No. 859,018. PATENTED JULY 2, 1907.

F. S. SMITH.

TRANSPORTATION SYSTEM.

APPLICATION FILED NOV. 21, 1906.

4 SHEETS—SHEET 1.

Fig. 1.

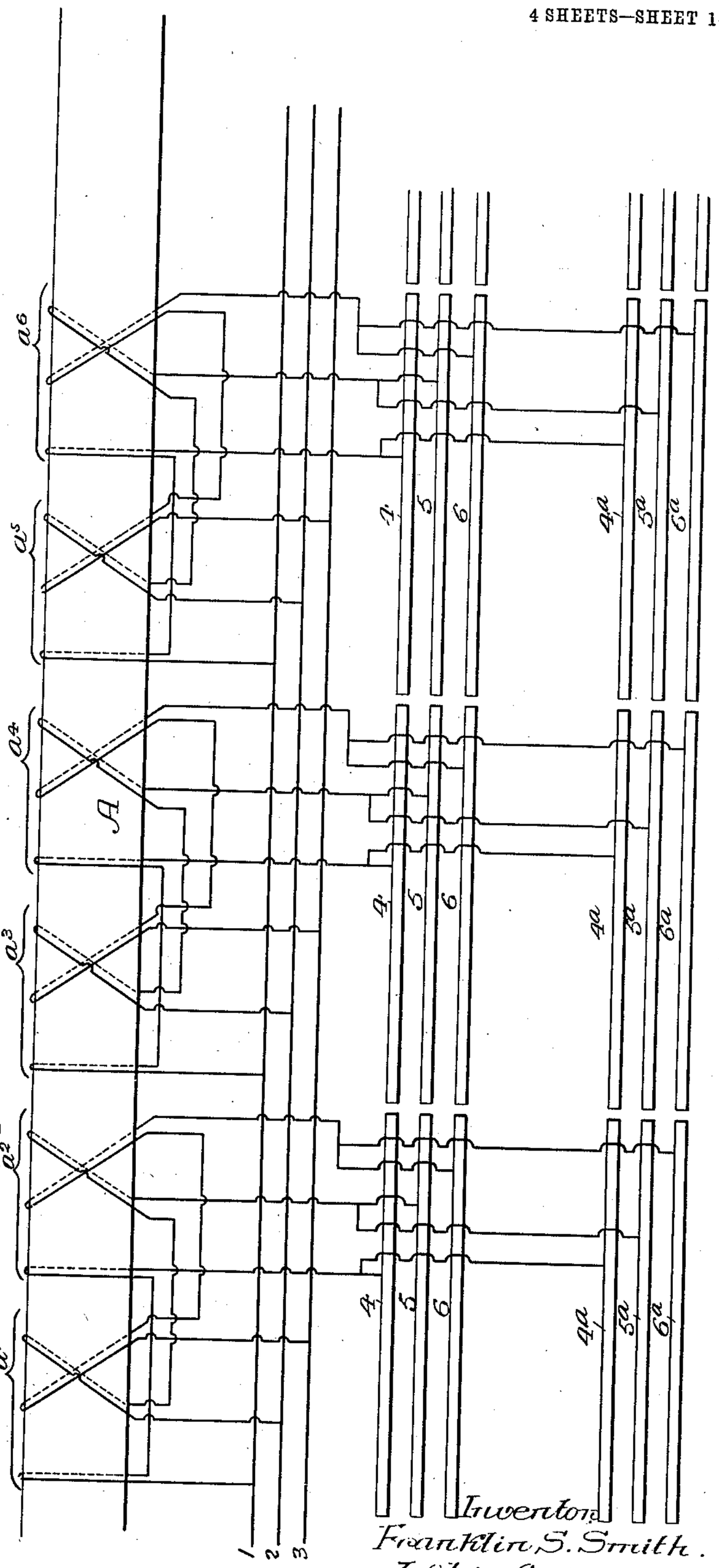
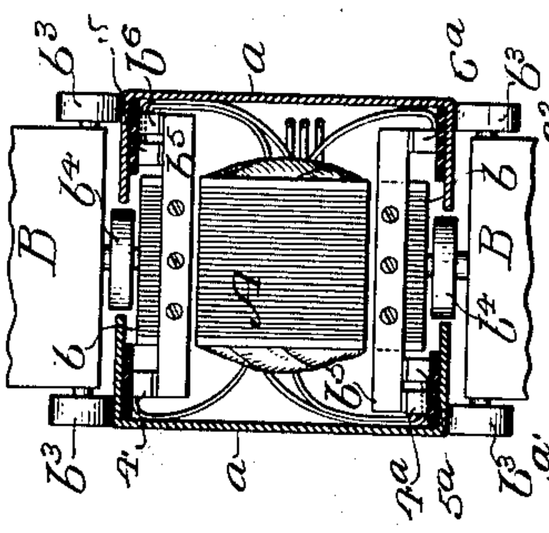


Fig. 4.



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Titus A. Howes.

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Howson & Howson

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4 SHEETS—SHEET 2.

Fig. 7.

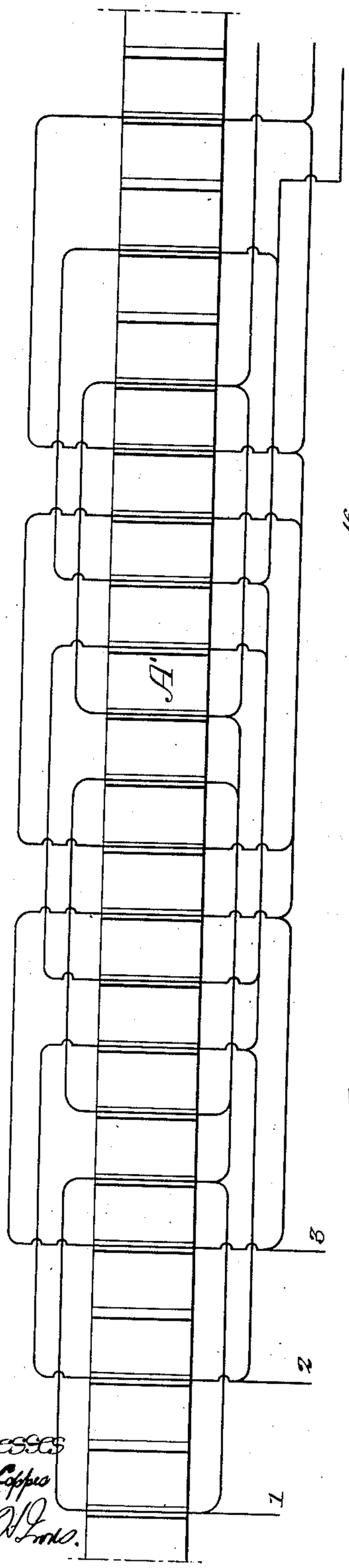


Fig. 6.

Fig. 2.

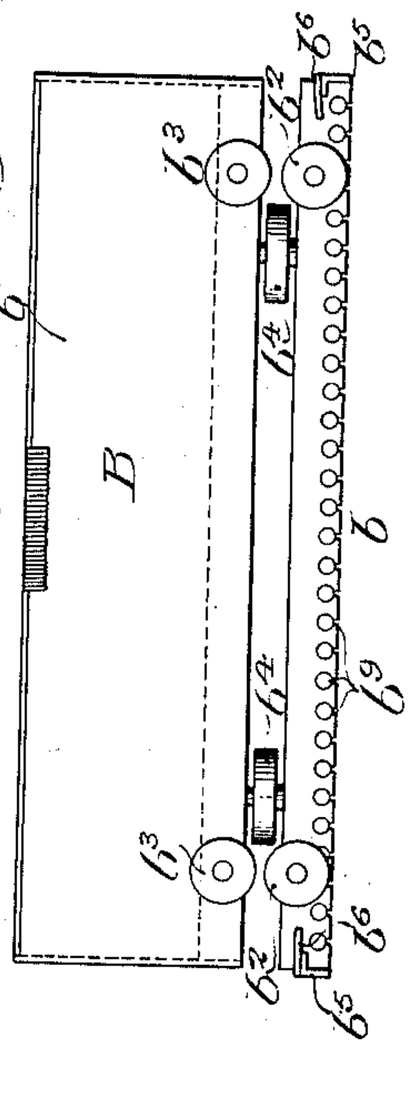
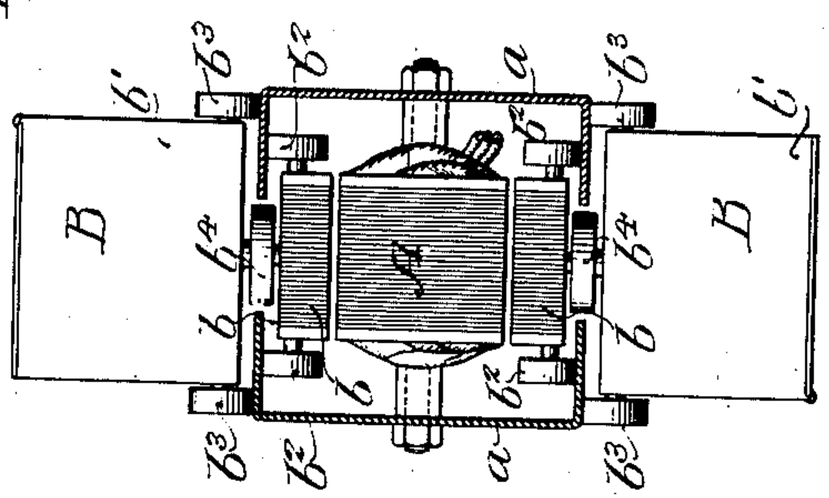


Fig. 5.

Fig. 3.



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4 SHEETS—SHEET 3.

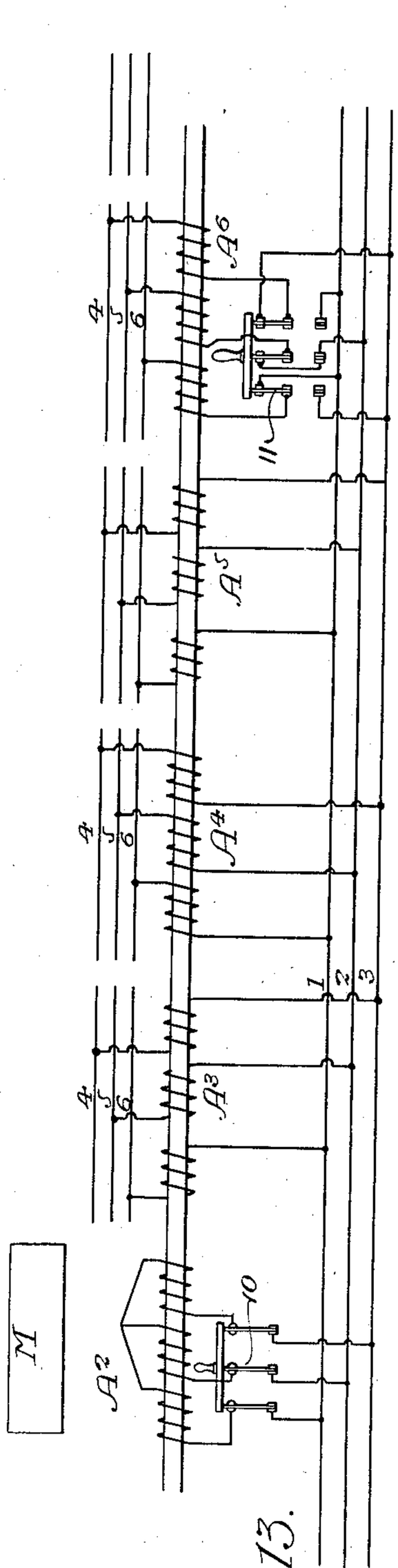

Fig. 13.

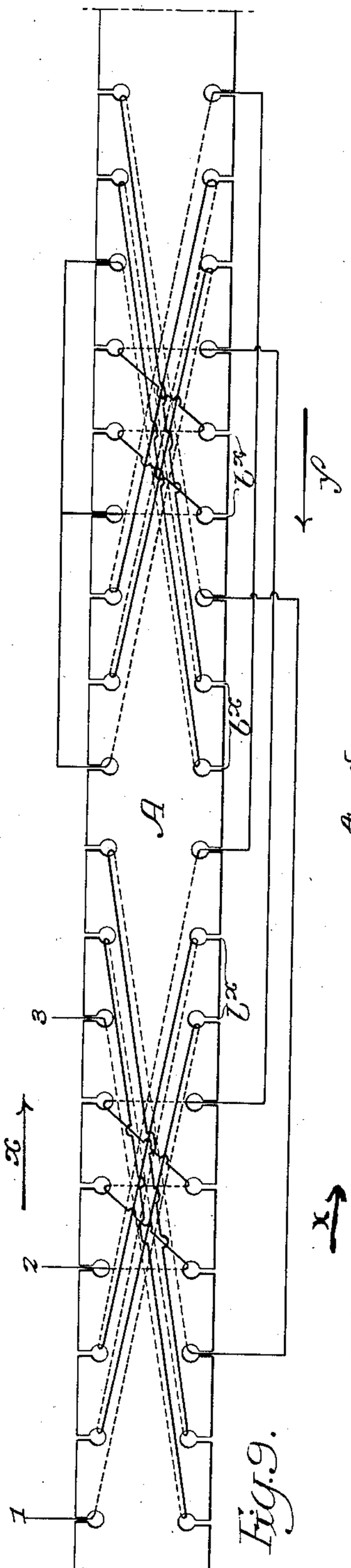

Fig. 9.

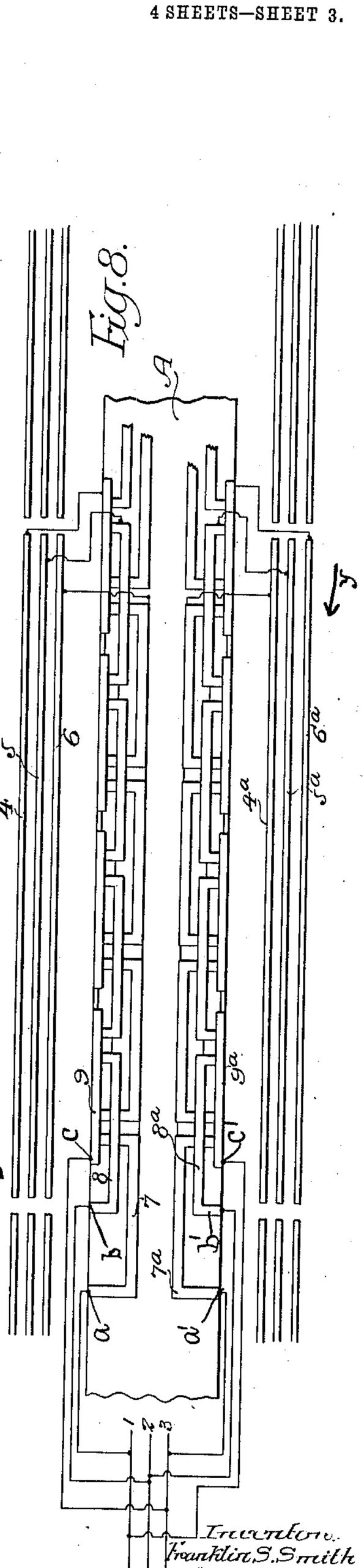

Fig. 8.

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4 SHEETS—SHEET 4.

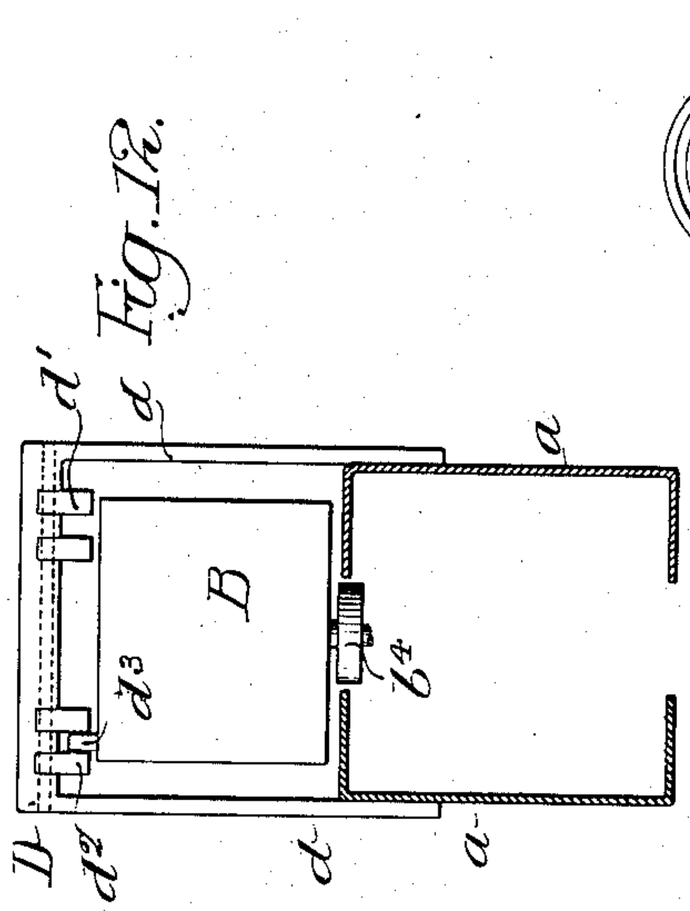

Fig. 12.

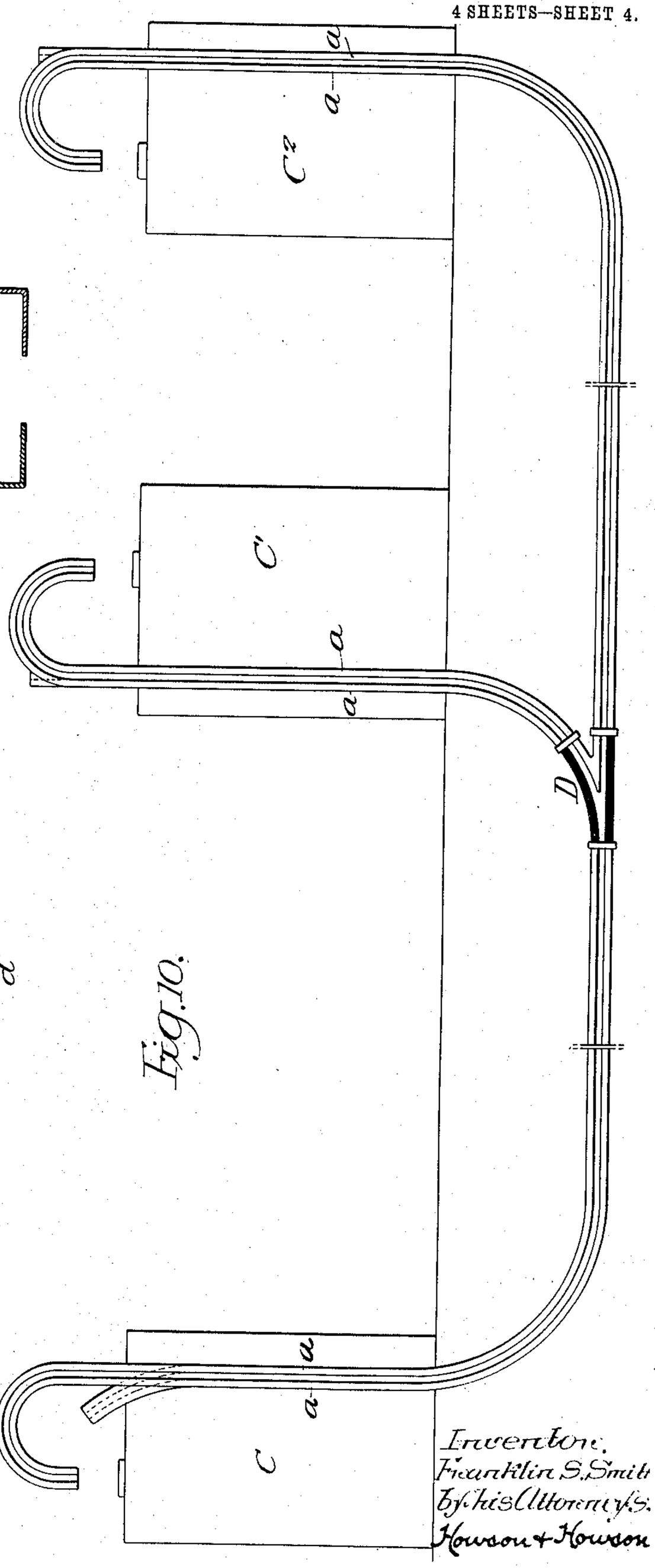

Fig. 10.

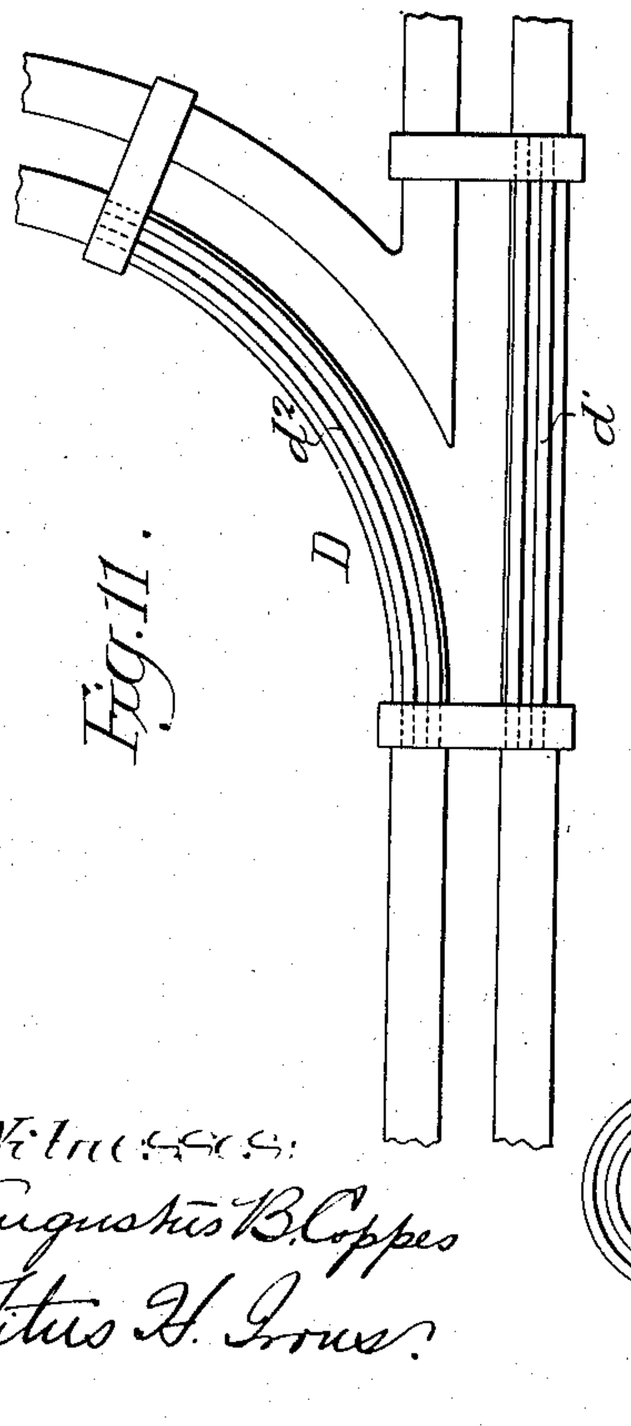

Fig. 11.

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By his Attorneys:
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UNITED STATES PATENT OFFICE.

FRANKLIN S. SMITH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO ELECTRIC CARRIER COMPANY, OF CAMDEN, NEW JERSEY, A CORPORATION OF NEW JERSEY.

TRANSPORTATION SYSTEM.

No. 859,018. Specification of Letters Patent. Patented July 2, 1907.

Application filed November 21, 1906. Serial No. 344,507.

To all whom it may concern:

Be it known that I, FRANKLIN S. SMITH, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Transportation Systems, of which the following is a specification.

My invention relates to railway or transportation systems of that particular class in which electrical apparatus is placed along a roadway or track so as to be operative upon other apparatus fixed to or carried by a car or vehicle to move the same upon the track; one object of the invention being to so construct and arrange the fixed and movable devices that an alternating current of electricity may be employed as the motive power, with a resulting high efficiency of operation of the system as a whole. I further desire to provide an alternating current railway or transportation system, having the general characteristics above noted, in which the fixed element supported along the roadway or track may be constructed in such manner as to render possible the operation or movement of cars or carriers in one direction on one of its faces or sides, and in an opposite direction on another face or side.

Another object of the invention is to provide an alternating current system of transportation in which the electrical elements shall possess the general characteristics of an induction motor, and yet be so arranged that movement of the car or carrier along a track is accomplished without the necessity for the use of any rotary driving mechanism. I also desire to provide an alternating current transportation system including electrical apparatus, of which one element is fixed along a track and provided with windings connected to a source of alternating current supply and the other element, being the cars or carriers carrying the remainder of the electrical apparatus, is constructed to operate over or along said track in such manner as to localize the energization of the fixed element of the apparatus within a region in their immediate vicinity. It is further desired to provide means whereby the moving element or elements of a system, having the above characteristics, may be conveniently started, stopped, and directed to any predetermined station.

These and other advantageous ends I secure as hereinafter set forth, reference being had to the accompanying drawings, in which:—

Figure 1, is a diagrammatic view illustrating the various parts and connections comprising a part of the fixed element of my system in one of its embodiments; Fig. 2, is a side elevation of a typical moving element of the system; Fig. 3, is a vertical transverse section taken through the track of a system embodying my invention, and illustrating two moving elements, being cars or carriers; Fig. 4, is a vertical transverse section similar to that illustrated in Fig. 3, but showing the moving elements or cars as equipped with means for localizing the energization of the fixed element of the system to the immediate vicinity of said cars; Fig. 5, is a perspective view of that portion of one of the movable elements which is acted on by the fixed element; Fig. 6, is a vertical transverse section of the structure shown in Fig. 5; Fig. 7, is a diagrammatic plan view illustrating the windings of a relatively simple form of the fixed element of a system embodying my invention, and designed for the operation of cars in but one direction; Fig. 8, is a diagrammatic side elevation of an embodiment of my invention in which the fixed element is adapted to be wound upon opposite faces in the manner illustrated as to but one face in Fig. 7,—and so the cars can move in opposite directions upon given faces; Fig. 9, is a diagrammatic side elevation, showing the windings of the fixed element of my system when employed to operate cars on both track faces of the casing, as illustrated in Figs. 3 and 4; Fig. 10, is a side elevation, to some extent diagrammatic, illustrating my system as arranged for store service; Fig. 11, is a side elevation on an enlarged scale of a portion of the store service system illustrated in Fig. 10; Fig. 12, is a vertical transverse section on a larger scale than that shown in Fig. 11, illustrating a means whereby the car may be shunted to any desired branch track, and Fig. 13, is a diagrammatic view illustrating means for starting and stopping the moving element or elements.

In the above drawings, A, Figs. 1 and 9, represents a fixed elongated core structure composed of a series of longitudinally extending laminations, preferably of iron, so arranged that their planes will be correspondingly in alinement with the planes of certain other laminations forming part of the movable elements *b* of the cars B, when the latter have been applied as hereinafter described. The fixed core structure may be supported in any desired manner, being preferably composed of members of suitable length, and in the present instance is illustrated as partially inclosed by a casing composed of channel shaped sections *a*, Figs. 3 and 4, extending along its opposite sides and so arranged that their flanges form between them slots above and below said core.

The core, as illustrated in Fig. 9, has a number of slots $b^{\times}$ extending transversely through the laminations, in two series respectively opening on a pair of its opposite faces, it being noted that in their simplest embodiments, the electrical elements of my system suggest the stator and rotor of an alternating current motor of the induction type. In its simplest form the core A′, Fig. 7, of the fixed element of my system, has a single series of slots opening on but one face and provided with windings as shown in said Fig. 7, which are

substantially the same as those of the stator of an induction motor; the windings shown being typical merely, and designed for connection to feeders 1, 2 and 3, supplied from a three phase generator. It is to be understood that the fixed element may, as indicated in Fig. 8, be wound upon both of its opposite slotted faces in the manner indicated in Fig. 7 as to but one of its faces, and that the free ends of the windings upon each face will be connected with a section of contact bars 4, 5 and 6, and 4^a, 5^a and 6^a, on the casing, to the end that a carrier traveling in the direction of arrow x, Fig. 8, will only occasion a current to pass through the windings upon the upper face of the fixed element, while a carrier traveling in the direction of the arrow y on said Fig. 8, will only occasion a current to pass through the windings upon the lower face of said fixed element. This difference in direction of travel of the moving element is caused by a difference in the terminal connections, as shown in Fig. 8, in which the terminals a, b, and c of the windings on the upper face are connected, a to, feeder 1, b to feeder 2, and c to feeder 3, while the terminals a', b' and c', of the windings on the lower face are connected, a' to feeder 3, b' to feeder 2, and c' to feeder 1.

In the form of my invention shown in Figs. 1, 3, 4 and 9, I construct the core A with slots opening on a pair of opposite faces, and provided with windings such that the movable elements B will be caused to move in the direction of the arrow x, Fig. 9, when placed on a track adjacent to the upper face of the core, and in the direction of the arrow y when placed on a track adjacent to the lower face of the core. To accomplish this end, I have devised the double windings illustrated in Figs. 1, 8 and 9, and while in this particular typical embodiment these windings are designed for a three phase current, it will be understood that they may, without departing from my invention, be arranged to be operative with other forms of alternating current.

In Fig. 7, I have illustrated a typical form of winding, the components of which are so connected that the entire length of the fixed element of the system will be constantly energized from the source of current supply; and in Fig. 9, I have shown a definite section of the fixed element, the three sets of the windings of which are connected at one end to supply feeders 1, 2 and 3, and at the other end are permanently connected together in the manner common to three phase apparatus.

The system, as a whole, may have its fixed element composed of a number of members, as illustrated in Fig. 9, although in order to obtain high efficiency of operation I provide means whereby only one or more divisions of the windings immediately adjacent to a movable element or car, is for the time being energized. This desirable end I attain by means typically illustrated in Figs. 1 and 8, from which it will be seen that the core A, or A', is wound for the operation of carriers along two of its opposite sides or faces, and for such purpose is provided with a number of sets of windings so arranged that in Fig. 1 there is one slot per phase per pole, while in Fig. 8 there are two slots per phase per pole, on each slotted side.

In Fig. 1 there are particularly illustrated three phase windings arranged to form six slots, a', a^2, a^3, a^4, a^5 and a^6 connected in pairs in series, and each pair, constituting a division, connected in multiple with the feeders 1, 2 and 3. The free ends of these windings are connected to a section of contact bars, 4, 5 and 6, which are in turn respectively connected with a similar section of contact bars 4^a, 5^a and 6^a. All of the contact bars, which parallel the core, are insulated from each other, and therefore each winding is open circuited until the windings terminating in a given section of the contact bars are closed by the operation of the contacts b^6 carried by the moving element, when said element is brought to contact with a given section of said contact bars.

In the particular system illustrated in Figs. 1 and 4, the contact bars 4, 5 and 6, are supported from the under sides of the upper overhanging flanges of the casing formed by the channel pieces a, while the bars 4^a, 5^a and 6^a are similarly supported upon the upper or inside surface of the underlying flanges of the same channel pieces. Each moving element of my system consists of a part b designed to be inductively energized by the magnetic field set up by the core A and its windings, and to this part b is attached a car or carrier body b' which serves as a carrier or container for articles or material to be transported. In one of its forms the part b may, as shown in Fig. 3, be provided with wheels b^2 designed to run on the inner faces of the flanges of the casing a, while the car body b' is provided with wheels b^3 designed to run on the outer faces of said flanges. I preferably also provide wheels b^4 upon that part of the car structure which connects the part b with the body b', so placed as to operate in the slot formed by and between the respective flanges of the casing a, and to serve to center the moving element, as well as to prevent possible injury thereto from the edges of the flanges. To localize the current supply of the fixed element of the system to such portion thereof as is immediately under or adjacent to the car, I apply to each of the car structures b at each end thereof transverse bars b^5, having contacts b^6 so placed that under operating conditions they will engage the fixed contact bars 4, 5 and 6, or 4^a, 5^a and 6^a, and electrically connect them. Any other means for electrically connecting the contacts b^6 on the part b, may obviously be employed in place of the bars b^5. The electro-magnetic part b of each car or moving element consists of a number of substantially parallel and relatively thin sheets or laminations of iron b^1, arranged as shown, and held in place by relatively thick side bars b^8. This part b forms a core which has extending transversely through it a number of copper bars b^9, electrically connected to the side bars b^8, which are also of copper. The transverse copper bars b^9 are placed relatively near one face of the core, which is slotted as shown. The entire moving element is, as stated, similar to the rotor of an induction motor, the parts b^8 and b^9 constituting the winding.

Under operating conditions, with the feeders 1, 2 and 3, connected to a source of three phase alternating current, it will be seen that until a moving element B has been placed on a track, there will be no current flowing through the system, for the reason that in every instance the windings of the fixed element are normally open circuited. When, however, a moving element has been placed on a track, as shown in Fig. 4, its contacts b^6 and cross bars b^5, will electrically connect a sec-

tion of contact bars 4, 5 and 6, or 4^a, 5^a, and 6^a, and close the circuit of the windings of the division of the fixed element of the system connected with said bars. As a result, a magnetic field will be produced which has an action upon the part *b* of each moving element, similar to that between the stator and rotor of an induction motor. The part *b* with its attached car and whatever load it may carry, will, in consequence, be drawn along the track at a speed bearing a definite relation in particular to the pole pitch and frequency of current,—the iron and other losses occurring only in the relatively small part of the fixed element immediately adjacent to the moving car.

In Figs. 10, 11 and 12, I have illustrated my invention as applied to a cash carrying or store service system, the various stations of which are shown at C, C′ and C^2. It will be understood that in this embodiment the construction employed is preferably that shown in Fig. 3, and that the channel sections *a* are to be so shaped as to properly receive and direct carriers, preferably of the construction illustrated in Fig. 2, to and from the various stations. In order that the carriers from the station C may be directed, for instance, either to station C′ or station C^2, I provide a switch structure D, shown in detail in Figs. 11 and 12, and consisting of a frame *d* conveniently supported from the channel sections *a* so as to extend above the carrier. This frame, immediately adjacent to the fork at which the tracks for station C′ meet those from station C^2, supports auxiliary tracks d' and d^2, Figs. 11 and 12, of which d^2 is a typical branch track, designed to co-act with pins such as d^3, suitably placed on the carriers. In other words, all carriers designed to go to station C′ will be provided with a pin d^3 so placed as to enter the branch track d^2, and thereby cause said carriers to be steered into that particular part of the system which leads to said station C′. Similarly, carriers for the station C^2 will be provided with a pin suitably placed to retain them in the straight run leading to said station.

In Fig. 13, I have illustrated diagrammatically means whereby a carrier may be conveniently started or stopped. In this embodiment the feeders 1, 2 and 3 are connected as shown with the windings of the various divisions, A^2, A^3, A^4, etc., of the fixed member of the system. The division A^2, which is shown as near the station M, is assumed to be one in the immediate vicinity of which a carrier is intended to be normally at rest, and to this end, as is obvious, the said division should be normally de-energized or dead. To permit of this, and also of the closing of the circuit of said division to cause the starting of the carrier, I provide a switch 10, interposed between the feeders 1, 2 and 3, and the windings of said division A^2, and normally open. I preferably also permanently connect the free ends of the windings of said division. Assuming that the division A^6 is near or partially within a terminal, or other station, where it is desired to slow down and stop the carrier, such result is accomplished by changing two of the terminal connections of the windings of said division, as illustrated in said Fig. 13, and also at the left hand of Fig. 8, with the result that the tendency of the carrier to continue its movement is overcome. In A^6 is also illustrated a division of windings, similar to those of the other divisions, but with a double throw switch 11, interposed between the windings and the feeders 1, 2 and 3. Normally the switch 11 is in the position shown, that is to say, with the feeders in such connection with the windings as would cause a carrier, except for its momentum, to travel in an opposite direction from that in which it would travel upon the other divisions A^2, A^3, A^4 and A^5. A carrier traveling at a high speed over the divisions A^2, A^3, A^4 and A^5 would, therefore, be immediately slowed down by the reversal in direction of the magnetic field set up in division A^6. When a carrier has been brought to rest it may, if desired, be caused to move further along said division by throwing switch 11 into a reverse position so as to cause the windings to be connected with the feeders 1, 2 and 3, in the same manner that those of the other divisions A^2, A^3, A^4 and A^5 are connected with them. When a carrier has been brought to the desired point, the switch may then be opened and the carrier be brought to rest.

I claim:

1. An electric transportation system consisting of a fixed member having windings adapted to be connected with a source of alternating current and normally open circuited, a track adjacent to and parallel with said fixed member, and a movable member adapted to close the circuit of the windings and thereby become inductively energized to travel along said track, substantially as described.

2. An electric transportation system consisting of a fixed member having normally open circuited windings, a track adjacent to and parallel with said fixed member, a movable member, and means whereby said normally open circuited windings are closed and said movable member caused to move along said track, substantially as described.

3. An electric transportation system consisting of a fixed member having windings adapted to be connected with a source of alternating current supply, normally open circuited and terminating in contact bars, a track adjacent to and parallel with said fixed member, contact bars, and a movable member carrying contacts adapted to electrically connect said contact bars and thereby close the circuit of the windings and inductively energize said movable member to occasion its travel along said track, substantially as described.

4. An electric transportation system including a fixed member having windings connected with a source of alternating current but normally open circuited, a movable member or members, and means carried by each movable member for electrically connecting the windings of said fixed member, substantially as described.

5. An electric transportation system including a fixed member having windings adapted to be connected with a source of alternating current, a movable member or members having parts adapted to be so placed as to be inductively energized by the fixed member, and means carried by said movable member for causing energization of the windings of said fixed member when in the immediate vicinity of such member or members, substantially as described.

6. An electric transportation system including a fixed member having windings connected with a source of alternating current but normally open circuited, a movable member or members each having parts adapted to be so placed as to be inductively energized by the fixed member, and means carried by each movable member for electrically connecting the windings of the fixed member in the immediate vicinity of such movable member or members, substantially as described.

7. An electric transportation system including a fixed member having windings connected with a source of alternating current but normally open circuited, a movable member or members each having parts adapted to be so placed as to be inductively energized by the fixed member, and means independent of said parts carried by each movable member for electrically connecting the windings of the fixed member, substantially as described.

8. An electric transportation system including a fixed member having successively disposed windings all connected with a source of alternating current, contact bars

connected with the windings, a movable member or members each having parts adapted to be so placed as to be inductively energized by the fixed member, and contact means placed to engage the contact bars and electrically connect them, substantially as described.

9. An electric transportation system including a fixed member consisting of an elongated core provided with successively disposed windings connected with a source of alternating current, said windings being open circuited, contact bars extending in parallelism with the fixed member and respectively connected to the windings, and a movable member or members each embodying a core provided with a series of windings electrically independent of those of the fixed member, with a contact device or devices for electrically connecting the contact bars, substantially as described.

10. An electric transportation system consisting of a fixed member provided with windings connected with a source of alternating current and normally open circuited, a movable member embodying a core of magnetic material having short circuited transverse conductors, and means for electrically connecting the windings of said fixed member, substantially as described.

11. An electric transportation system consisting of a fixed member provided with windings connected with a source of current, tracks supported in adjacency to opposite faces of said fixed member, and movable members adapted to operate upon said tracks, substantially as described.

12. An electric transportation system consisting of a fixed member provided with windings connected with a source of current, tracks supported in adjacency to opposite faces of said fixed member, and movable members adapted to operate upon said tracks and each embodying parts adapted to be inductively energized by said fixed member, substantially as described.

13. An electric transportation system including a fixed member, two tracks extending along two faces of said member, and a movable member or members adapted to be inductively operated in opposite directions along said tracks, substantially as described.

14. An electric transportation system including a fixed member having tracks supported in adjacency to two faces of said member, a movable member or members operative on said tracks and each provided with parts adapted to be inductively energized by the fixed member, and windings on said fixed member adapted to cause said movable members to move in opposite directions on the respective tracks, substantially as described.

15. An electric transportation system including a fixed member having tracks in adjacency to two of its faces, a movable member or members adapted to operate on said tracks, contacts on said movable members, normally open circuited windings successively disposed along said fixed member, and contact bars in the path of travel of the contacts of the movable members, substantially as described.

16. An electric transportation system including a fixed member, a plurality of independent tracks extending along said fixed member, windings on said fixed member connected with a source of alternating current supply, and a car or cars each embodying a device adapted to be inductively energized by the fixed member and operated on either track, substantially as described.

17. An electric transportation system consisting of an elongated fixed member provided with an inclosing casing having a slot, a car adapted to be operated upon said casing, and a device projecting from said car and adapted to be inductively energized by the fixed member, substantially as described.

18. An electric transportation system including a fixed member having windings adapted to be connected with a source of alternating current, a track adjacent to and parallel with said fixed member, a switch structure for said track, a movable member adapted to be operated upon, and provided with means for shunting it from said track through the instrumentality of the switch structure, substantially as described.

19. An electric transportation system including a fixed member having windings adapted to be connected with a source of alternating current, a main track in adjacency to and parallelism with said fixed member, a branch track, and a movable member adapted to be operated upon both of said tracks and provided with a device whereby it may be shunted from the main track on to the branch track, substantially as described..

20. An electric transportation system including a fixed member having windings adapted to be connected with a source of alternating current, a main track in adjacency to and parallelism with said fixed member, a switch structure at the intersection of said main and branch tracks, and a movable member adapted for operation upon both of said tracks and provided with means for shunting it from the main track on to the branch track through the instrumentality of the switch structure, substantially as described.

21. An electric transportation system including a fixed member adapted to be connected with a source of alternating current, main tracks adjacent to and parallel with said fixed member, branch tracks leading from said main tracks, switch structures at the intersections of the main and branch tracks, and a movable member or members adapted for operation upon all of said tracks, and provided with a device or devices whereby it or they may be shunted from a main track on to a branch track, substantially as described.

22. An electric transportation system consisting of a fixed member embodying a plurality of divisions of normally open circuited windings, a track adjacent to and parallel with said fixed member, a movable member adapted to travel upon said track, means whereby a division of normally open circuited windings of the fixed member is closed by said movable member to occasion its travel along said track, and means whereby said division of windings is again open circuited as soon as said movable member has traveled beyond it, substantially as described.

23. An electric transportation system including a fixed member having divisions of normally open circuited windings connected with a source of current supply, a movable member or members embodying means for completing the circuits of certain of said windings, and means independent of said movable member or members for completing the circuits of others of said windings, substantially as described.

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

FRANKLIN S. SMITH.

Witnesses:
WM. E. SHUPE,
JOS. H. KLEIN.