive shunt including condenser 11, is in parallel to the two devices 6 and 7, and the most comprehensive shunt including the condenser 9, is in parallel to all the devices. If the least comprehensive shunt had been connected in parallel to one of the other devices, as 5, and the next comprehensive shunt had been connected in parallel with another two devices, as 5 and 6, the operation and result would have been the same.

Which vapor device shall be chosen for shunting by the least comprehensive shunt, which pair shall be shunted by the next shunt, and so on, is immaterial. In other words, any desired order may be used in the application of voltage upon the different vapor devices in the series.

I claim as my invention:—

1. The combination with a circuit carrying alternating current, of a suitable ground, a spark-gap in the ground circuit, a series of vapor devices also in the ground circuit, and a number of shunts each containing a condenser, the several shunts being connected individually so as to shunt different numbers of vapor devices.

2. The combination with a circuit carrying alternating current, of a suitable ground, a spark-gap in the ground circuit, a series of vapor devices also in the ground circuit, and a number of shunts each containing a condenser, the several shunts being connected to the ground circuit beyond the most remote vapor device and being connected progressively so as to shunt the first, the second and finally all the vapor devices.

3. The combination with a circuit carrying alternating current, of a suitable ground circuit therefor, a spark-gap in the ground circuit, a series of vapor devices in series therewith also in the ground circuit, and a number of shunts for the vapor devices each containing a condenser, the shunts constituting alternative paths of different length for any current traversing the ground circuit.

4. The combination with a circuit carrying alternating current, of a suitable ground, a spark-gap in the ground circuit, a series of vapor devices also in the ground circuit, and a number of shunts each containing a condenser, and shunt paths having a common origin at one end of said series and each a separate termination at the end of a vapor device remote from their common origin.

5. The combination with a circuit carrying alternating current, of a suitable ground, a spark-gap in the ground circuit, a series of vapor devices also in the ground circuit, and a number of shunts each containing a condenser, said shunts severally constituting paths around different numbers of these devices, said paths being connected in multiple.

6. The combination with a circuit carrying alternating current, of a suitable ground, a

spark-gap in the ground circuit, a series of
vapor devices also in the ground circuit, and
a number of shunts each containing a con-
denser, said shunts constituting conducting
5 paths respectively shunting one of said vapor
devices and groups of increasing number,
the most comprehensive of said paths shunt-
ing the entire number of vapor devices.

Signed at New York, in the county of
New York, and State of New York, this 10
25th day of September, A. D. 1905.

PERCY H. THOMAS.

Witnesses:

WM. H. CAPEL,
THOS. H. BROWN.