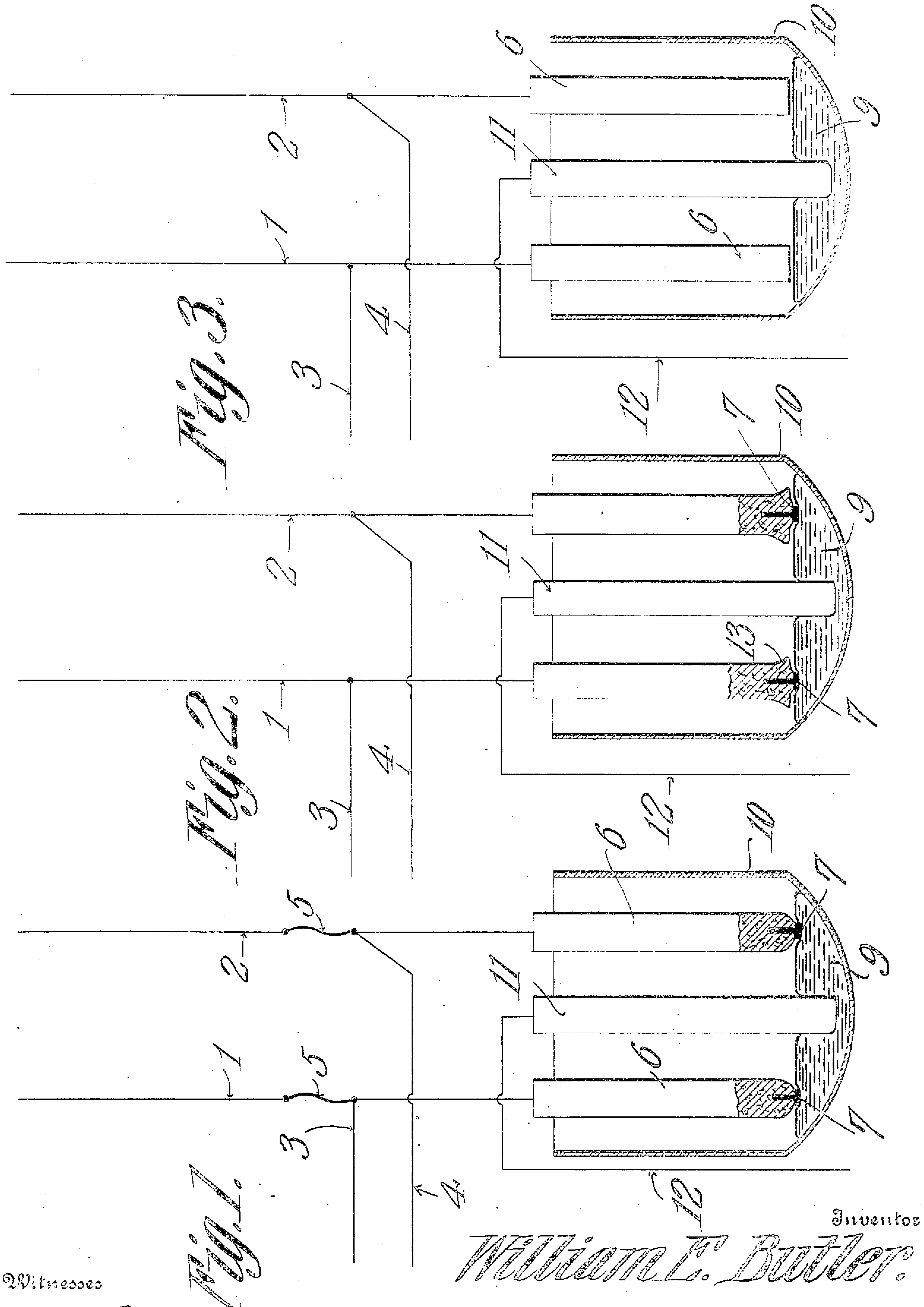
W. E. BUTLER.

LIGHTNING ARRESTER.

APPLICATION FILED JULY 16, 1908.

931,033. Patented Aug. 17, 1909

2 SHEETS—SHEET 1.



Witnesses

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Fig. 4.

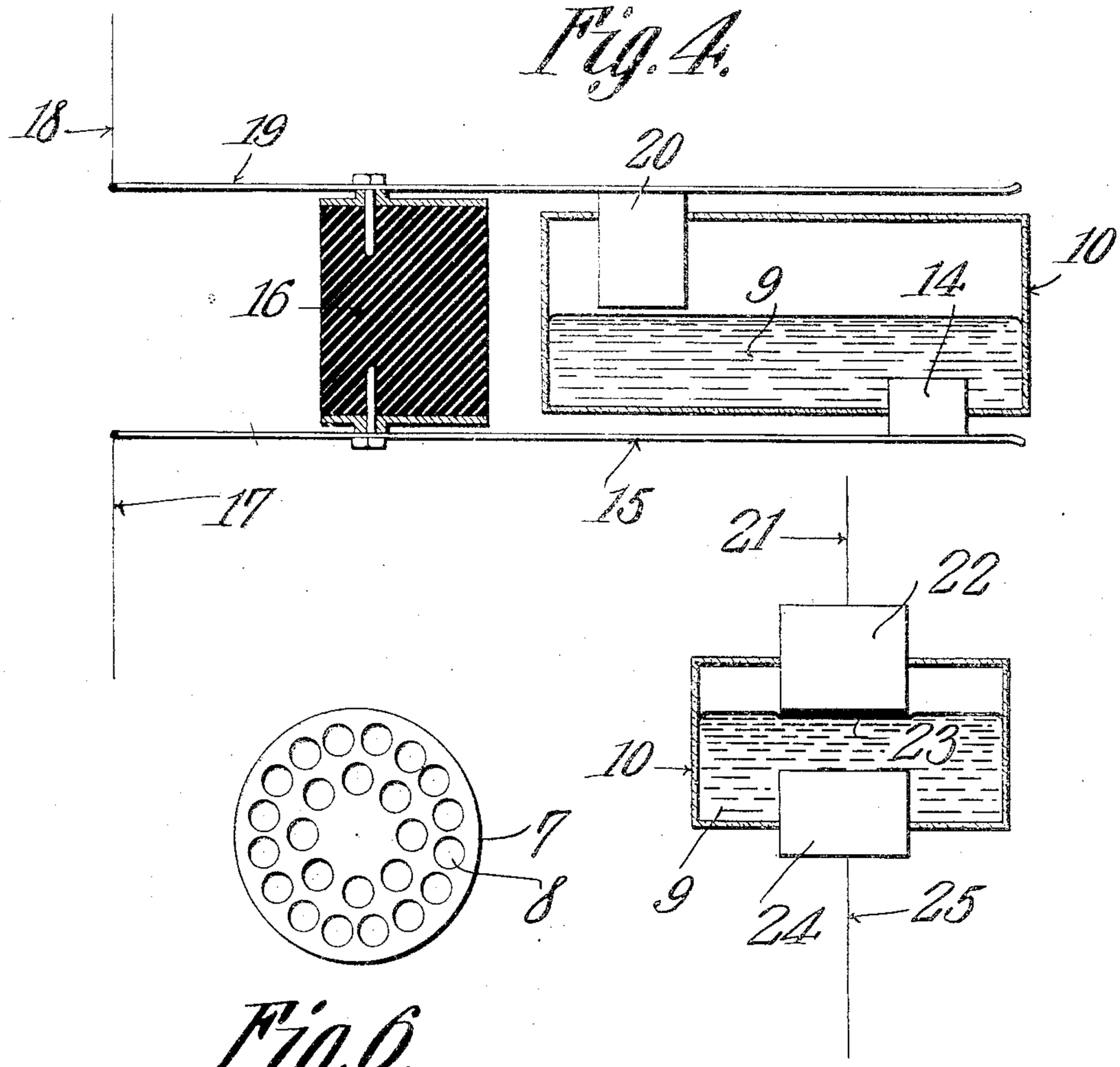

Fig. 6.

Fig. 5.

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UNITED STATES PATENT OFFICE.

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LIGHTNING-ARRESTER.

No. 931,033. Specification of Letters Patent. Patented Aug. 17, 1909.

Application filed July 16, 1908. Serial No. 443,853.

To all whom it may concern:

Be it known that I, WILLIAM E. BUTLER, a citizen of the United States, residing at David City, in the county of Butler and State of Nebraska, have invented a new and useful Lightning-Arrester, of which the following is a specification.

This invention has reference to improvements in lightning arresters and it is designed to provide a lightning arrester of the mercury type which will reset itself after each lightning discharge.

The invention comprises essentially a suitable vessel or container in which is lodged a quantity of mercury. Entering the mercury is a conductor of suitable material connected to ground, and also in close relation to the surface of the mercury are other conductors connected to the line. The conductors out of contact with the mercury may carry at the ends adjacent to the mercury surface suitable insulating material which itself may be in contact with the mercury, and in such case the insulating material is suitably perforated so that there are one or more air gaps between the active end of the line terminals and the mercury surface. Provision is made for the use of the invention either for the protection of a single line or for more than one line, in which case but a single ground is necessary.

The invention will be best understood from a consideration of the following detail description taken in connection with the accompanying drawings forming a part of this specification, in which drawings,

Figure 1 is a longitudinal section partly in elevation of the improved lightning arrester showing the line connection. Fig. 2 is a similar view of a slightly modified form. Fig. 3 is a similar view of still another form. Fig. 4 is a like view of another form. Fig. 5 is a similar view showing the application of the invention to a single line. Fig. 6 is a view showing the manner of constructing the insulating diaphragm introduced between the active ends of the terminals of the line and the mercury surface.

Referring to the drawings and more particularly to Fig. 1, there are shown line wires 1—2, leading by conductors 3—4 to the parts to be protected, which parts however have been omitted from the drawings, and it will be understood that any type of instrument may be used in connection with the lightning arrester wherein it is desirable to protect the instrument from the effect of lightning strokes or of any high voltage current which would be liable to injure the instrument. By the term lightning as has been heretofore, and will be hereinafter used, in this specification, it is to be understood that not only the natural electrical discharges usually called lightning, but also any high voltage current liable to injure the instrument and which might not blow fuses when the latter are used, are to be included in the same term.

In Fig. 1 fuses 5 are indicated at each line wire 1 and 2 and these fuses are designed to protect instruments where heavy currents are liable to pass over the line wires 1 and 2, but where such heavy currents are not liable to be encountered but only the high voltage current, like lightning strokes, then these fuses may be omitted.

In the other figures of the drawings no fuses are shown, but it will be understood that fuses may be used in connection with the other forms of lightning arresters as well as with that shown in Fig. 1.

Each line wire 1 and 2 beyond its connection with the branch conductors 3 and 4 leading to the instrument, terminates in a rod 6 which may be made of some material capable of conducting electric current but which at the same time is not affected by or is inert to mercury. Among the materials which may be used for this purpose may be mentioned carbon and iron. In the structure shown in Fig. 1, each rod 6 has its free end rounded and there carries a button or diaphragm 7 of insulating material and preferably refractory insulating material, such for instance as mica.

The mica diaphragm 7 both in the form shown in Fig. 1, and in the other forms may be shaped as shown in Fig. 6, that is it is provided with a suitable number of perforations 8. The insulating plate, or diaphragm, or disk 7 rests upon the mercury surface, which mercury body is indicated at 9 in the figures, and is contained in a suitable vessel 10, which may be made of any vitreous material such as glass, or this containing vessel may be made of iron, both of which are unaffected by mercury. Any other suitable material not affected by mercury may be used as the material for the containing vessel 10.

Having one end dipping into the mercury 9 is a rod 11 of carbon, or iron, or other suitable material, and this rod is connected

by a conductor 12 to ground. Suppose now that a lightning discharge should be received upon either line 1 or 2. The air gap between the end of the rod 6 and the surface of the mercury is purposely small so that the impedance offered by the instrument to be protected will cause the lighting discharge to pass from the rod 6 through the small air gap to the mercury surface, and from there it finds an easy path through the rod 11 and ground conductor 12. The lightning discharge will arc across the space between the ends of the rod 6, and the surface of the mercury body 9, and as soon as the discharge stops then any displacement of the mercury will be remedied by the mercury again seeking its normal level. With this structure there is no burning out of the terminals of the lightning arrester circuit on each side or either side of the spark gap and there is no change in relation of the terminals constituting the confines of the spark gap since after the discharge the mercury always returns to its normal level and the spark gap is maintained constant thereby.

In Fig. 2 the arrangement is substantially that of Fig. 1 except that the fuses 5 are omitted, although it will be understood that they may be present if desired, and the terminal ends of the rods 6 adjacent to the mercury 9 are laterally flared as shown at 13 so as to present a large surface adjacent to the mercury surface and thus increase the area of the effective spark gap without increasing the distance between the ends of the rods 6 and the surface of the mercury. In both the structures shown in Figs. 1 and 2, it is possible to use the mica disk without perforations if it be made small, since on entering the mercury the latter is depressed adjacent to the mica and the surface is therefore concaved adjacent to the end of the rod 6. In Fig. 3 the ends of the rod 6 are made substantially flat and are brought to close relation to the surface of the mercury but out of contact therewith, and the mica insulation is omitted. In Fig. 4 the mercury vessel 10 is entered through the bottom by a conducting block 14 carried at one end of a strip 15 supported by an insulating block 16, and this strip 15 is connected by a conductor 17 to ground. A single line wire 18 is designated and this is connected to a strip 19, also carried by the insulating block 16, and the strip 19 carries a block 20 having its free end in close relation to the surface of the mercury 9 within the vessel 10. In Fig. 5 a similar arrangement is shown, that is an arrangement for a single line wire. In this case the line wire 21 terminates in a block 22 having its free end covered by a mica or other insulating plate 23. Extending through the bottom of the mercury vessel 10 is another block 24 entering the mercury and connected by a ground conductor 25 to the ground. In all these cases the ground connection is of course perfect, being made through mercury and cannot therefore corrode or become disconnected, thus endangering the instrument that the lightning arrester is designed to protect. In each instance, the carbon or iron conductors used in connection with the ground conductor, are of ample size as is also the ground conductor to carry off any charge which may be imposed upon the line whether by a lightning stroke or by crossing a high tension service conductor. Wherever there is danger of the line conductors 1 and 2 becoming crossed or charged with heavy electric currents liable to injure the instruments, then fuses 5 will be included in the line conductors on the service side of the conductors 3 and 4.

Since the rods 6 may be made of ample area, there is no danger of their active ends becoming corroded or burned out by the passage of the lightning stroke, and the mica insulation is also unaffected by the heat generated by the passage of the current across the air gap.

When the air gap is through perforations in the mica disk or plate then the length of the air gap is determined by the thickness of the mica plate, but where an unperforated mica button is used at the ends of the rods 6, then the air gap will be exterior to this mica button, and the length of the air gap will depend entirely upon the degree of immersion of the mica button into the mercury surface, the term immersion being used relatively only since the mercury surface will be concaved to a greater or less extent by the contact of the button 7 therewith.

It is of course within the scope of the invention to divide the mercury and use two ground connections one for each line.

A proper amount of air space above the mercury is provided to take care of all mercury vapor which may be produced on the passage of high voltage currents, which vapor will afterward condense and fall back into the liquid mercury.

What is claimed is:

1. In a lightning arrester, a grounded body of mercury, a bare circuit terminal separated from the surface of the mercury by an air gap within striking distance of the mercury and by insulating material of relatively small area and of such thickness as to bridge the air gap.

2. In a lightning arrester, a grounded body of mercury, a bare circuit terminal separated from the surface of the mercury but within striking distance thereof and carrying refractory insulating material of relatively small area bridging the air gap.

3. In a lightning arrester, a grounded body of mercury, a bare circuit terminal within striking distance of the surface of the mercury and an insulator of refractory

perforated material carried by the circuit terminal and bridging the air gap.

4. In a lightning arrester, a grounded body of mercury, a circuit terminal having an exposed end within striking distance of the surface of the mercury, and an insulating body of less area than the end of the circuit terminal adjacent to the mercury and interposed between the bare end of the circuit terminal and the surface of the mercury.

5. In a lightning arrester, a grounded body of mercury, and a circuit terminal having the end adjacent to the mercury in contact with but insulated from the surface of the mercury and within striking distance thereof, the said insulation being of such thickness as to engage the surface of the mercury when the terminal is in operative relation to said mercury but separated therefrom by an air gap.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

WILLIAM E. BUTLER.

Witnesses:
A. M. WALLING,
J. R. EVANS.