(50.)

9 Sheets--Sheet 1.

I. L. PULVERMACHER.

Improvement in Electro-Galvanic Chains, Bands, &c.

No. 120,772. Patented Nov. 7, 1871.

Fig. 1.

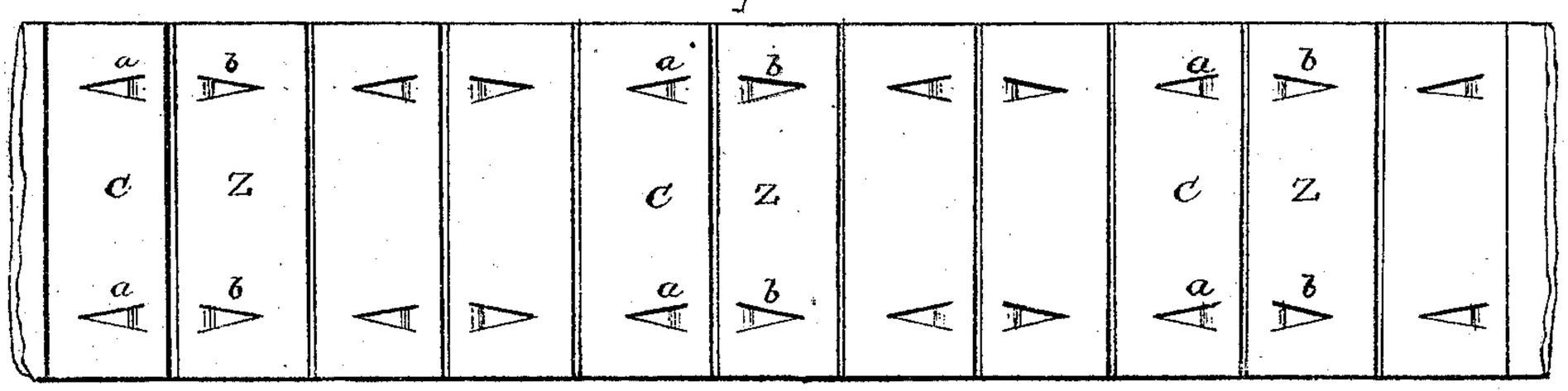
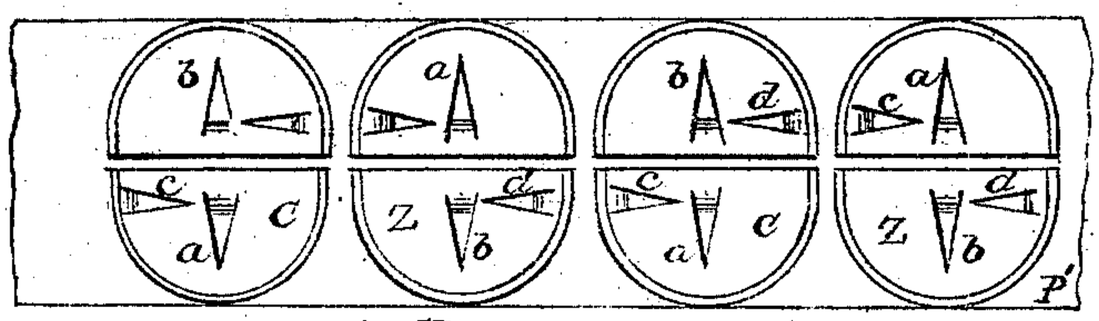


Fig. 2.

Fig. 3.



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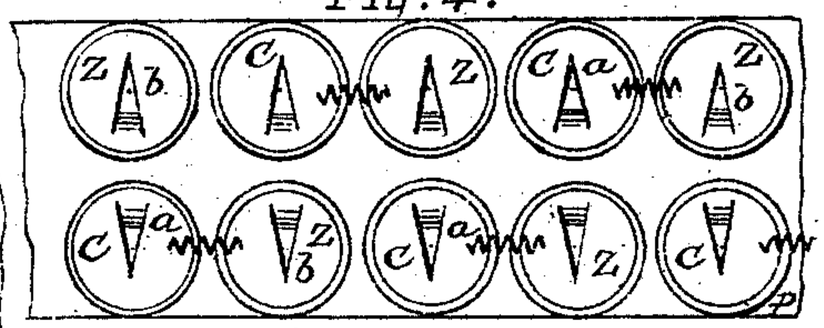
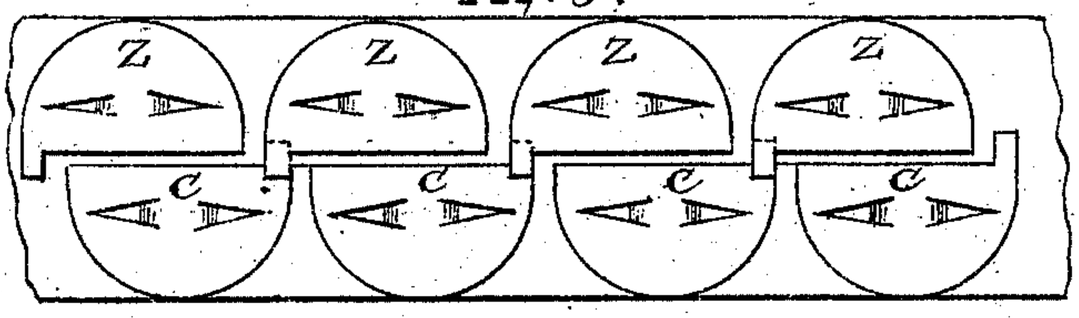


Fig. 11.

Fig. 5.



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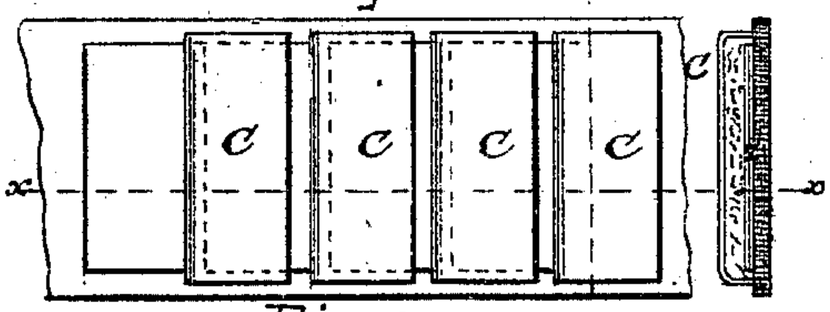

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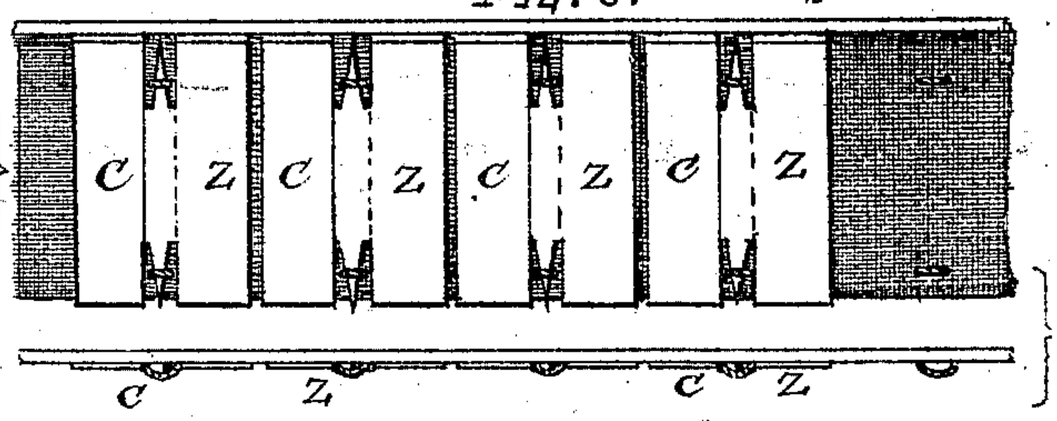

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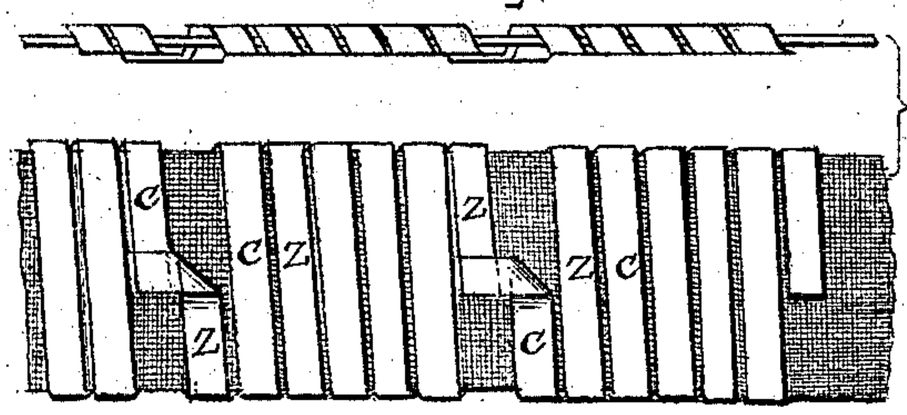

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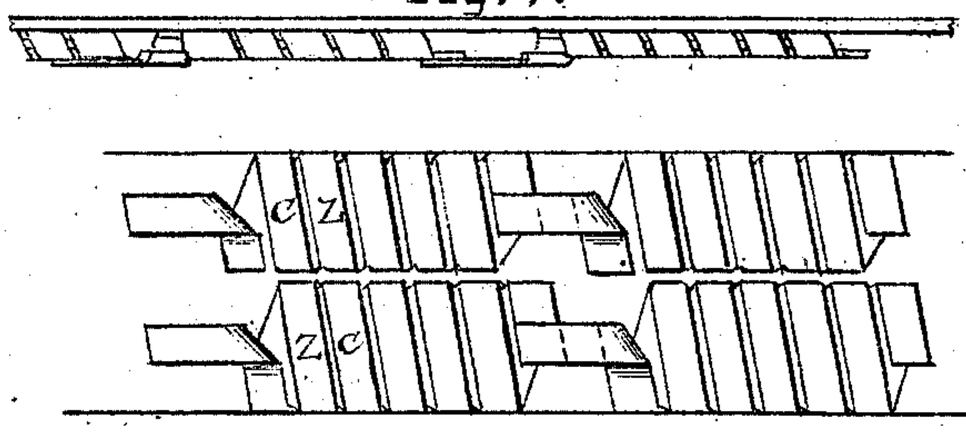

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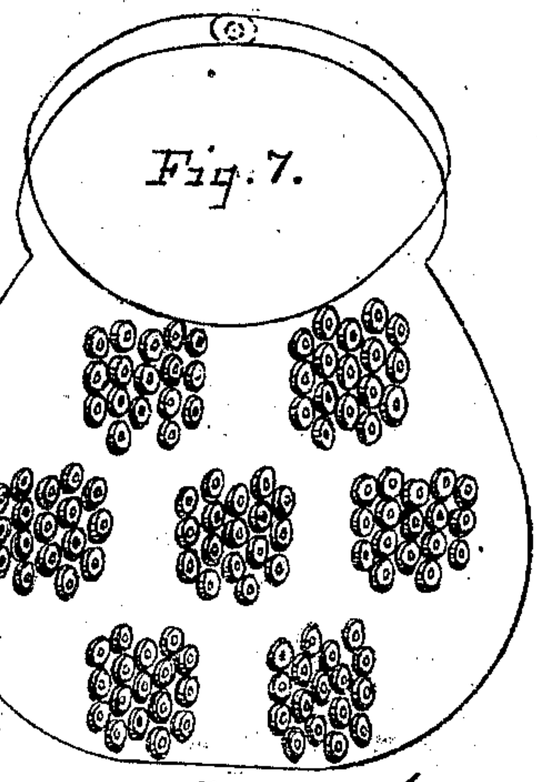

Witnesses:

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Parker H. Sweet, Jr.

Inventor:

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By Burke, Fraser & Osgood.

Atty.

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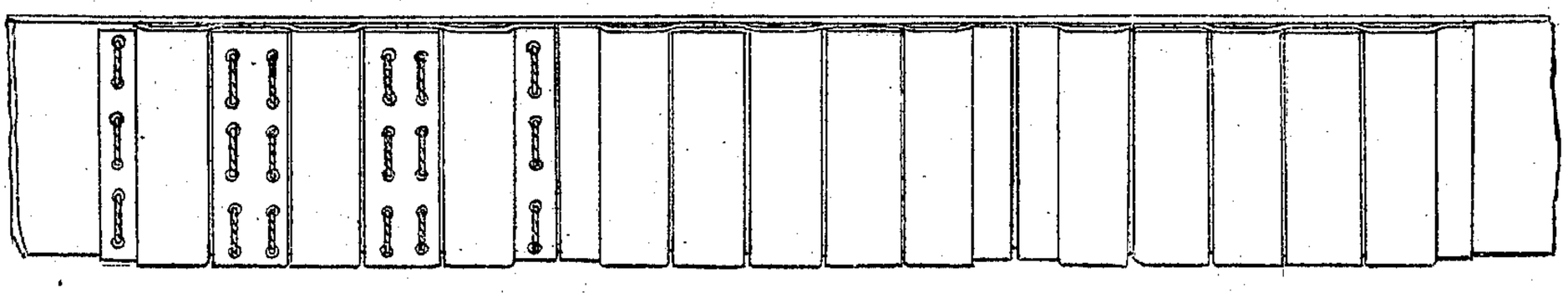
9 Sheets--Sheet 2.

I. L. PULVERMACHER.

Improvement in Electro-Galvanic Chains, Bands, &c.

No. 120,772. Patented Nov. 7, 1871.

Fig. 13.



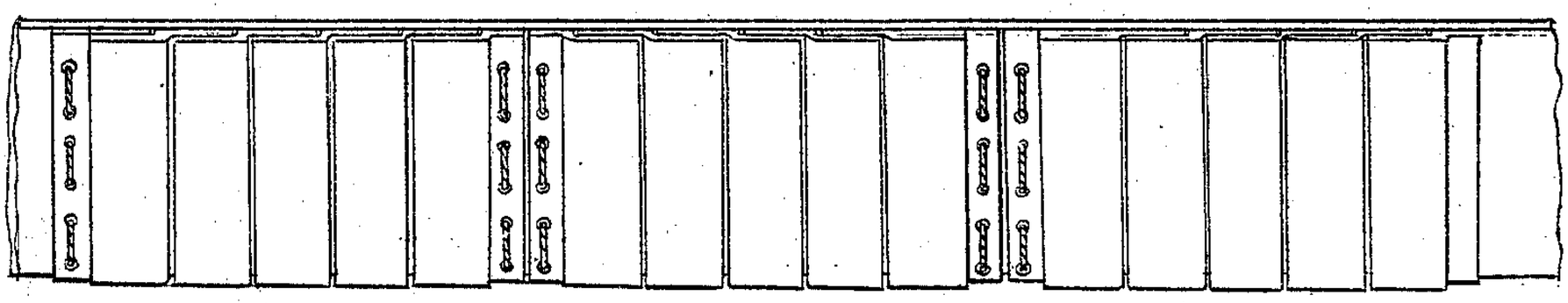
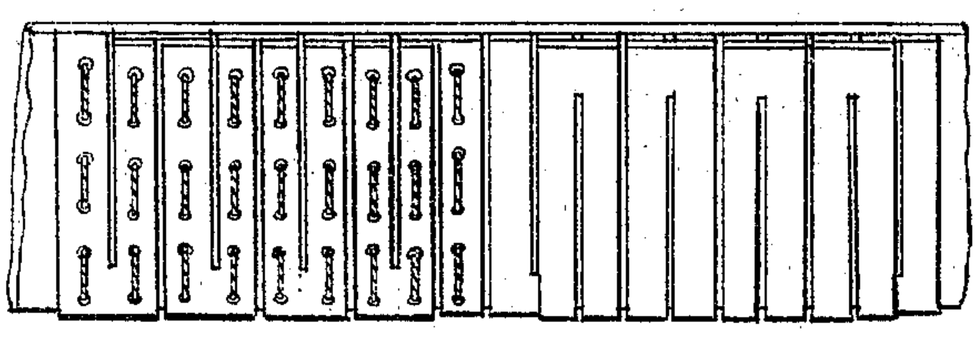


Fig. 14.

Fig. 15.



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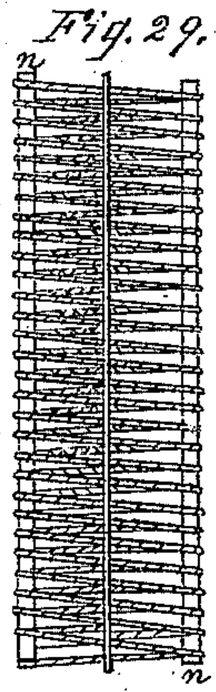

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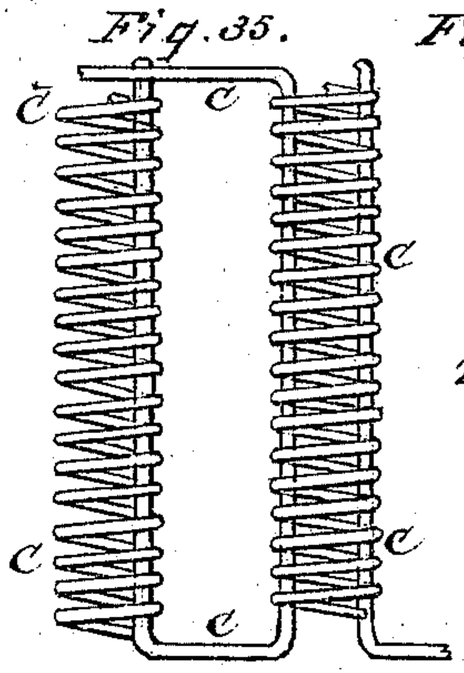

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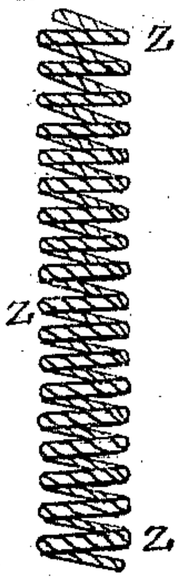

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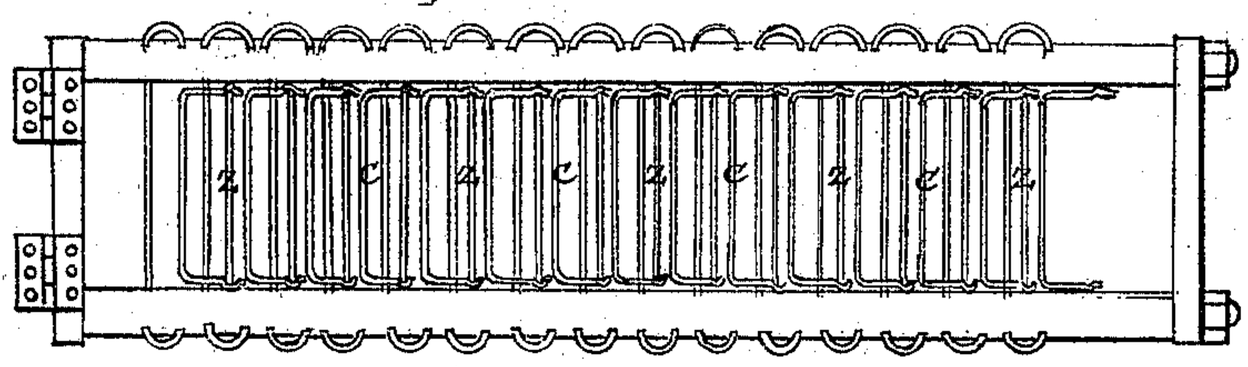

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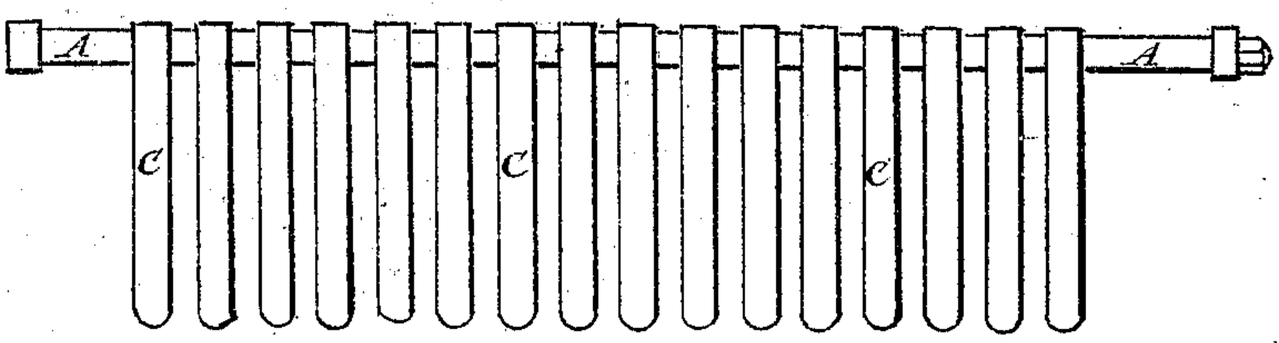

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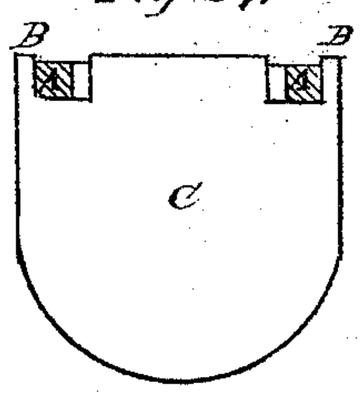

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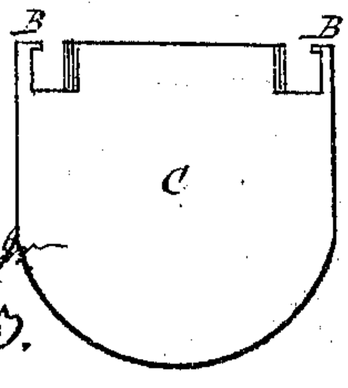

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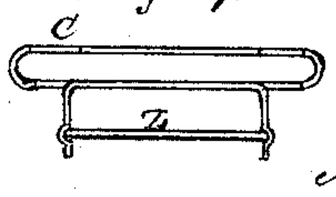

Witnesses:

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A. C. Norris.

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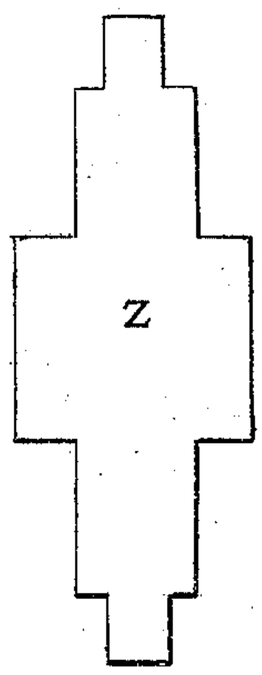
I. L. PULVERMACHER.

Improvement in Electro-Galvanic Chains, Bands, &c.

No. 120,772. Patented Nov. 7, 1871.

Fig. 19.



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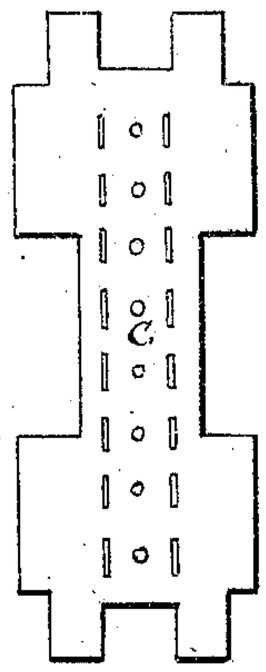

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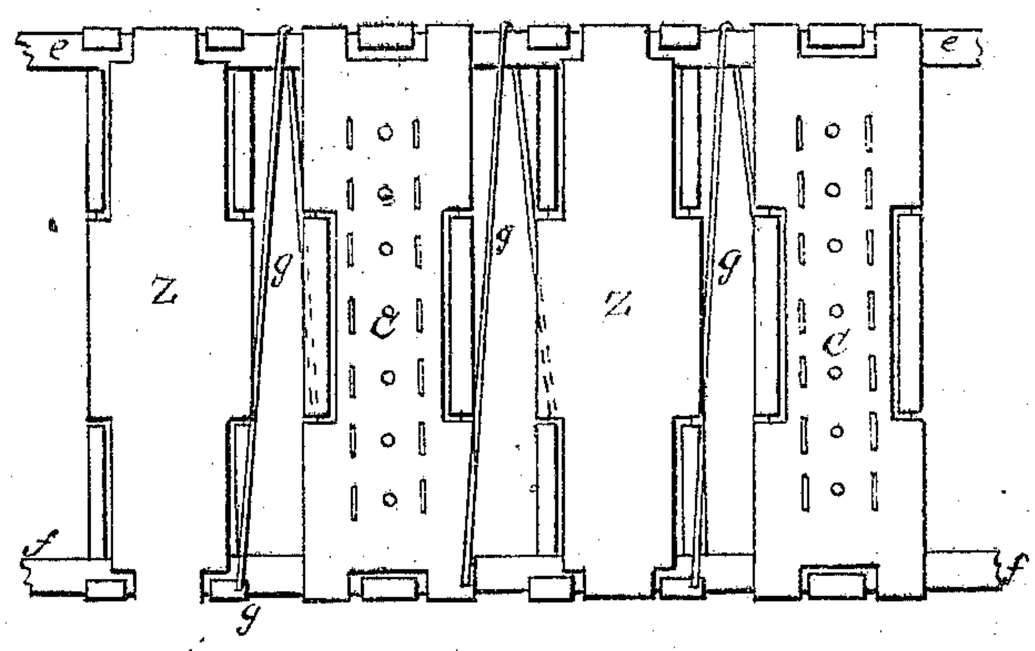


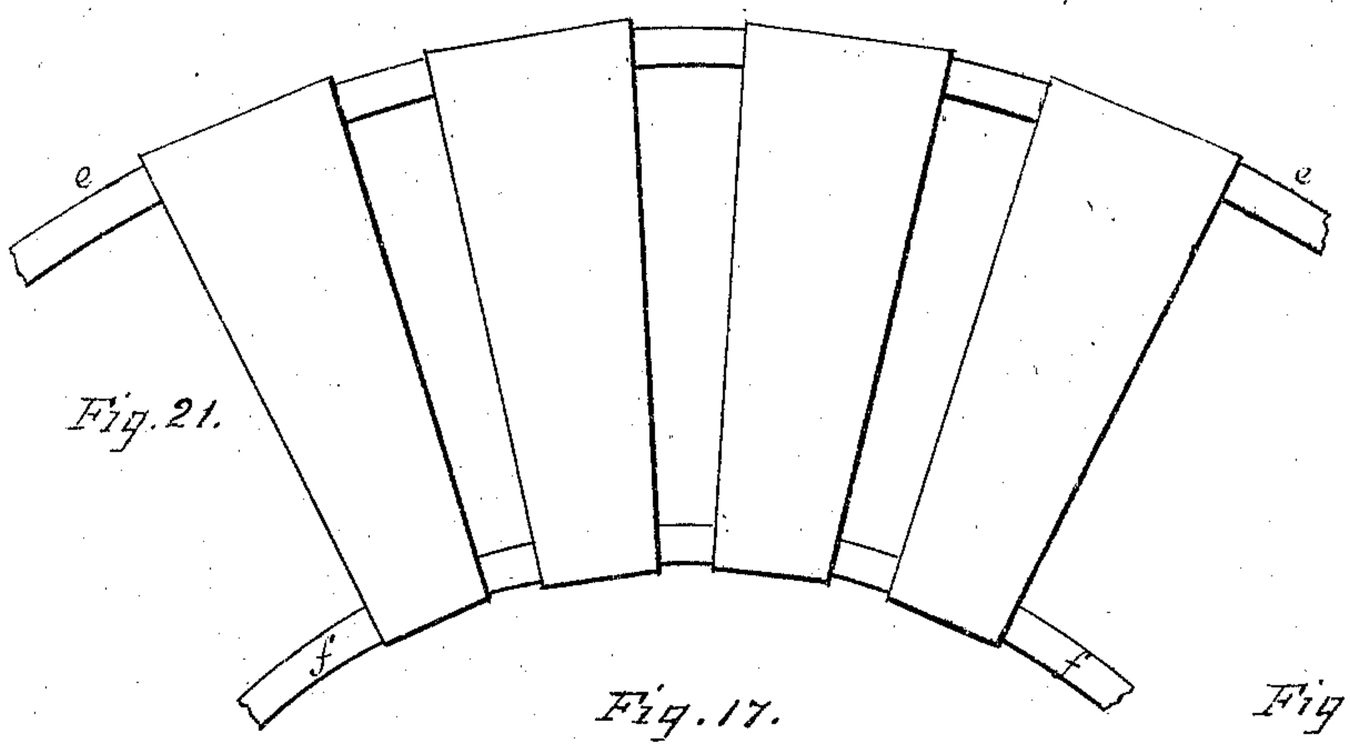
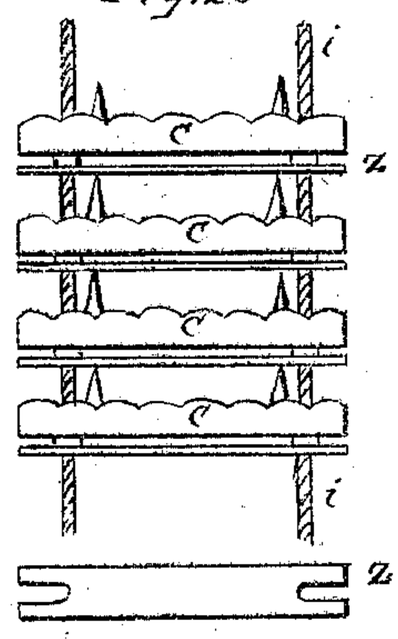


Fig. 21.

Fig. 17.

Fig. 23a



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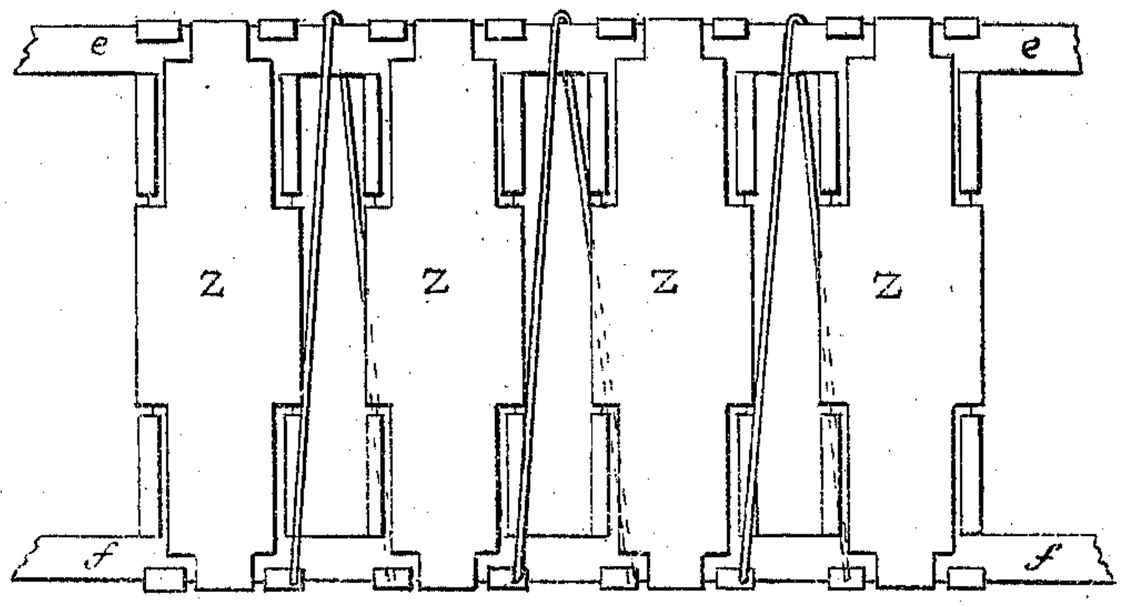


Fig. 22.

Fig. 23b

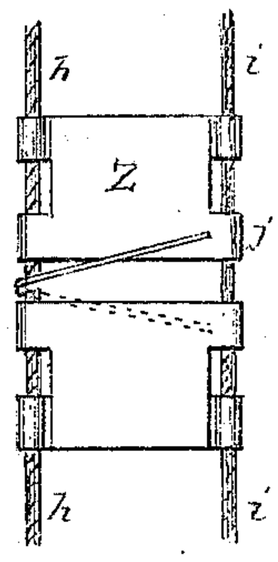
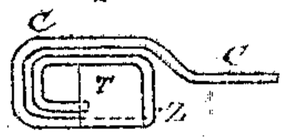


Fig. 50.

Fig. 49



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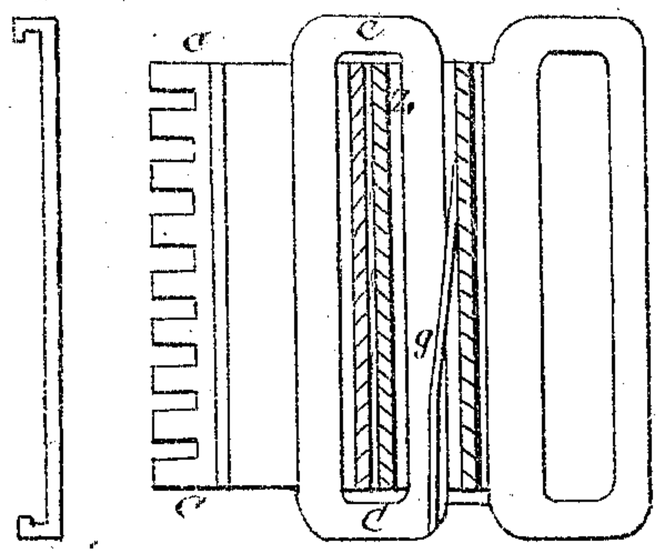

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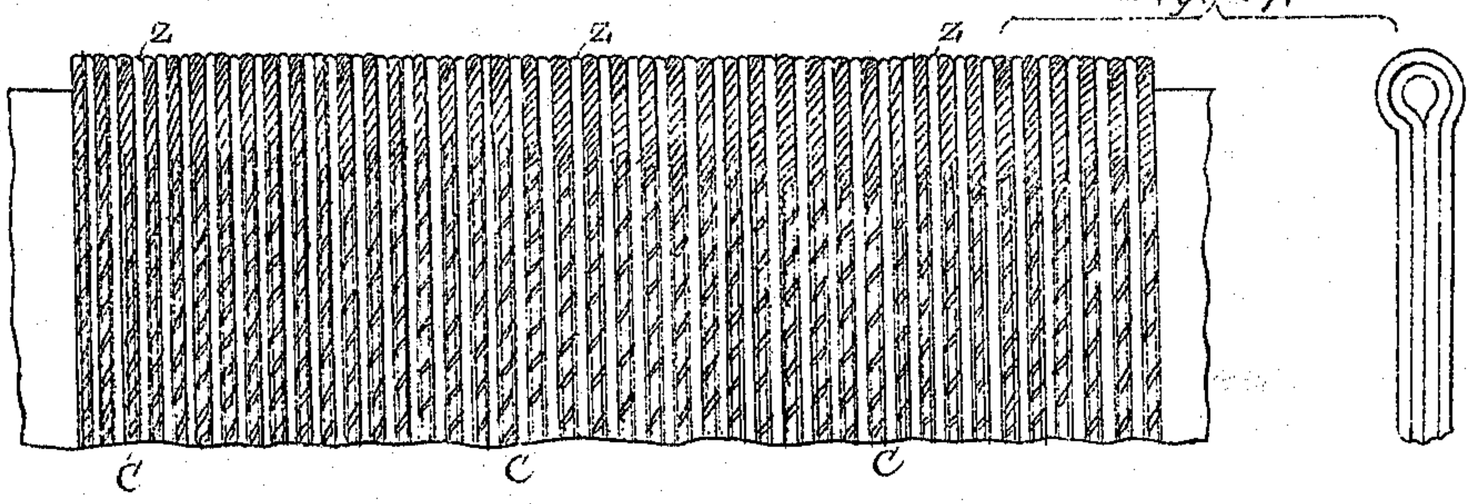
I. L. PULVERMACHER.

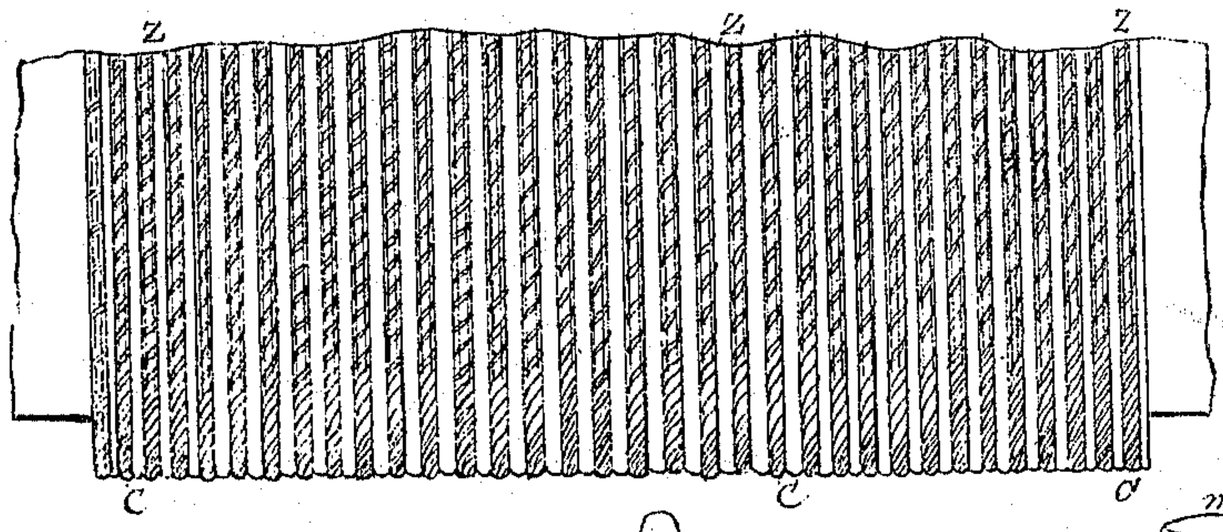
Improvement in Electro-Galvanic Chains, Bands, &c.

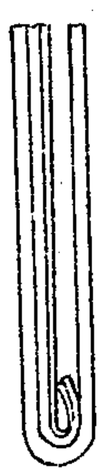
No. 120,772.

Patented Nov. 7, 1871.

Fig. 27.







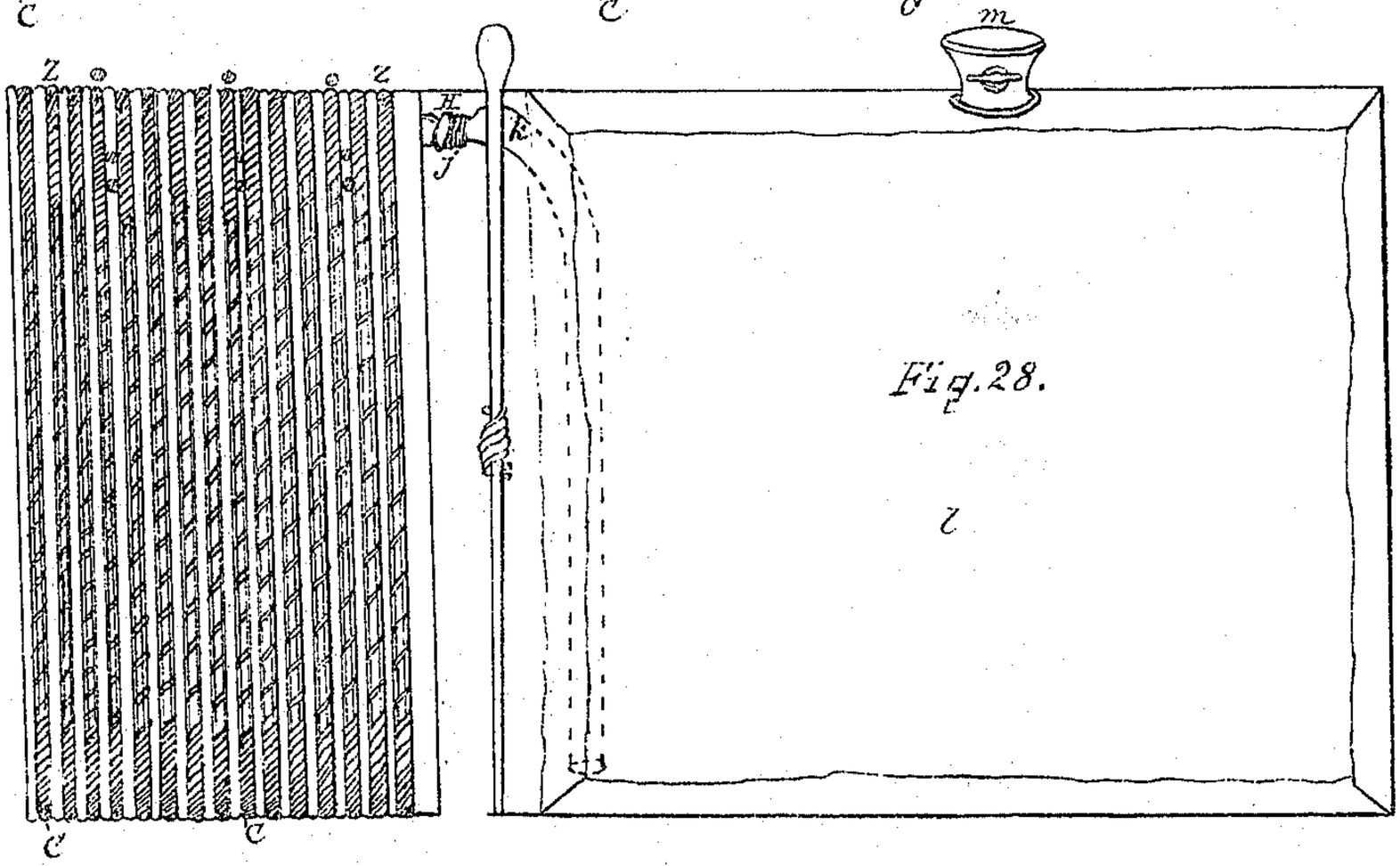
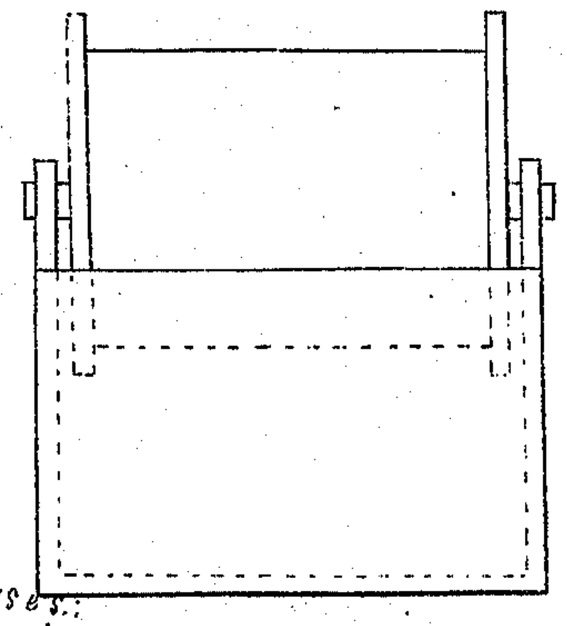
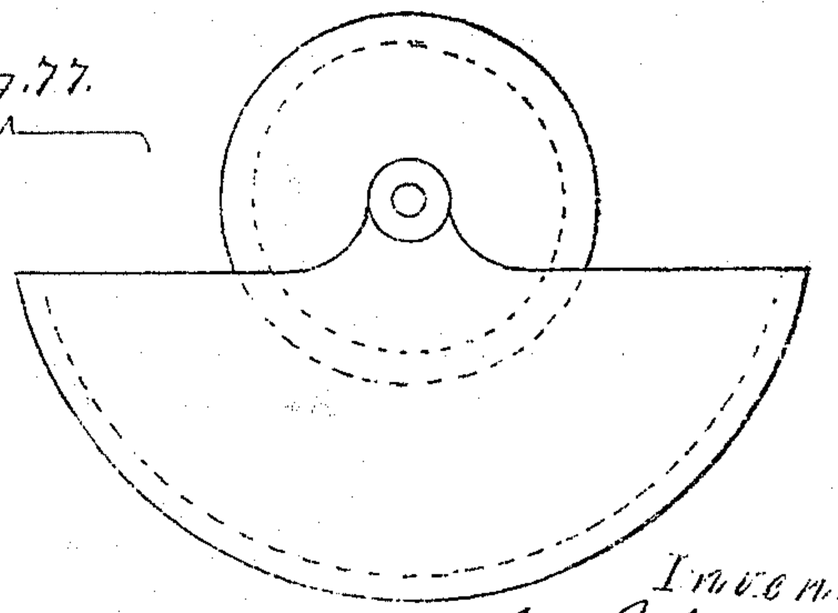


Fig. 28.

Fig. 77.





Witnesses:

A. C. Norris,

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Inventor:

I. L. Pulvermacher.

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9 Sheets--Sheet 5.

I. L. PULVERMACHER.

Improvement in Electro-Galvanic Chains, Bands, &c.

No. 120,772. Patented Nov. 7, 1871.

Fig 37 a

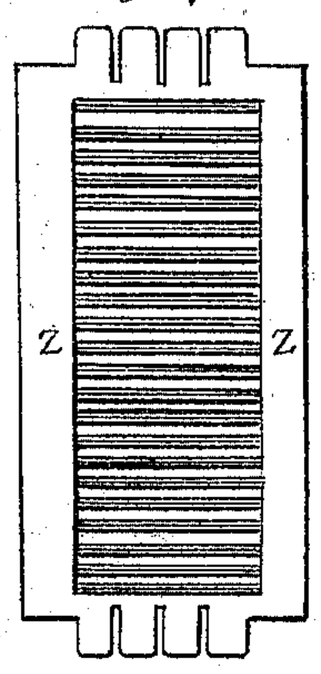


Fig 37.

Fig 32. Fig 33.

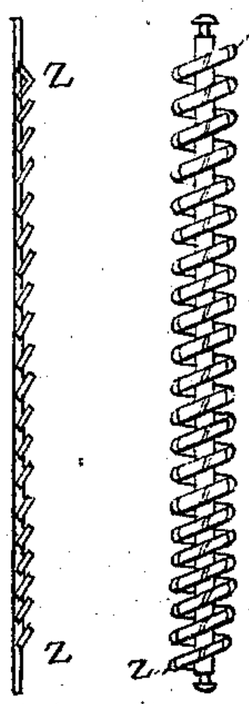


Fig 38.

Fig 38 a

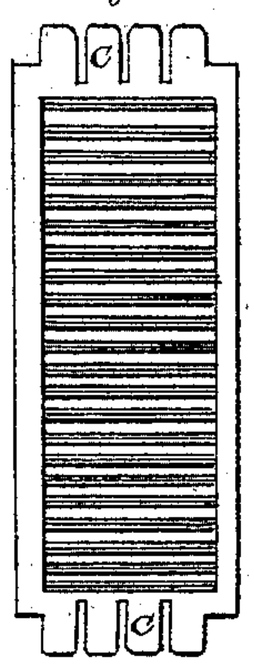
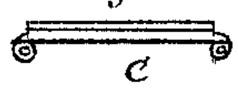


Fig 36.

Fig. 39.



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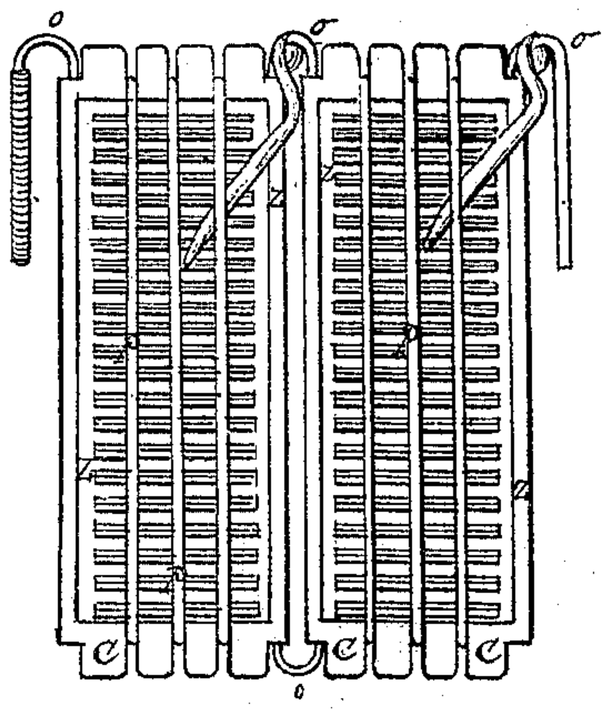

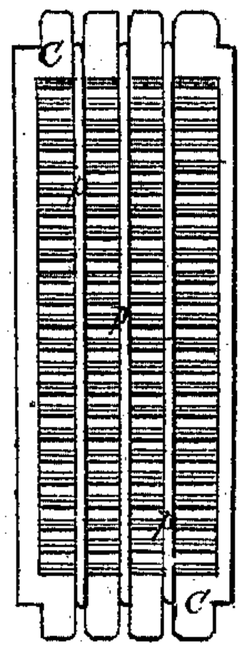

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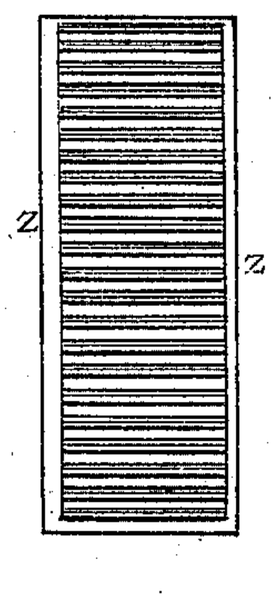

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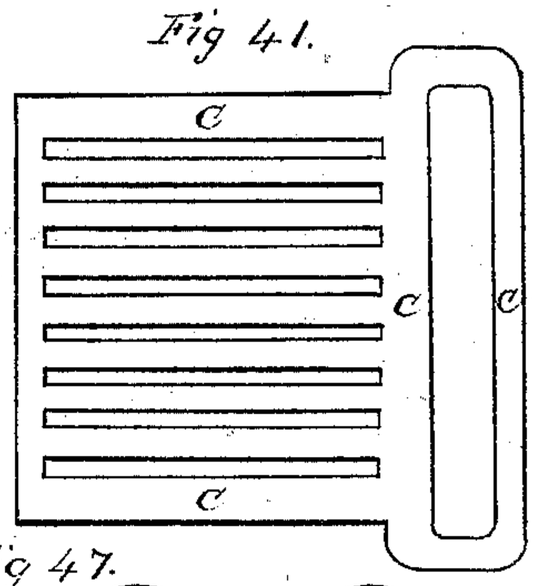
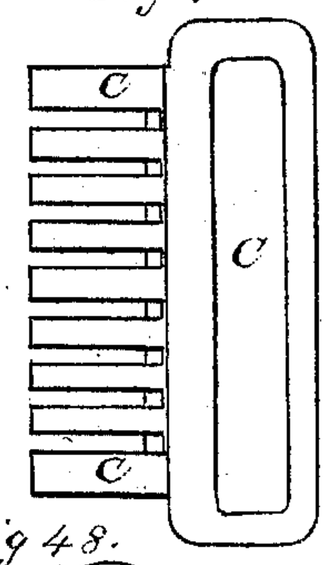


Fig 47.

Fig 42.



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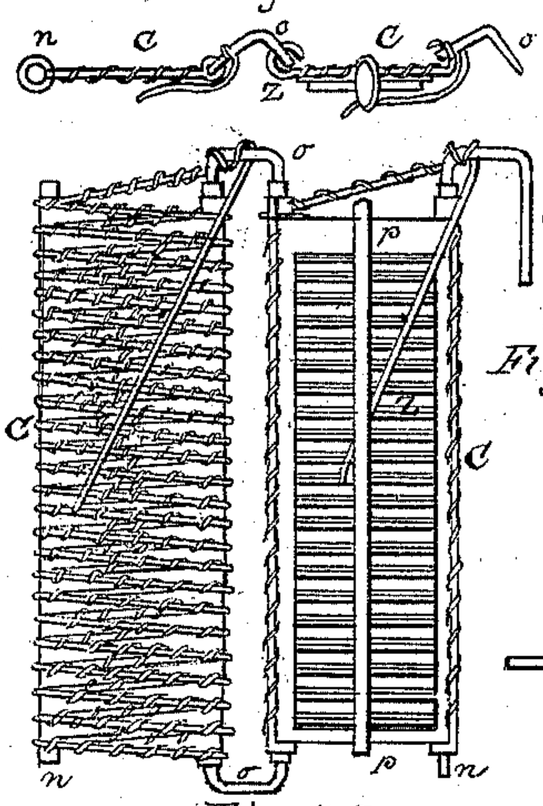

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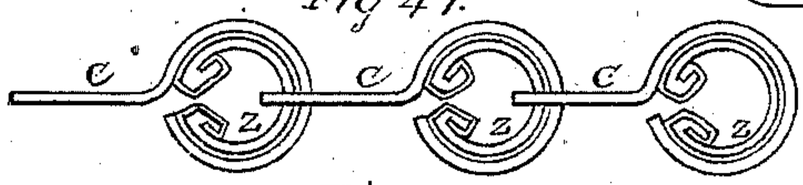

Fig 43.

Fig 44.

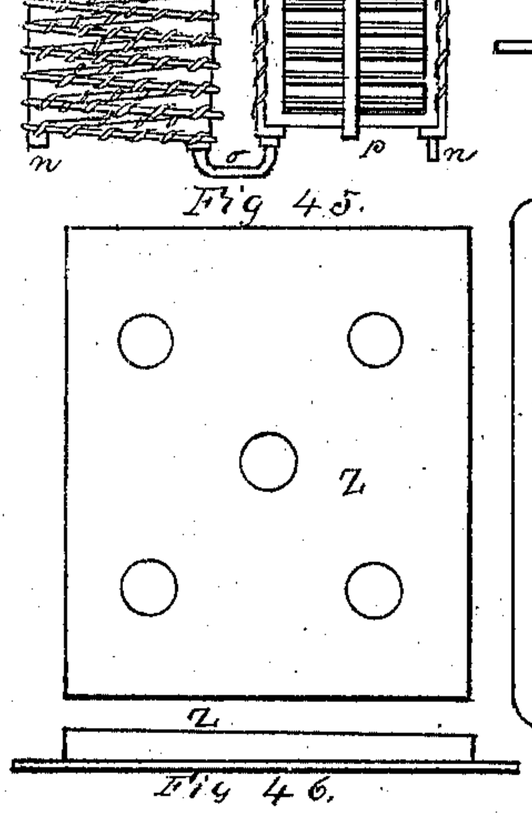

Fig 45.

Fig 46.

James L. Norris
W. H. Blodgett

S. L. Pulvermacher
By Burke, Fraser & Osgood.

(50.)

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I. L. PULVERMACHER.

Improvement in Electro-Galvanic Chains, Bands, &c.,

No. 120,772. Patented Nov. 7, 1871.

Fig. 52.

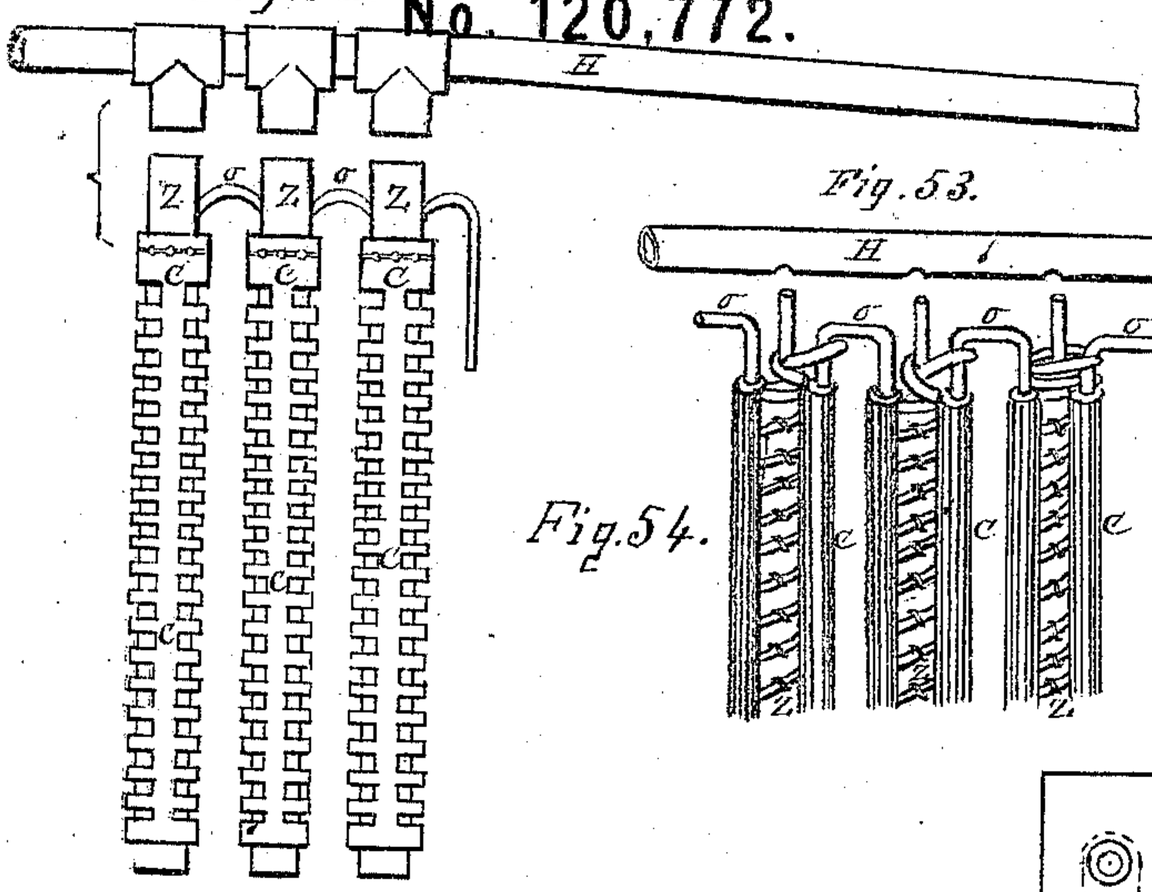
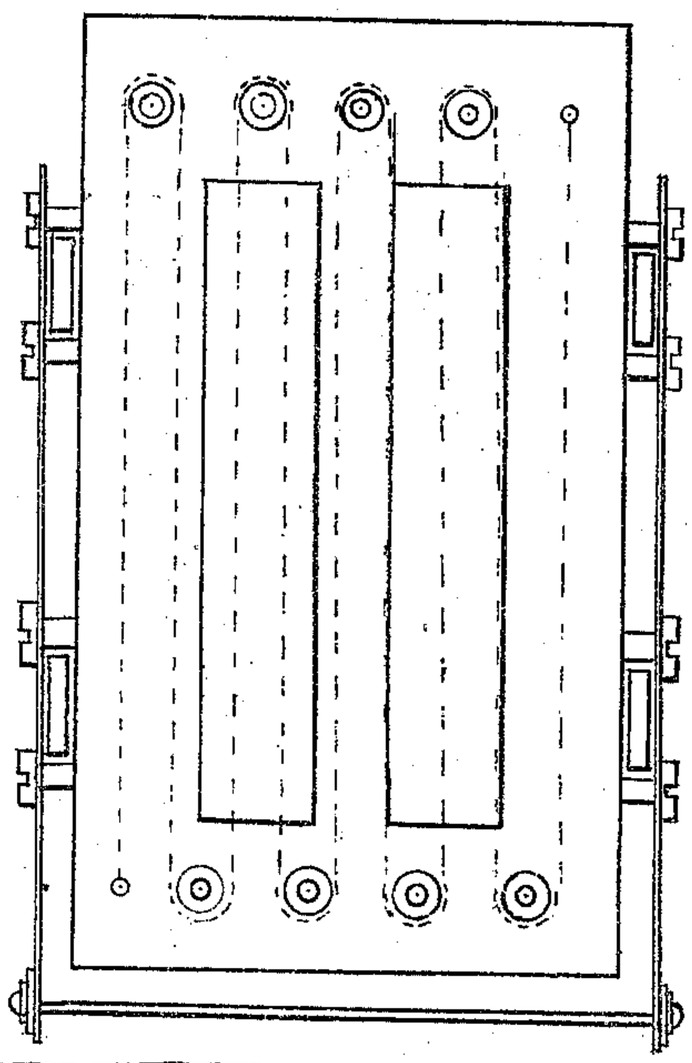


Fig. 53.

Fig. 54.

Fig. 81.



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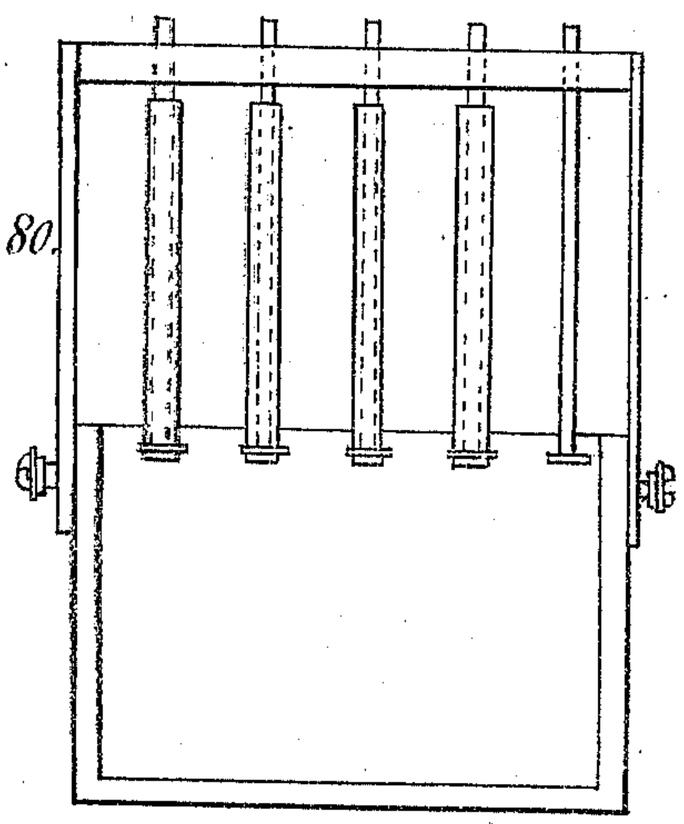

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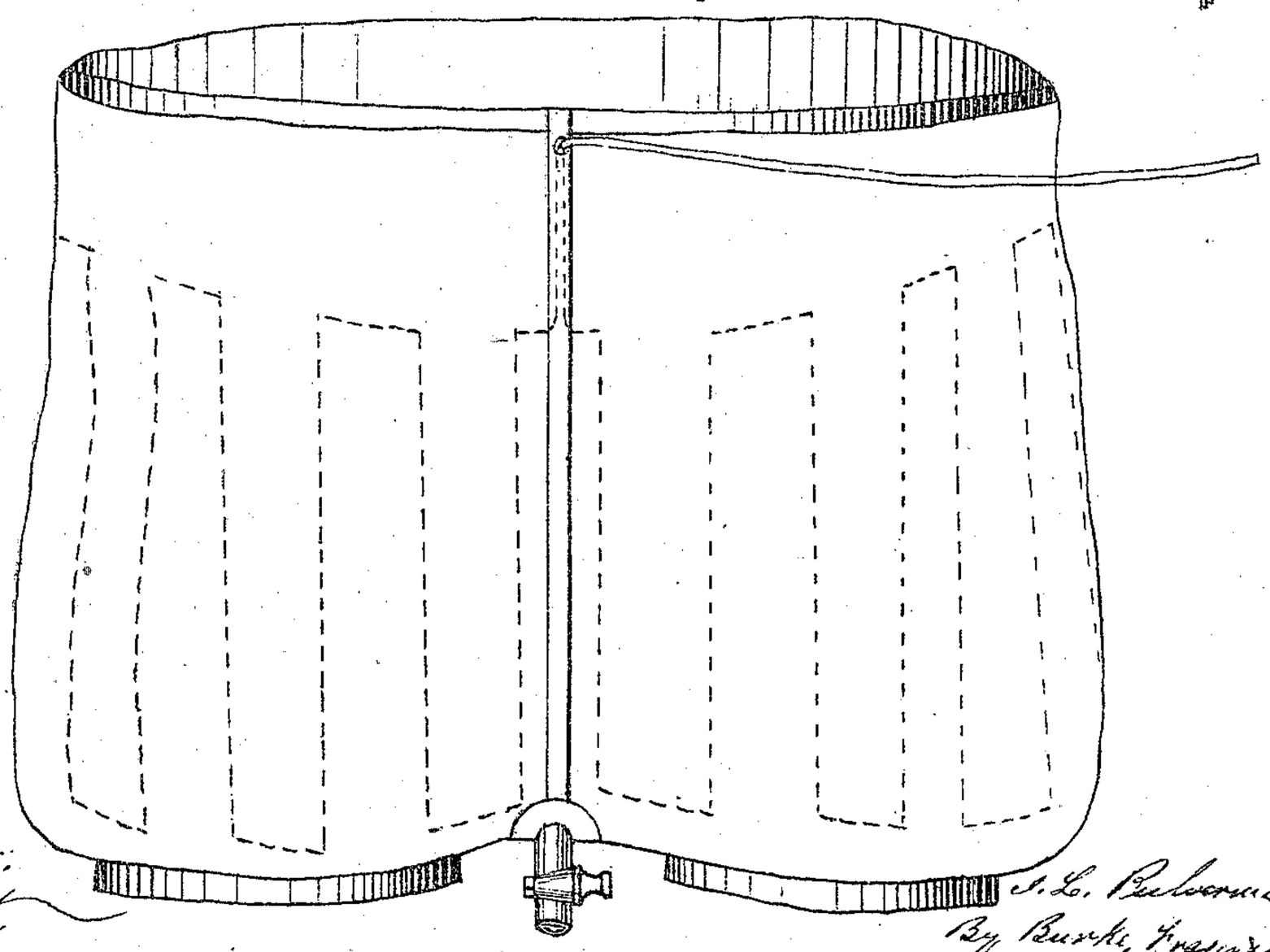

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W. H. Blodgett.

A. L. Pulvermacher
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Attys

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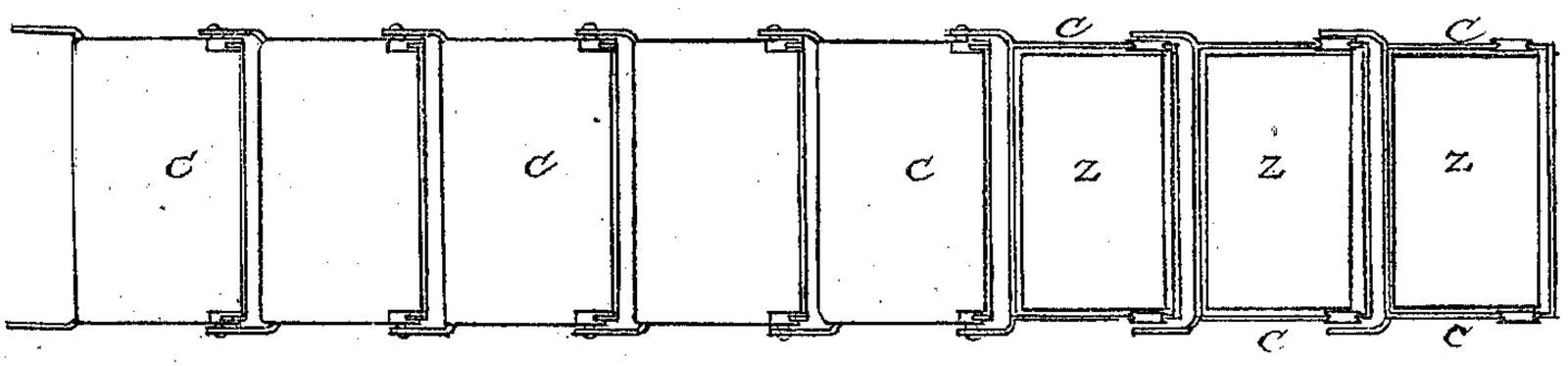
I. L. PULVERMACHER.

Improvement in Electro-Galvanic Chains, Bands, &c.

No. 120,772. Patented Nov. 7, 1871.

Fig. 70.



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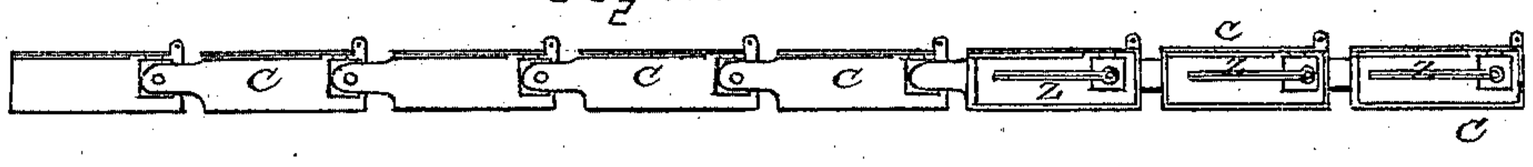

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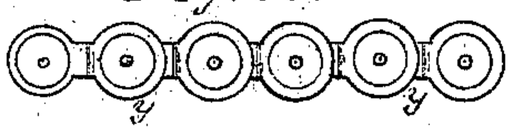


Fig. 72.

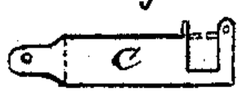
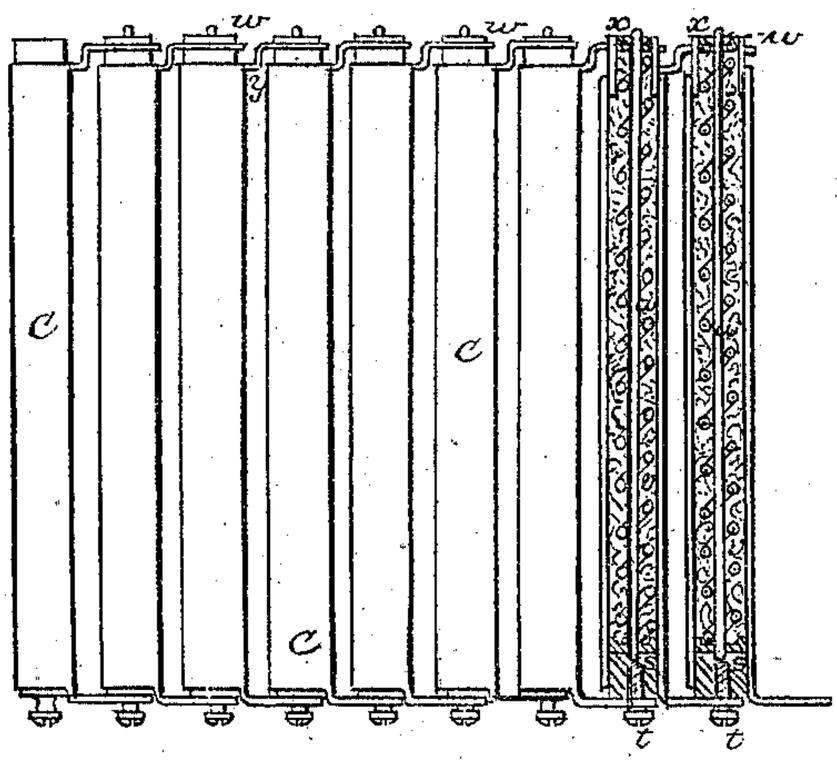


Fig. 56.

Fig. 57.



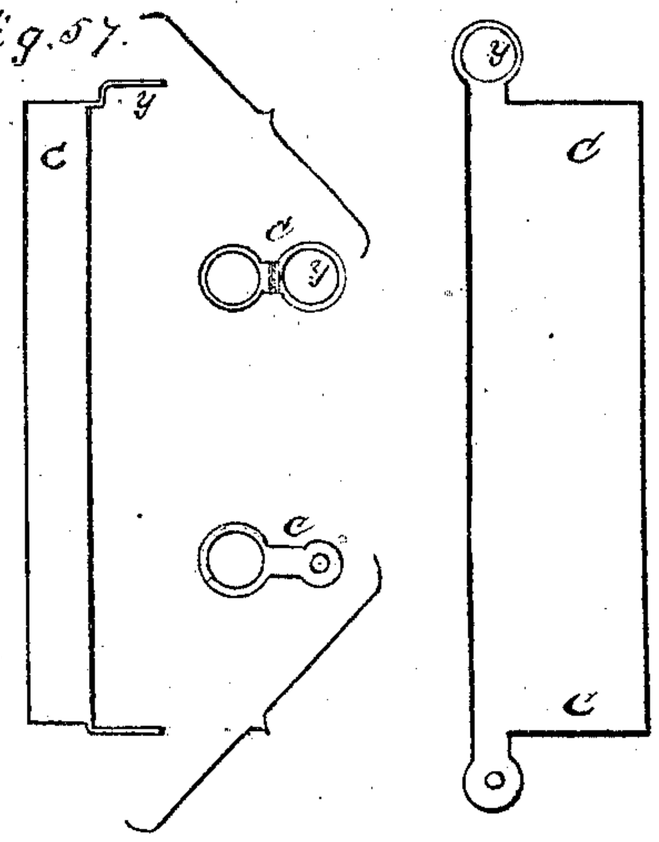


Fig. 61.

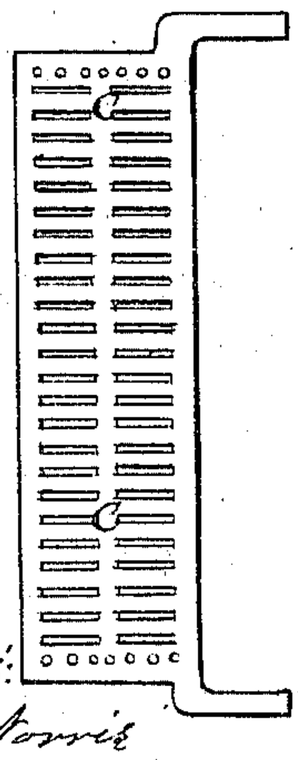


Fig. 62.

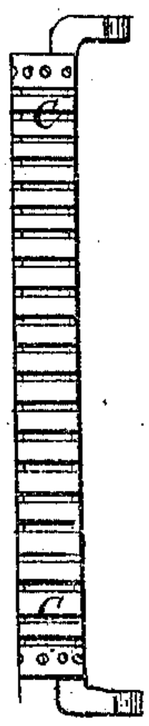
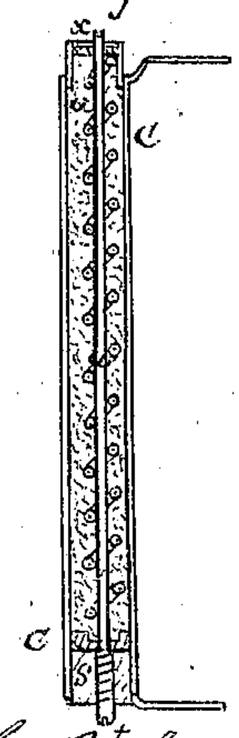


Fig. 58.



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(50.)

9 Sheets--Sheet 8.

I. L. PULVERMACHER.

Improvement in Electro-Galvanic Chains, Bands, &c.

No. 120,772.

Patented Nov. 7, 1871.

Fig. 24.

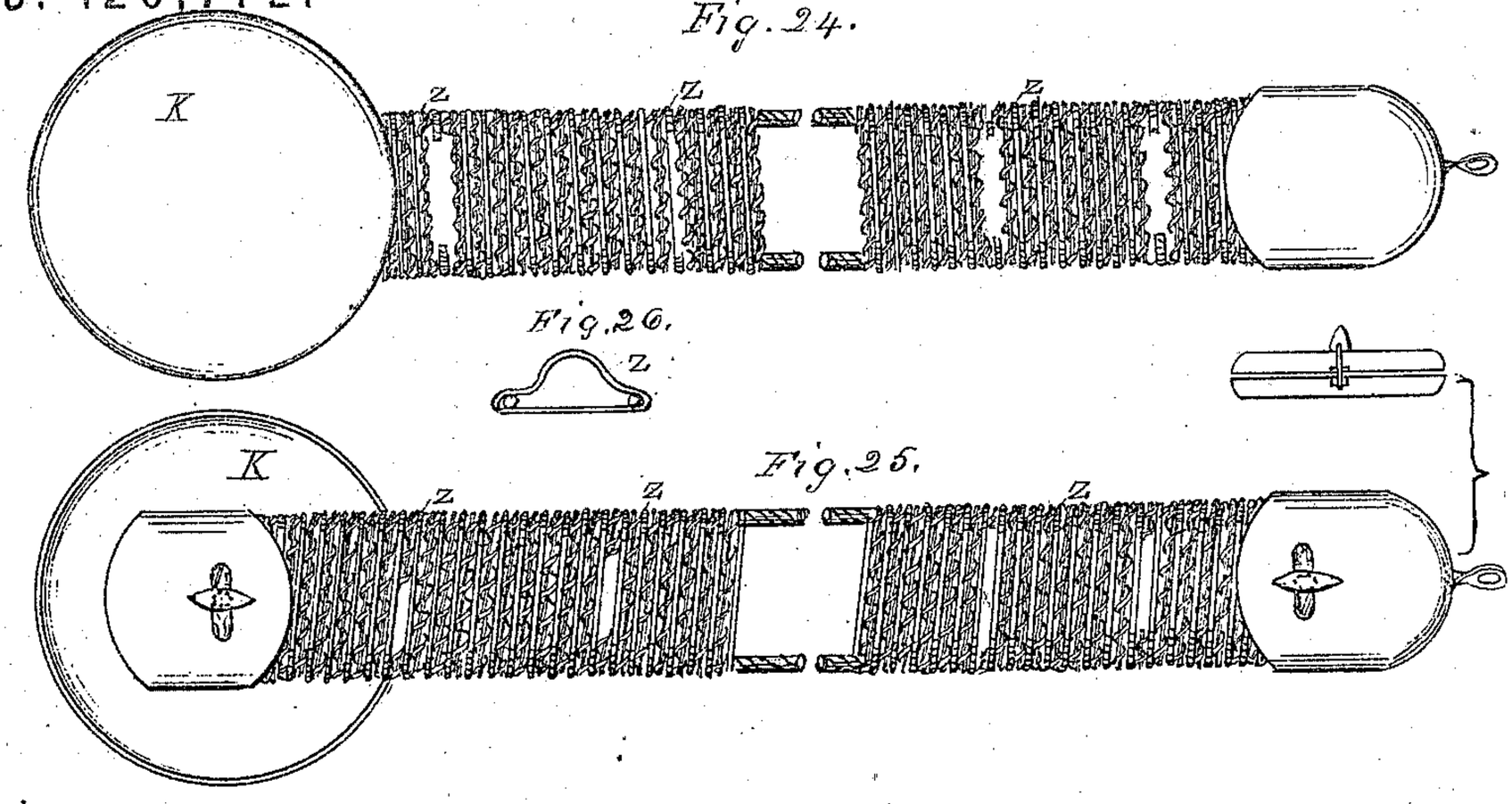


Fig. 26.

Fig. 25.

Fig. 73.

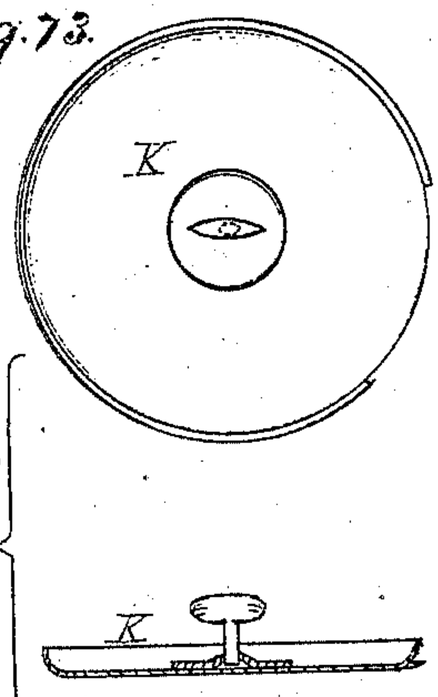


Fig. 74.

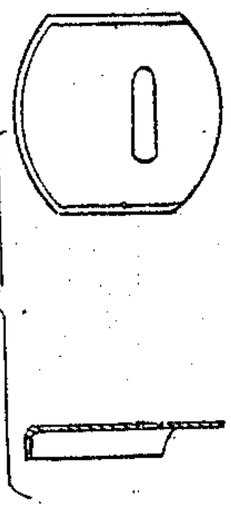


Fig. 75.

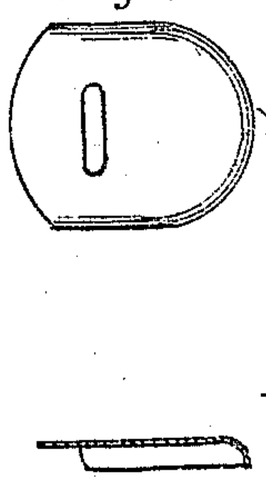


Fig. 76.

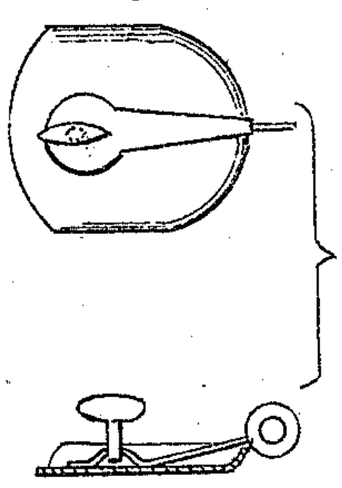


Fig. 60.

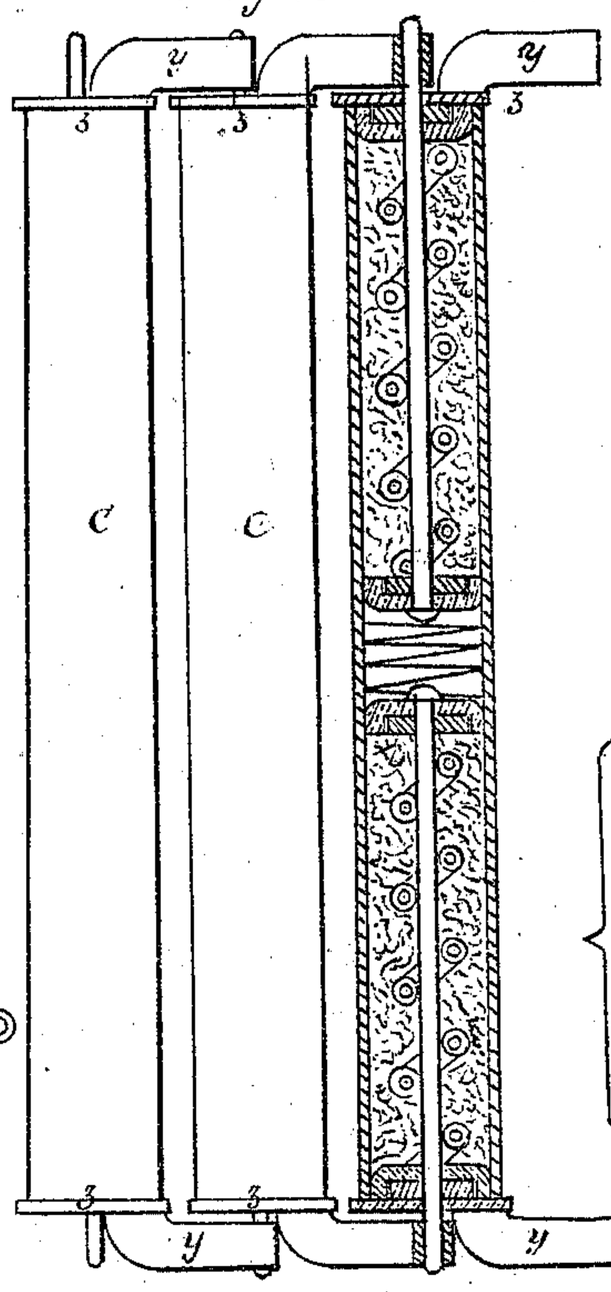


Fig. 63.

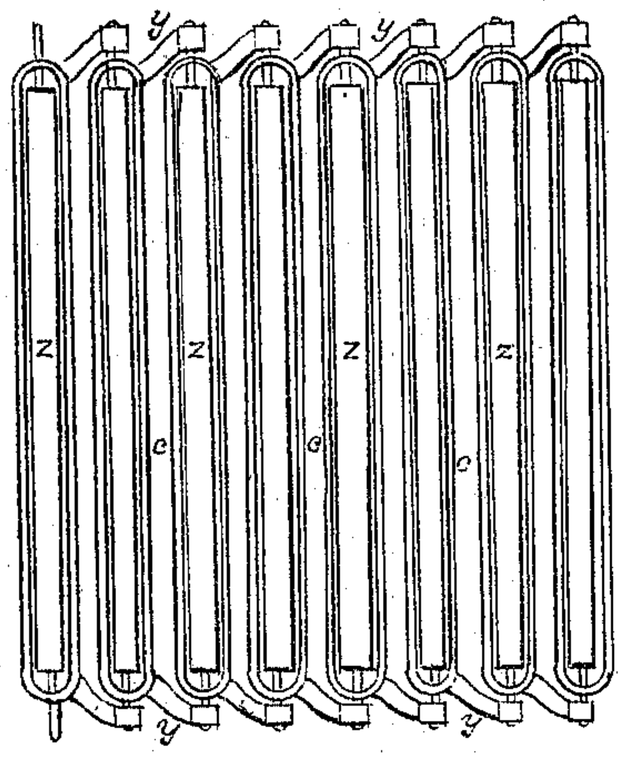


Fig. 59.

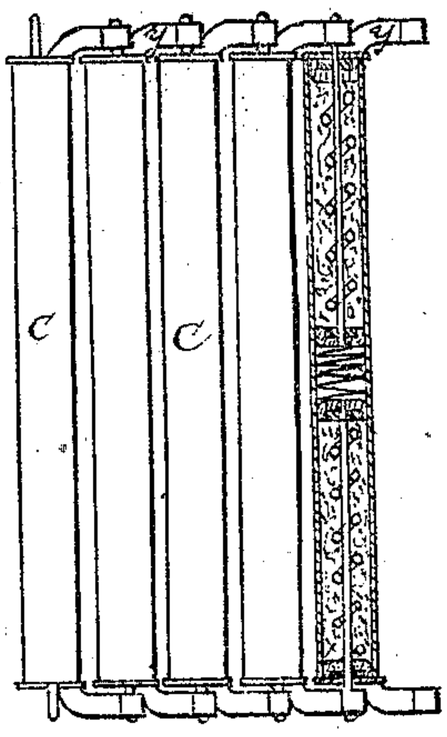
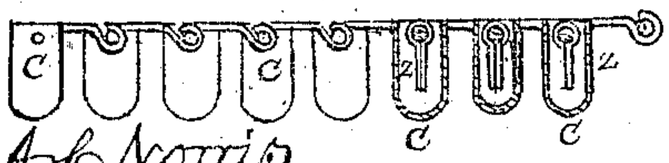
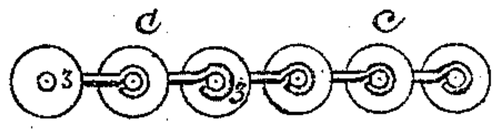


Fig. 64.





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9 Sheets--Sheet 9.

I. L. PULVERMACHER.

Improvement in Electro-Galvanic Chains, Bands, &c.

No. 120,772. Patented Nov. 7, 1871.

Fig. 78.

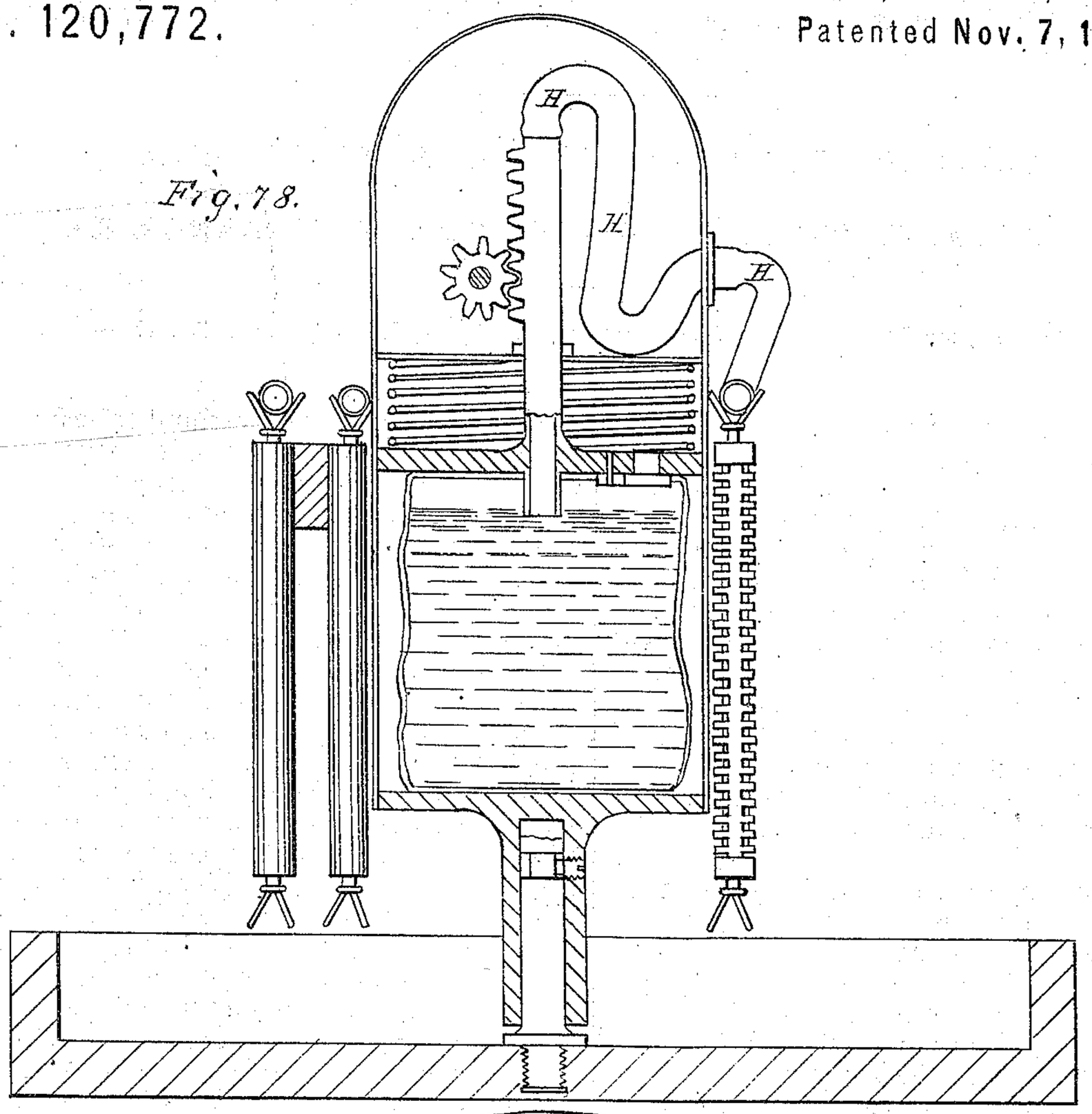
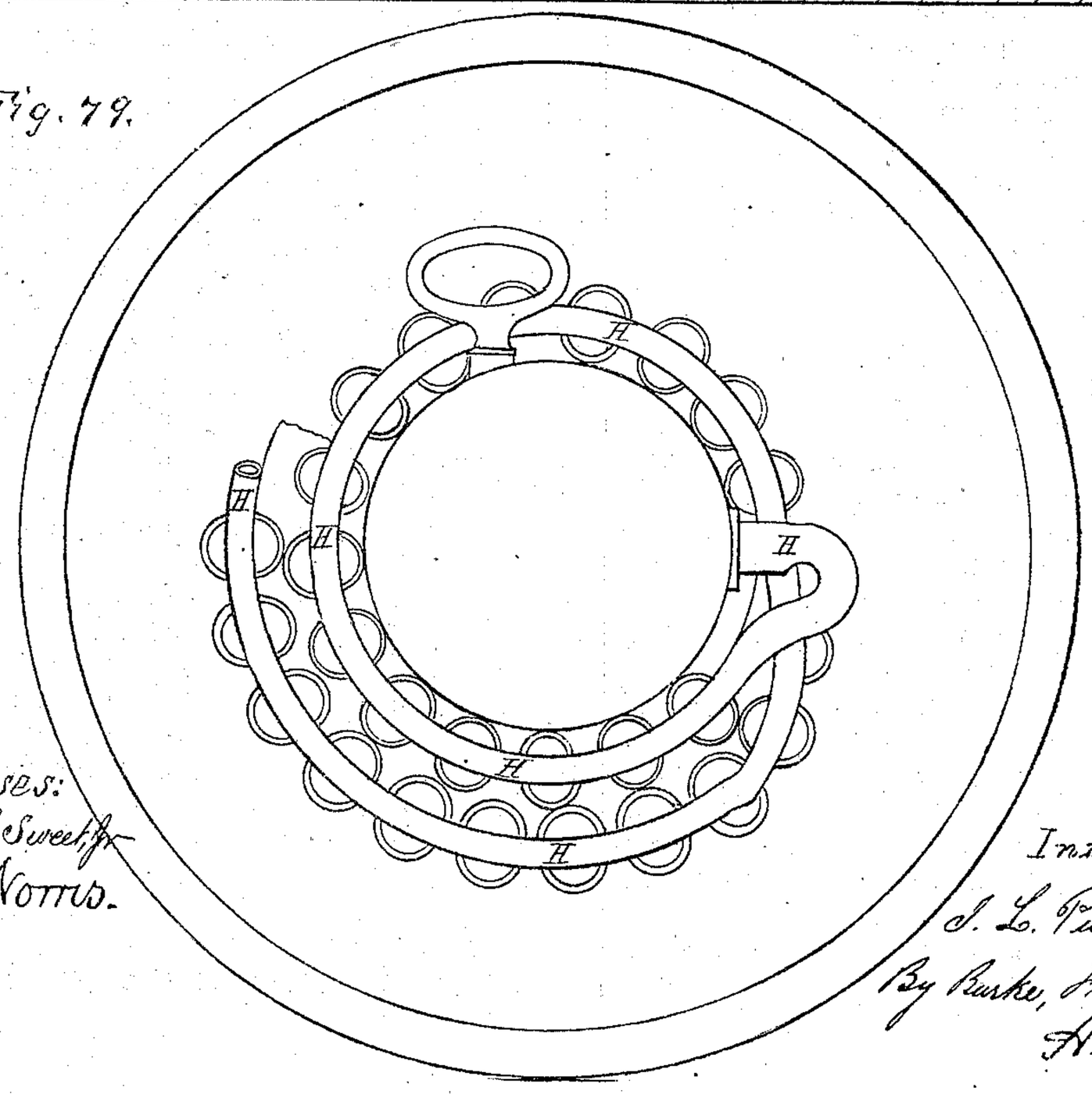


Fig. 79.



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By Burke, Fraser & Offord.
Attys.

120,772

UNITED STATES PATENT OFFICE.

ISAC LOUIS PULVERMACHER, OF LONDON, ENGLAND.

IMPROVEMENT IN ELECTRO-GALVANIC CHAINS, BANDS, &c.

Specification forming part of Letters Patent No. 120,772, dated November 7, 1871.

To all whom it may concern:

Be it known that I, ISAC LOUIS PULVERMACHER, of Regent street, London, England, electrician, have invented or discovered certain new and useful Improvements in the Construction of Electric, Galvanic, and Magnetic Chains, Bands, Pads, and Garments, and in means of applying such to the human body for treating diseases and complaints, and for other purposes; also in fasteners and electro-conductors in connection with such chains, bands, pads, and garments; and I do hereby declare that the following is a full, true, and exact description thereof, reference being had to the drawing hereunto annexed—that is to say:

The object of the first part of my present invention is to manufacture chains, bands, articles of dress, or wearing apparel with metal plates or pieces of metal so arranged that they can be used with a self-sustaining and permanent electrical or galvanic action, derived either from an exciting liquid or by the perspiration thrown off from the body of the wearer; and this I accomplish by sewing, looping, or otherwise securing the plates or pieces of metal upon a backing of porous or absorbent material, such material having a sticky substance—such as wax, diachylon, or "sparadrap"—on the exposed parts to enable the patient to fasten the article upon his body at the part affected, or, in lieu of the backing being covered with the sticky substance, the plates or the pieces of metal themselves may be coated over a portion of their surfaces with such substance. The plates or pieces of metal may be of any shape, perforated or not; or they may have pins or projections in or on them; or they may be formed of strips wound into flat spirals or helms, or of beads, eyelets, or tinsels. If spirals are used, they may be wound upon a core or secured to a backing after they are wound. In that case an independent core or lining, elastic or not, could be introduced into them, the filling-in materials or substances being of a porous or absorbent nature; or it may be a chemical salt of exciting or electro-depolarizing action; or the spirals may be left open and the exciting liquid applied to the backing in any convenient manner. The backing may also be formed of threads wound upon portions of the spirals to prevent false contacts, and these threads may form the means of combining the elements in voltaic arrangement without interfering with the flexibility and elasticity of the spirals. Beads or other pieces may be joined in sections by looping the opposite metals of the elements together; or the core or lining may be composed of a combination of elastic or non-elastic material, one of them forming the absorbent and the other the flexible and elastic portions of the article. In some cases the plates or pieces of metal forming the elements are to be soldered together either before or after they are stamped out or otherwise prepared. If this is done before stamping, I propose to solder the overlapping edges of long strips together to prevent waste of labor and material. In other cases the pins of one metal could be soldered to the pins of the other metal after they have been passed through the backing or the lining and bent down to touch, to fasten and establish regular voltaic contacts.

I have, in the accompanying drawing, shown several shapes of plates, strips, or pieces of metal, which are cut by dies, in a press or otherwise; but I do not restrict myself to those shapes, as the pieces may be cut to any pattern found desirable.

Figure 1 is a view of part of a band or belt with flat rectangular plates C Z, which can be secured upon or to a backing of water-proof or other material by the tongues or lips *a b* in the manner represented in Fig. 2—that is, by bending the tongues outward and then passing their points through the meshes of the fabric forming the backing, and afterward pressing them down upon the other side. The tongues are of such a length that when those of one plate—say the copper—are bent over toward those of the other plate—say zinc—they are brought into contact to complete the voltaic connection and to form a battery. These tongues, when in contact, are then soldered together to secure permanent contact and also to prevent them becoming disconnected.

In all the figures where copper and zinc, or other metal with corresponding properties, are referred to, they are, for the sake of clearness, indicated with C and Z.

Fig. 3 represents a series of plates, C Z, of a different shape, which are formed with tongues or lips in a similar manner to those above referred to, so that they can be fastened into the fabric. These plates are arranged in voltaic or-

der, so that the current can flow in a zigzag manner, the two poles being represented by P P^1. By folding these plates one above the other and placing a wet conductor between them the band can be used also as a pole-battery. There are additional tongues *c d* formed in these plates for directing the current into the proper direction, the tongues being bent over and fastened in a similar manner to those marked *a b*.

Fig. 4 is a view of a series of plates of different form and shape, in which the current flows in a zigzag manner. In lieu of using the additional tongues, as in the previous figures, I attach small lengths of coiled wire. The coils give a springy character to the belt or article to which they are attached without disconnecting one plate from the next, and also without interfering with the electrical action of the elements.

Fig. 5 represents a modification of the shape of the plates shown in Fig. 3, the difference being that these plates are made with a tongue at the corner of each of them, and these lay upon one another or overlap in voltaic order in elements or single batteries; but they may be connected to form a continuous band or pad by either of the above-mentioned methods, or in any other way found suitable.

Fig. 6 shows a series of plates, C Z, with the tongues also formed at the edges, but with the points not projecting beyond the edges. In this case the points are passed under loops formed either in the weaving of the fabric or by means of a sewing-machine after the fabric is made. These plates are cut from long strips of metal, two edges of which—say one of copper and one of zinc—are overlaid throughout their whole lengths and soldered together before the plates are stamped out or otherwise produced, the tongues or lips being made at the part where the plates are overlapped.

In the foregoing I have shown a few forms of plates and the modes of attaching them to the fabric or backing; but there are other ways of doing this, such as with separate pins or tongues which can be passed through holes in the plates as well as through the fabric. In speaking of the fabric I do not strictly mean by fabrics those which are woven, as a felted or a netted body is equally applicable, and this may be coated or impregnated with a solution of any acidulated liquid to assist the exciting action of the perspiration thrown off from the body. The parts of the fabric which are not covered by the plates may be coated with an adhesive substance, such as those before referred to, and which will adhere to the flesh of the human body with tenacity without interfering with the movements; or the plates themselves may be more or less coated with such substance to enlarge or reduce the surfaces which are intended for the electrical or galvanic action on the part affected.

In Fig. 7 I represent an article known as a chest protector. I propose to cover one face of this by metal beads or tinsels, which can be sewn on or otherwise attached, the beads being arranged in clusters, connected in a similar voltaic manner as the plates before mentioned.

Fig. 8 represents a portion of a band or belt in which the galvanic plates (positive and negative) are formed of long narrow plates or strips C Z bent into spirals, the metals forming one element being soldered, as before explained. In this arrangement the fabric (absorbent or not) is lodged in the coils and acts as a band for retaining the plates in place. This band or lining may be composed of or be connected with a porous material, to permit of the air passing through it. According to this figure the spirals are placed end to end; but one coil could be below the other, as shown in Fig. 9. This figure shows the spirals attached to a backing, to which the absorbent can be attached; or an absorbent could be passed into the folds of the spiral and secured in any suitable manner. The backing or the lining may, in some cases, be formed with recesses or channels for holding the absorbent material, such as a fibrous pulp or sponge, and this pulp or the sponge may be mixed or impregnated with a salt or a chemical compound possessing exciting and depolarizing properties; or the plates themselves may be bent or shaped into the form shown in Fig. 10, so that the absorbent can be prevented falling out or escaping should too much liquid be supplied by accident or otherwise. In this view I have shown all the copper plates C at the front or wearable side and the zinc plates Z at the back, and these are prevented from touching the copper plates except at the proper places by a fabric or sheet which acts as an insulator.

Fig. 11 is a transverse sectional view on the line *x x* of the series of the plates shown in Fig. 10, and Fig. 12 is a vertical section through the line *z z*. I have not indicated how these elements should be secured to the fabric; but they may be sewn, pinned, or otherwise fastened thereto, so that a faulty plate or a faulty element could be easily renewed should occasion require it.

The object of the second part of my invention is to make magnetic bands, belts, and articles to be worn or applied to the body in a similar manner and by similar means to those referred to in the first part, whereby a gentle self-sustaining magnetic action is kept up on the affected parts or throughout the whole body. I sew or otherwise secure thin plates, strips, or other pieces, bent or not, of magnetized steel, hardened, tempered, or annealed, in or to a fabric or web in sections, each section being composed of four, five, or more pieces in direct contact to form compound magnetic staves, horseshoes, or elements, and these may be connected to other similar elements in any convenient manner so as not to interfere with the movements of the wearer.

Figs. 13, 14, and 15 show separate forms or shapes of steel plates sewn on or to a backing. In Fig. 13 the plates are flat and bent plates, arranged alternately. The flat plates are pierced with holes which correspond with other holes pierced in the flanges of the bent plates, so that one sewing serves to fasten both of them in place.

In Fig. 14 each plate is bent and the sewing is through the holes of the flanges, which are covered by the overlap of the neighboring plate; thus a smoother surface is produced than in the previous figure.

In Fig. 15 the plates are all flat and cut like the letter **U**, but with the corners square, so that the whole of the surface is in contact. These, like the other plates, may be pinned, riveted, or eyeleted on or to the backing, in lieu of being sewn on.

I have only given these three examples of what I desire to claim in this part of my invention. I may, however, state that the plates may be wound into spiral or any other shape before they are fastened on the backing.

The object of the third part of my invention is to make self-sustaining bands, belts, and other articles of a combination of elements such as those described in the first and second parts before referred to, in order to produce combined electrical, galvanic, and magnetic action.

I have not shown in any figure how I attach a copper or zinc plate at one part of the articles and a steel plate at another for the purpose referred to, because that will be readily understood, and also because the plates would be of similar shapes to those already given or described.

The next part of my invention relates to chains, bands, pads, garments, or articles of dress which are to be secured on or to the body by tapes, cords, straps, or other fastenings, and which are to be supplied with an exciting liquid for the purpose of establishing a continuous electrical or galvanic action throughout the same for treating diseases and complaints, as before referred to. I have in the following figures shown several examples of these.

Fig. 17 is a view of a few plates of copper and zinc, forming elements which are articulated or joined by tapes *e f* passed through the overlaps of the copper plates, the plates being pinched thereon to prevent their shifting. I prefer to make the plates with projections or lips, as in Figs 18 and 19, which can be turned over to hold a tissue or strip of fiber absorbent in place, the impregnating of which may take place through the interstices round the edges, or through perforations or slits shown in the copper plates in Fig. 20. The voltaic arrangement is maintained by bent wires *g* soldered to one plate of one element and to the opposite plate of the next element.

Fig. 21 represents a portion of a circular band or patch battery, which can be arranged on the afflicted part by being bound therein by a handkerchief or a roll of bandage, the plates being fitted at their ends to tapes in a similar manner to the chain first explained. This circular or patch battery may be of any dimensions, and may be formed of concentric rings or washer-like plates, as shown in Fig. 22. In this figure the ring or washer-plates are sewn onto a backing, but they may be pinned to it if found desirable.

Fig. 23 represents a portion of a flat-plate battery, the plates of which are suspended or held by cords *h i* in a similar manner to the plates shown in Figs. 17 and 20. In Fig. 17 it will be seen that all the copper plates are brought to the front, while in Fig. 20 they are alternate.

Fig. 23[a] represents another mode of stringing the plates for localizing the currents, that, by so making the copper plates with tongues which are bent at right angles to distance the elements by the points of the tongues bearing upon the zinc plates of the element next them, by which voltaic contacts are established. I prefer that the copper plate should be formed with the tongues in the central line of the strings or rods, as shown in Fig. 23[b], and that the cords or the rigid bars, as the case may be, may be passed through the holes provided for them, the zinc plate being insulated from the copper by small washers and with the ends slotted.

Figs. 24 and 25 are front and back views of a band in which the elements are formed of narrow thin lengths of copper and zinc, one of which is insulated from the other by a cord or thread wound in distance spirally upon it before the strips themselves are laid in position to be wound into plates or elements. The edge cords maintain the elements at their respective distance apart, and the voltaic arrangement is obtained by securing the ends of the one metal strip to the opposite metal strip of the next element by soldering. By this means a perfectly flexible band is produced which can be bent to set upon any part of the body or be wound upon the leg or arm, as desired. In some cases I fit a strip of absorbent material the full length of the band inside the elements, so that when dipped into the exciting liquid the whole of the elements become moistened. In others I make a bulge or raised part at the back of the band to hold a perforated tube, through which a liquid can be forced for the purpose of charging the absorbent. This will be understood by referring to Fig. 26, where the channel is formed in the center, and by Fig. 27, where it is formed at the edge; the only other difference between these two last sets of figures being that in one the elements are upon cords, while in the other the elements are upon a flat sheet or web.

Fig. 28 shows the end of the belt, with a reservoir fitted to one end of it, so that the charging can take place at the will of the wearer by removing the clip *j* from the pipe *k* and compressing the bag or reservoir *l*. The top of the reservoir has a filling-mouth, *m*, fitted with a stop-cock.

Fig. 29 represents a single element composed of thin metallic strips, copper and zinc, wound in a spiral manner upon two rigid rods or tubes, *n n*, upon which the coils are pinched to hold the rods or tubes in place. The spirals in this case are not so closely brought together as in the former case. I prefer to use tubes at the sides instead of rods, because they enable me to pass staple-shaped pins *o* into the ends of them and form the connection between one element and another, and thus to make up a band of any length without using a backing or a lining of any kind,

as will be understood by referring to Fig. 30, in which two spirally-wound elements or plates are shown.

I have shown the zinc plate in this figure with slots or openings, which openings are formed by slitting the plate in three lines and then bending the tongues or flaps outward, as seen in Fig. 32, to find a lodgment in the folds or interstices of the coils. The staple-pins, being fitted in the tubes, serve for hinge-joints, as seen in Fig. 31, upon which the band accommodates itself to the form or shape of the part of the body to which it may be applied. The absorbent medium is the same in this case as in the previous one.

If rods are used as side pieces of the plates or elements they can be formed with annular notches near their ends, as seen in Fig. 33, into which perforated end pieces may be forced; or pieces of conductible wire or a narrow strip may be twisted into the notches.

As a modification of the foregoing, I can, if desirable, twist each of the narrow strips forming the elements into elliptical shape and of different diameters or sizes, as seen in Figs. 34 and 35, so that the smaller—say the zinc strip—can be forced into the larger one—the copper—when its coils will find a lodgment in the coils of the other or outer strip, and these may be held firmly in contact by the connecting-pins or wires *o*, shown in Fig. 35. The wire in this case is so shaped that one end, which is looped, takes over the other, which is crooked, to receive it. I have, in reference to Figs. 30, 31, and 32, mentioned that one of the plates—the zinc one—is made open-worked, so that the tongues could fix themselves in the folds of the spirals; but I do not in all cases confine myself to this method when open-worked plates are employed, because, by making both plates of each element with tongues or flaps and turning them upside down, the tongues of one plate will lodge in the apertures of the other plate. These plates can be held in contact by an India-rubber band, *p*, stretched over them, and the pressure which it exerts upon the absorbent material placed between the plates can be regulated to the greatest nicety thereby. This will be clearly understood by Fig. 36, which is a sectional view of two plates so cut and attached to form a complete element. The two plates need not be of the same size, but of different sizes, such as I have shown in Figs. 37 and 38, and in that case the top and bottom edges of one of the plates can be notched to receive the required number of rubber bands or rings *p*, as found requisite.

In order to establish the connection between the elements I sometimes make the side edges of one of the plates a little wider, as seen in Fig. 37[a], so that the extra portions can be turned round into a tubular form, as shown in Figs. 38[a] and 39, when the staple-pins before referred to can be used. (See Fig. 40.)

It will be inferred from the foregoing description that my plates forming the elements can be bent into a variety of shapes to suit the taste and also to meet the requirements of the medical practitioner, and as these shapes do not in any way interfere with nor cause me to depart from my invention, whether they relate to the first or the second part thereof, I only give a few of such shapes, reserving to myself the right to make them in any other that may occur in the practical working out of the same. For some cases the plates forming the elements could be bent in a circular or tubular shape, such as I have shown in some of the following figures, and these or the copper plates alone may be made with separate slots, so that the reduced portions of the neighboring plates can be passed into them to form a connection. One example of this is represented in Fig. 41, where a flat copper plate has the slots formed by the removal of the metal at certain parts of it, so that a portion can be bent round, as shown in Fig. 42, upon a mandrel or tool, after which the core or plate of opposite metal, which has been similarly bent, has to be pushed within it. The meeting edges of the two plates are then to be sprung open to pass them over the broadest portion of the copper plate of the next element, as shown in Fig. 43, and in this manner the band is made up of any length. The two plates are prevented touching by the sheet or film of absorbent material with which the zinc is first coated; or, in lieu of that, the copper plate may have holes in its top and bottom edges for a thread to be laced into, as shown in Fig. 42. It does not follow that the zinc plate should be slotted in a similar manner as the copper plate, as it may be perforated with holes, as shown in Fig. 45, and the tissue may be of larger size than it is itself, so that it can extend beyond the edges, as shown in Fig. 46. A top view of a series of these elements or links is represented in Fig. 47 in a finished state, while Fig. 48 only shows the copper plates of two neighboring elements. Various methods can be adopted to retain the core within the bends, and perhaps the most simple mode is that represented in Fig. 49—that is, by forming lips *r* on the top and bottom edges of the copper plates, which can be turned down to cover or partly cover the core; and these lips *r* may be prevented touching the core to prevent false contacts by resting upon the ends of pieces of non-conducting material of the shape shown in Fig. 50, one of which must be inserted into the bend of each element. In order to establish the voltaic arrangement I attach a piece of wire by solder to the zinc of one element and the copper of the next in the manner shown in Fig. 51. This permits of the band being folded or rolled up, and preserves the contact permanently.

In other cases, when I make the copper and zinc plates or elements of tubular form, I insert a plug or core of bi-oxide of manganese mixed with graphite and bisulphate of potassium, or a chemical compound which has a depolarizing influence, for the purpose of maintaining a permanent action upon the metals, and these plugs or cores, in a compressed state or not, can be of greater lengths than the plates, so that when used up they can be easily withdrawn and fresh ones in-

serted. This, however, is not material, because if they are shorter than the plates they can be readily pushed in or out. If they are longer they afford a means of charging by fitting caps thereon, which caps are in connection with a tube, H, through which a liquid can be forced by a pump or syringe. This will be understood by reference to Fig. 52, the tube of which has perforations, as seen in Fig. 53.

I do not confine myself to making the plugs or cores of a bi-oxide of manganese or any chemical compound, as it may be a solid plug or core of zinc, or a hollow one into which a charging-tube can be inserted, as shown in Fig. 54. If the bi-oxide of manganese or other depolarizing chemical body is not compressed into shape the plates, both copper and zinc, can be used without perforations or slots, and the chemical body can be prevented falling out by stoppers inserted into the ends of the tubular elements, and in that case the interstice left at the meeting edge or edges would be sufficient for the liquid to find its way to the interior to moisten the body or mixture.

Fig. 55 represents a number of elements of a plain character, in which the chemical body or compound inserted can be retained by stoppers *s*, which may be tapped for a threaded pin, *t*, to be screwed down upon a central wire, *u*, to push it through the other end sufficiently to give a finger-hold to withdraw it by. In this withdrawal the cup-leather *v* cleans the copper completely out and takes the zinc, which is wound spirally round it, at the same time. When the fresh quantity of chemical agent and zinc is put in the screw-pin *t* is turned partly back and the central wire *u* caused to bear upon it to form a conducting medium from the zinc to that end of the next element. The other end of the copper plate has a metal tube, *w*, insulated from the copper pushed into it, and this is in contact with the zinc in the inside of the cylinder. There is a washer or disk, *x*, for retaining the depolarizing chemical compound in place. The eye or perforated piece *y* of the cylinder passes over the insulated tube *w*. It will be seen by the detached view, Fig. 56, that the lips in which the eyes are made are stamped out with the plate and are bent in a proper manner after the tubular part is shaped, the eyes being of different sizes, as in Fig. 57, one to suit the tube *w* and the other the screw-pin *t*, the head of which limits the movements of the lips and prevents false contacts. The lip at the screw-pin end is prevented touching its neighboring copper plate by the projecting portion of the stopper *s*. It is not essential that the screw-pin should have a head, as when it and the central wire are made from one piece of metal a nick can be made at each end, as shown in Fig. 58.

Sometimes two zinc wires can be used in each copper tubular plate in the manner represented in Fig. 59, and then they are provided with a cupped leather at each end, as more clearly seen in Fig. 60. The outer leathers of each wire are here covered by a non-conducting disk, *z*, to prevent the lip of the adjoining copper plate making false contacts, the disk *z* being rather larger in diameter than the copper plates for the purpose. In these last two figures the lips are bent round to form eyes or loops, in lieu of being perforated, as previously spoken of. I propose to fit a coiled piece of springy insulated metal between the two inner leathers to force them apart, and thus keep the outer ends of the central wires outside the disks *z* for connecting purposes; and when the salt or chemical core requires renewing it can be done by simply pushing the central wires in to detach it from the lip, which can then be moved to one side to enable the faulty core to be withdrawn and a fresh one inserted, when, by overcoming the tension of the spring, the connection can be remade.

Plates made with the last form of lips can be perforated or slotted, as seen in Figs. 61 and 62, as well as those with the previous ones.

Figs. 63 and 64 represent the copper plates stamped into trough form, so that the zinz plate can be inserted and held therein by a wire which is passed through insulated holes at the ends of the troughs, the wires projecting to engage into the lips of the next copper plate of the adjoining element. I prefer to pinch the zinc plates in close contact with the central wires, so as to retain them in position and to prevent false electrical contacts occurring. The copper troughs may be of any dimensions, and can be pressed to any depth, so that a band, chain, or other battery can be constructed of great intensity of action in a comparatively small size; and these, if held in a frame in a rigid manner, will be found suitable for sending currents along wires if attached to an ordinary telegraphic sending instrument.

In the trough battery shown in Figs. 65 and 66 I propose only to bend the lips outward, and to form two of them from one side, so that they may both touch the zinc plate of the adjoining elements, the lips being slightly recessed, as shown in the detached view, Fig. 67, to hold the zinc plate firmly. The other side of the troughs have their lips entirely removed, and the slots or notches are somewhat larger than the slots or notches on the lip sides, for the purpose of permitting the lips of the next copper plates to pass in without touching. I maintain the rigidity of the battery by bars of ebonite or other hard non-conducting substance, A, which are forced into the slots, and these are prevented falling out or even shifting their position accidentally by the points B B taking over them, as shown in the side views, Figs. 68 and 69.

Another form of bending or stamping the copper plates into is the box shape—that is, with four raised sides or edges—into which the zinc plates can be fitted, and access of exciting liquid can be obtained through the crevices or perforations either at the bottom, at the sides, or at the top; or, if the depolarizing salts or chemical compound be used, the lids can be opened, when both sides of the zinc plate can be got at.

In Figs. 70 and 71 I have shown a few elements in voltaic arrangement through lips which are perforated to receive the wires in a similar

manner to those described, these wires being insulated from the copper of its own element by small buttons or filling-in pieces of ebonite L, which are forced into the apertures in the side walls of the box and then retained by the projections B, Fig. 72, which are pressed down upon them, and thus a chain in regular voltaic contact is formed.

The zinc, when placed in the box, may rest upon a layer of depolarizing salt or chemical compound, and another layer can be laid above it; or it may be inclosed in paper or fibrous material of an absorbent character, for the purpose of retaining the moisture to insure the continuous electrical action. The zinc plates are preferably doubled or folded over, and the wires are pinched in the folds, so that they form the hinge-pins upon which they can be turned up to renew the salt, and are also the hinge-pins upon which one side or lid of the copper box moves.

There are many ways of fastening the end plates or pieces of metal upon the end elements of voltaic bands or chains for the purpose of applying the current to any particular part of the person that may require to be acted upon, and in order that the intensity or power of the current can be brought to bear upon a larger or a smaller surface of the body at will I have invented a fastener by which those objects can be obtained. The fastener is shown in detail in Figs. 73, 74, 75, and 76 of the accompanying drawing.

Fig. 73 is an inside and a sectional view of the disk K of one pole of the battery. The inner face has a disk of copper soldered on it, and this holds a T-headed pin of non-conducting metal in its center, so that it can be turned by the fingers. The pin is passed through the spiral coils or the plates before spoken of, and through a slot in the back plate shown in Fig. 74, after which it is turned a quarter round to hold the disk securely. The pole at the other end of the band or chain is formed in a similar manner, and its T-headed pin is passed through the spiral coils or the plates, and also through the back plate, before the pin is turned a quarter round to secure it. The inside disk in this pole terminates in a tongue which projects beyond the edge and is perforated, so that a hook can be attached to combine other elastic bands therewith, as will be understood by referring to Figs. 75 and 76. The poles are prevented turning on the pins when in position by the edges of the plates being turned down to hold them firm.

The electrical action of the disk K, shown in Fig. 73, can be enlarged or diminished at will by drawing a canvas cap over the edges, more or less, by a cord laced into the edge.

I have referred to one mode of charging bands—that is, by the flexible tube-and-socket pieces shown in Figs. 52 and 53; but I do not confine myself to that alone, as the band can easily be dipped or run under a roller into a trough or bowl of exciting liquid, the bowl being of the shape shown in Fig. 77; or it may be wound spirally round a pump-cylinder, such as I have shown in Figs. 78 and 79; and when it is all in place I lay a flexible tube, H, over the top ends, when the liquid will flow through the perforations under the pressure of the internal spring, which causes the bag to collapse, all overflow or droppings of liquid being received by the tray upon which the cylinder is mounted; they may, however, be wound over flanged pegs in a frame, in the manner shown in Figs. 80 and 81.

When I affix the metal plates or strips in wearing articles, such as drawers, stockings, gloves, &c., I propose to sew them in in a zigzag manner, in the manner represented in Fig. 82, so that the garment can be used as a wet or a dry battery by turning the canvas on which the plates are sewn inside out. I propose to employ a water-proof material outside, and with the lower ends elastic, to fit tight to the skin to prevent the water trickling down, and to prevent the water passing away in that direction, and from evaporation, so that the current would then be conducted through the lining and the water to the skin.

Having now described the nature of my invention and the manner in which the same may be carried into effect, I declare that I claim—

1. Metal plates combined with a backing of porous or absorbent material, said backing being provided with a wax or sparadrap, arranged so that they can be used with a self-sustaining and permanent electrical or galvanic action derived from an exciting liquid or by perspiration thrown off from the body of the wearer, substantially as and for the purpose set forth.

2. The arrangement of the devices, constructed as herein shown and described, for applying electric, galvanic, and magnetic currents to the human body, as set forth.

3. The apparatus herein shown and described for charging the bands, chains, garments, or articles of dress, as set forth.

4. The arrangement of the deep trough battery shown in Figs. 65 and 66, operating as and for the purpose set forth.

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