(No Model.)

E. THOMSON.

GUARD WIRE PROTECTOR AND LIGHTNING ARRESTER FOR ELECTRIC RAILWAYS.

No. 428,653. Patented May 27, 1890.

Fig. 1.

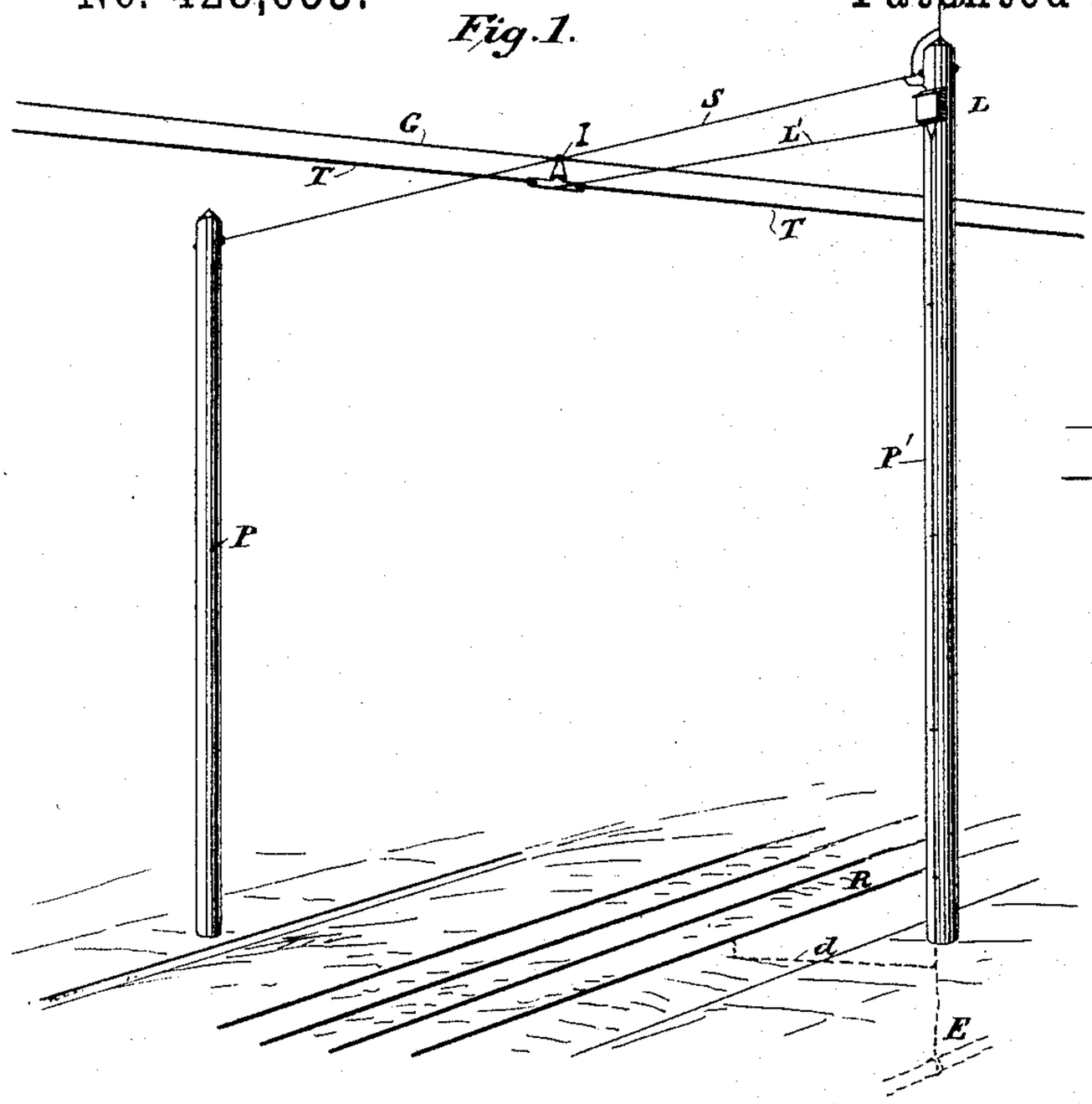


Fig. 2.

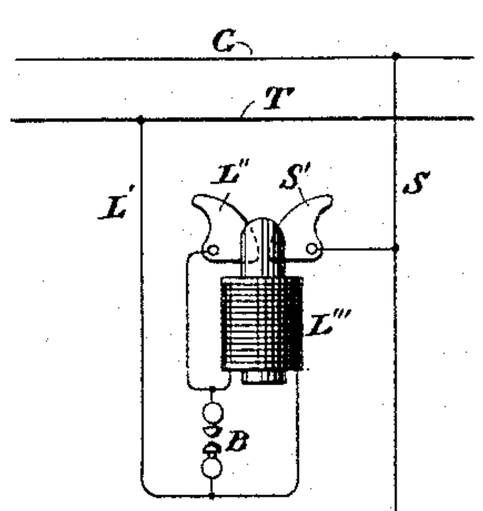


Fig. 3.

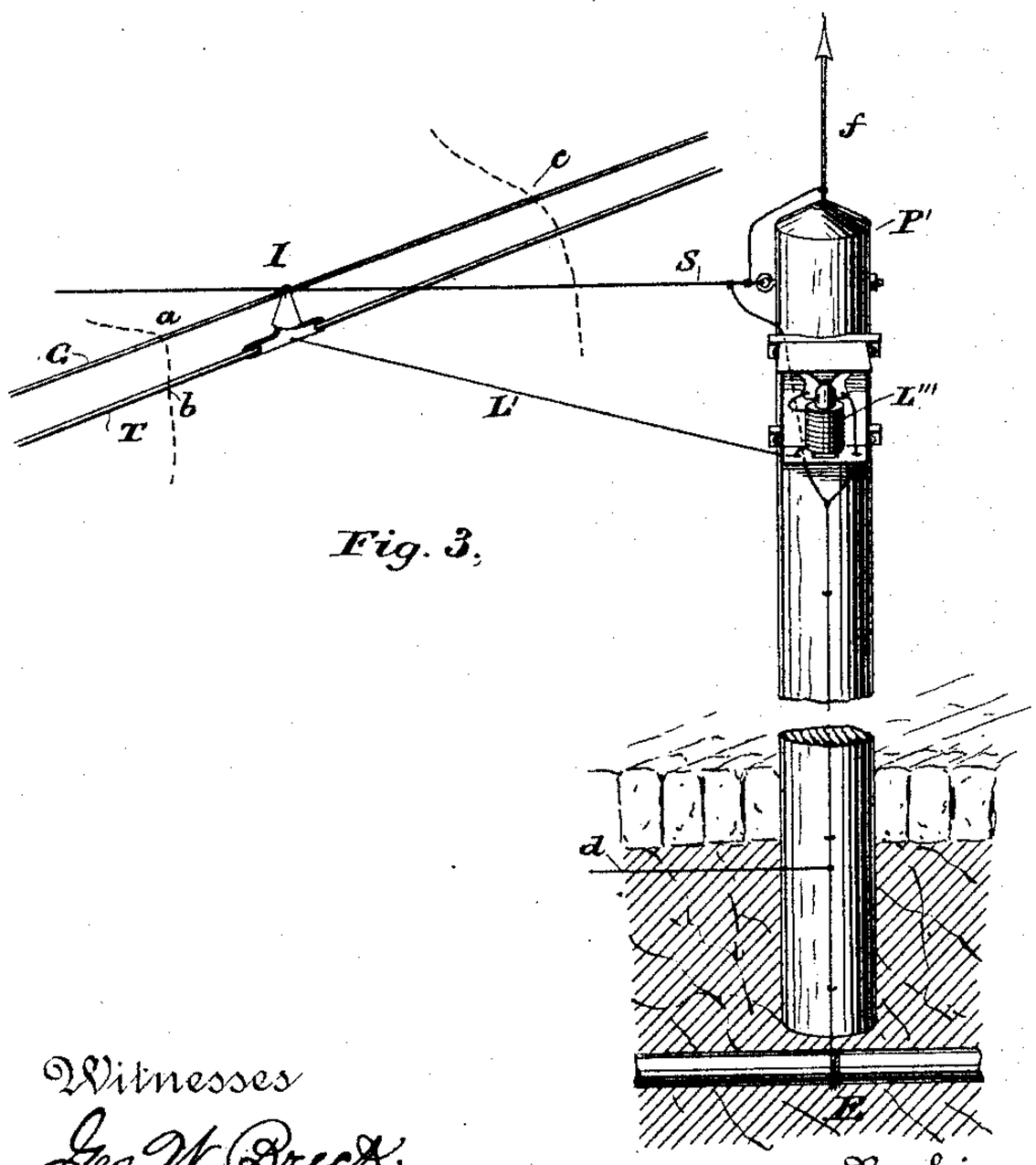
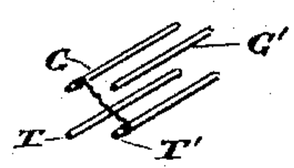


Fig. 4.



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GUARD-WIRE PROTECTOR AND LIGHTNING-ARRESTER FOR ELECTRIC RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 428,653, dated May 27, 1890.

Application filed June 15, 1889. Serial No. 314,351. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Guard-Wires and Lightning Protectors for Electric Railways, of which the following is a specification.

My invention relates to electric lines that are suspended or supported in position where they are liable to have parallel or crossing lines fall upon them.

My invention is designed for use especially with aerial power-lines for electric railways, which are usually constructed of bare wire suspended over the streets or over the roadway, and as usually employed are liable to be grounded or to be short-circuited to their return-connection by the falling upon them of telegraph, telephone, or other aerial conductors.

The object of my invention is to protect the aerial line from contact with neighboring conductors, to provide a safeguard against damage to persons taking hold of any wires or conductors dropping down over the power-line in the act of removing them, and to counteract the induction from the aerial line upon neighboring wires.

The object of my invention is, further, to afford an efficient means of carrying off any static discharge or lightning from the aerial line to earth.

My invention consists, essentially, in the combination, with the aerial power-line, of a guard-wire or conductor suspended parallel to the same and provided at intervals along the aerial power-line with branch connections to the earth or return wire, such branch connections being devoid of artificial resistances, so as to form a low-resistance connection.

My invention consists, also, in certain combinations of devices and arrangements of apparatus designed to more effectually accomplish the objects of my invention, and hereinafter more particularly described and claimed.

I shall hereinafter describe my invention particularly in its application to a power-line the return-connection of which is by the ground or by a conductor in connection with the ground; but it will be readily understood by electricians that the invention is likewise applicable to power or aerial lines the return-connection of which is by a second line suspended or supported in the air in the neighborhood of the first.

In the accompanying drawings I have illustrated, in Figure 1 and in perspective, that portion of an aerial power-line for an electric railway provided with a guard-wire. Fig. 2 shows in side elevation the power-line and protective or guard line with connections to a lightning-arrester. Fig. 3 is a perspective view of an aerial power-line and guard-wire with their connections to a post, lightning-arrester, and ground shown in detail. Fig. 4 illustrates a modification in the connections.

In the drawings, P P′ indicate suitable posts or poles for holding cross wires or bars from which an aerial line T is suitably suspended or supported. In the present instance the line T is supposed to be a bare conductor of copper, upon which the trolley of an electrically-propelled car runs, such conductor being suitably connected with a source of current, as a dynamo-machine, and running the length of the line. The line-wire T, suitably insulated at its supports along the way, is usually connected to a return-conductor consisting of the railway-track R, and is therefore in electrical connection with the ground. Above and parallel to the line T, I run one or more guard-wires G preferably rather close to the wire T and connected at intervals by lateral wires S to the earth or return circuit of the conductor T. The conductor S may be the usual cross supporting-wire from which the conductor T is suspended, and the connection to the earth may be by a wire running upon the pole P or P′ when the same is made of wood, or may be by the pole itself when it is made of iron. The connection of the wire S with the guard-wire is preferably made where the supporting-insulator I for the aerial power-line T is located. The wire G is likewise bare.

In addition to the ground-connection for the guard-wire, as indicated, I prefer to combine with the power-line T a lightning-arrester. (Indicated at L, Fig. 1.) This lightning-arrester may be of the general character described in my prior patent, No. 321,464.

L^2 S′ are the two plates of the arrester, the former of which connects by wire L′ with the

power-line T, while the latter or ground-plate S′ is connected to earth by attachment to the earth-connection of S or by other suitable means. In the connection L′ to the plate L″ are the coils L‴ of the arc-rupturing magnet, as described in my prior patent. In a connection around the coils L‴ are two plates or conductors B, separated by a small air-space, across which the lightning-discharge may force its way when it meets with the self-induction of the coils L‴. The device B affords protection for L‴. In case of a discharge of high potential from the line T, it forms an earth by traversing the line L′, and snapping across the space at B, then across the space between L″ S′, and to earth E. Should the current of the power-line also attempt to follow this path set up by the lightning-discharge, the magnet L‴ becomes energized, because its coils afford a better path for the current than the space at B, and the arc at such space is not able to maintain itself. The magnet then operates through rupture of the arc at the space between the plates L″ S′, disconnecting the power-line from *t* and leaving it in a condition for a subsequent discharge. The guard-wire G, being solidly grounded, also acts as a protection to the power-line T from lightning, because it operates as a sort of shield or inductive path, whereby the lightning may find earth without jumping to the line T.

The manner in which the guard-wire operates to prevent damage by the falling of another wire across the power-line T is indicated in Fig. 3, where a telephone-wire is shown as having fallen in contact with the guard-wire at *c*, and as held thereby out of contact with the under power-line T. Should by any accident, however, the contact be made by the telephone-line with the power-line T also, as indicated at *a b*, a rush of current from the power-wire T through such telephone-line to the guard-wire G and through the ground-wires of the latter will take place, and such current, being of great volume and intensity, will burn out and destroy the short connecting-paths from *b* to *a*, thus freeing the power-line from the overhanging wire. This connection obviously takes place only in the case of a double contact—one with the guard-wire and the other with the power-line. If the falling wire make contact only with the guard-wire, no such action is needed and does not occur.

The connections of the guard-wire G with the earth are of comparatively little resistance, and good connection may be made by attachment to buried pipes, as indicated in Fig. 3. Owing to the small resistance of the normal connection of guard-wire G it is obvious that a safeguard is provided for persons taking hold of any wires dropping down over the power-line for the purposes of removing them, since any one standing on the ground and in a circuit from the power-line to earth will have the current of such power-line shunted around him by the short resistance-connection just mentioned. Danger of shocks, therefore, in removing any fallen wires is avoided.

I have described my invention as applied to power-lines the return of which connects to earth; but it may be applied also to a power-line, as T, Fig. 4, the return of which is by another aerial line T′ in proximity to the first. In this instance the guard-wire G would preferably be connected to the return-conductor T′. A second guard-wire G′ might be used over the wire T′, as shown. The guard-wires would then operate to prevent cross-connection of the power-wire with its return and shunting of the current across such connection; or in case contact should be made between the guard-wire G and wire T by the falling wire then the current passing from T to G and by way of the return would burn out such connecting-wire, as before explained, and free the power-line.

It will be observed that in case the ground-connection from any lightning-arrester should be broken between the point of connection of the ground-plate S′ with the wire S and earth the lightning-discharge may pass to the guard-wire G and over the earth-connections of the same.

In order to assist in making a good ground for the lightning-arrester and connection from the guard-wire G, I in some cases prefer to run connections from the earth-wire to the railway-track R, when such is used for the return-connection. Such a wire, which may be insulated or not, as desired, is indicated at *d*, Fig. 1. In order still further to protect the railway-car and its contents from lightning-discharges which, under ordinary circumstances, would pass from the power-wire T directly through the car to earth, I provide the posts P P′, one or both, with proper lightning-rod tips *f*, as indicated in Fig. 3, which are made to extend somewhat above the level of the power-wire T, so as to invite the lightning-discharge which passes to such wires in preference to passing to the wire T and by the lightning-arrester connected therewith. The lightning-rod tips mounted on the posts P P′ are provided with the usual earth-connections and, for the purpose of making an earth-connection, may be connected, as shown, with the wire S. The guard-wire G, connected to the return of the power-wire T in the manner described, also serves the purpose of counteracting the induction of the power-wire upon neighboring wires, since a portion of the return-current will naturally pass by the guard-wire. The heavier the guard-wire and the better the connections thereof with the return the more current will tend to pass thereby, and the more the current flowing therein will counteract or neutralize the induction from the leading power-wire T in the well-known manner.

I am aware that it has been before proposed to protect a line-conductor from contact with

falling wires by means of a guard-wire or conductor; but in such case the guard-wire or conductor was connected to earth at or near the generating-station only and through a number of devices which interposed an electrical resistance. In my invention the guard-wire is connected at intervals along the aerial portion of the line-conductor or circuit and at points more or less remote from the terminal of the line, so that not only is protection afforded against injury to persons or objects, as hereinbefore described, by an efficient shunting of the dangerous current, but also the induction from the power-line is counteracted through the partial return of the current on the main conductor by way of the guard-wire or conductor. In my invention also the branches or connections from the guard-wire are made of as low resistance as practicable.

What I claim as my invention is—

1. The combination, with an aerial electric line, of a guard-wire or conductor supported or suspended parallel to and above the same and normally insulated therefrom, and one or more low-resistance branch connections taken from the guard-wire or conductor directly to the return of the aerial line at points along the aerial portion of the circuit removed from the generating-station.

2. The combination, with an electric circuit, a portion of which is formed by an aerial line, of a guard-wire parallel to the aerial portion of such circuit, and low-resistance branches taken directly to ground from said guard-wire at intervals along the working portion of the aerial line or circuit, as and for the purpose described.

3. The combination, with the aerial line, of the guard-wire or conductor parallel thereto, branches of low resistance taken from such guard-wire to ground at intervals, and lightning-arresters whose plates or electrodes are put in ground branches from the said aerial line, as and for the purpose described.

4. The combination, with an aerial line, of a guard-wire or conductor having branch wires connected directly to earth at intervals along the portion thereof parallel to the aerial circuit, and lightning-arresters having one pole connected to the aerial line and the other to the branch wire leading from the guard-wire or conductor to earth.

5. The combination, with the power-line having an earth return, of the parallel guard-wire carried by supports insulated from said line, and branch connections from said guard-wire taken therefrom at intervals along the portion thereof parallel to the working portion of the power-line, said branch connections having immediate connection with earth and being devoid of devices interposing artificial electric resistance.

6. The combination, with the aerial line T, of posts P, cross-supporting wires S, connected directly to earth, and guard-wire G, electrically connected to said cross-wire.

7. The combination, with an electric-railway power-line supported over the track by posts P P′, and cross wire or bar between the same, of a conductor G, supported between said posts over such line and electrically connected at intervals with the return of the line, as and for the purpose described.

Signed at New York, in the county of New York and State of New York, this 29th day of May, A. D. 1889.

ELIHU THOMSON.

Witnesses:
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