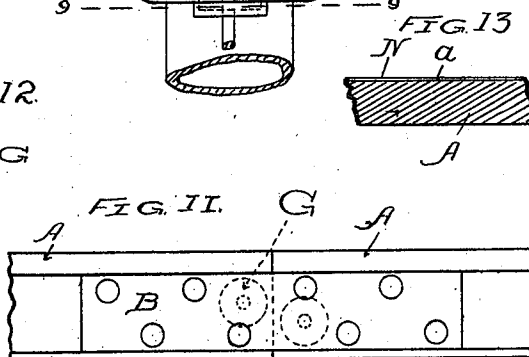
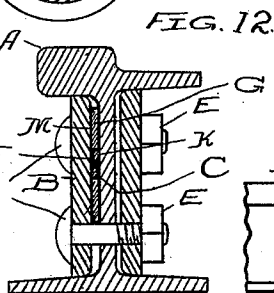
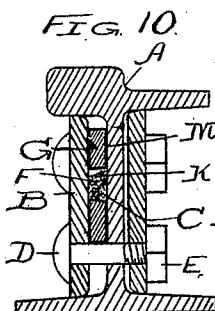
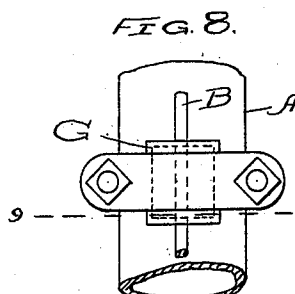
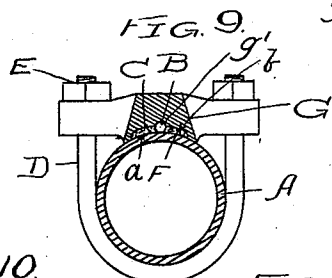
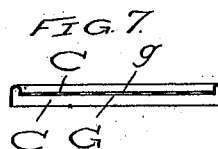
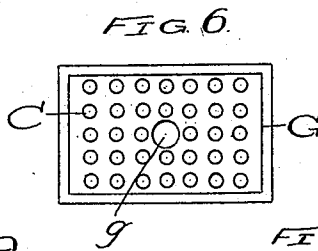
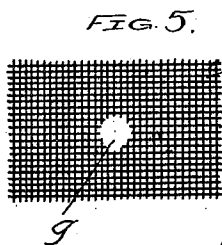
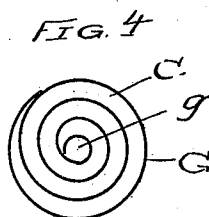
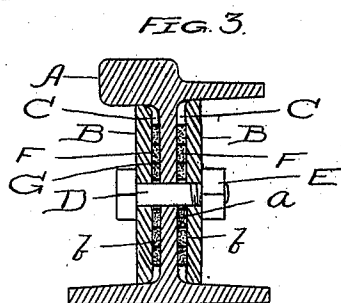
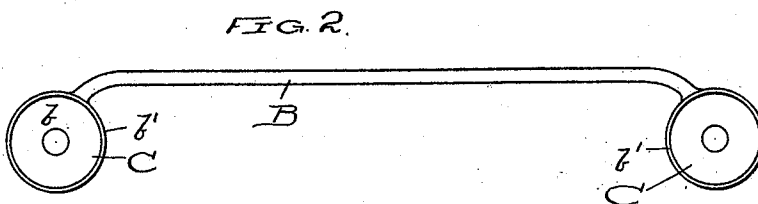
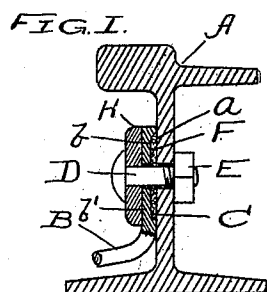


(No Model.)

H. P. BROWN.
ELECTRICAL CONNECTION.

No. 581,263.

Patented Apr. 27, 1897.



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UNITED STATES PATENT OFFICE.

HAROLD P. BROWN, OF NEW YORK, N. Y.

ELECTRICAL CONNECTION.

SPECIFICATION forming part of Letters Patent No. 581,263, dated April 27, 1897.

Application filed February 2, 1895. Serial No. 537,084. (No model.)

To all whom it may concern:

Be it known that I, HAROLD P. BROWN, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a new and useful Improvement in Electrical Connections, of which the following is a specification.

My invention relates to electrical connections at the joints of rails, pipes, or other conductors underground.

Heretofore difficulty has been experienced in maintaining a good electrical connection at the joints of rails or between an iron or steel rail or pipe and a copper wire, rod, cable, or other conductor where the joint lies on or is wholly or partially buried in the ground. It is extremely difficult, if not impossible, to maintain in the ordinary way a good electrical contact between an iron rail or pipe and a copper wire, rod, or cable or between iron and iron when the joint is buried underground. In spite of the best and most perfect mechanical contact at the outset moisture will find its way between the surfaces and oxidize the iron, leaving a film of iron oxid of high electrical resistance between the two metals, and iron and copper in acidulated water form a galvanic couple whose action is at the expense of the iron. On the passage of a current through joints made of two different metals they form a thermo-electric couple, and the consequent difference of temperature and expansion aids in permitting the admission of moisture, as well as in causing a loss of energy. The contact-surfaces have been filed to an absolute fit and bolted together under great pressure, or the iron has been electroplated with tin, zinc, or copper to resist corrosion, or lead strips have been compressed between the surfaces, or the joint has been covered with viscous paint, or both or all of these; but in spite of all precautions water will eventually find its way between the surfaces, and the iron oxid will spoil the conductivity of the joint. It is especially important to obtain perfect electrical joints of low resistance in electric-railway work between the ends of contiguous rails, as the rails are in most instances used as return conductors. Here, in addition to the presence of water as a factor of disintegration, we have the movement of the rails themselves

as the cars pass over them to gradually wear out the connection. A broken or poor connection means a definite loss of motive power in overcoming the resistance of the bad joint, and in large railway systems hundreds of horse-power are thus thrown away every day. So well is this recognized that in some places attempts have been made to electrically weld the rails at very great expense. Again, it is important to have some method of making a permanent electrical connection upon gas and water pipes in order to protect them from the corrosion due to electrolytic action of the current when leaving the pipes and passing through the ground to the rails or some other conductor in order to complete the circuit. To overcome these defects and obtain a perfect and permanent electrical joint, I have invented an electrical connection comprising a cup-shaped or hollowed terminal and means for bolting it firmly to the rail, in combination with a plastic alloy of great conductivity embraced between the hollowed terminal and the rail or pipe or other conductor.

The interior of the hollowed portion is preferably first treated with some solution or chemical, as a bath of soda, to remove oil. It is then rubbed with an easily-decomposed alloy of mercury, which will amalgamate the surface and permanently protect it from rust, as mercury will penetrate some distance into the metal and resist any tendency to oxidize. The surface of the rail or pipe where the joint is to be applied is treated in the same manner. The hollowed portion is then filled with a soft alloy of the consistency of putty, which can be made to gradually harden and at the same time expand. The joint is then made by bolting, clamping, or riveting, and as the alloy hardens and expands it puts the joint under tremendous pressure, permanently excluding water and making as good an electrical contact as though the rail or pipe were continuous. I prefer to use for this soft alloy some permanent amalgam or other suitable metal, whose combination I reserve for the subject of a future patent application, as such an amalgam by proper proportioning and by electrical treatment can be made to expand a predetermined amount in hardening, to make a molecular contact upon either copper,

steel, or iron, and to resist water, acids, or such alkalies as are liable to be encountered in the soil under the streets. This metal is made to give the same thermo-electric effect as steel or iron, so as to avoid a loss from this source.

My invention consists in the combination with two jointed conductors—such, for example, as a rail and a fish-plate, a rail and a bond wire or rod, a rail or pipe, and a wire, rod, or cable—furnished with a hollowed or open space or receptacle between them, and means for clamping or binding the two firmly together—such, for example, as a threaded bolt and nut, a wedge, or a rivet—and a plastic metallic alloy—such, for example, as an amalgam of mercury with a suitable metal or metals—filling the space or receptacle between the conductors.

It also consists, as a further improvement or perfection of the invention, in forming the receptacle for the plastic metallic alloy in part of an elastic, compressible, waterproof, non-oxidizable ring or gasket adapted to adhere to the surfaces of the conductors between which it is compressed—such, for example, as a ring of cork boiled in or impregnated and coated with petroleum-tar, or the tailings or residue of petroleum distillation, or other gummy inoxidizable substance—and in adding to the plastic metallic alloy a small quantity of free mercury, so that the plastic alloy will not harden, but remain permanently soft, thus preventing all possibility of its being cracked, broken, or injured by the hammering or shocks of passing cars or other external strains to which the conductors may be subjected.

It also consists in the novel construction of parts and devices and in the novel combinations of parts and devices herein shown and described, and specified in the claims.

In the accompanying drawings, forming a part of this specification, Figure 1 is a vertical sectional view of one simple form of electrical connection embodying my invention, the same showing the connection as applied to the joint between the bond wire or rod and one end of two abutting street-car rails; and Fig. 2 is a detail view of the bond-wire. Fig. 3 is a vertical sectional view illustrating one form of application of the invention to the joint between the rail and fish-plate, and Fig. 4 is a face view of a spiral which in part forms the receptacle for the plastic alloy in this form or means of reducing the invention to practice. Fig. 5 represents another modified form of the receptacle for the plastic alloy. Figs. 6 and 7 represent still another modified form of this receptacle. Fig. 8 is a plan view and Fig. 9 a vertical section illustrating my electrical connection as applied to the joint between an underground pipe and a copper or other conductor wire or rod. Fig. 10 is a vertical sectional view illustrating the improved or perfected form of my in-

vention in which the wall of the receptacle is in part formed of an elastic compressible ring, gasket, or wall and wherein the plastic alloy contains free mercury to preserve it in a soft plastic non-frangible state, and Fig. 11 is a side elevation of the construction shown in Fig. 10. Fig. 12 is a view similar to Fig. 10, but showing the elastic ring compressed. Fig. 13 is an enlarged detail sectional view to indicate the film of easily-decomposed alloy of mercury which rapidly forms a permanent amalgam on the surface of the metal upon which it is applied.

In all the figures of the drawings corresponding parts are indicated by like letters of reference.

In the drawings, A and B represent two conductors which are joined together or between which an electrical connection is to be formed, be the same rail, fish-plate, wire, rod, or other conductor; C, the receptacle or open space between the conductors A B to receive the plastic alloy; D, the means for binding the two conductors together, preferably a threaded bolt; E, the nut for the bolt; F, the plastic alloy; *a b*, the surfaces of the conductors with which the plastic alloy comes in contact, these surfaces forming in part the walls of the receptacle C, and G a supplemental device in a separate piece from either of the conductors A B, forming in part a retaining wall for the receptacle C. N represents the film of decomposable alloy of mercury with which the surfaces *a b* of the conductors A B are rubbed and by which such surfaces are amalgamated.

In Figs. 1 and 2 the conductor A is a street-car rail and the conductor B a bond connecting two abutting rails. The bond B is furnished with an enlarged end *b'*, hollowed to form the receptacle C for the plastic alloy F, which is placed between the rail A and the bond B.

H is an iron washer to evenly distribute the pressure produced by the tightening of the nut E upon the bolt D; or the bolt may be made with a head the size of the washer H, if preferred. As pressure is applied to the bolt D the thin edges of the inner face of the hollow disk *b'* are or can be somewhat flattened, thereby forcing some of the soft alloy into the hole in the rail through which the bolt D passes, thus increasing the area of contact with the surface of the rail and sealing it against the admission of moisture. This thin film of the alloy will be the first portion to harden, so that the expansion of the remainder of the alloy can be exerted only in forcing itself into the irregularities of the surfaces of the rail and of the bond, putting a tremendous pressure upon the same. This pressure not only serves to reduce the electrical resistance of the joint, but enables it to resist the loosening effect produced by the hammering of passing car-wheels.

In some cases it is possible to use fish-plates

or chairs at the rail-joints for conductors instead of a conducting-bond, as shown in Figs. 1 and 2.

In Figs. 3 and 4 a fish-plate is represented as constituting one of the conductors B, the other being the rail A. In this case if both the rail and fish-plate are left with their ordinary flat or plain surfaces it will be necessary to provide some supplemental wall or device G for the receptacle C of the plastic alloy F in addition to the surfaces *a b* of the conductors, in order to hold the soft alloy in place until it hardens. One method of doing this is shown in Figs. 3 and 4, where the retaining wall or device G consists of a spiral wire or narrow strip of sheet metal on edge placed between the fish-plate and rail as a washer surrounding the bolt D. The receptacle C is thus made of a spiral form. The spiral device G has a central hole *g* for the bolt D; or in place of a spiral coil of wire or other material the retaining device or wall G may consist of a disk or other shaped piece of open-mesh wire-cloth, and this used as a means of holding the soft alloy in place, as shown in Fig. 5. In this case the open spaces or meshes of the wire constitute the receptacle C for the plastic alloy, and the bolt D passes through the hole *g*.

As shown in Figs. 6 and 7, the retaining device G may be formed of a piece of sheet metal punched full of small holes to receive the plastic alloy, the edges of such perforated sheet being bent first up and then down, as illustrated in Fig. 7, so as to hold some of the plastic alloy on each side of the perforated plate G.

In Figs. 8 and 9 the conductor A is shown in the form of a gas or water pipe, and the conductor B in the form of an ordinary wire, cable, or rod. In this form the bolt D is made U-shaped to surround the conductor-pipe A, and the supplemental retaining wall or device G, which completes the wall of the receptacle C for the plastic alloy F, is in the form of a saddle or clamp, by which, in connection with the bolt D, the conductors A and B are clamped together. In this construction the receptacle C is formed by making a recess in the face of the device G, which fits against the periphery of the pipe A; and the device G is provided with a slot or groove *g'* to receive the conductor B, so that its surface *b* will come in contact with the plastic alloy F as well as in contact with the surface *a* of the pipe or conductor A.

Figs. 10 and 11 show a still better or more improved method of making an electrical contact between rails and fish-plates uniting them. On roads where the traffic is heavy and the current transmitted is large I use a similar plastic alloy, but add to it a small portion of free mercury. This, if prevented from escaping, will cause the alloy to remain soft permanently, so that it can never be injured by the hammering of passing car-wheels or by the expansion and contraction

of the rails. In order to provide an effectual seal against leakage of the free mercury or loss by evaporation even though the bolts holding the fish-plate may slacken or the fish-plate loosen by wearing a little on the edge bearing against the rail, I provide an elastic receptacle, preferably made of cork, which is boiled in petroleum-tar or the tailings or residue of petroleum distillation or other gummy inoxidizable substance.

In Figs. 10 and 11 the conductor A is shown in the form of a street-car rail, and the conductor B in the form of a fish-plate, and the supplemental device or retaining-wall G of the receptacle C in the preferred form of an elastic waterproof non-oxidizable ring or gasket, and the soft alloy F as containing an addition of free mercury to maintain it always in a soft or plastic condition. The elastic ring or gasket G is preferably made of cork, as before described, and coated with the gummy compound M before mentioned. The receptacle C is preferably conical in form. The plastic alloy F is placed in the receptacle C after causing the ring G to adhere to the rail by slightly heating its gummy coating M.

K is a spiral washer of spring-steel, which prevents too great compression of the receptacle C, and whatever the distance between rail and fish-plate always keeps one of its ends on each.

In this (Figs. 10 and 11) form of my invention in service for use upon a girder-rail weighing ninety pounds to the yard, for example, the retaining device G should preferably be four inches outside diameter and five-eighths of an inch thick, covered with a coating M one-sixteenth of an inch thick. The receptacle C is one and seven-sixteenths inches in diameter on the side toward the fish-plate and one and nine-sixteenths inches in diameter on the other side. The cubical space occupied by the spring-washer K and plastic alloy F in the receptacle C before the elastic receptacle is compressed amounts to about eighty per cent. of the cubical space of the receptacle C. The spring-washer K, when not under compression, occupies three-quarters of an inch space from end to end. When compressed, it assumes the shape of a flat ring five-sixteenths of an inch thick. The space occupied by the washer and the alloy is so proportioned to the total space in the receptacle C before compression that after the entire receptacle has been compressed to five-sixteenths of an inch, which is the limit imposed by the thickness of the washer F, there is still ample space for the metal, the shrinkage of the size of the hole being compensated by the compression of the air-space. This is an important factor, since if no air-space were left before compression the receptacle might be split open by its metal contents when pressure was applied. The heavy pressure applied by tightening the fish-plate bolts causes the compound M to adhere firmly

to the metal, so that if the pressure is subsequently removed and the fish-plate loosened the elastic receptacle will resume its former dimensions and keep the receptacle C hermetically closed. The plastic alloy F will settle to its new length and still maintain a perfect electrical connection between the rail and the fish-plate. This redistribution of the alloy is assisted by the expansion of the spring-washer K. So tenacious is the compound M when petroleum-tailings are used for the same that the cork will pull apart before it will leave the metal surfaces. In order to prepare the surface M for shipment, it is covered with powdered talc. When ready to apply to the rail, the surface M on the side upon which is the larger opening of the receptacle C is heated by laying it on a warm metal surface. It is then placed against the rail at the proper point near the end where the surface has been sandpapered and rubbed with the decomposable mercury alloy. A little box containing the plastic alloy and the spring-washer K is emptied into the receptacle C, which is made tapering, so as to provide a pocket for the free mercury in the alloy. Another retaining device or ring G is similarly placed upon the adjoining rail and the corresponding surfaces of the fish-plate rubbed with sandpaper and the decomposable alloy N. The fish-plate is then put into position and the bolts tightened. The plastic alloy and the spring-washers K in each receptacle C then form a conducting-path from the end of one rail to the fish-plate and from the fish-plate to the next rail.

To give a practical idea of this new method of making contact, the following tests were made: A sample joint was made up between two lengths of girder-rail weighing ninety pounds to the yard and having a cross-section of nine square inches. The rail was six inches wide on the base and nine inches high. The web between base and tread was three-eighths inches thick and six inches high. The fish-plates were twenty-eight inches long, six inches high, and three-fourths of an inch thick, held in place by four three-quarter-inch bolts through each rail. A bond of pure copper five-eighths of an inch in diameter and thirty-two inches long was fastened to each rail just beyond the end of the fish-plate and tightly secured by bolts five-eighths of an inch in diameter. The copper was given a contact area against each rail of ten times its cross-section and both steel and copper surfaces in contact machined to a perfect fit. When a current of one hundred amperes was passed through the joint, a loss of one-thirtieth of a volt was shown. With twelve hundred amperes the loss was seven-thirtieths of a volt. This is about three times the loss due to the measured resistance of the copper. Two-thirds of the loss therefore seem to be due to the thermo-electric effect of dissimilar metals in contact with each other. With amalga-

mated surfaces and the plastic alloy between steel and copper the loss was four-thirtieths at twelve hundred amperes. The copper was then removed and the elastic receptacles of above size put into place, each holding two and one-half ounces of the plastic alloy and a spring-washer one and one-fourth inches outside diameter. The fish-plate bolts were tightened until the receptacles and their contents had been compressed to five-sixteenths of an inch in width. This is the distance ordinarily left between the rail and the middle of the fish-plate. A current of fifteen hundred amperes was then passed through the joint and a loss of but one-thirtieth of a volt was shown. The fish-plate was left in place for several weeks, when the nuts were removed from the bolts holding it in place. The fish-plate slacked off one-fourth of an inch from its former position, but on again passing fifteen hundred amperes through the joint only one-thirtieth of a volt loss was encountered, as before.

As the compound M will not oxidize, crack, or melt and as the cork so treated is practically indestructible, this type of joint will outlast any solid-metal joint. It will also be noticed that the plastic alloy is perfectly protected against decomposition by electrolysis, as it is entirely insulated by the cork receptacle.

The walls of the receptacle C for the plastic alloy F or a portion thereof, whether the same be made in the form of the hollowed disk *b'* on one of the conductors itself or made in a separate piece, as represented in Figs. 3, 4, 5, 6, and 7, or as represented by the petroleum-tar-coated cork ring or gasket G, (shown in Fig. 10,) are somewhat compressible, so that when the conductors A B are clamped together by the bolts D or other clamping means the plastic alloy F is put under pressure, and this pressure is still further increased by the expanding of the alloy as it hardens, in cases where it is so proportioned or compounded as to permit of hardening.

While I have herein specifically shown and described a few different modifications, constructions, or forms suitable for embodying my invention and reducing it to practice, in order to more fully and clearly explain its nature, it will of course be understood by those skilled in the art that my invention may be embodied and reduced to practice in a great variety of forms or constructions other than those specifically shown and described herein and that my invention is not confined to the few specific forms or constructions shown in the drawings. I desire, however, to include herein, in addition to the claims embracing or covering my invention in its entirety or broadly in all the different forms, constructions, or modifications in which it may be embodied, also claims for one of the specific forms herein shown and described—viz., that indicated in Figs. 10 and 11—as that I consider to be the

best form now known to me for practicing my invention.

I claim—

1. An electrical connection consisting in
5 the combination with two conductors jointed together and furnished with a hollowed or confined space or receptacle between them, means for clamping or binding the two conductors firmly together, and a plastic alloy or amal-
10 gam confined in the space or receptacle between the conductors and forming an electrical connection between the conductors, substantially as specified.

2. The combination with two meeting or
15 jointed conductors, of a permanently plastic alloy electrically connecting the two, substantially as specified.

3. The combination with two meeting or jointed conductors, of a permanently plastic
20 alloy under pressure electrically connecting the two, substantially as specified.

4. The combination with two meeting or jointed conductors furnished with a hollow
25 space or receptacle between them, of a plastic alloy confined in such space or receptacle, substantially as specified.

5. The combination with two meeting or jointed conductors furnished with a hollow
30 space or receptacle between them, of a plastic alloy confined in such space or receptacle, and means for clamping or binding the two conductors together, substantially as specified.

6. The combination with two meeting or
35 jointed conductors furnished with a confined space or receptacle between them, means for clamping or binding the conductors together, and an alloy compressed and confined in said space or receptacle while in a plastic
40 condition, substantially as specified.

7. The combination with two meeting or jointed conductors furnished with a confined
45 space or receptacle between them, means for clamping or binding the conductors together, and a mercury alloy compressed and confined in said space or receptacle while in a plastic
condition, substantially as specified.

8. The combination with two meeting or jointed conductors, of a permanently plastic
50 alloy electrically connecting the two, the surfaces of said conductors in contact with said alloy being amalgamated, or rubbed or impregnated with a decomposable alloy of mercury, substantially as specified.

9. The combination with two meeting or
55 jointed conductors furnished with a confined space or receptacle between them, means for clamping or binding the conductors together, and a mercury alloy compressed and confined
60 in said space or receptacle while in a plastic condition, the surface of said conductors in contact with said alloy being amalgamated, substantially as specified.

10. The combination with two meeting or
65 jointed conductors furnished with a hollow space or receptacle between them, of a plastic alloy in such space or receptacle, and means

for clamping or binding the two conductors together, a portion of the wall of said space or receptacle being compressible, substantially as specified. 70

11. The combination with two meeting or jointed conductors furnished with a confined
space or receptacle between them, means for clamping or binding the conductors together, 75
and an alloy compressed in said space or receptacle while in a plastic condition, the retaining device or wall of said space or receptacle being compressed between said conductors by said means for clamping or binding 80
the conductors together, substantially as specified.

12. The combination with two meeting or jointed conductors furnished with a hollowed
space or receptacle between them formed in 85
part by a supplemental retaining device G in a separate piece from the conductors, and a plastic alloy in said space or receptacle, substantially as specified.

13. The combination with two meeting or
90 jointed conductors furnished with a hollowed space or receptacle between them formed in part by a supplemental retaining device G in a separate piece from the conductors, means for clamping said supplemental retaining 95
device between the conductors, and a plastic alloy in said space or receptacle, substantially as specified.

14. The combination with two meeting or jointed conductors furnished with a hollowed
100 space or receptacle between them formed in part by a supplemental retaining device G in a separate piece from the conductors, means for clamping said supplemental retaining 105
device between the conductors, and a plastic alloy in said space or receptacle, said supplemental retaining device being of elastic, compressible, non-oxidizable, waterproof material, substantially as specified.

15. The combination with two meeting or
110 jointed conductors furnished with a hollowed space or receptacle between them formed in part by a supplemental retaining device G in a separate piece from the conductors, means for clamping said supplemental retaining 115
device between the conductors, and a plastic alloy in said space or receptacle, said supplemental retaining device being of elastic, compressible, non-oxidizable, waterproof material, coated or impregnated with a gummy or 120
adhesive material, substantially as specified.

16. The combination with two meeting or jointed conductors furnished with a hollowed
space or receptacle between them formed in 125
part by a supplemental retaining device G in a separate piece from the conductors, means for clamping said supplemental retaining 130
device between the conductors, and a plastic alloy in said space or receptacle, said supplemental retaining device being of elastic, compressible, non-oxidizable, waterproof material, coated or impregnated with a gummy or adhesive material, and the surface of said conductors with which the plastic alloy comes

in contact being amalgamated or coated with a film of decomposable mercury alloy, substantially as specified.

17. The combination with two meeting or
5 jointed conductors furnished with a hollowed space or receptacle between them formed in part by a supplemental retaining device G in a separate piece from the conductor, means for clamping said supplemental retaining
10 device between the conductors, and a plastic alloy in said space or receptacle, said supplemental retaining device being of elastic, compressible, non-oxidizable, waterproof material, such plastic alloy containing a proportion
15 of free mercury to keep it in a plastic condition, substantially as specified.

18. The combination with two meeting or jointed conductors furnished with a hollowed space or receptacle between them formed in
20 part by a supplemental retaining device G in a separate piece from the conductor, means for clamping said supplemental retaining device between the conductors, and a plastic alloy in said space or receptacle, said supplemental retaining device being of elastic, compressible, non-oxidizable, waterproof material, coated or impregnated with a gummy or
25 adhesive material, said plastic alloy containing a proportion of free mercury to keep it in a plastic condition, substantially as specified.
30

19. The combination with two meeting or jointed conductors furnished with a hollowed space or receptacle between them formed in part by a supplemental retaining device G in
35 a separate piece from the conductor, means for clamping said supplemental retaining device between the conductors, and a plastic alloy in said space or receptacle, said supplemental retaining device being of elastic, compressible, non-oxidizable, waterproof material, and the surface of said conductors with
40 which the plastic alloy comes in contact being amalgamated or coated with a film of decomposable mercury alloy, said plastic alloy containing a proportion of free mercury to
45 keep it in a plastic condition, substantially as specified.

20. The combination with two meeting or jointed conductors furnished with a hollowed space or receptacle between them formed in
50 part by a supplemental retaining device G in a separate piece from the conductor, means for clamping said supplemental retaining device between the conductors, and a plastic alloy in said space or receptacle, said supplemental retaining device being of elastic, compressible, non-oxidizable, waterproof material, and a spring inserted in said receptacle,
55 substantially as specified.

21. The combination with two meeting or jointed conductors furnished with a hollowed space or receptacle between them formed in part by a supplemental retaining device G in
60 a separate piece from the conductor, means for clamping said supplemental retaining device between the conductors, and a plastic

alloy in said space or receptacle, said supplemental retaining device being of elastic, compressible, non-oxidizable, waterproof material coated or impregnated with a gummy
70 or adhesive material, and a spring inserted in said receptacle, substantially as specified.

22. The combination with two conductors, of a cork ring or gasket G inserted between said conductors and forming therewith a receptacle C, a plastic alloy F in said receptacle
75 C, and means for clamping the two conductors together and compressing the cork ring, substantially as specified.

23. The combination with two conductors, of a cork ring or gasket G inserted between said conductors and forming therewith a receptacle C, a plastic alloy F in said receptacle
80 C, and means for clamping the two conductors together and compressing the cork ring, said cork ring being coated or impregnated with a gummy compound M, substantially as specified.
85

24. The combination with two conductors, of a cork ring or gasket G inserted between
90 said conductors and forming therewith a receptacle C, a plastic alloy F in said receptacle C, and means for clamping the two conductors together and compressing the cork ring, and a spring K in said receptacle C, substantially as specified.
95

25. The combination with two conductors, of a cork ring or gasket G inserted between said conductors and forming therewith a receptacle C, a plastic alloy F in said receptacle
100 C, and means for clamping the two conductors together and compressing the cork ring, said plastic alloy containing a proportion of free mercury, substantially as specified.
105

26. The combination with two conductors, of a cork ring or gasket G inserted between said conductors and forming therewith a receptacle C, a plastic alloy F in said receptacle
110 C, and means for clamping the two conductors together and compressing the cork ring, said cork ring being coated or impregnated with a gummy compound M, said plastic alloy containing a proportion of free mercury, substantially as specified.
115

27. The combination with two conductors, of a cork ring or gasket G inserted between said conductors and forming therewith a receptacle C, a plastic alloy F in said receptacle
120 C, and means for clamping the two conductors together and compressing the cork ring, said cork ring being coated or impregnated with a gummy compound M, said plastic alloy containing a proportion of free mercury, and a spring K in said receptacle C, substantially as specified.
125

28. The combination with two conductors, of a cork ring or gasket G inserted between said conductors and forming therewith a receptacle C, a plastic alloy F in said receptacle
130 C, and means for clamping the two conductors together and compressing the cork ring,

the surfaces *a b* of said conductors in contact with said alloy being amalgamated, substantially as specified.

29. The combination with two conductors, 5 of a cork ring or gasket G inserted between said conductors and forming therewith a receptacle C, a plastic alloy F in said receptacle C, and means for clamping the two conductors together and compressing the cork ring, 10 said cork ring being coated or impregnated with a gummy compound M, said plastic alloy containing a proportion of free mercury, and a spring K in said receptacle C, the surfaces *a b* of said conductors in contact with said alloy being amalgamated, substantially as specified. 15

30. The combination with a rail conductor A of a fish-plate conductor B, clamping-bolt D, and an alloy F of mercury inserted and 20 clamped and confined and compressed between said rail and fish-plate while in a plastic condition, substantially as specified.

31. The combination with a rail conductor A, of a fish-plate conductor B, clamping-bolt 25 D, and an alloy F of mercury inserted and clamped between said rail and fish-plate while in a plastic condition, and a supplemental retaining device between the rail and fish-plate for the plastic alloy, substantially 30 as specified.

32. The combination with a rail conductor A, of a fish-plate conductor B, clamping-bolt D, and an alloy F of mercury inserted and 35 clamped between said rail and fish-plate while in a plastic condition, and a supplemental elastic, compressible, non-oxidizable retaining device between the rail and fish-plate for the plastic alloy, substantially as specified.

33. The combination with a rail conductor A of a fish-plate conductor B, clamping-bolt D, and an alloy F of mercury inserted and 40 clamped between said rail and fish-plate while in a plastic condition, a supplemental elastic, compressible, non-oxidizable retaining device between the rail and fish-plate for the plastic alloy composed of cork, substantially 45 as specified.

34. The combination with a rail conductor 50 A of a fish-plate conductor B, clamping-bolt D, and an alloy F of mercury inserted and clamped between said rail and fish-plate while in a plastic condition, a supplemental elastic, compressible, non-oxidizable retaining device 55 between the rail and fish-plate for the plastic alloy composed of cork coated or impregnated with a gummy compound, substantially as specified.

35. The combination with a rail conductor 60 A of a fish-plate conductor B, clamping-bolt

D, and an alloy F of mercury inserted and clamped between said rail and fish-plate while in a plastic condition, a supplemental elastic, compressible, non-oxidizable retaining device 65 between the rail and fish-plate for the plastic alloy, composed of cork coated or impregnated with a gummy compound, and a spring K in said receptacle, substantially as specified.

36. The combination with a rail conductor A of a fish-plate conductor B, clamping-bolt 70 D, and an alloy of mercury inserted and clamped between said rail and fish-plate while in a plastic condition, a supplemental elastic, compressible, non-oxidizable retaining device between the rail and fish-plate for the plastic 75 alloy, said plastic alloy F containing a proportion of free mercury, substantially as specified.

37. The combination with a rail conductor A of a fish-plate conductor B, clamping-bolt 80 D, and an alloy F of mercury inserted and clamped between said rail and fish-plate while in a plastic condition, a supplemental, elastic, compressible, non-oxidizable retaining device between the rail and fish-plate for the plastic 85 alloy, composed of cork coated or impregnated with a gummy compound, said plastic alloy F containing a proportion of free mercury, substantially as specified.

38. The combination with a rail conductor 90 A of a fish-plate conductor B, clamping-bolt D, and an alloy F of mercury inserted and clamped between said rail and fish-plate while in a plastic condition, a supplemental, elastic, compressible, non-oxidizable retaining device 95 between the rail and fish-plate for the plastic alloy, composed of cork coated or impregnated with a gummy compound, and a spring K in said receptacle, said plastic alloy F containing a proportion of free mercury, substan- 100 tially as specified.

39. The combination with a rail conductor A of a fish-plate conductor B, clamping-bolt D, and an alloy F of mercury inserted and 105 clamped between said rail and fish-plate while in a plastic condition, a supplemental, elastic, compressible, non-oxidizable retaining device between the rail and fish-plate for the plastic alloy, composed of cork coated or impregnated with a gummy compound, and a spring K in 110 said receptacle, said plastic alloy F containing a proportion of free mercury, the surfaces *a b* of the rail and fish-plate in contact with the alloy being amalgamated, substantially as specified.

HAROLD P. BROWN.

Witnesses:

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