H. C. WIRT.

LIGHTNING ARRESTER.

APPLICATION FILED DEC. 22, 1905.

958,454. **Patented May 17, 1910.**

Fig. 1.

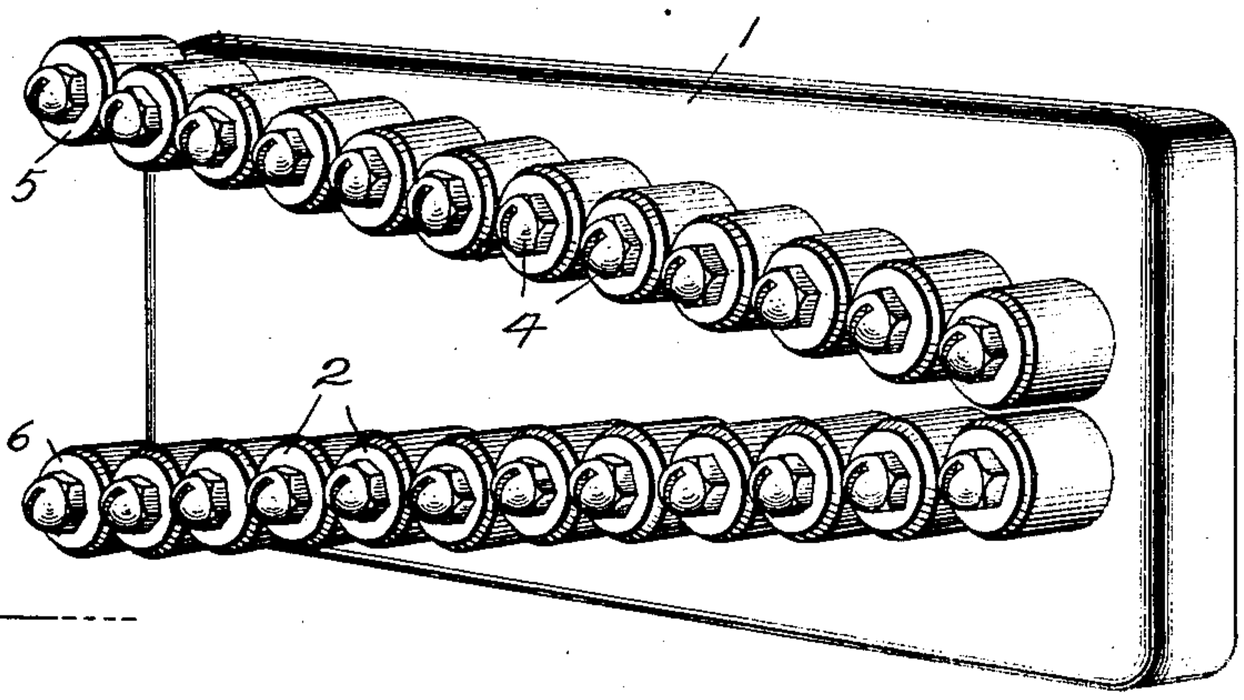


Fig. 2.

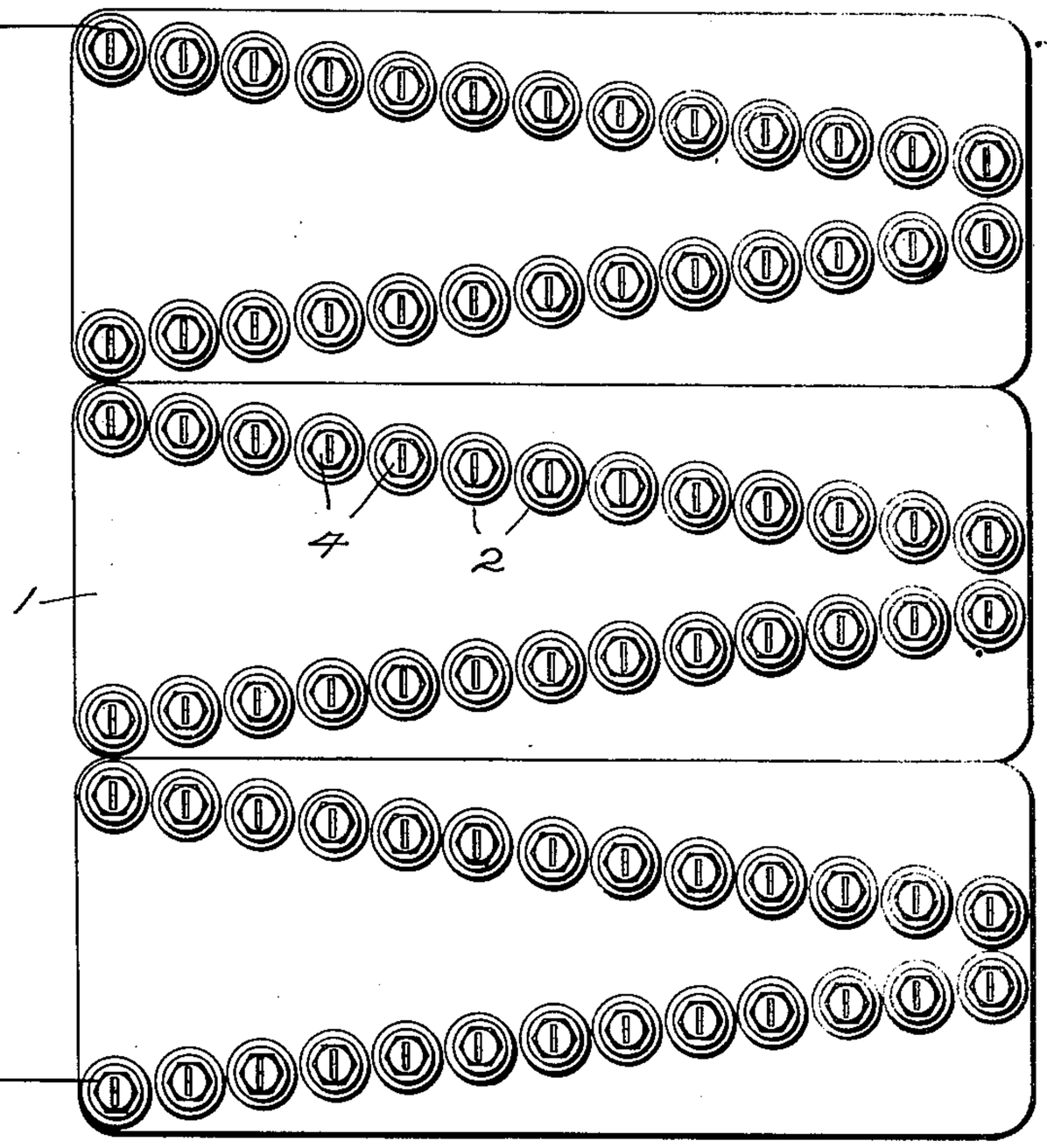
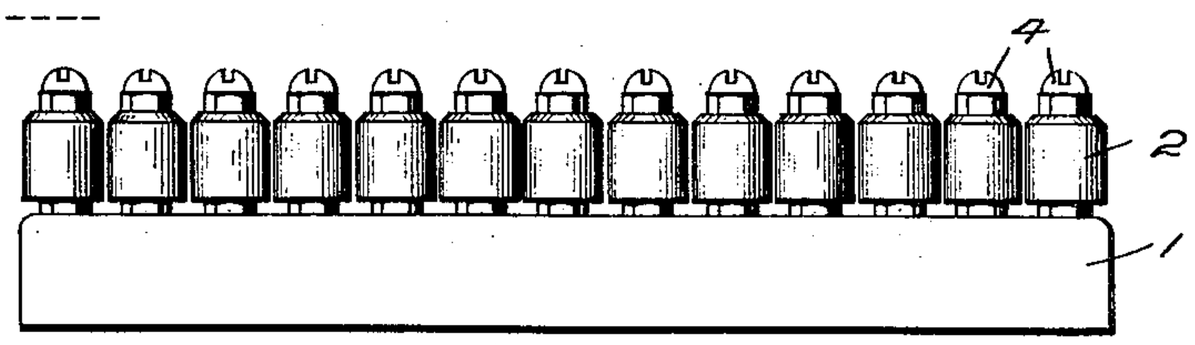


Fig. 3.



WITNESSES.

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UNITED STATES PATENT OFFICE.

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LIGHTNING-ARRESTER.

958,454. Specification of Letters Patent. Patented May 17, 1910.

Application filed December 22, 1905. Serial No. 292,927.

To all whom it may concern:

Be it known that I, HERBERT C. WIRT, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

My invention relates to devices for protecting electrical circuits and apparatus from static and high voltage strains resulting from lightning or other causes.

In the design of a successful lightning arrester two important requirements must be satisfied, first, the device must present a ready path to ground for static or other abnormal charges, and second, it must not permit the line current to follow through to ground on the arc established by the high potential discharge. The apparatus which I have devised for carrying out these two requirements includes a plurality of conducting members grouped upon an insulating base to form a plurality of spark gaps, and the conductors and gaps are so proportioned and are in such number that the arrester unit as a whole may be connected directly between the line to be protected and a second conductor, such as ground, without the interposition of any series resistance or other impedance devices which might, under certain circumstances, cause a choking of high potential discharges, especially when these discharges are of the exceedingly high frequency sometimes encountered in lightning arrester work.

When using a plurality of spark gaps without resistance in series, as above described, I find it desirable to utilize the electro-static capacity of the conductors which form the conducting poles of the several spark gaps. By this arrangement the spark gaps are broken down successively, and not simultaneously as would, no doubt, be necessary if the electro-static capacity of the conductors was not utilized. This successive breaking down of the several spark gaps was, I believe, first disclosed in a patent to Elihu Thomson, #444,687 of Jan. 13, 1891. The successive breaking down of the several gaps is, in my opinion, due to the fact that the static charge readily jumps the first gap, thereby destroying its electro-static resistance, and subjecting the second gap to substantially the full force of the static charge, whereupon the second gap is likewise broken down and permits the charge to pass on to all the gaps in succession. When this principle is applied to alternating current circuits the electro-static capacity of the several conducting elements of the arrester gives to the discharge path a certain selective action whereby discharges of a certain frequency are permitted to pass, although the path is substantially impervious to discharges of a lower frequency. This selective or resonant action of the discharge path is of prime importance in preventing the line current from following through on the static discharge.

My invention embodies novel features of construction and arrangement and in order that my invention may be better understood, reference will be had to the following description taken in connection with the drawing forming a part of this specification.

Figure 1 is a perspective view of my improved lightning arrester unit; Fig. 2 shows three of these units arranged one above another to form a zigzag path for the discharge current; and Fig. 3 is a side elevation showing details of construction.

The unit shown in Fig. 1 comprises a porcelain or other insulating base 1, and a plurality of metal cylinders 2 arranged in the form of a V. These cylinders are mounted on suitable pins cemented or otherwise set into the porcelain base and are locked in position by the nuts 4. I have found that the diameter and length of these metal cylinders have an important bearing on their electro-static capacity, and consequently on the resistance to break down offered by the spark gaps which intervene between one cylinder and another. I find that the size and shape of the cylinders and the distance between cylinders should be carefully proportioned for each particular frequency, voltage and other operating condition, but for frequencies such as are commonly used commercially I find it best to make these cylinders approximately 7/8″ in diameter and 1″ long, and to separate them by a distance

say of 1/32″, for when so constructed and arranged the electro-static capacity is very satisfactory for commercial operation.

By arranging the cylinders as shown in Fig. 1 an arc or discharge entering on one side of the cylinder is transmitted across the cylinder and leaves at a diametrically opposite point, and even before the arc or discharge forms there is more or less of a concentration of electro-static energy on those portions of the conducting cylinders which are nearest to adjacent cylinders, it being understood that the electro-static strain or charge is confined principally to the outer surface of each conducting cylinder.

The number of gaps to be used in each particular installation depends on the voltage of the circuit, but for a 33,000 volt circuit operating at a usual frequency, I find that 624 gaps between lines will break down under abnormal static strain and will satisfactorily break the dynamic arc established by the line current.

In commercial installations the most destructive effects are produced by high frequency discharges, and the multi-gap arrangement above described, without series resistance of any kind, is especially suited to readily transmit these discharges. At the same time the arrester forms an adequate protection against high voltages having a frequency of five hundred to one thousand cycles, which might be generated in the line by resonance or other disturbing phenomena more or less independent of atmospheric disturbances.

The V shaped arrangement shown in Fig. 1, affords several important advantages; first, it properly separates the first and last cylinders 5 and 6 of each unit so that there is no danger of the discharge jumping across between these conductors in preference to passing across the series of gaps, and second, it places each gap in such a position that the discharge or arc which forms is substantially horizontal, and hence is acted upon by a draft of hot air tending to bow it up in the center, thereby increasing its length and forcing it upward over the curved surfaces of adjacent cylinders. As the increase in arc length produced by the draft occurs at each spark gap the total increases in arcing distance is very great, and consequently is very effective in producing the extinction of the arc. The V-shaped arrangement also makes it possible to conveniently group the units one above another without the intervention of complicated wiring or other parts which would be hard to insulate at the high potentials commonly present in lightning arresters.

I contemplate connecting a group of units as shown in Fig. 2, directly across between line conductors 7 and 8, though it is to be understood that the total number of units thus connected is calculated for each particular installation, and is dependent on the working voltage of the line and on other factors of a like nature. For high voltage systems I may use as many as twenty-five units arranged in the same manner as the three units of Fig. 2. Instead of connecting the spark gaps between line conductors I may if desired connect a group between each line conductor and ground, thus securing separate paths to ground for each line conductor and at the same time securing a path between any two conductors by way of the two corresponding groups, in series.

As previously stated the electro-static capacity of the cylinders is believed to produce the break down at each gap, these break downs occurring one after another and thereby transmitting to successive gaps substantially all the electro-static strain to which the first gap was subjected. The total spark gap distance traversed by the high potential discharge is thus made very much greater than the distance which it would jump between two fixed needle points, or in other words this series of gaps has a very low "equivalent spark gap". Not only does my improved arrester provide for a rapid removal of high potential, high frequency charges, but it is also exceedingly effective in suppressing the "following" line current, and furthermore, suppresses this current almost at the instant it is formed, thereby preventing sudden current rushes on the system, which if allowed to form might produce oscillations, resonance and other phenomena highly detrimental to rotary converters or other sensitive apparatus operating on the system.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a lightning arrester, the combination of an insulating base, and a plurality of conducting cylinders supported on said base and grouped in two converging rows.

2. In a lightning arrester, the combination of a plurality of units each comprising an insulating base and a plurality of conducting members mounted thereon, said units being disposed in proximity to each other to form a discharge path for high potential charges, and the end members of adjacent units being separated by air gaps.

3. The combination with the conductors of an electrical distribution circuit, of a plurality of conducting members spaced apart to form air gaps and grouped to form a zig-zag path for high potential discharges from one of said conductors.

4. In a lightning arrester, the combination of an insulating base and a plurality of con-

ducting cylinders supported thereon, said cylinders being arranged in two approximately horizontal converging lines to permit a rapid circulation of air between said cylinders when an arc forms therebetween.

5. In a lightning arrester, the combination of an insulating base, and a plurality of conducting cylinders supported thereon, said cylinders being arranged in a plurality of converging but approximately horizontal lines and with their axes substantially horizontal.

In witness whereof I have hereunto set my hand this 20th day of December, 1905.

HERBERT C. WIRT.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.