(No Model.) 4 Sheets—Sheet 1.

E. E. RIES.

ART OF REPAIRING METAL STRUCTURES BY THE AID OF ELECTRICITY.

No. 453,164. Patented May 26, 1891.

Fig. 1.

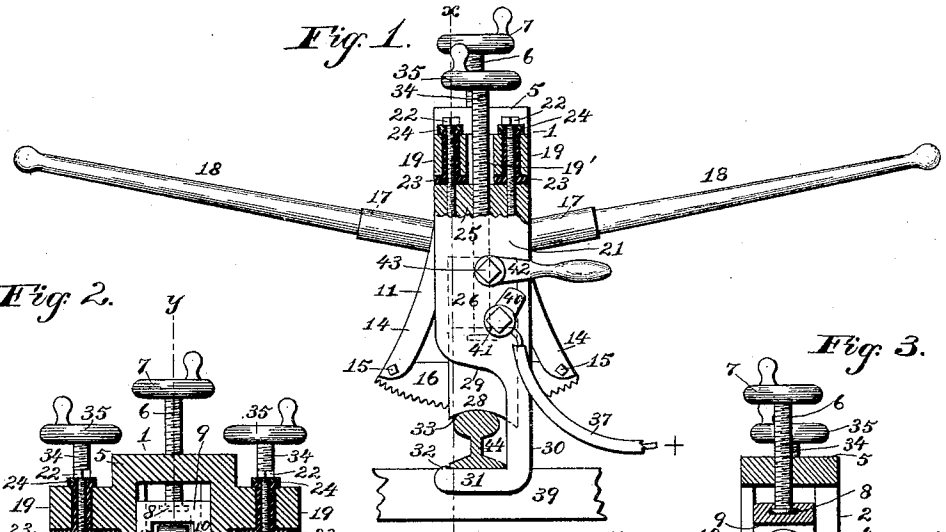


Fig. 2.

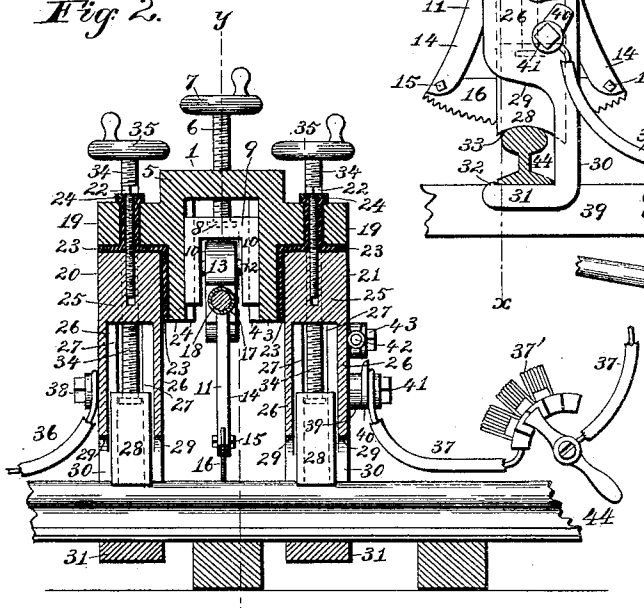


Fig. 3.

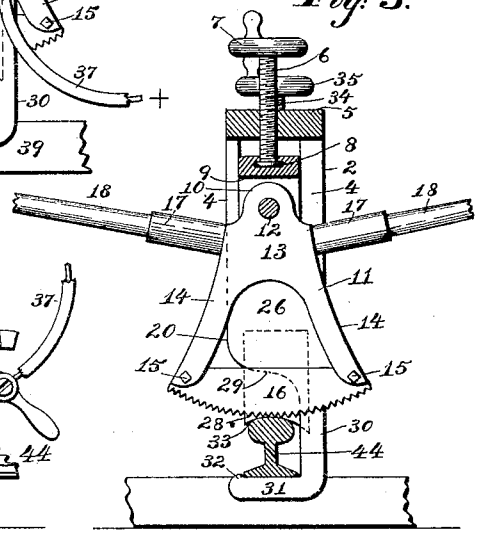


Fig. 4.

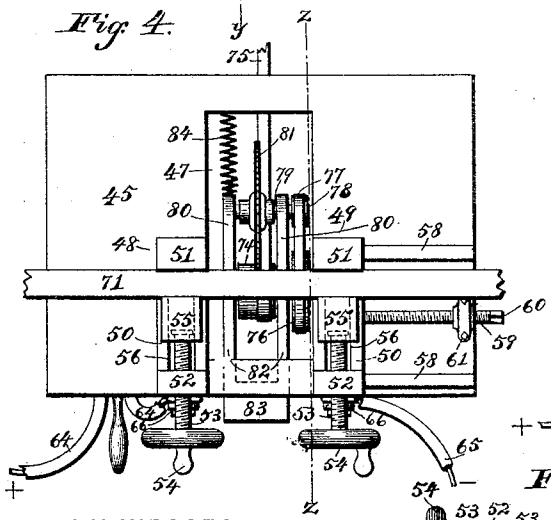


Fig. 5.

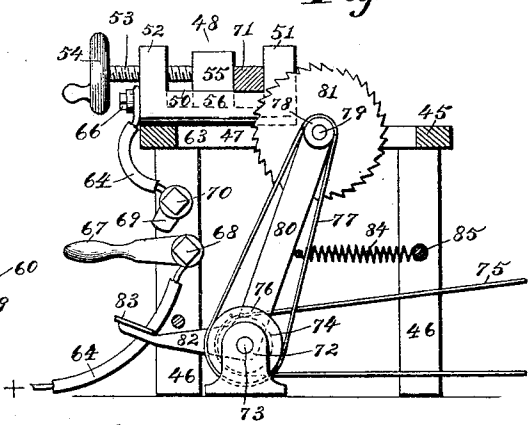
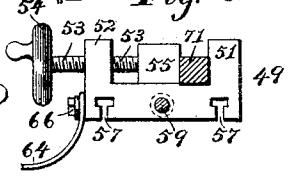


Fig. 6.



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(No Model.) 4 Sheets—Sheet 2.

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ART OF REPAIRING METAL STRUCTURES BY THE AID OF ELECTRICITY.

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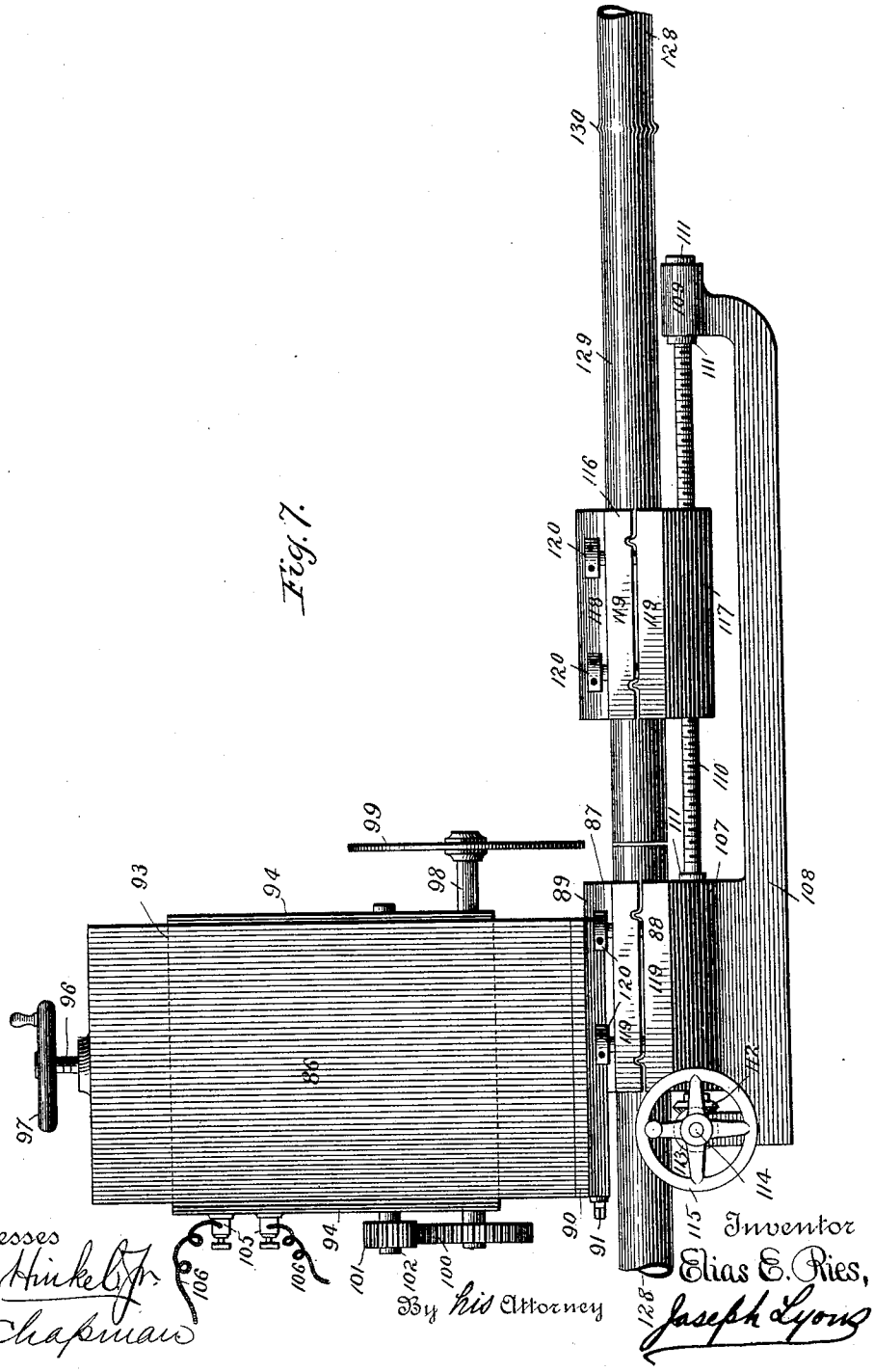
Fig. 7.



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(No Model.) 4 Sheets—Sheet 3.

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ART OF REPAIRING METAL STRUCTURES BY THE AID OF ELECTRICITY.

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Fig. 8.

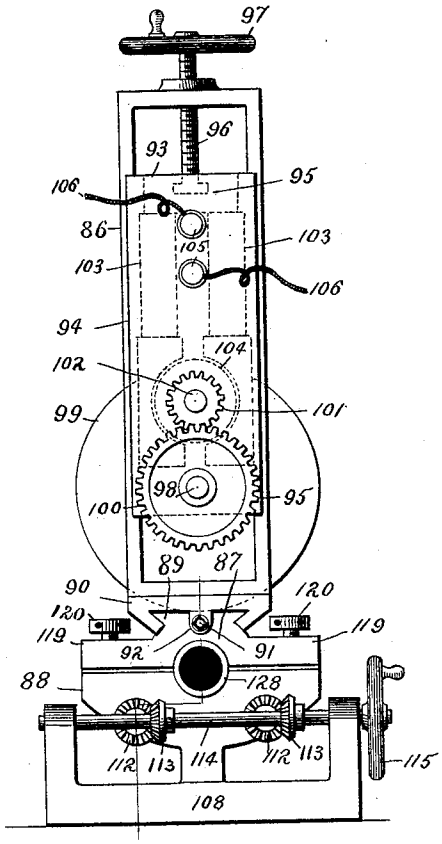
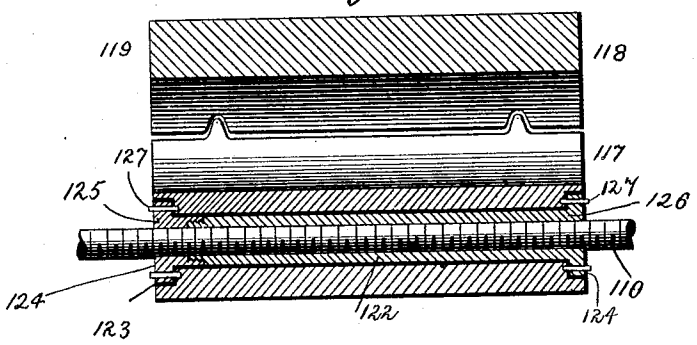


Fig. 9.



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ART OF REPAIRING METAL STRUCTURES BY THE AID OF ELECTRICITY.

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Fig. 10.

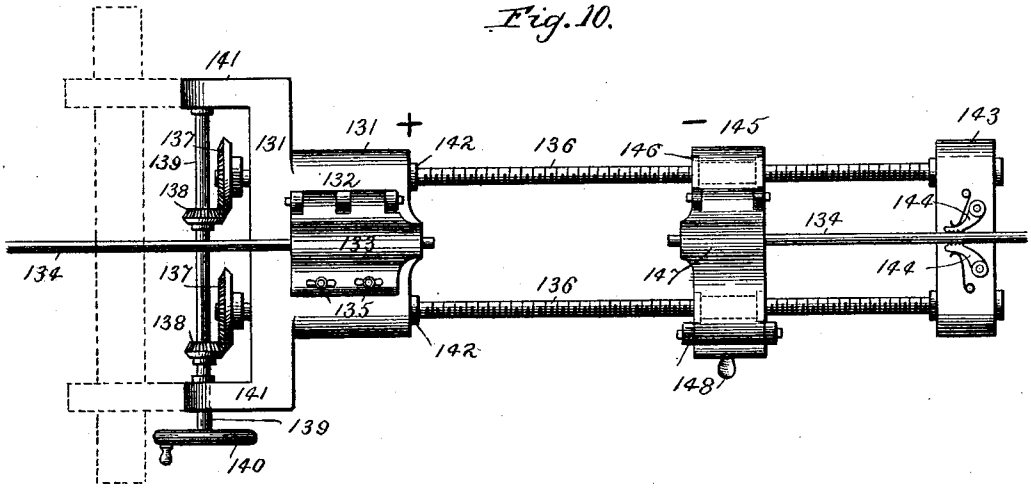

Fig. 11.

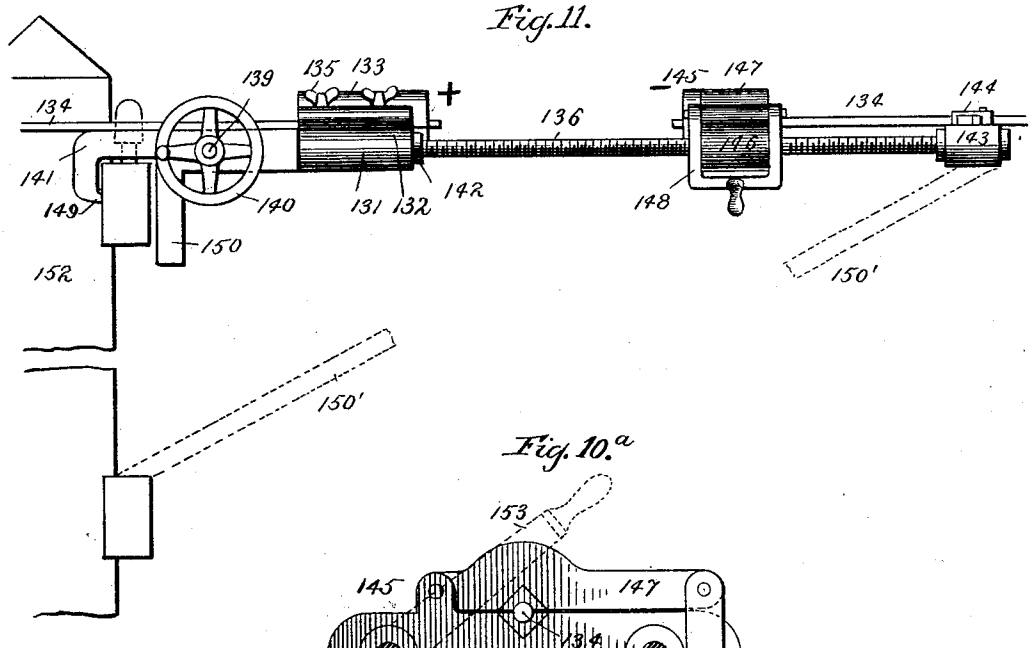

Fig. 10.a

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UNITED STATES PATENT OFFICE.

ELIAS E. RIES, OF BALTIMORE, MARYLAND.

ART OF REPAIRING METAL STRUCTURES BY THE AID OF ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 453,164, dated May 26, 1891.

Application filed November 9, 1889. Serial No. 329,755. (No model.)

To all whom it may concern:

Be it known that I, ELIAS E. RIES, a citizen of the United States, and a resident of Baltimore, in the State of Maryland, have invented certain new and useful Improvements in the Art of Repairing Metal Structures by the Aid of Electricity, of which the following is a specification.

This invention has reference to improvements in the art of repairing metal structures by the aid of electricity in the manner substantially as indicated in my application Serial No. 301,915, filed March 5, 1889. In my aforesaid application I describe and claim, generically, a process of metal-working under which metallic articles can be expanded, compressed, separated, or otherwise operated upon by subjecting the article to the heating action of a current of electricity, and then applying a suitable force for expanding, compressing, separating, or otherwise acting upon the metallic article. For the attainment of the objects of my present invention I make use of the process described in my aforesaid application, and I also make use of the processes of welding electrically set forth in my patent, No. 370,282, granted September 20, 1887. If a portion of a metallic structure becomes defective and it is desired to repair the same, it is often necessary to remove the defective portion and to replace it by new sound structures, and prior to my invention such repair could only be effected by cutting out the defective portion in a cold state and inserting a new sound section, which had to be riveted or bolted on with the expenditure of a great amount of labor and time. Besides this, by the use of rivets and bolts the strength of the structure was impaired and the original design of the same was changed. In many instances, in order to avoid this weakening and this change of form and design, extensive portions of a permanent structure had to be removed and replaced by new ones, and this was found cheaper and more satisfactory than the repairing of defects in the laborious and unsatisfactory manner alluded to. Thus, if a small circumscribed spot in an iron truss forming part of a permanent structure became defective, the whole truss would be removed and a new one inserted in its place. A defective spot in a railway-rail necessitates the removal of the whole structure of between thirty and forty feet in length. This latter mode of repairing railroads is quite inadmissible in the case of rail-sections of from five hundred to one thousand feet length, made by welding together sections of from thirty to forty feet in the manner set forth in my aforesaid patent, No. 370,282, of September 20, 1887. It is therefore especially important that in cases where the original component parts of the structure are firmly welded together instead of bolted or otherwise removably secured—as, for example, in the case of electrically-welded rail, girder, pipe, or electric-conductor lines of considerable length—a mode of removing a defective spot or length and of otherwise repairing the structure in a convenient and expeditious manner be provided.

It is the object of my present invention to provide such mode of repair and to overcome all these difficulties, and for this purpose I proceed as follows: I first remove the defective portion either in the ordinary manner, or I heat the defective structure electrically a short distance from each side of the defect, and then cut the defective portion out by suitable tools, which is easily done while the metal is in a heated and softened state. I then insert in place of the removed defective portion a new sound portion, fitting as closely as possible in place, and I then weld or unite electrically one end of the new inserted piece to the permanent structure, whereby the former becomes slightly shorter. This piece is then heated electrically and is expanded, so that its other end abuts against and bears upon the other side of the permanent structure, to which it is then welded electrically. In some cases, as in the repair of rails, the permanent portions may be temporarily forced apart to permit the insertion of a slightly-longer piece to compensate for the portions afterward taken up to form the weld. By this method the repaired portion of the structure becomes as strong as any other part of the same and does not involve a change in form or design.

It will be understood that my process of electrically repairing as applied to permanent structures is applicable to all kinds of such structures, including, in addition to those

hereinafter named, line conductors for electric lighting, for electric railroading, and more especially for the contact and traffic rails of electric railways, whether the same be underground or overhead. It is often found that from exposure to wear or traffic a portion of a metal structure will have expanded beyond its normal or desirable length. Illustrations of such wear may be found not only in the case of track-rail sections of considerable length, but also in the case of electric railway and other conductors, in cable ropes for the transmission of power, &c. In such cases I simply remove a section of the structure, as already described, of a length corresponding to the undesirable expansion, and then by a suitable force bring the ends of the structure together and weld the same to each other electrically, all as hereinafter described.

For carrying my invention into effect certain devices and apparatus for heating, cutting, welding, and also for expanding or compressing metals or for taking up the slack of a structure, are necessary, and these devices and apparatus may take a great variety of forms. I am, for this reason, not limited to the use of the identical apparatus which I hereinafter show and describe.

In the annexed drawings, which form part of this application, Figure 1 is a side elevation, partly in vertical section, of a portable cutting-machine constructed for the practice of my process in repairing the track-rails of a railroad. Fig. 2 is a vertical longitudinal section of the same on the line *x x* of Fig. 1. Fig. 3 is a vertical cross-section on the line *y y* of Fig. 2. Fig. 4 is a plan view of a cutting-machine designed more particularly for shop use and having means for compressing and expanding the article to be treated. Fig. 5 is a vertical section on the line *z z*, Fig. 4. Fig. 6 is a detail side elevation of a movable clamp shown in the machine illustrated in Figs. 4 and 5. Fig. 7 is a side elevation of a portable cutting and welding machine constructed for the practice of my invention in repairing pipe-lines, but is also applicable to the repair of rails. Fig. 8 is an end elevation of the machine shown in Fig. 7. Fig. 9 is a detail sectional view of the movable clamp shown in Fig. 7. Fig. 10 is a plan view of a portable welding apparatus in position for the practice of my invention in repairing and taking up slack in line-wires and electric conductors. Fig. 10ª is a side elevation of the movable clamp shown in Fig. 10, indicating also the cutter used in connection therewith; and Fig. 11 is a side elevation of the apparatus shown in Fig. 10.

Referring more particularly to the machine shown in Figs. 1, 2, and 3, there is the main frame 1, which is here shown as a casting, consisting, essentially, of two side plates 2 3, a suitable distance apart and each having on its inner face at each edge a projecting flange 4 and a top piece 5, connecting their upper ends together.

Passing through a nut in the top piece 5 is a screw-rod 6, provided with a hand-wheel 7 at the upper end, and at the lower end having a swivel connection 8 with the top cross-piece of a cross-head 9, as shown. This cross-head has two side arms 10 10, which lie in ways formed by the flanges 4 4 on the plates 2 3 and are held and guided therein. As will be seen, the cross-head may be adjusted vertically by suitable manipulation of the screw-rod 6.

Between the arms 10 10 of the cross-head 9 is pivoted a sector-frame 11 by means of the pin 12, which passes through the upper end or head 13 of said frame and to each side thereof and enters the said arms 10 10. Depending from the head 13 of the sector-frame are two diverging arms 14 14, to the lower ends of which is secured by bolts 15 or otherwise a blade 16, having its lower edge curved on an arc struck from the pivot-pin 12 and provided with saw-teeth, as shown. Projecting outward from each side of the head 13 of the sector-frame are sleeves 17, preferably slightly inclined upward, and in these sleeves are placed the butt-ends of handles 18. It will now be seen that the sector or saw frame 11 may be rocked on its pivot by moving the handles 18 alternately up and down and that the frame, with the saw-blade, may be fed downward or elevated by the screw-rod 6.

Extending outward from each plate 2 3 of the main frame near the upper end is a horizontal arm 19, having a vertical passage 19′ formed in it, as shown in Fig. 1. To the under sides of these arms 19 19 are secured clamp-stocks 20 21 by means of bolts 22. These clamps are both insulated from their supporting-arms and from the adjacent parts of the side plates 2 3 of the main frame by suitable insulating material 23, and the bolts 22 are insulated from the arms 19 19 by bushings 24, through which the said bolts pass. Each clamp-stock is composed of a block or body 25, into which the bolts 22 extend, two opposing side plates 26 26 depending from the sides of the body and provided with flanges 27 near the edges and forming ways between them for the reception of a follower 28, hereinafter described. At the lower end each plate 26 is cut away at one side, as shown at 29, and merges at the other side into a tail-piece 30, forming the fixed jaw of the clamp. This tail-piece 30 has its power part 31 bent at right angles and the extreme end thereof has formed on it an upturned lip 32. Each follower 28 is a rectangular block, as shown, with a curved face 33 for engaging the object to be clamped; or this face may be of any other desired shape, and the said follower is supported between the plates 26 26 of the clamp-stock by a screw-rod 34, having a swivel connection with the follower, as indicated, and extending upward through a nut in the block or body 25 and through the passage 19′ in the arm 19, and above the latter it is provided with a hand-wheel 35. It will now be evi-

dent that the follower may be adjusted to or from the fixed jaw of the clamp by suitable manipulation of the screw-rod 34 and be moved to clamp between itself and the fixed jaw any object placed on the latter.

To the clamps 20 21 are connected leading-in wires 36 37, respectively, coming from a generator (not shown) capable of supplying an electric current of great quantity and low tension, and such a generator may consist of an inductional transformer, a secondary battery or a dynamo, the direct low-tension current of which may be used. The conductor 36 is attached directly to the clamp 20 by a screw 38, and the conductor 37 is connected to a post 39, of insulating material, secured to the clamp 21. This post 39 carries a projecting contact-plate 40, held to the said post by a screw or bolt 41, which also serves to clamp the end of the conductor 37 to the post. The contact-plate 40 is arranged in the path of a switch-lever 42, pivoted to the clamp 21 in electrical connection therewith by a bolt 43, so that when the said lever is turned on its pivot it may be moved into or out of contact with the plate 40 and the electric connection established or broken, as desired.

The machine constructed as above described is used in my process as follows: Assuming that it is desired to remove a defective section of a rail 44 without taking the latter from the ties or changing its relation to the other rails of the track, I first expand the clamps 20 21 and elevate the saw-frame, and then place the clamps at the point to be cut—that is, at one side of the defect in the rail with the fixed clamp-jaws under the rail-flanges. The followers 26 are then forced against the tread of the rail by manipulating the screw-rods 34, and as the rail is immovable the fixed jaws are lifted into contact with the under side of the rail with the flanges thereof between the upright part of the said jaw and the lip 32. This operation, it will be seen, will secure the entire device firmly to the rail and prevent lateral or longitudinal displacement of the clamps on the rail. The saw-frame is now depressed by turning the screw-rod 6 until the saw is almost in contact with the rail, as shown in the drawings. The parts having been adjusted as described, the switch-lever 42 is turned on its pivot until in contact with the plate 40 to complete the circuit, and it will be seen that the electric circuit will then pass from the generator through the clamps and intervening rail back to the said generator. The section of rail between the clamps offers sufficient resistance to the passage of the electric current to be heated thereby until in a softened or plastic state, as will be readily understood. The saw-frame is now rocked on its pivot by a suitable manipulation of the handles 18, and at the same time it is fed downward by the screw-rod 6 and the teeth easily and rapidly cut into the softened metal until the rail is divided.

The current may be maintained throughout the cutting operation, or may be cut off at any time before or during the cutting operation by turning the switch-lever, and it may be varied by any suitable regulator in circuit with the generator.

In Fig. 2 I have indicated one kind of current-regulator which may be used. It consists of an ordinary rheostat 37′, the manipulation and effect of which are so well known that no further description is required. It will, however, be understood that it is of no consequence in what part of the circuit the current-regulator may be placed so long as it is within convenient reach of the operator; nor is it necessary that the regulator be a rheostat, since other means well known in the art may be used with advantage. If the current is generated by means of an inductional transformer, the current-regulator is preferably of the counter-electro-motive-force type, and is ordinarily located in the primary circuit of the transformer in the usual manner. When the rail has been divided, the saw-frame is lifted by the screw-rod 6 and the clamps expanded, and then the entire device is removed to the other point to be cut—that is, to the other side of the defect in the rail—when the operation of securing it to the rail and heating and cutting the latter is repeated and the defective section removed.

To replace the removed section by a new section free from defects, the latter is placed with its ends adjacent to the cut ends of the main rail and the inserted section is welded to the cut ends electrically in the manner set forth in Letters Patent No. 370,282, granted to me September 20, 1887, or in any suitable or improved manner. The clamps 20 21 or a suitable modification thereof—such as shown in my aforesaid patent—may themselves serve as the welding-clamps for this purpose, in which case the apparatus is provided, also, with means for laterally moving one clamp with respect to the other, as hereinafter more fully described, and for exerting the necessary endwise force to bring together or separate the ends of the rail-sections, as required. If it is found that the upsetting of the ends first welded has so reduced the length of the new section that the other ends not yet welded cannot be placed in contact, or that for any reason the new section is too long, the rail must be either elongated or contracted, and for this purpose I may make one of the clamps 20 21 adjustable relative to the other, instead of having both fixed to the central frame, so that the device may be used to expand or compress the rail-section, as will hereinafter appear by reference to other figures of drawings.

Referring now to the machine illustrated in Figs. 4, 5, and 6, there is a table or bed-plate 45 of any suitable material—such, for instance, as wood or metal—and it may be the top of a shop-bench, as shown, supported on legs 46. The table 45 is provided with a cen

tral opening 47, at the sides of which, on the said table, are clamps 48 and 49, respectively. These clamps each consist of a block 50 with upwardly-projecting ends 51 52, one end 51 forming the fixed jaw or tail-piece of the clamp and the other end 52 having formed in it a nut for a screw-rod 53. This rod is provided at one end with a hand-wheel 54, by means of which it is manipulated, and at the other end has a swivel connection (indicated in dotted lines, Fig. 4) with a follower 55, which is constructed to move on the block 50 between the upturned ends and is guided in a slot 56, formed in said block. It will now be seen that each screw 53 may be manipulated to move the follower toward the fixed jaw, and thus clamp and firmly hold any object placed between said fixed and movable jaws.

The jaws, as shown in the drawings, are shaped to hold straight rectangular objects, such as bars or rods; but they may be variously formed or have removable face-plates of suitable shape to adapt them to the conformation of any object to be clamped, whether it be straight or curved, as will be readily understood. The clamp 48 is stationary on the bed and the clamp 49 is movable thereon to and from the fixed clamp. In the base of the clamp 49 are grooves 57 of T or other shape, and through these grooves extend guides 58 of like shape and secured to the bed 45. The guides 58 are parallel and arranged at right angles to the length of the clamp, so that an object grasped by the clamp may be moved in a longitudinal direction when the clamp is moved on its guides.

To effect the movement of the clamp 49 to and from the clamp 48, I provide between the guides a screw-rod 59, having a swivel connection with the base of the clamp, as indicated in dotted lines, Fig. 6, and terminating in a polygonal head 60, to which a wrench may be applied to turn the rod, or in place of the head 60 a hand-wheel may be used. The rod 59 passes through a nut formed in a bearing-block 61 on the bed or table 45. It will now be understood that by manipulating the screw-rod 59 the clamp 49 and any article grasped thereby may be moved to or from the other clamp 48. The clamps are insulated one from the other, either by the table 45, which may be constructed of insulating material, or by a plate 63, of insulating material, introduced between the clamp 48 and the table, as shown in Fig. 5. Leading-in wires 64 65, coming from a dynamo-generator or other source of electric current of low tension and great quantity, are connected to the clamps 48 and 49, respectively, by screws or bolts 66, entering suitable nuts in the bodies of said clamps. The wire or conductor 65 should be sufficiently flexible to admit the movement of the clamp 49 on its guides, and the conductor 64 includes a switch within easy reach of the operator. This switch may be and is shown as similar to that illustrated in Fig. 1, and consists of a switch-lever 67, to the pivot-bolt 68 of which is attached the conductor 64, and a contact-plate 69, to the securing-bolt 70 of which the continuation of the conductor 64 is attached. The switch may be secured directly to one of the front legs 46 of the bench, as shown, or may be otherwise mounted and secured to the said bench.

It will be understood from the construction thus far described in relation to Figs. 4, 5, and 6 that an article—such, for instance, as a metal structure 71, placed on the blocks 50 between the jaws 51 and 55—may be clamped against movement on the blocks by manipulating the screws 53. Then by turning the switch-lever 67 into contact with the plate 69 the current from the generator will pass through the clamps and the intervening section of the metal structure 71 and back to the generator.

Beneath the bench and journaled in suitable bearings 72 is a counter-shaft 73, carrying a drive-pulley 74, which receives motion from a belt 75, coming from any suitable source of power. The shaft 73 also carries a pulley 76, from which latter a working-belt 77 passes to a pulley 78 on one end of a saw-arbor 79. The arbor 79 is journaled in the upper ends of two arms 80 80, extending into the opening 47 in the table 45, and between which arms the said arbor carries a circular saw 81. At the lower ends the arms 80 80 are loosely journaled or pivoted on the counter-shaft 73, and from thence extend at an angle and form treadle-arms 82 82, the outer ends of which are joined by a step 83 within reach of the foot of the operator. It will now be seen that if the treadle be depressed the arms 80, with the saw 81, will be carried around the shaft 73 toward the bar or other structure 71, held in the clamps 48 49, and may be made to operate thereon, and since the shaft 73 is the pivot of the saw-carrying frame the belt 77 will not be affected by the movement of said frame. When the treadle is released, the saw-carrying frame will be returned to its normal position by a spring 84, attached to the said frame and some fixed portion of the bench-frame—such, for instance, as a brace-rod 85, between the rear legs of the bench—or the saw-frame may be returned to its normal position by any other suitable means.

With a machine constructed as described, and shown in Figs. 4, 5, and 6, my process may be practiced as follows: Assuming that it is desirable to cut out a section of a metallic structure preparatory to inserting and welding to it a new section, I first place the structure in the clamps 48 49 with the point to be cut opposite the saw 81. Then by manipulating the screw-rods 53 the structure is forced against the fixed jaws 51 by the followers and firmly clamped against movement. The switch-lever 67 is now moved into contact with the plate 69 to establish the circuit, and the current coming from the generator

enters one clamp and passes through the intervening section of the bar to the other clamp and back to the generator. The structure having been heated until softened the treadle of the saw-frame is depressed and the saw, which is rotated by the application of power through the belts 75 and 77, is brought into contact with the softened structure and the teeth rapidly cut into and through the structure, being fed by the continued downward movement of the treadle. The circuit may be broken at the switch by moving the lever out of contact with the plate 69 after the structure is sufficiently heated, or the current may be allowed to pass during the operation of cutting.

A current-regulator similar to the one shown in connection with Fig. 2 may be used in any part of the circuit, whereby the degree of heat imparted to the article operated upon can be controlled.

The adjustability in a lateral direction of the clamp 49 enables me to extend or compress any metallic article placed in the clamps. This is done by first heating the article by the passage of the current through the same, and then manipulating the screw-rod 59 to force the clamp 49 either toward or from the other clamp. As has been stated above, the same arrangement of one laterally-movable clamp may be used in connection with the apparatus shown in Figs. 1, 2, and 3, whereby in the process of repairing rails the inserted section may be fitted for welding and may be welded at both ends.

It will be evident that in the repair of metal structures composed of electrically-welded sections or parts it may sometimes be expedient to cut out the defective section without electrically heating the same at the points of separation, since when time is not of prime importance, or when an absolutely clean surface is required, or when the structure operated upon is of comparatively small sectional area, the defective portion may be cut out cold by any of the means above described, or in any other well-known or desirable manner. The remaining portion of my process, that of inserting and welding in the new section, is in such case carried out in precisely the same way as previously described, and I do not therefore limit myself to the application of my method to cases where the defective portion is removed in the manner described.

Referring now particularly to Figs. 7, 8, and 9, which illustrate a machine constructed more especially for repairing pipe, rail, and conductor lines, there is shown a rectangular frame 86, mounted on the upper jaw 87 of a clamp 88, hereinafter described. There is a dovetail guide 89 formed on the top of the clamp-jaw 87, and a slide 90, cast on or secured to the under side of the frame 86 and having an under-cut groove, is fitted to the guide 89. This construction, it will be understood, admits of a movement of the frame 86 longitudinally on the clamp-jaw 87, and such movement is effected by means of an adjusting screw-rod 91, having a bearing in a lug 92, formed on the under side of the slide 90 and entering a nut formed in one end of the clamp-jaw 87. The free end of the rod 91 is squared to receive a crank, key, or hand-wheel, by means of which the rod may be rotated and the frame 86 adjusted on the clamp-jaw in a manner well understood.

Movable vertically within the frame 86 there is a carriage 93, consisting, essentially, of two end plates 94, overlapping the ends of the said frame 86, and upper and lower blocks 95, extending longitudinally through the frame 86 and connecting together the end plates 94. This carriage 93 is adjusted in the frame 86 by means of a feed-screw 96, swiveled in the upper block 95, as indicated in dotted lines in Fig. 8, and extending upwardly through a nut formed in the top of the frame 86, above which the said screw 96 terminates in a hand-wheel 97.

Extending through and journaled in the lower part of the carriage 93 there is a horizontal arbor 98, having at one end a fusion disk or saw 99 and at the other end a gear-wheel 100. The arbor 98 is driven by an electric motor, (indicated by dotted lines, Fig. 8,) mounted in the carriage 93. This motor in itself forms no part of the present invention and may be of any suitable and well-known type; or it may be replaced by any other kind of motor, it being immaterial, for the purposes of the present invention, as to what means are employed for driving the arbor or shaft 98. For this reason no detailed description of the motor is deemed necessary, further than to state that the gear-wheel 100 meshes with a pinion 101 on the armature-shaft 102 of the motor, the field-magnets 103 and armature 104 of which are shown in dotted lines, Fig. 8. The circuit-terminals of the motor are connected to binding-posts 105 on one of the plates 94, (see Fig. 7,) and the motor-current, supplied by any suitable source of electricity, is carried by conductors 106 106. It will now be understood that if the fusion disk or saw be rotated by means of the electric motor, and the carriage 93 be adjusted by means of the feed-screw 96, any object held in the path of such rotating disk or saw will be engaged and cut by the same, and if the feeding of the carriage is continued will ultimately be severed thereby.

The clamp 88, on the upper jaw 87 of which the frame 86 is mounted, has its lower jaw 107 cast on a bed-plate 108 near one end thereof. This bed-plate extends laterally for a distance with its upper surface below the level of the jaw 107 and it terminates in an upturned end 109, as shown. The lower jaw 107 of the clamp 88 is provided near each side with a longitudinal perforation, forming bearings for rods 110, extending to and having bearings in the upturned end 109 of the bed-plate. Each of these rods is free to turn on

its axis in its bearings in the jaw 87 and upturned end 109, but is prevented from moving longitudinally therein by collars 111, as clearly shown in Fig. 7. Each rod is screw-threaded between its end bearings, and beyond the jaw 107 it carries a bevel-pinion 112. These rods 110 are driven simultaneously by bevel-pinions 113, both secured on a shaft 114, journaled in bearings raised on the end of the bed-plate 108 beyond the clamp-jaw 107, and said shaft extends at right angles to the rods 110. The shaft 114 is provided with a hand-wheel 115, by means of which it is rotated and the rods 110 turned on their axes.

On the screw-threaded portions of the rods 110 is mounted a clamp 116, provided with nuts for the passage of said rods 110, so that when the rods are rotated the clamp will be moved to or from the other clamp 88, which for convenience will be termed the "fixed clamp." The clamp 116 consists of a lower jaw 117 and an upper jaw 118 and is similar in construction to the clamp 88. The jaws of each clamp have side wings 119 formed on them, and through these wings extend clamp-screws 120, which pass freely through perforations in the wings on the upper jaw and enter nuts in the wings on the lower jaw, the construction being such that they may be manipulated (in an obvious manner) to force the clamp-jaws together and grasp and firmly hold any object placed between them. In the present instance the contiguous faces of the jaws of each clamp are formed with grooves or channels to adapt them to receive and firmly hold a pipe or tube; but it will be understood that the working-faces of the clamp-jaws will be shaped to conform to the object to be grasped.

In Fig. 9 there is shown the construction for insulating the clamp 116 from its supporting and adjusting rods 110. Each rod passes through a nut 122, seated in a perforation in the side of the jaw 117 of the clamp 116 and surrounded by a sleeve or bushing 123, of insulating material, interposed between the said nut and the walls of the perforation or passage in the clamp-jaw. The clamp-jaw 117 is countersunk at each end of each perforation or passage, and each nut has an enlargement or head 124 at each end seated in the countersunk portions of the jaw, the said nuts being each constructed of two parts 125 126, screwing together, as shown, so that they may be readily introduced into and secured in the said perforation in the clamp-jaw. There are provided locking-pins 127 127, passing through the parts 124 and entering the jaw 117 to prevent the accidental loosening or separation of the two parts of the nut.

A machine constructed as described with reference to Figs. 7, 8, and 9 is especially adapted for repairing pipe-lines, and with it my process may be practiced as follows: Assuming that a line of pipe 128 contains a defective portion and that it is desired to remove such defective portion and substitute a new and sound portion therefor, I first mount the clamps on the pipe at one end of the portion to be removed, and then adjust the frame 86 until the fusion disk or saw 99 is directly over the pipe at one of the points at which the latter is to be severed. When the cutting-tool 99 is a saw, a heating-current of electricity is passed through the clamps and the intervening pipe, it being understood that the said clamps are in circuit with a suitable source of electricity by means of conductors (not shown) in the same manner as illustrated in Figs. 1 to 6, inclusive. When the pipe has become softened by the heat generated by the electric current, the carriage supporting the saw 99, rotated by the electric motor in said carriage, is lowered by means of the feed-screw 96 until the saw is in contact with the pipe. A further downward movement of the carriage will cause the saw to cut into and ultimately cut through the pipe. If the cutting-tool 99 is a fusion-disk, the cutting of the pipe or other object will generally be effected without specially heating the same by the electric current. After the pipe is severed at one point the carriage, with the cutting-disk and motor, is by the manipulation of the feeding-screw moved along the clamp to the other point to be severed—that is, to the other end of the heated defective portion—at which point the operation of cutting the same is repeated. Where the portion to be removed is of considerable length, the entire apparatus may be moved forward and the operation of clamping, heating, and cutting repeated, or two sets of apparatus—one at each end of the section—may be used. By this operation the defective or undesirable portion of the pipe is removed expeditiously and without disturbing any other portion of the pipe-line, and this removed portion may then be replaced by another or new section 129, free from defects and of a length sufficient to fill the gap formed by the removal of the said defective portion, or by a section having a branch or distributing pipe or connection formed therein, as the case may be. It will generally be found advantageous to make the new section slightly longer than the portion removed, so that it will be necessary to temporarily force the severed ends of the pipe farther apart in order to insert it, since I usually prefer to unite the new section of pipe to the cut ends of the pipe-line by welding it electrically thereto in such a manner as to leave an increased thickness of metal or bead upon the outside of the welded portions by upsetting a portion of the heated metal, as hereinafter explained. After the new section has been placed in the gap the clamps 88 and 116 are applied to the pipe-line near one of the cut ends, and to the said section, respectively, the clamps being placed as near together as practicable with the joint between them. A heating-current of electricity is now passed through the clamps and intervening pipe in the manner before explained, and, traversing the joint,

raises the abutting ends of the pipe and new section to a welding temperature. The hand-wheel 115 is now manipulated to rotate the shaft 114 and screw-rods 110, geared to said shaft in such direction that the clamp 116 will be moved toward the clamp 88, forcing the pipe ends between the said clamps together and upsetting the softer metal, and thus producing a firm and homogeneous joint. Such a joint is indicated at 130, Fig. 7. The clamps are now moved to the other end of the new section, and the operation of welding is repeated. It will now be understood that the upsetting of the metal of the pipe-line and new section will take up the excess of length of the said new section over the portion removed.

It frequently occurs that line structures—such as electric conductors, cables for the transmission of power, and the like—become stretched from various causes until longer than desirable in practice. An apparatus especially constructed for removing a portion of a line conductor or cable and then taking up the slack and welding the ends together in accordance with my invention is shown in Figs. 10, 10ª, and 11, to which reference is now made. There is shown a bed-plate 131 with a central raised portion 132, Fig. 11, to one side of which is hinged one edge of a jaw 133, constructed to be turned down upon the upper surface of said raised portion of the bed-plate. This hinged jaw, together with the raised portion of the bed-plate, constitutes a clamp which is fixed with relation to the frame, and for this reason, when hereinafter mentioned, will be termed a "fixed clamp." The hinged jaw is held in the closed position, so as to firmly clamp any object—such as a line conductor 134—by means of thumb-nuts 135 or by any other suitable means. The bed-plate 131 is bored longitudinally on each side of the clamp, and in each passage so formed is journaled one end of a screw-threaded rod 136. Each rod extends a short distance to the rear of the bed-plate and there carries a bevel gear-wheel 137, and both of these gear-wheels, together with the rods carrying them, are rotated by means of bevel-pinions 138, meshing with the said gear-wheels. These bevel-pinions are mounted on a counter-shaft 139, rotated by a hand-wheel 140, and journaled at right angles to the screw-rods 136 in L-shaped arms 141, projecting from the corners of the bed-plate. The screw-rods 136 are prevented from moving longitudinally in their bearings in the bed-plate by collars 142, secured on them at the front of the bed-plate, acting in conjunction with the gear-wheels 137 at the rear of the said bed-plate. The other ends of the screw-rods 136 are journaled in and held parallel to each other by a block 143, which may be constructed of insulating material. On the upper surface of this block are two pivoted spring-actuated gripper-jaws 144, having their gripping-faces serrated, as indicated.

The screw-rods 136 carry an adjustable or movable clamp 145, one jaw 146 of which is provided with insulated nuts for the passage of said rods. These nuts may be of the same construction as shown in Fig. 9 and are indicated by dotted lines.

Hinged at one end to the jaw 146 is a movable clamp-jaw 147, held onto the jaw 146 by means of a latch 148, which in this instance is shown as a forked lever pivoted to the free end of the jaw 147 and straddling and engaging under the corresponding end of the jaw 146. The working-faces of the jaws of the movable clamp and also of the fixed clamp are formed with grooves as seats for the conductor when clamped, so that the conductor may be held in the clamps by friction and without being flattened or otherwise injured.

By manipulating the hand-wheel 140 the movable clamp may be adjusted to or from the other or fixed clamp, and any object held by said clamp will participate in such movement.

In taking up the slack of overhead conductors it is, as a rule, necessary that the bed-plate be secured to the pole or other support for the conductor. For this purpose the free ends of the L-shaped arms 141 are extended rearwardly beyond the bearings of the shaft 139 and terminate in downwardly-extending hook-shaped fingers 149, and the said arms are also provided with downwardly-projecting bearing-plates 150. When the arms 141 are placed on a cross-arm 151 of a supporting-pole 152 for an overhead conductor, with the bearing-plates 150 and the fingers 149 engaging the opposite vertical faces of the cross-arm it will be seen that the bed-plate is held against any movement to or from the cross-arm and is supported in an approximately horizontal position. For greater security a brace-rod 150′ (indicated in dotted lines in Fig. 11) may be used.

With an apparatus constructed as described with reference to Figs. 10, 10ª, and 11 my process of repairing metal structures as applied to taking up the slack of conductor, cable, or other lines may be practiced as follows: The clamps are first separated to a distance corresponding to the amount of slack to be taken up and are then applied to the conductor, in which case, however, the arms 141 on the bed-plate are placed over the cross-arm to which the conductor is secured, and the conductor is also placed between the grip-jaws 144 on the block 143. The conductor is then severed close to the front edge of each clamp by any suitable means, and I may employ a cutter, which may be pivoted on one of the rods 136, so as to be moved across the conductor close to the front face of each clamp. This cutter is shown in dotted lines at 153, Fig. 10ª; but it is to be understood that I may use any suitable cutting-tool—such, for instance, as ordinary hand cutting-pliers. The severing of the conductor may be facilitated by passing a heating-current of elec-

tricity coming from a suitable source through the clamps and intervening portion of the conductor. The current is conveyed to the clamps by means of suitable conductors, which are not shown, since they may be identical with those shown in Figs. 1 to 6. The hand-wheel 140 is now manipulated to rotate the shaft 139, and thereby turn the screw-rods 136 and advance the clamp 145 toward the fixed clamp. This movement takes up the slack in the conductor and puts it under its normal tension, and it is continued until the severed ends of the conductor abut, when the heating-current is caused to traverse these abutting ends and quickly raises them to a welding temperature. The movable clamp is then still farther advanced toward the fixed clamp until the softened ends are upset and welded together. During the operation of taking up the slack of the line a considerable strain is caused upon the movable clamp, and this is in a measure relieved by the grippers 144, which prevent the back slip of the line. These grippers also serve to hold the wire should it be found necessary to return the movable clamp to take up an additional length. The burr or enlargement produced by the welding may be removed by filing or otherwise, if so desired; but in many instances this is altogether unnecessary.

When a metal structure is repaired in the manner hereinbefore described, it may happen that the newly-inserted portion, which has taken the place of the removed defective portion after it has been welded at one end, is too short to be welded at the other end. In this case the apparatus shown affords a means for extending or stretching any part of the structure to the required extent. This is done by clamping the structure between the fixed and movable clamps and heating it by the passage therethrough of an electric current. After which or simultaneously therewith the said clamps are moved apart until the required extension is produced.

Having now fully described my invention, I claim and desire to secure by Letters Patent—

1. The hereinbefore-described method of repairing fixed metal structures, which consists in cutting out the defective or objectionable section, and then inserting a new section in place of the old and welding it at both ends electrically to the fixed structure, substantially as described.

2. The method of repairing fixed metal structures, which consists in cutting out the defective or objectionable section, then inserting a new section in place of the old, then welding said new section at one end electrically to the fixed structure, then fitting the other end of the same into welding-contact with the fixed structure either by expansion or compression, and then welding said second end electrically to the fixed structure, substantially as described.

3. The method of repairing fixed metal structures, which consists in cutting out the defective or objectionable section, and then again completing the structure by electric welding under such strain of the parts as will secure the required welding-contact, substantially as described.

4. The method of repairing metal structures, which consists in heating the ends of the defective section thereof electrically, cutting out the heated defective portion at the heated points and removing the same from the structure, and then inserting a new portion in place of the old and electrically welding the new portion at both its ends to the said structure, substantially as described.

5. The method of repairing metal structures, which consists in heating the same electrically on each side of the defective section thereof and cutting said section at the heated points and removing the same from the structure, and then inserting a new section in place of the old and welding it at both ends electrically to the structure, substantially as described.

6. The method of repairing fixed metal structures, which consists in cutting out the defective or objectionable section, then inserting a new section in place of the old, then welding said new section at one end electrically to the fixed structure, then heating the inserted or any other section of the structure electrically and expanding or compressing the same to produce proper welding-contact of the other end of the inserted section with the fixed structure, and then welding said second end electrically to the fixed structure, substantially as described.

7. The hereinbefore-described method of repairing railway, pipe, cable, or conductor lines, which consists in cutting out the defective or objectionable section of such lines, then inserting a new section in place of the old, then welding said new section at one end electrically to the line, then fitting the other end of the new section into welding-contact with the line, substantially as described, and then welding said second end electrically to the line structure.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ELIAS E. RIES.

Witnesses:
LEOPOLD RIES,
JAMES D. SCOTT.