No. 758,922. PATENTED MAY 3, 1904.

T. H. JONES.

SIGNALING ON ELECTRIC TRACTION SYSTEMS.

APPLICATION FILED JULY 7, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

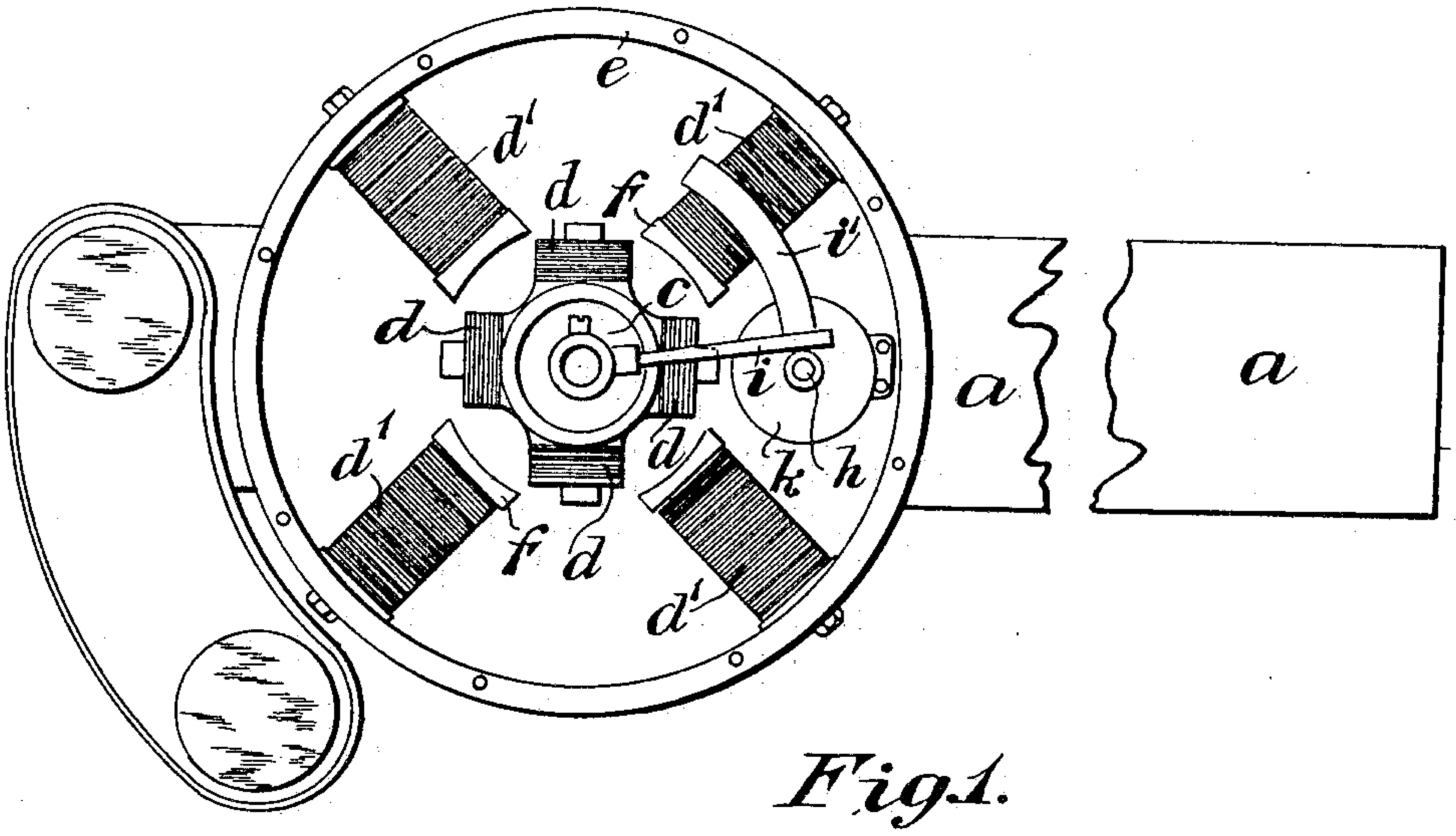

Fig.1.

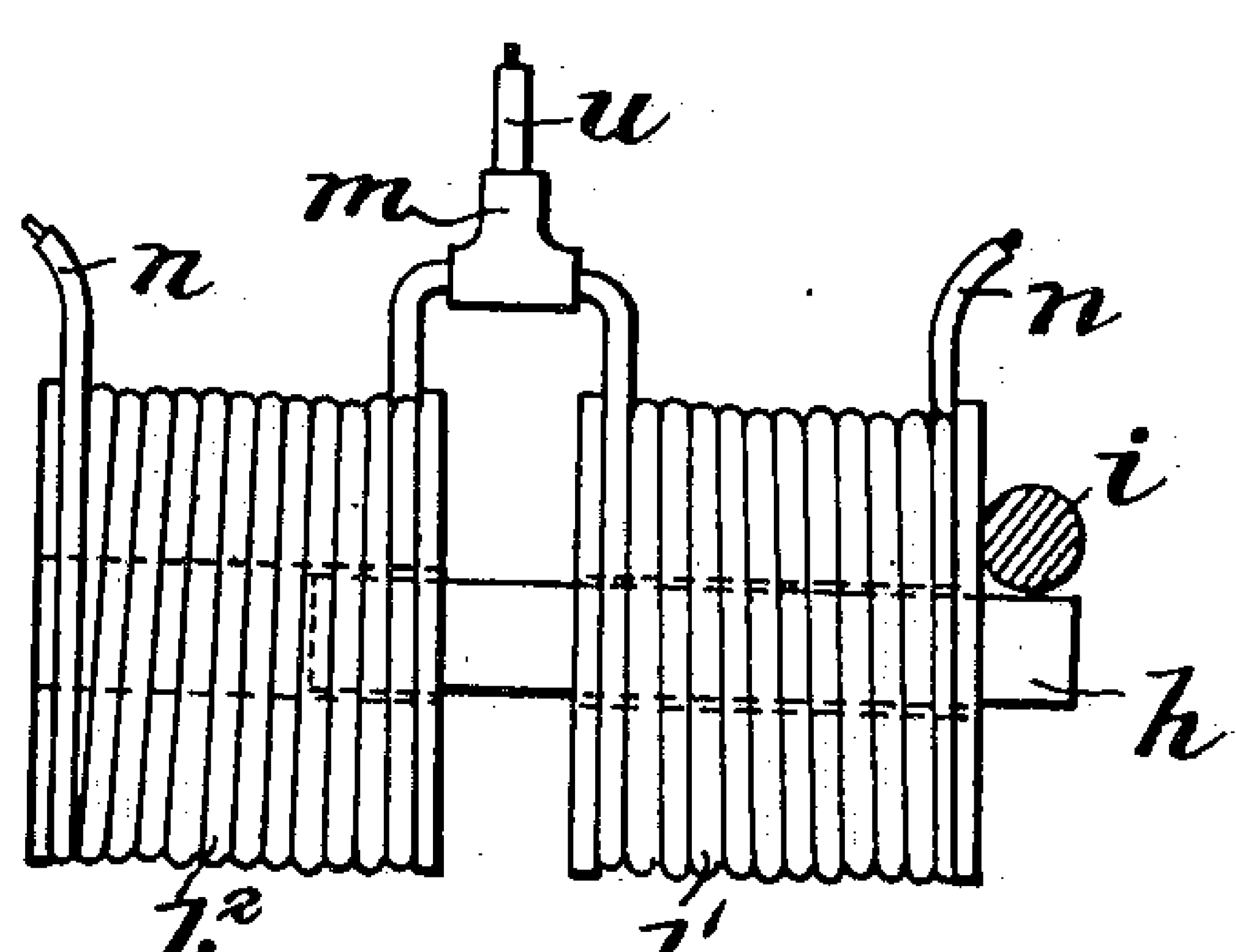

Fig.2.

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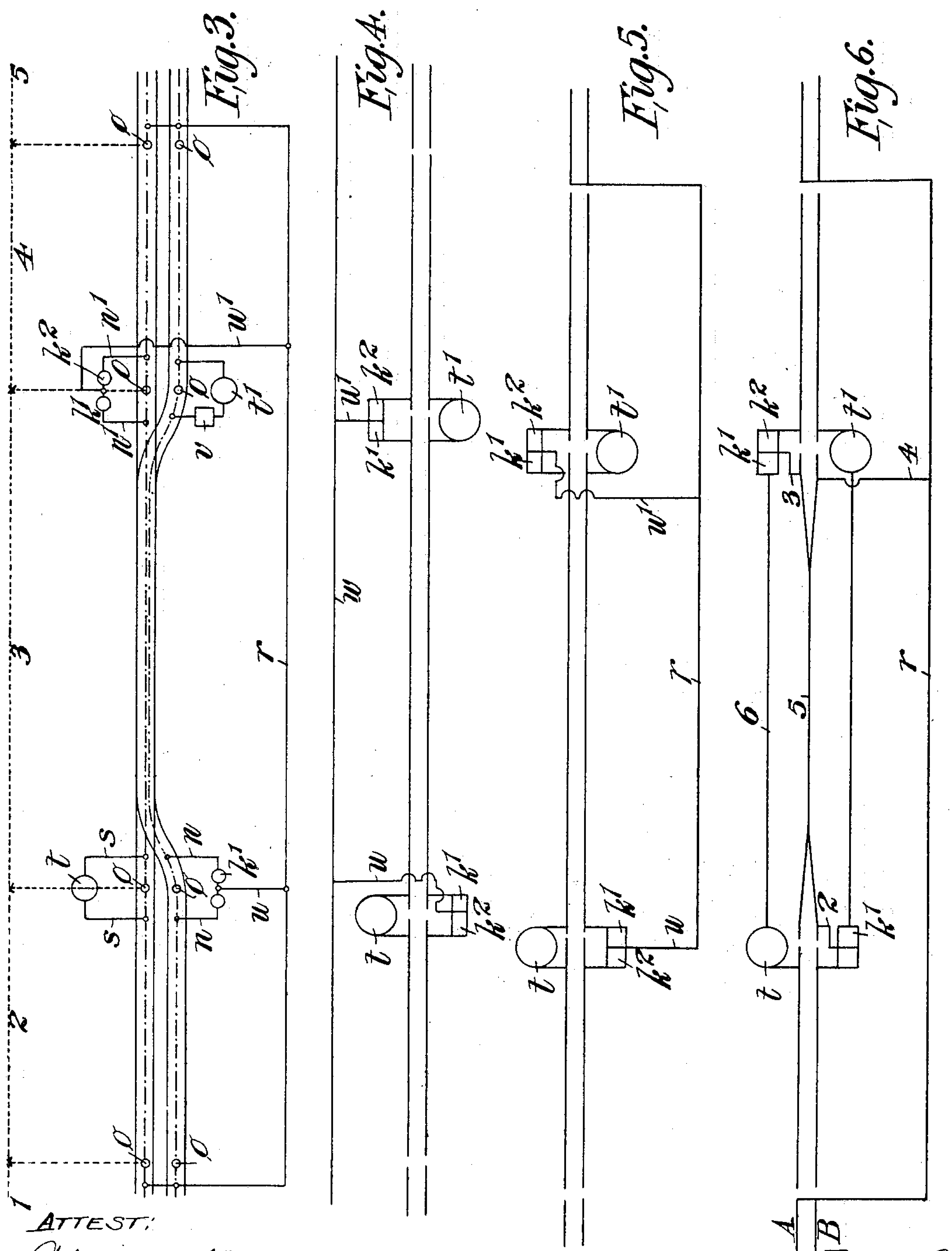
NO MODEL. 3 SHEETS—SHEET 2.



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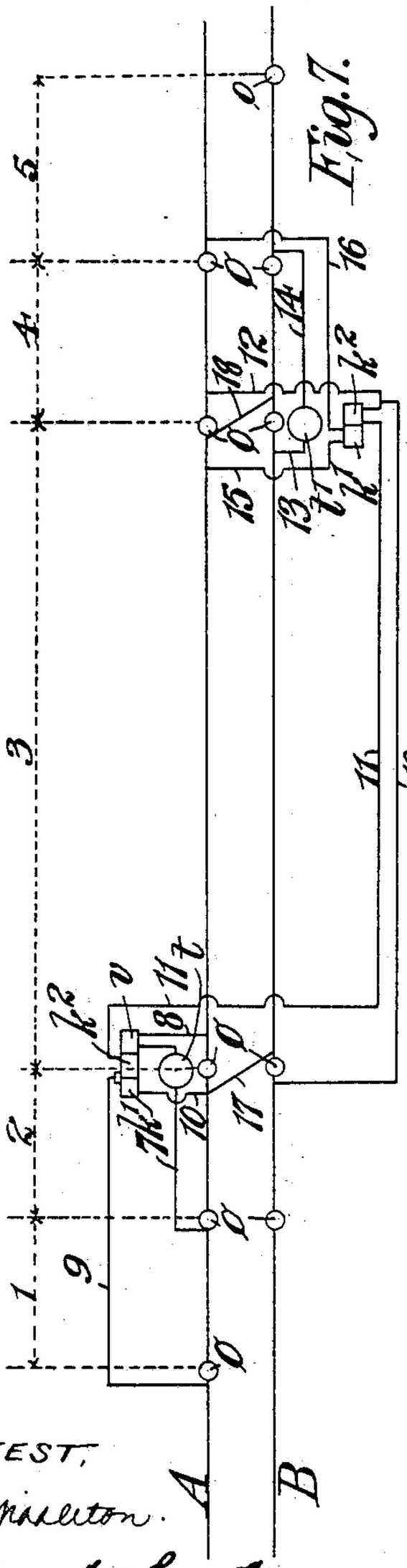
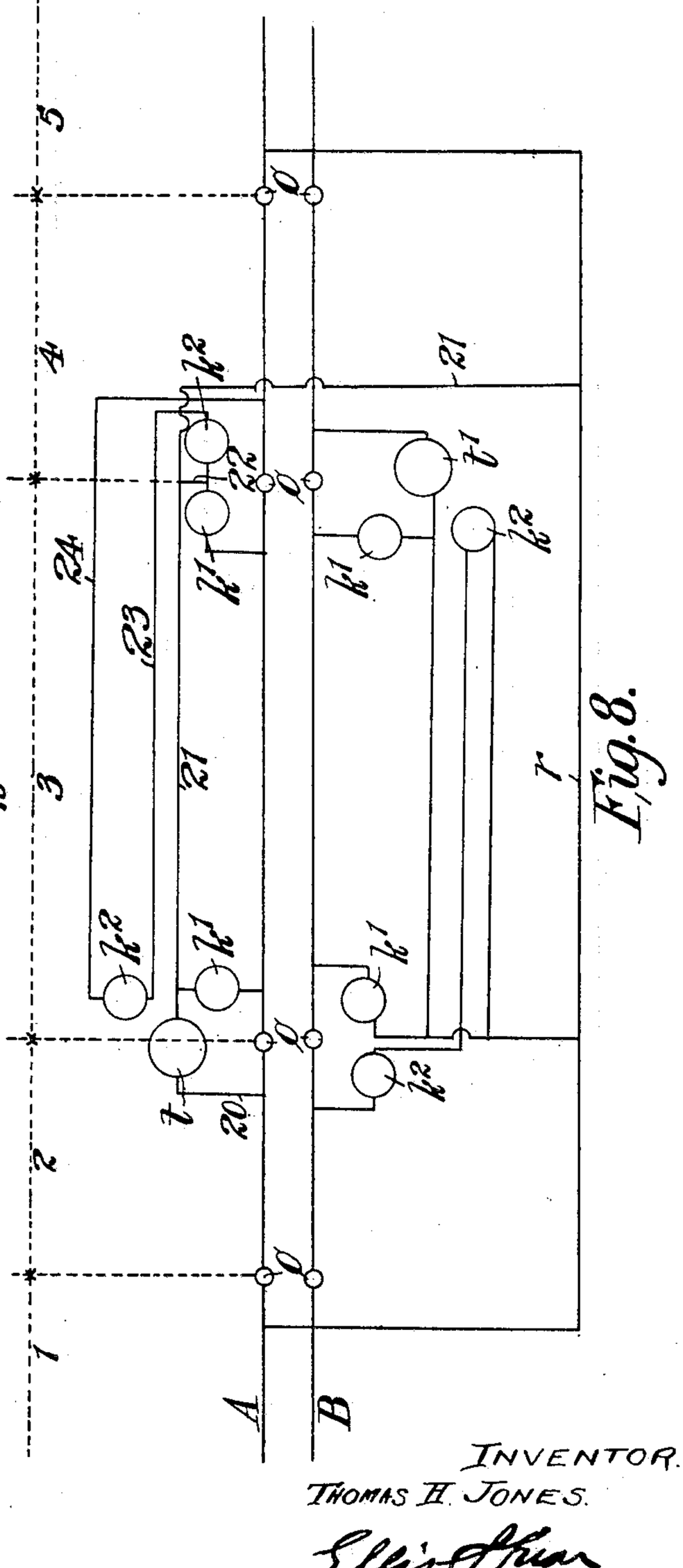
NO MODEL. 3 SHEETS—SHEET 3.





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No. 758,922. Patented May 3, 1904.

UNITED STATES PATENT OFFICE.

THOMAS HARISON JONES, OF PORTSMOUTH, ENGLAND.

SIGNALING ON ELECTRIC-TRACTION SYSTEMS.

SPECIFICATION forming part of Letters Patent No. 758,922, dated May 3, 1904.

Application filed July 7, 1902. Serial No. 114,600. (No model.)

To all whom it may concern:

Be it known that I, THOMAS HARISON JONES, tramway engineer, a subject of the King of Great Britain and Ireland, residing at The Town Hall, Portsmouth, in the county of Hants, England, have invented certain new and useful Improvements in and Relating to Signaling on Electric-Traction Systems, (for which I have made application for Letters Patent in Great Britain, No. 26,744, dated December 31, 1901,) of which the following is a specification.

My invention relates to improvements in apparatus for signaling on electric-traction systems and appliances for use therein.

My invention consists, broadly, in means for automatically utilizing the main current or a portion of the current which is employed for driving the car or train to operate signaling devices for indicating the progress of the car or train along the line.

My invention relates to the application of my apparatus to interlacing double tracks, single tracks, or other lines where two cars cannot pass, or where it is not held desirable that the cars should pass in opposite directions, and especially the application to double-track tramway or railway systems having sections in which two tracks merge into one along which the cars or trains travel in opposite directions; and the object of my invention is to provide a system in which an automatic indication is given showing whether a section is clear, so as to avoid two cars traveling in opposite directions attempting to pass onto the section.

In connection with my invention I provide at each end of the single-track section to be protected and along which the electric-supply conductors are run one or more automatic signaling devices and one or more signal locking and releasing devices operated electromagnetically by the current-supply drawn by the car from the mains.

My invention may also be applied with a lock-and-block system of signaling, the car or train automatically locking the signal behind it and unlocking it as it passes out of the section. I also provide an arrangement whereby if two cars endeavor to operate their signals simultaneously one is given the preference over the other.

In the application of my system to lock-and-block signaling I may lock and unlock the signals at the ends of a section by drawing current through the locking and unlocking devices either in series or parallel in a manner to be more fully described hereinafter, and I may use two or more locking and unlocking devices to each signal.

It will be obvious that more than one signal may be employed at each end, if desired—say in a case in which junctions are situated at the ends of the protected section. In this case all the signals are arranged to be locked by the operation of any one of the others.

More than one locking device may be applied in each signal, if desired.

In the following description when I use the expression "trolley fed from one end" it will be understood that the working conductor at one end—say to the right of 4 in Figure 3—is connected with the source of power-supply, while the current is supplied to the working conductor to the left of 2 by the wire *r*, connected to the first-mentioned working conductor on the right.

By the expression "trolley fed from both ends" it will be understood that the working conductors on the right and left are each connected separately to the source of power.

Figs. 4, 5, 7, and 8 do not show "single-track rails" as we understand the expression here. The tracks in all the modifications are as shown in Fig. 3—namely, double tracks merging into a single track through section 3. In Figs. 4, 5, 6, 7, and 8 the track-rails are not represented at all, only the trolley-conductors being shown. In all the figures except Fig. 6 the trolley-wires are kept separate for cars coming in opposite directions on the protected single section of track. Of course on the double portions (sections such as 2 and 4, Fig. 3) each track has its own conductor.

Referring to the accompanying drawings, Fig. 1 shows the signal-operating mechanism with the front cover-plate of casing removed. Fig. 2 is a detail view, to a larger scale, of the electromagnetic locking and releasing device. Fig. 3 is a diagrammatic view

of the portion of track to be protected, showing electrical connections, &c., for a double trolley fed from one end. Fig. 4 shows connections for a double trolley fed from both ends if a feeder be near enough to be tapped direct. Fig. 5 shows also a double trolley fed from both ends, but with no feeder conveniently accessible. Fig. 6 shows the case of a double trolley merging into one over the protected portion of track and fed from one end, while Figs. 7 and 8 show the application of automatic lock-and-block signaling in my system.

It is assumed in the following description of the above figures that in each case the construction represented is adapted to cars going in both directions. It is also assumed that the cars travel on the left-hand track reckoned with regard to the direction in which they are traveling.

Although I do not claim the signal-operating mechanism as part of my invention, nevertheless to make the description of my system quite clear I will describe a suitable signaling appliance provided with locking and unlocking arrangements.

I provide a signal-arm *a* of any usual form, which I pivot in the usual manner on a suitable support—as, for example, a trolley-standard in an electric-traction system. This arm is balanced so that it hangs normally in the horizontal or "danger" position. I attach to the arm coaxially with the pivot an iron armature *c* of convenient form and which is provided with a winding of insulated conductor *d*. Surrounding the armature I provide a ring *e*, of cast iron or other suitable magnetic metal, which forms part of the inclosing casing of the mechanism and is fixed to the side of the pole, bracket, arm, or other support on which the signal-arm is pivoted. This ring *e* has formed on its interior one or more projecting pole-pieces *f f*, (four are shown in the drawings,) preferably placed so as to alternate in position with the armature-coils when the signal-arm is in the horizontal position. The space between the pole-faces forms the field-gap in which the armature rotates. The pole-pieces *f f* are provided with suitable windings *d'*. The two extremities of the circuit thus formed are brought to insulated terminals on the fixed casing *e*.

In order to enable the signal-arm to be locked automatically in the horizontal position and released so that it is free to move, I provide an electromagnetically-operated stop *h*, which is fitted so as to lock or free the armature. For this purpose I fix to the pivotal axis of the armature a projecting arm *i*, and preferably within the fixed ring-casing I fix two solenoids *k' k²*, placed end to end and provided with a common core *h*, forming the stop above mentioned and capable of movement axially through the solenoids. The adjacent extremities of the solenoid-windings are connected together, as shown at *m*, and the common connection is taken to an insulated terminal on the casing, while the free extremities *n n* of the windings are connected to two separate insulated terminals on the casing. When a current is passed through the solenoid *k'*, the core is projected out of the solenoid, so that it engages with the projecting arm *i* on the armature, thereby locking the signal-arm, and when the current is passed through the solenoid *k²* the core is drawn out of engagement with the said arm, which is then free. A tailpiece *i'* is provided on the end of the arm *i* to prevent the core *h* of the locking-solenoid *k'* getting above the arm *i*, which can therefore only be locked when the signal-arm is in the danger position.

I will now describe the application according to one modification of the signaling appliance above described for signaling on an electric tramway or railway system where the two tracks merge into a single track for a portion of the system, and I will take as an example the case of a double trolley fed from one end only. (See Fig. 3.) The two electric trolley-conductors (shown dotted in the figure) which are employed in the double track are also employed on the portion of single track. The trolley-conductor for each track is divided into sections insulated from each other, the points of insulation being shown at *o o*. For the purpose of explanation I will take two of the parallel sections of conductors on the double track and number the consecutive sections 1 2 3 4 5, number 3 being the section of single track. I provide an auxilary conductor *r*, which I connect metallically to the first and fifth sections of both current-supply conductors. To the insulated extremities of the second and third sections of one conductor I connect the circuit-terminals *s s* of the signal-operating mechanism *t*, and to the adjacent extremities of the second and third sections of the other conductor I connect the two terminals *n n* on the free ends of the solenoid circuit of the locking and releasing device for this signal mechanism, so that the circuit of the signal-operating mechanism is connected in series with the middle section or length of one of the supply-conductors and the circuit of its locking and releasing device in series with a length or section of the other conductor. The common terminal *u* of the solenoids of the locking and releasing device I connect to the auxiliary conductor *r* above mentioned. On the same conductor with which the circuit of the signal-operating mechanism just mentioned is connected and at the other end of the portion of single track—that is, between the adjacent extremities of the third and fourth sections of the conductor—I connect the locking and releasing circuit *n' n'* of a second signal-operating mechanism *t'*, the circuit of which mechanism I include in series with the other conductor between the extremi-

ties of the third and fourth sections of that conductor. The common terminal n' of the two solenoids of the locking and releasing device just mentioned is connected to the auxiliary conductor r.

The auxiliary cable r above mentioned in the system chosen for the purpose of description can, however, be dispensed with in the case of a double trolley fed from both ends if the feeders be sufficiently near to be tapped direct. The necessary connections in this case are shown in Fig. 4, the common junction of the solenoids being connected to the feeder w instead of to the auxiliary cable r, as in Fig. 4.

In the case shown in Fig. 5—viz., a double trolley-conductor fed from both ends, but with no feeder, such as w in Fig. 4, accessible—an auxiliary cable r again becomes necessary. This is connected to the two trolley-conductors of, say, section 5 at one end and at the other end to the common junction of the locking and unlocking solenoids of the signal t between sections 2 and 3. The common junction of the solenoids of the signal t' between sections 3 and 4 is also connected to the auxiliary cable r.

The following description of the operation of my improved system, though written with special reference to Fig. 3, can be applied without difficulty to Figs. 4 and 5 also.

Assuming, for example, a car is traveling from left to right in Fig 3 and is on the second section of one of the conductors, it takes current for operating its driving motor or motors from the first section of insulated conductor by way of the auxiliary conductor r through the locking-solenoid k' at the distant end of the third section and through the circuit of the signal-operating mechanism t in series with the second and third sections of insulated conductor. If no car has entered on section 4, coming from the right, then of course the locking device at k' on the left is in unlocked position, and hence the car moving toward the right on section 2 can operate its signal t, indicating that the way is clear. At the same time the locking device k' just referred to is actuated so as to prevent movement of the signal-arm whose operating-circuit is connected between the extremities of the third and fourth sections of the other supply-conductor. A car traveling in the opposite direction along the fourth section is therefore unable to operate its signal and is thus warned that the portion of the single track is not clear. As the first car proceeds from the second on to the third section the signal t between these sections is automatically cut out of circuit and the signal-arm returns to the danger position. The locking device k' of the distant signal t' on the other line, however, remains operative so long as the car is on the third section or single-track portion. When the car passes off this section, the current-supply to the locking-solenoid is cut off, and as the car travels onto the fourth section of the conductor it receives current by way of the auxiliary conductor r through solenoid k^2 of the signal-releasing device. The signal between the third and fourth sections on the other conductor is thus freed, and the car traveling in the opposite direction on the fourth section can travel along the portion of the line to be protected, taking current from the auxiliary conductor r through the locking device k' of the signal t between the second and third sections of the track and unlocking the signal as it passes on to the second section.

Fig. 6 illustrates the case of a double trolley-conductor fed from one end only and merging into a single conductor 5 over the portion of track to be protected. In this case an auxiliary cable r connects the two trolley-conductors of section 1 to those of section 5. The common junctions of the locking and unlocking solenoids at each end of the protected portion of track are connected direct to the merged trolley-conductor by the connections 2 3, said conductor being also connected to the auxiliary cable r by the wire 4. The signal t at one end of the protected section is connected on the one hand to the trolley-conductor of section 2 of track A, over which cars entering from the left hand in Fig. 6 pass, and on the other hand to the locking solenoid k' of the signal t' at the other end of the protected section by way of the wire 6. The unlocking-solenoid k^2 of the signal t' is connected to the trolley-conductor of section 4 of track A. The connections for the signal t' and the locking and unlocking solenoids of the signal t are *mutatis mutandis*, precisely similar to those just described. A car entering from the left in Fig. 6 and being in section 2 will draw its current by way of the signal t, wire 6, locking-solenoid k' of the signal t', and its connections 3, 5, and 4 to the auxiliary cable r. The signal t will therefore be operated and the signal t' locked. On entering section 3 the car takes its current by way of the direct connection 4 to the auxiliary cable r and when in section 4 by way of the unlocking-solenoid k^2 of the signal t' and its connections 3, 5, and 4 to the cable r. The signal t' will therefore be unlocked and can then, if section 3 is free, be operated by a car coming in the other direction. The operation of my system for cars approaching from the right in Fig. 6 is precisely similar and will be understood without further description.

In Figs. 7 and 8 I have shown the application of my system to lock and block signaling on a portion of track fed from both ends.

In Fig. 7 the signals are shown at t and t', while k' k' and k^2 k^2 are the locking and unlocking arrangements, respectively, o o the section-insulators, and e the additional selecting-solenoid, described hereinafter. Numbering the sections from 1 to 5, as before, and calling the tracks A and B, respectively, for

cars approaching from the left and from the right in the figure, the following connections are then made. The signal t and the selecting-solenoid v are connected between sections 1 and 3 of track A by the wires 7 and 8. The locking and unlocking solenoids k' k^2 of the signal t have a common connection 9 to a live portion of the trolley-conductor, the other end of the locking-solenoid being connected to section 2 of track A by the wire 10, while the other end of the unlocking-solenoid is connected by way of the wire 11 to the unlocking-solenoid k^2 of signal t' and thence to section 4 of track A by the wire 12. The signal t' is connected between sections 3 and 5 of track B by the connections 13 and 14, while the locking-solenoid k' of this signal is connected to sections 3 and 5 of track A by the wires 15 and 16, respectively. It will be observed that in this case although the solenoids k' and k^2 of signal t' are placed end to end, as in Fig. 2, and act on the same core h, yet they have not a common connection to a wire, such as u, as in that figure. There is also a connection 17 between section 2 of track A and section 3 of track B and a connection 18 between section 3 of track A and section 4 of track B. Furthermore, section 2 of track B is connected, as shown, by the wire 19 to the unlocking-solenoid k^2 of the signal t'. Upon a car entering section 1 of the track A from the left in Fig. 7 it draws its current by way of wire 7, signal t, selecting-solenoid v, wire 8, section 3 of track A of trolley-wire, wire 15, locking-solenoid k' of signal t', and wire 16 from section 5 of track A of trolley-wire, which is alive. Signal t is therefore operated and signal t' locked. On entering section 2 current ceases to be drawn through the signal t, which therefore flies to the danger position, when it is locked by its solenoid k', (the arm i' of Fig. 1 prevents this locking taking place until the signal is at danger,) the car while in section 2 drawing its current through wire 10, locking-solenoid k', and wire 9. The car now passes onto section 3, which is to be protected, taking current through wire 15, locking-solenoid k' of signal t', and wire 16. This signal, however, having been already locked, no further effect is produced. The car while on section 3 is thus protected by a locked signal at each end of the section. On passing into section 4 current is drawn through wire 12, unlocking-solenoid k^2 of the signal t', wire 11, unlocking-solenoid k^2 of signal t, and wire 9, the unlocking-solenoids k^2 k^2 of both signals being in series. As the connections are not precisely symmetrical for cars passing in both directions, the operation of this modification of my invention will also be described for cars passing along track B from the right in Fig. 7. When on section 5 of track B, the car takes its current through wire 14, signal t', wire 13, section 3 of its trolley-conductor, cross connection 17, wire 10, locking-solenoid k' of signal t, and wire 9. Signal t' is therefore lowered and signal t locked. Passing onto section 4 it takes current through the cross connection 18, wire 15, locking-solenoid k', and wire 16. The car is now protected by locked signals both in front and behind. On track B, therefore, the car is protected throughout sections 3 and 4, and it will be seen that section 4 may be made as short as is desired and the visual signal placed at any suitable part of the track. The car now enters section 3 and takes its current through the cross connection 17, wire 10, locking-solenoid k', and wire 9. The signal t, however, being already locked, no further effect is produced. Finally, when in section 2 current reaches the car by way of the wire 19, unlocking-solenoid k^2 of signal t', wire 11, unlocking-solenoid k^2 of signal t, and wire 9, thus unlocking both signals.

Another modification of the lock and block signaling is shown in Fig. 8, the same letters being used as in the last figure. The section-insulators o o and necessary connections are clearly shown in the drawings, each signal t t' being provided with two locking devices k' k' and two unlocking devices k^2 k^2, as shown, r being an auxiliary cable. The electrical connections are arranged as follows, the sections being numbered from 1 to 5, as before, and the tracks lettered A and B: An auxiliary cable r connects the two trolley-conductors of section 1 to those of section 5. The signal t is connected, on the one hand, to the trolley-conductor of section 2 of track A by the wire 20, and on the other by way of the connection 21 to the auxiliary cable r. The locking devices k' k' of the signals t and t', which are operative for track A, are connected in parallel, as shown, between the wire 21 and section 3 of the trolley-conductor. The A track unlocking-solenoid k^2 of the signal t' has, together with the corresponding locking-solenoid k', a common connection 22 to the wire 21 and is also connected in series, by means of the wires 23 and 24, with the unlocking-solenoid k^2 of the signal t to section 4 of the trolley-conductor. The connections for the duplicate set of signaling appliances for track B being practically the same as those just described will be readily understood from the drawings without further description.

The operation of the modification described above is as follows: On a car entering section 2 of track A from the left in Fig. 8 it draws its current through the wire 20 and signal t, part of the current coming direct from the auxiliary cable r through the wire 21 and part coming by way of the wire 22, locking-solenoid k' of signal t', section 3 of the A track trolley-conductor, and locking-solenoid k' of the signal t, this circuit forming a shunt to the connection 21. The signal t and its locking-solenoid k' are thus energized simultaneously; but, as will be explained more in de-

tail hereinafter when describing the action of a device for giving one car the preference when two cars simultaneously attempt to operate their signals, in such a case the signal-arms falls quickly enough to escape locking. The car then on passing into section 2 operates the signal t and locks the signal t'. Passing onto section 3 the car will now take its current from the auxiliary cable r by way of the connection 21 through the locking devices k' k' of both the signals t and t', said locking devices being in parallel. The signal t' having been already locked, no further action takes place as far as it is concerned; but as current ceased to be drawn through the signal t as soon as the car passed onto section 3 the signal therefore flew to "danger" and is now locked in that position. Consequently while on section 3 a car is protected by a locked signal at each end of the section. The car now enters section 4 and draws its current from the auxiliary cable r through the wire 24, unlocking-solenoid k^2 of signal t, wire 23, unlocking-solenoid k^2 of signal t', wire 22, and thence by way of the connection 21. Both signals are now unlocked, and the car finally passes onto section 5.

With the aid of the above-detailed description the action of this modification of my invention in connection with cars passing over the track B from the right in Fig. 8 will be readily understood without further description.

It will be seen that in each modification described above two lines of trolley-conductors are necessary, although, as in Fig. 5, they need not necessarily extend over the entire distance between the double-line portions.

In view of the possibility on a tramway system of two cars reaching opposite ends of the section to be protected and putting on their controllers at exactly the same instant both signals would be liable to be lowered at the line-clear position. To obviate this difficulty by giving one car preference over the other, I place a third coil on the locking arrangement of one signal—as, for instance, the coil e on signal t, Figs. 3 and 7—which third coil is connected in series with the signal itself. This coil is proportioned and the core adjusted so that the current in the coil will produce a magnetic field which, with the disposition of the iron of the core, will hold against the ordinary locking-coil k' which is in series with the other signal. The third coil will thus always give the preference to the car at its own end of the line.

Instead of the solenoid v I sometimes use a tooth on the projection i' of the arm, Fig. 1, which will engage with the stop h and hold the signal-arm at "half-cock." Thus, supposing two cars to approach simultaneously from opposite directions, current would be drawn through both signals and both locking-coils. The armature e and plunger h will therefore start to move at the same instant; but whereas the plunger has to move some three to four inches before it can lock the signal at "danger" the edge of the arm has only to lower about a quarter of an inch to escape locking, so that if the armature and plunger start to move together the arm i will have moved sufficiently far to escape locking before the plunger comes through. The plunger will, however, catch on the tooth on the projection i' and prevent the signal-arm going right down. If, therefore, the selecting-solenoid v be omitted and a tooth on the arm i be substituted, one car will be able to lower its signal at the line-clear position, while the other car will be able only to slightly lower its signal, the first-mentioned car, therefore, having the preference.

It will be obvious from the above description that a signal cannot be operated unless the car is actually drawing current from the main conductors.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A system of automatic electric signaling comprising, in combination, two series of lengths of trolley-conductors insulated from each other and corresponding to the portion of track to be protected and to adjacent portions at each end; connections bridging certain insulation-gaps at each end of the protected portion of the track; other connections from certain of said bridging connections to a supply-cable together with signal-operating mechanisms and locking and unlocking devices for each series in said bridging connections at respectively opposite ends of the protected portion of track.

2. A system of automatic electric signaling comprising in combination a series of lengths of trolley-conductors in pairs insulated from each other and corresponding to the portion of track to be protected and to adjacent portions at each end; connections bridging certain insulation-gaps at each end of the protected portion of the track; other connections from certain of said bridging connections to a supply-cable together with signal-operating mechanisms and locking and unlocking devices for each series in said bridging connections at respectively opposite ends of the protected portion of track.

3. A system of automatic electric signaling comprising in combination a series of lengths of trolley-conductors in pairs insulated from each other and corresponding to the portion of track to be protected and to adjacent portions at each end; connections bridging certain insulation-gaps at each end of the protected portion of the track; signal-operating mechanisms in certain of said bridging connections and locking and unlocking devices in

other of said connections at each end, a pair of said locking and unlocking devices having a common connection with a supply-cable.

4. A system of automatic electric signaling comprising in combination a series of lengths of trolley-conductors in pairs insulated from each other and corresponding to the portion of track to be protected and to adjacent portions at each end; connections bridging certain insulation-gaps of the conductors at each end of the protected portion of the track; signal-operating mechanisms in certain of said bridging connections and locking and unlocking devices in other of said connections at each end, a pair of said locking and unlocking devices having a common connection with a supply-cable and the operative device of each signal being in series with a locking device of all the others and with a supply-cable.

5. A system of automatic electric signaling comprising, in combination, a series of lengths of trolley-conductors in pairs insulated from each other and corresponding to the portion of track to be protected and to the two adjacent portions at each end; an auxiliary cable connecting the extreme pairs of corresponding lengths of said trolley-conductors; connections bridging the insulation-gaps immediately at each end of the protected portion of track; other connections from certain of said bridging connections to said auxiliary cable together with signal-operating mechanisms and locking and unlocking devices for each series in said bridging connections at respectively opposite ends of the protected portion of track.

6. A system of automatic electric signaling comprising, in combination, a series of lengths of trolley-conductors in pairs insulated from each other and corresponding to the portion of track to be protected and to the two adjacent portions at each end; an auxiliary cable connecting the extreme pairs of corresponding lengths of said trolley-conductors; connections bridging the insulation-gaps immediately at each end of the protected portion of track; signal-operating mechanisms and locking and unlocking devices for each series in said bridging connections at respectively opposite ends of the protected portion of track together with a common connection from each coöperative pair of said locking and unlocking devices to said auxiliary cable.

In witness whereof I have hereunto set my hand in presence of two witnesses.

THOMAS HARISON JONES.

Witnesses:
DUDLEY CARLETON COLCLOUGH,
ROBERT ALFRED SHEPPARD.