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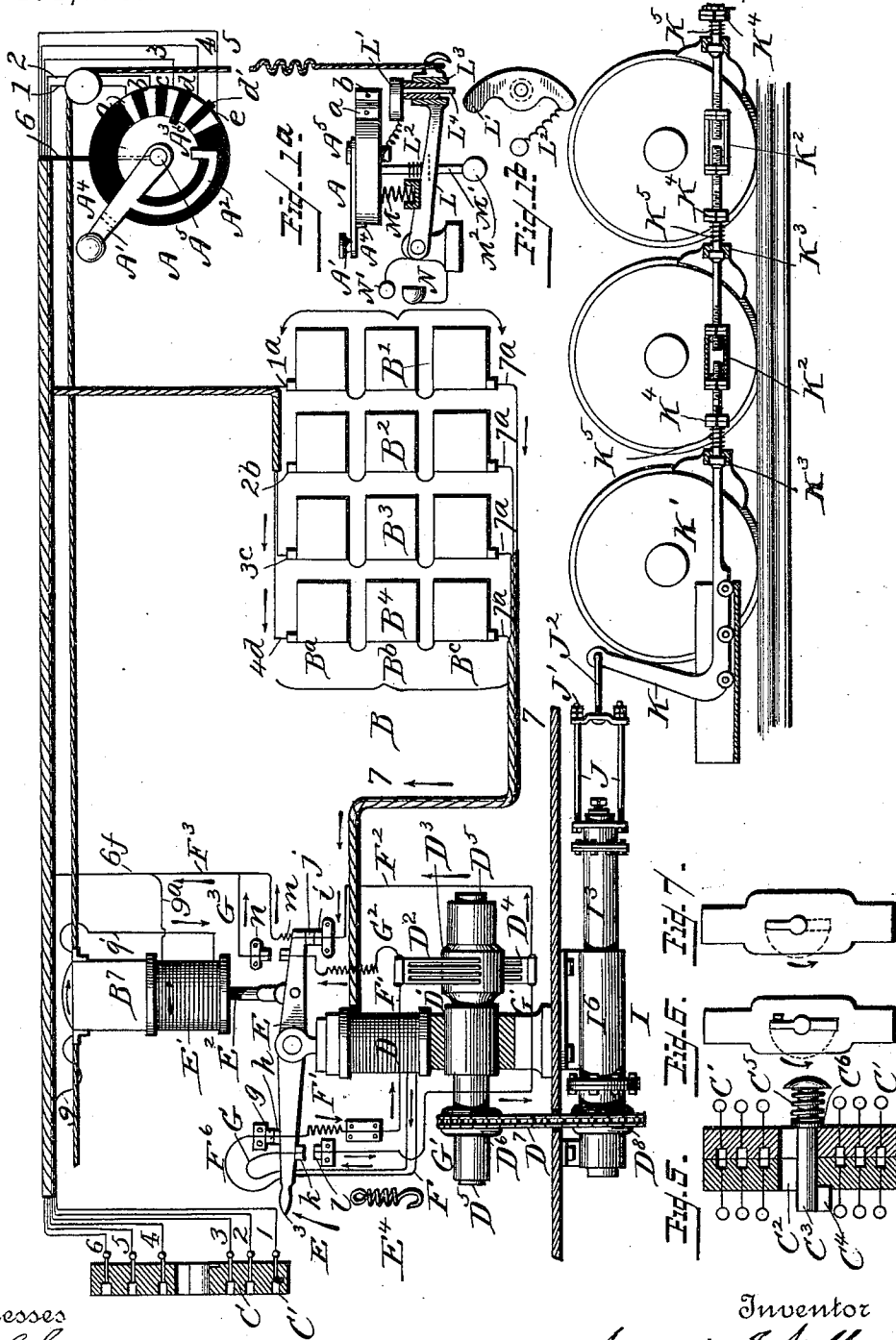
5 Sheets—Sheet 1.

A. I. AMBLER.
ELECTRIC RAILWAY BRAKE.

No. 461,770.

Patented Oct. 20, 1891.

Fig. 1.



Witnesses
Albert Speiden.

Inventor
Augustine F. Ambler

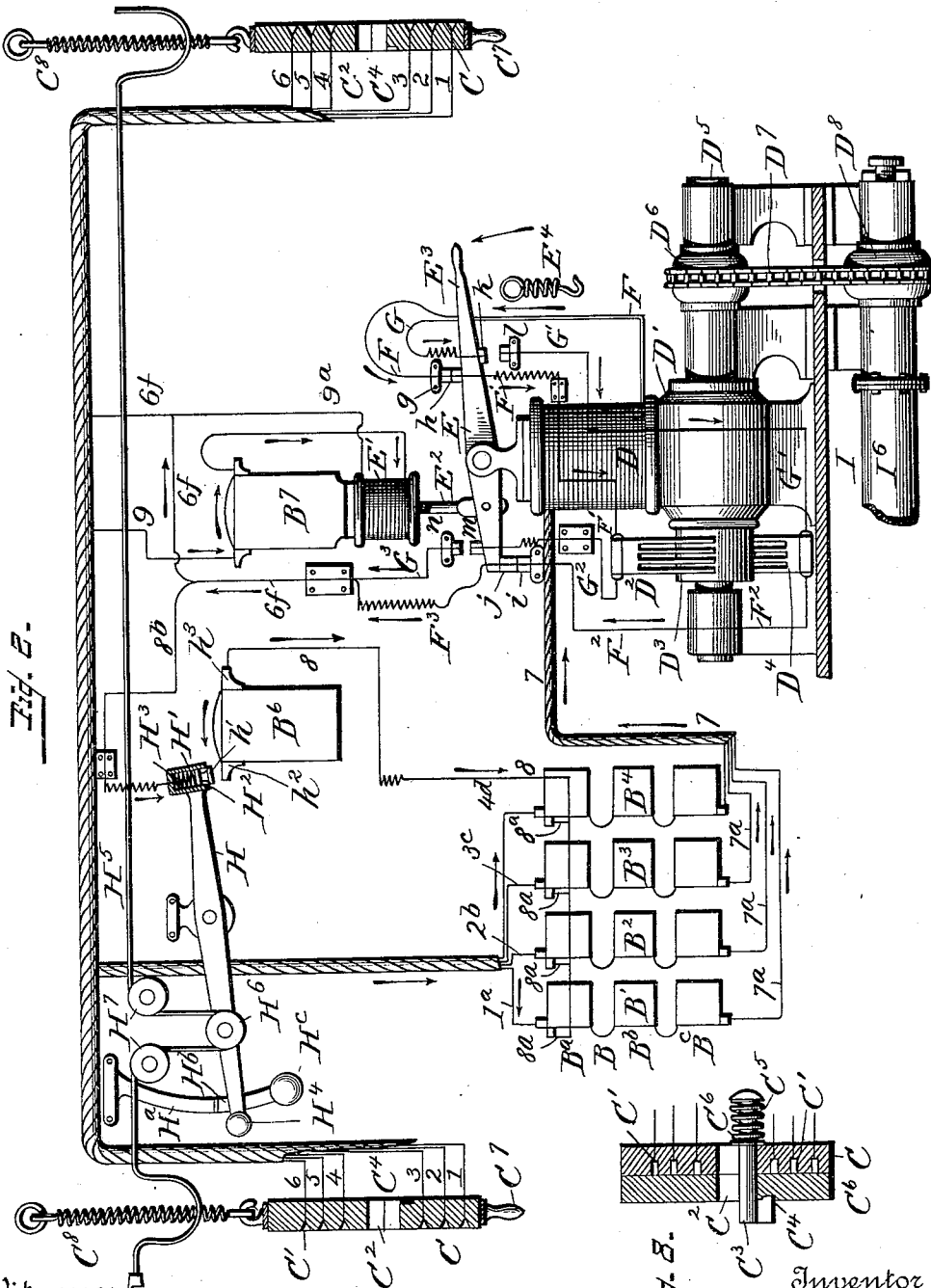
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5 Sheets—Sheet 2.

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Witnesses

Albert Spiden.

Fig. B.
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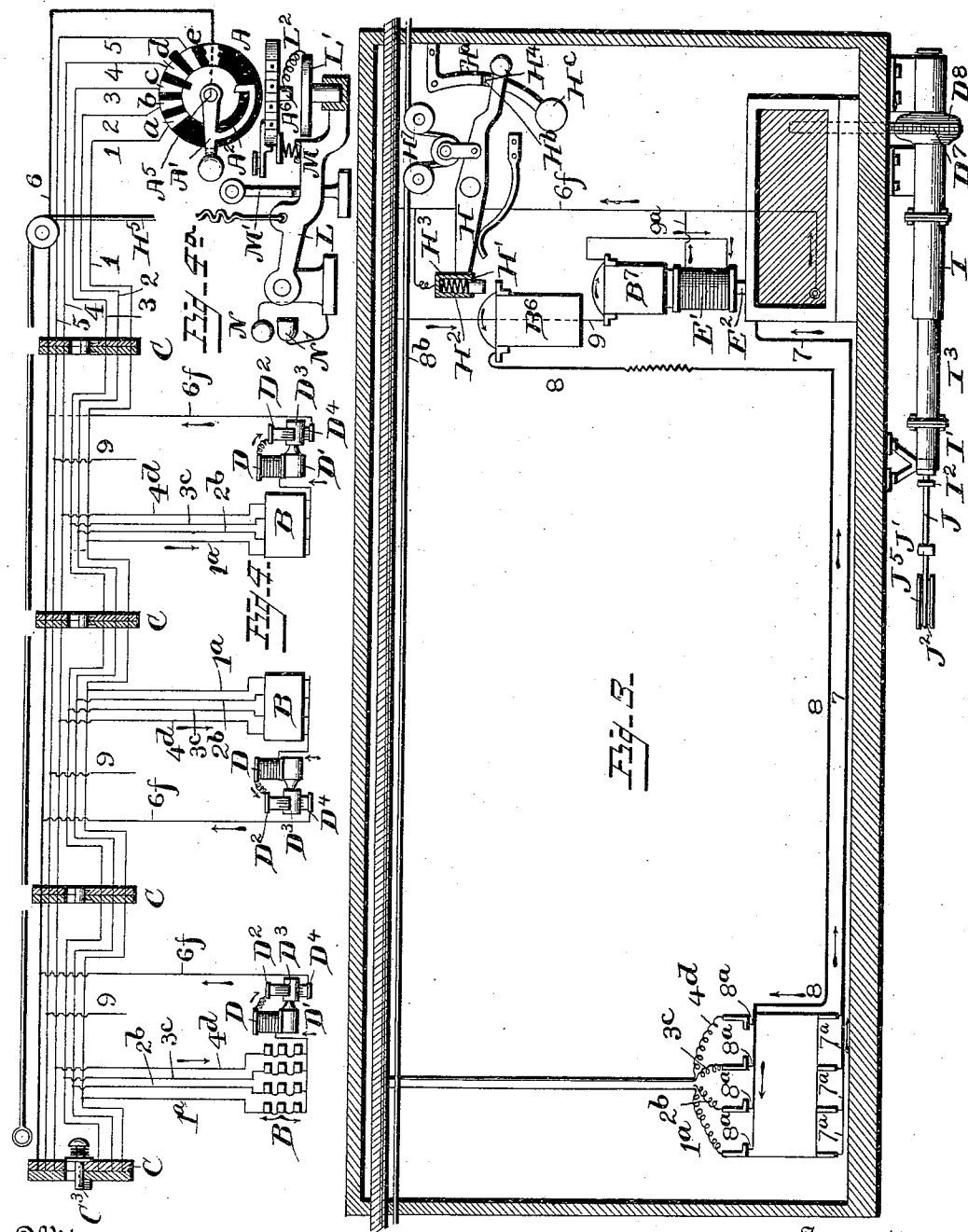
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5 Sheets—Sheet 3.

A. I. AMBLER.
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No. 461,770.

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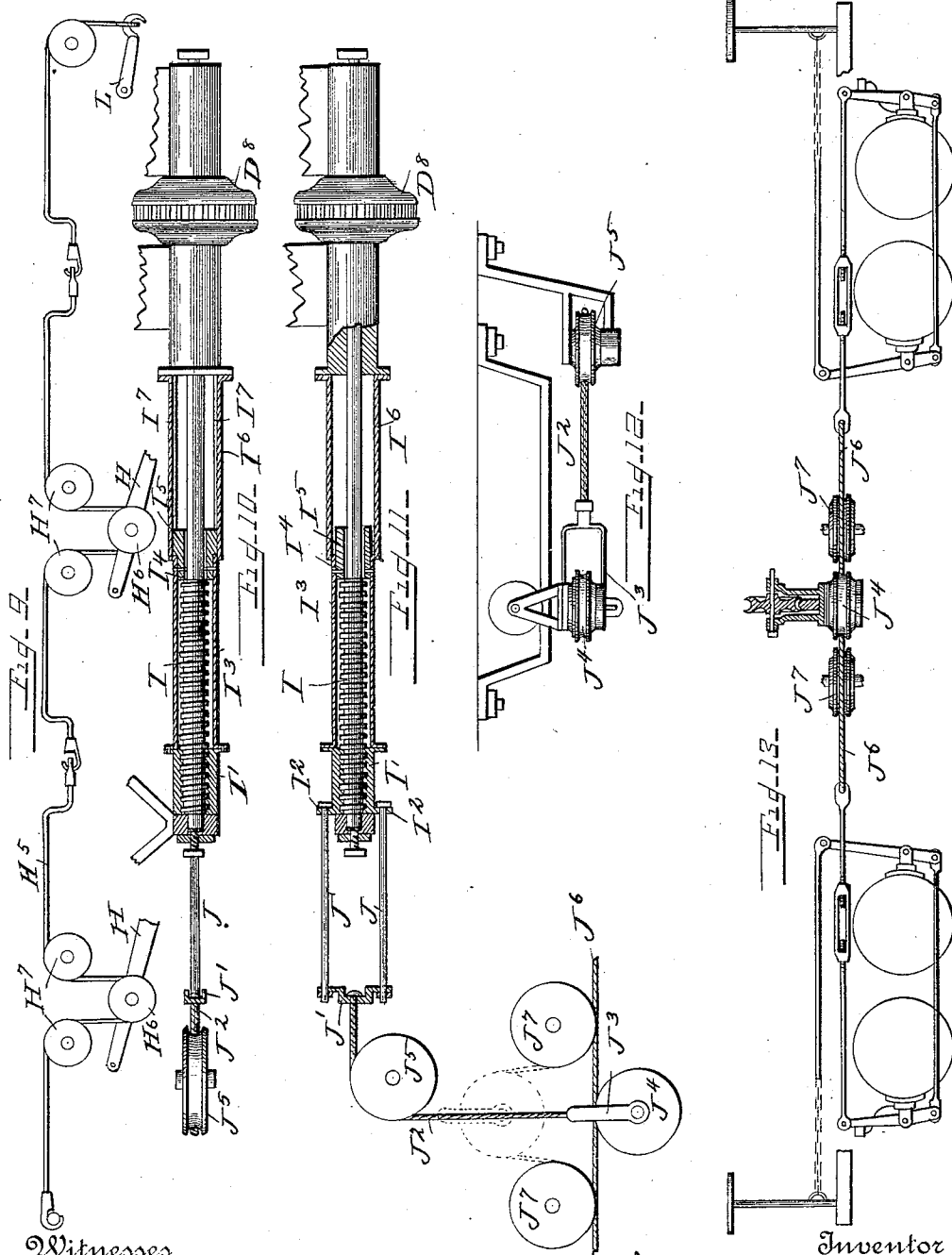
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Patented Oct. 20, 1891.



Witnesses

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J. D. Kung'ari

Augustin J. Embler
By his Attorneys
Whitaker & Trench

(No Model.)

5 Sheets—Sheet 5.

A. I. AMBLER.
ELECTRIC RAILWAY BRAKE.

No. 461,770.

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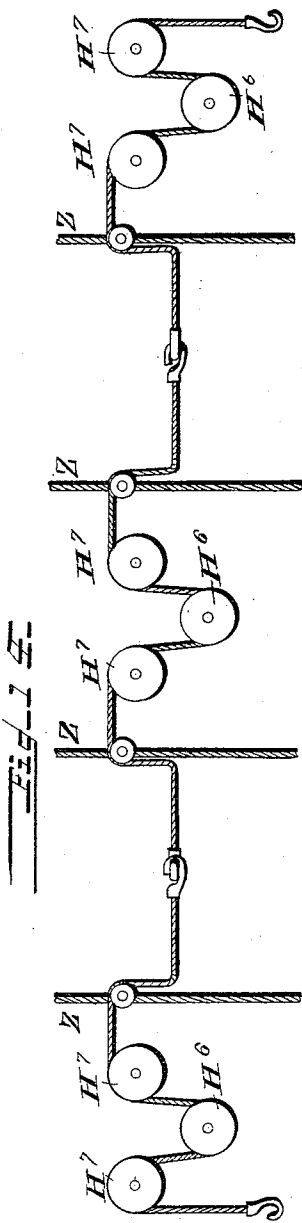
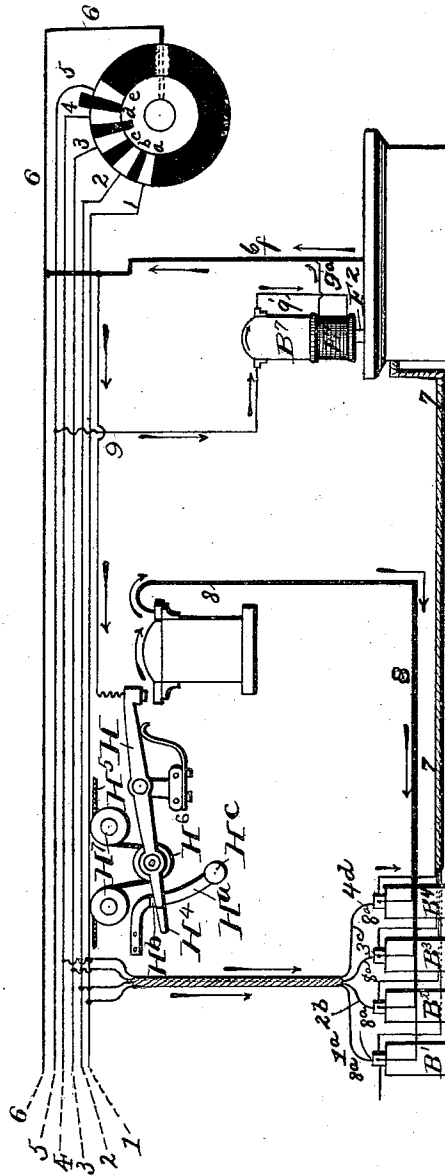


Fig. 15



Witnesses

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Augustin J. Ambler

UNITED STATES PATENT OFFICE.

AUGUSTIN I. AMBLER, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR
TO ROSELINE N. AMBLER, OF SAME PLACE.

ELECTRIC RAILWAY-BRAKE.

SPECIFICATION forming part of Letters Patent No. 461,770, dated October 20, 1891.

Application filed December 18, 1890. Serial No. 375,162. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTIN I. AMBLER, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Electric Railway-Brakes; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The nature of my invention consists in the application of electricity to the mechanical means employed to operate the brakes of a train of cars, first, by the engineer on the locomotive in daily use; second, by the conductor from any car in the train, and, third, by automatically setting the brakes on each car if the train accidentally breaks apart and the cars become detached and separated. It embraces a primary system and a secondary or sub system having certain elements that act in common with both and certain distinctive features in application and mode of operation, hereinafter fully described and shown.

My invention has for its object first, to provide means whereby ordinary and emergency braking may be done from the locomotive; second, from any car of the train, and, third, automatically, as aforesaid; and, further, whereby the brakes on the driving-wheels of the locomotive and the wheels of each car composing the train may be instantaneously and simultaneously applied and with equal pressure throughout the train, and as instantaneously released by the engineer upon the locomotive. To these ends the locomotive and tender and each car are fully equipped with suitable acting and coacting mechanism and provided with the electro-motive force required.

In constructing and applying a train-brake apparatus of this character I employ a suitable switch-board having movable and fixed contacts, main-line transmitting-wires, coupling, branch wires, storage-batteries, reversible motors, switch-levers, worm or screw shafts and connections, fixed and movable pulleys, flexible connections, and the levers and brakes of the hand-brake system as now in use.

I will now proceed to designate the several parts of my invention, as illustrated by the

drawings, by letters and numerals of reference, indicating corresponding parts in the several figures, in which—

Figure 1, Sheet 1, represents my invention as applied to a locomotive and tender combined, showing a switch-board, current-transmitting wires, storage-batteries, a reversible motor and connections, and the mechanism for applying the power to the driving-wheels of the locomotive. Fig. 1^a is a side view of the switch-board in elevation, showing a segmental contact in open circuit attached by wire to the center post, a switch-lever, bell and sounder, and connections for operating the same. Fig. 1^b is a top or plan view of segmental contact, center post, and connecting-wire. Fig. 2 represents such parts as are intended to be applied in the equipment of each separate car, including couplers, storage-batteries, a reversible electromotor and connections for operating the same, also including a device having a continuous rope, a movable pulley, fixed pulleys, a switch-lever, an auxiliary battery, movable contact and fixed contacts, and connections, as a sub-system for operating the brakes on each car by hand or automatically. Fig. 3 represents the interior of a car-body, showing a storage-battery and connections, a motor incased, including the device or sub-system for operating the brakes as in the former figure. Fig. 4 represents a diagrammatic view of the main-line wires separated to show the running of the current, attached to the switch-board and forming a complete circuit, open-circuit couplings, an inclosing cap in place, branch wires, batteries and motor, and sections of continuous rope. Fig. 4^a is a slightly-modified form of the construction shown in Fig. 1^a, Sheet 1. Fig. 5 is a sectional view of the open-circuit coupling-blocks with coupling-key in place uniting the same. Fig. 6 is a back view of the inclosing cap to be used and applied to each open-circuit coupling when the latter is not connected to the coupling of an adjacent car, and always to be applied to the open-circuit coupling on the rear end of the last car composing the train. This cap must be applied to all open-circuit couplings when disconnected at each end of the car to protect the headings of the current

transmitting-wires from injury from dust, dirt, smoke or other causes, as it is well known to persons skilled in the art that all contacts must be kept in a clean and bright condition to secure a good conductivity and the greatest efficiency in practical use. This inclosing cap must be made of insulating material to prevent short-circuiting. Fig. 7 is an inside view of the insulated inclosing cap to cover the headings of the current transmitting-wires from contact with injurious substances. Fig. 8, Sheet 2, shows a sectional view of the inclosing cap connected to the open-circuit coupling-block in section, with coupling kept in place. Figs. 9, 10, 11, 12, and 13, Sheet 4: Fig. 9 shows a continuous rope and coupling-hooks, similar to a bell-rope fastened to a switch-lever on the locomotive and to a fixture on the rear end of the last car, engaging fixed pulleys, and a movable pulley pivoted to an arm of a switch-lever on each car to operate the brakes by hand or automatically. Fig. 10 is a side view, partly in section, of screw-shaft, transversing lug-nut, tubular coverings and connections for transmitting power to the brakes. Fig. 11 is a plan view of the same, showing tension or drawing rods, a movable pulley, fixed pulleys, and flexible connections for the same purpose, as stated above. Fig. 12 shows a detail of the invention to suspend the movable pulley, including a suspended track, a traversing pulley thereon, and a fixed pulley in line of draft. Fig. 13 shows in elevation the truck-wheels of a car and the operating mechanism connected therewith, including a side view, partly in elevation and partly in section, of the central device located between the trucks of each car to operate the brakes. Fig. 14, Sheet 5, is a side view showing a continuous rope with coupling-hooks between the cars similar to the bell-rope in ordinary use, engaging fixed pulleys on the upper circle and a movable pulley on the lower circle and sections of the ends of each car. Fig. 15, same sheet, is a side view of a part of the apparatus as applied to each car, being a modification of Fig. 3, showing switch-board main-line wires separated from each other into distinct lines, and partly-separated branch wires, the latter being connected both with the line-wires and each division of the battery—that is, each branch wire is connected to the line-wire and to the division of the battery in circuit, showing also motor-casing, solenoid, and battery to energize the same, connecting wires, and the device or sub-system to operate the brakes automatically or by hand.

A is the switch-board on the locomotive for operating the brakes of all the cars throughout the train by the engineer. This board is circular in form, sunk in the central portion of non-conducting material, and so constructed as to separate and insulate the metallic electric conducting parts from each other when not in circuit and to limit the movement of the movable contact. Upon the

switch-board there is located a switch-lever or movable contact-arm A', having a segmental plate A², attached thereto, arranged concentrically and pivoted to a metal conducting center post A⁵ to close and open the circuit both in setting and in releasing the brakes. This switch-board is further provided with fixed metallic contact-pieces arranged concentrically around a part of the periphery of the board (lettered *a*, *b*, *c*, *d*, and *e*) and insulated from each other, and to each fixed contact-piece is connected one of the main-line current-transmitting wires, respectively 1, 2, 3, 4, and 5. Line-wire 6, being a common return-current-transmitting wire for all the wires, is connected with the center-post A⁵ of the switch-board, being the pivotal contact of the operating switch-lever A', through which all the circuits are closed and opened. As shown, A' is the movable contact and has a lug A⁴ projecting downward on its under side to limit its movement in one direction. A² is the segmental contact, and has a lug A³ turned down on the inner side of the heading at the end to limit the movement in the opposite direction. A⁵ is the metallic and conducting center-post of switch-board A, to which is attached the common return-current wire 6. The non-conducting part of the switch-board separating the contacts *d* and *e* extends outward beyond the outer circle of the switch-board lettered *d'*, and between fixed contacts *c* and *d* the same material extends inward beyond the inner circle lettered *c'*.

Numerals 1, 2, 3, 4, and 5 are the main-line transmitting-wires, respectively connected with fixed contact-pieces *a*, *b*, *c*, *d*, and *e*, as stated, and extending continuously through each car, and by means of the open-circuit and connecting coupling-blocks throughout the entire train to the rear end of the last car.

6 is the common main-line return-current wire, referred to, running through the entire train to complete the circuit for all the transmitting-wires.

1^a 2^b 3^c 4^d are branch wires, connecting the corresponding line-wires with the poles of the several divisions of the battery in circuit.

7 is a wire connecting the pole of each separate division of the main battery B by means of branch wires 7^a 7^b 7^c 7^d and the field-magnets of the electromotor, and 6^f 6^f are the branch wires on each car for transmitting return currents after passing through all parts of the motor and connections in circuit to the main-line return-current wire 6 to the center-post A⁵.

8 is a wire connecting the fixed contact of one pole of each division of the main battery by means of the branch wires 8^a 8^b 8^c 8^d.

8^b is a branch wire connecting return-current wires F³ and 6^f, after passing through the motor, with the movable contact in the boss end of switch-lever H, to complete an independent circuit as a part of the sub-system for use in cases of emergency.

The auxiliary battery B⁶ is not deemed of

any certain advantage beyond the necessity of completing the circuit, as illustrated in the drawings, and possibly in practical use by supplying two additional volts to the electro-motive force to the motor in its connection with the main battery in case of application for quick stops in cases of emergency, for which alone it is brought into use.

9 is a branch wire connecting line-wire 5 with an auxiliary battery to energize solenoid and reverse motor, (illustrated in Figs. 1, 2, 3, and 15, Sheet 5, of the drawings;) 9', wire connecting battery with solenoid, and 9^a return-current wire to 6^f, to line-wire 6.

B is the main working storage-battery on each car connected both in series and parallel to energize the magnets and armature of the motor. B^a B^b C^c are placed in series, and B⁴ B³ B² B¹, in Fig. 1, Sheet 1, are placed in parallel with the numerals, as indicated, and in Fig. 2, Sheet 2, they are also in parallel, and are indicated as follows: B¹ B² B³ B⁴; also as in Fig. 15, Sheet 5. These letters and numerals represent, respectively, the divisions of the battery, and they must be placed as indicated to form a part of the circuit for the running of the current through them.

B⁶ B⁶ are batteries by which the circuit may be closed on each car to operate the brakes separately, either by hand or automatically, if the train breaks apart. One pole of this battery being connected with all the poles in circuit of all divisions of battery B, the current passes through all divisions of the battery, and thence to and through the motor, and by return-current branch wires F³, 6^f, and branch wire 8^b to the movable contact h' on the boss end of switch-lever H, and when the circuit is closed to the return-pole contact at h² of battery B⁶ completing an independent circuit on each car.

B⁷ is a battery to energize solenoid to reverse motor and release the brakes.

C C are the open-circuit couplings or coupling-blocks between cars for connecting main-line wires. These coupling-blocks are made of non-conducting material and are provided with fixed contact-plates C', and connecting wires, also with a centrally-located key-hole C² and coupling-key C³ for coupling the blocks of adjacent cars. On one side they are provided with a recess C⁴, to retain the coupling-key in place when connected together. They are also so constructed as to insulate the wires and headings from each other. The headings and wires are also securely fastened therein and each heading is stamped with the numeral belonging thereto, commencing at the bottom, as shown. Coupling-key C³ is provided with a spring C⁵ and a pressure-cap C⁶.

C⁷ is a handle to bring coupling-blocks together, and C⁸ the means for suspending the couplings from the top of the car-body. It will be readily seen that the usual amount of slack should be provided between the cars.

D is the magnet of motor; D', armature;

D², upper contact-brush; D³, commutator; D⁴, under contact-brush; D⁵, shaft of motor; D⁶, sprocket-wheel of motor; D⁷, sprocket-chain or band or rope connection, with corresponding wheel on screw-shaft; D⁸, wheel on end of worm-shaft to rotate the same; E, switch-lever to reverse motor; E', solenoid; E², armature of solenoid to operate switch E; E³, extended arm of switch-lever to reverse the motor by hand; E⁴, spring with hook to hold lever in contact; F, wire connecting magnet with fixed contact g; F', wire connecting movable contact h on switch-lever E with upper contact-brush D²; F², wire connecting under contact-brush D⁴ with fixed contact i; F³, wire connecting movable contact j on switch E with branch return-current wire 6^f, these contacts being closed and shown in circuit; G, wire connecting magnet with movable contact k (open circuit shown) on switch E; G', wire connecting fixed contact l with under brush D⁴; G², wire connecting upper contact-brush D² with movable contact m on lever E, open circuit; G³, wire connecting fixed contact n with return-current wire 6^f.

H is a switch-lever to close circuit, either by hand or automatically, if the train breaks apart. This lever is provided with a boss H' and a recess H² at one end, and with a spring H³ to give elasticity to the contact, and at the other end with a handle H⁴ to operate the same by hand, also a spring H⁵, having a dog or catch H⁶ to hold this lever in contact, and a knob H⁷ to release the same.

h' is a movable contact at the boss end of switch-lever H.

h² is a fixed contact at the left pole of battery B⁶, and h³ is a fixed contact at the other pole of the same battery. Fixed contact h² may be located and secured at any convenient place in the car, so that connection may be made by the downward movement of the movable contact h' at the boss of the switch-lever H, said contact h² being directly connected by transmitting current-wires with all the poles of the main battery to complete an independent circuit, and by such an arrangement the battery itself may be dispensed with, as heretofore indicated. With this lever, by means of a continuous rope H⁸, movable pulley H⁶, pivoted thereto, and two fixed pulleys H⁷ H⁷, the contacts may be closed and the cars broken by a pull or strain upon said rope from any part of any given car; or the engineer may use it on the locomotive for the same purpose, and if the train breaks apart the pull or strain upon this rope will automatically set the brakes on each and every car composing the train by the upward movement of the movable pulley H⁶ and the downward movement of the other end of lever H to contact with the fixed contact h² of one pole of the battery B⁶, by which the full force of battery B is brought into use and the full power of the motor is communicated to the screw-shaft, and by the mechanism employed the brakes are on each car brought practi-

cally instantaneously to the maximum of pressure, either by means of tension upon the rope or by hand. The rope, it will be seen, is in all respects precisely like the bell-rope now in constant use, and it is fastened at both ends of the train—at the locomotive to the lever, as shown in Fig. 1^a, Sheet 1, and at the rear end of the last car in the train, allowing, as now used, the usual amount of slack. This rope H⁵ passes over and engages the fixed pulleys H⁷ H⁷ and passes under and engages the movable pulley H⁶, pivoted to the lever H, and when a sufficient pull or strain is made upon the rope, either by hand or the breaking apart of the train, the brakes will be applied upon every car composing the train, whether detached or not.

I is the screw-shaft, upon which a thread is cut about half-way of its length.

I' is a traversing nut made to fit the screw or screw-shaft and traverse thereon. This nut has two lugs I² opposite to each other at one end, and at the other end it is securely connected to a tube-covering I³, said tube having a heading I⁴ at the other end secured thereto. This heading has two projections or lugs I⁵ opposite to each other. This heading and connecting-tube enter a larger stationary tube or covering I⁶ and telescope therein. This latter tube has grooves or channels I⁷, in which the lugs I⁵ move in the stationary tube or covering I⁶ to prevent the inner tube and traversing nut from turning with the movement of the screw-shaft. These tubes or coverings are for the twofold purpose of keeping dust and dirt from the screw-shaft and protecting the same and for providing a reservoir for oil for the lubrication of the working parts, which is supplied by suitable oil-cups in the usual way. The lugs I² have holes for the passage and application of two drawing-rods J J.

J' is a heading connecting the ends of the rods J J, through which heading J', and securely connected thereto in the line of draft, is a wire rope J², which rope is attached to a stirrup or clevis J³, connecting said rope with a movable pulley J⁴, said rope having passed over and engaged with a fixed pulley J⁵. Said pulley J⁴ engages on its upper side a wire rope J⁶. There are also two fixed pulleys J⁷ J⁷, one on each side of pulley J⁴, the bottoms of which are in line with the top of pulley J⁴. These pulleys engage on the under circle with wire rope J⁶, while pulley J⁴ engages the same rope between the two pulleys on the upper circle. This wire rope being connected with the long arms of the truck-levers, as shown in Fig. 13, Sheet 4. It will be seen that the movement of the nut upon the worm-shaft and the upward movement of the pulley J⁴ will draw the wire rope J⁶ into a loop or bight, (see dotted lines, same figure,) the effect of which is to shorten the distance between the connected long arms of the truck-levers, and thereby set the brakes on each car. The reverse movement releases them.

The truck-wheels, levers, brake-beams, and shoes and their connections, as in common use, are so clearly shown in Fig. 13, Sheet 4, that no detail description is necessary.

In Fig. 1, Sheet 1, representing that part of the invention as applied to the brakes of the driving-wheels of the locomotive, the following letters indicate the several parts: K is a turn-up or goose-neck on the end of the operating-rod to bring the draft in line with the center of the worm-shaft. This end of the rod runs in a groove or channel-frame, and has anti-friction rollers therefor. K' is a combination brake-rod connecting all the brake-beams of the locomotive. This rod is made in three parts connected together by means of couplings K², and there are forged thereon at the proper places on the connecting-rod suitable collars K³ to keep the brake-shoes off the tread of the wheels when not in use in braking. These collars might be made with a collar fastened on the rod by set-screws, or by other means; but they would be less secure and therefore objectionable. This rod has also threaded parts, as shown, between the brake-beams and abutting jam-nuts, and at the couplings connecting the three parts of the brake-rod and nuts K⁴ and springs K⁵ intervening between the brake-beams and the nuts, as clearly shown, the nuts serving as abutments for said spring. The object of making the rod in three parts is to enable me to use forged bearings thereon, and of the spring to equalize and give elasticity to the pressure when brought into use.

In Figs. 1^a, Sheet 1, and 4^a, Sheet 3, L is the switch-lever to operate an independent segmental contact by means of the rope H⁵ connected therewith. This lever is made with a boss and recess having a metal rod connected with the segmental contact passing down through the bottom of the same, but insulated therefrom. L' is the segmental contact. L² is a transmitting-wire connecting said contact with center post of switch-board A. L³ is a rubber tube to give elasticity to the contact pressure when engaged, and extends from the segmental contact to the bottom of the recess. L⁴ is the metal rod; M, pressure-spring connected with switch-board and lever L to press down lever and segmental contact out of circuit; M', spring slanting-catch to hold segmental plate in contact when in circuit; M² knob to release the same; N N' are the signal-bell and sounder attached to the frame and lever L.

In order to a clear understanding of the operation of the invention I will proceed to describe the same. First I will state that the electro-motive force is divided into four divisions or parts for the purpose of effecting four different kinds of stops: first, to slow downgrade; second, to make a moderate stop; third, a quick stop, and, fourth, an emergency stop. Second, the current should only be used in ordinary braking for the few seconds required in bringing the brakes to the maxi-

mum of pressure required, when the circuit should be opened and the current cut off. In slowing downgrade the engineer will move his contact-arm A' into contact with fixed contact *a* on his switch-board, and as soon as the brakes are applied return his arm A' to its normal location on the insulated part of the board, as the thread of the worm should have such pitch both for power and resistance to reaction that it will practically hold all it gets without any further flow of current. The circuit being thus closed, the current will run on the main-line wire 1 from fixed contact *a* on switch-board A on the locomotive to branch wire 1^a on each car, thence to one pole of division B' of battery B (see Fig. 15, Sheet 5,) through same in series to the opposite pole B^c (see Figs. 1 and 2,) thence by wires 7^a and 7 to the magnet of the motor, thence by wires F and F' to upper brush D² by commutator D³ to and through armature D' to lower brush D⁴, and thence by wires F², F³, and 6' to main-line return-current wire 6 to center post of switch-board A, and the circuit will be complete for one division of the battery on the locomotive and each car composing the train. It will be thus seen that the current traversing the main-line wire will shunt at each car and perform its function of shunting throughout the train to the center post of the switch-board A, and thereby complete the circuit. If the engineer desires to make a moderate stop, he will connect his contact-arm with fixed contacts *a* and *b*, by which means he adds another division of his battery to his electro-motive force, the current passing onto two main line-wires 1 and 2 branch wires 1^a and 2^b instead of one, and taking two divisions in circuit instead of one, B' and B², Figs. 1, 2, and 15, the operation being otherwise precisely the same as in the former case, and in case an emergency stop is required he includes all divisions of the battery by contact of arm A' with *a*, *b*, *c*, and *d*, beyond which he cannot go, and the same results follow as in the former cases, except he includes all his electro-motive force and makes the quickest possible stop. When he desires to release the brakes, he moves his contact-arm in the opposite direction until the lug on the heading A³ on the segmental part A² of the arm A' comes in contact with the inner projection, when he will close the circuit on fixed contacts *d* and *e*. Contact *d* will cause the current to run on line-wire 4 and branch wire 4^a on each car to the fourth division of the battery B—that is, to each division on each car in series of B⁴—and at the same time contact *e*, being also closed, will cause the current to run on line-wire 5 and branch wire 9 to battery B⁵, thence to solenoid, and through same back to return-current wire and to center-post, as in the former cases, the effect of which latter operation will be to energize the solenoid, draw in the armature, lift the switch-lever, connect and close the contacts that have been open, and open the contacts

that are normally closed, and thereby reverse the current through the armature of the motor, and release the brakes by means of the close of the circuit at *e* and of the electro-motive force of division B⁴ of battery B, and on each car the brakes will not only be released, but entirely removed from the wheels. As soon as the brakes are released and the arm A' is returned to its normal location on the insulated part of the switch-board and the circuit is opened, the switch-lever on each car will be pressed down by the weight of the armature of the solenoid and will return to its normal condition. Thus it will be seen that the engineer has the most perfect control of the brakes of his train, both in setting and in releasing them, and that all the brakes in the train are simultaneously applied and with equal pressure upon all the cars and all the wheels throughout the train, and should the train break apart and the cars become detached and separated from each other the strain upon the rope H⁵, as heretofore indicated, will not only apply the brakes on each car by means of the mechanism described, but it will also raise up the lever and segmental contact and connect the same with the fixed contacts *a b c d* simultaneously on the switch-board of the locomotive, and at the same time notify the engineer by striking the bell-signal. (See Fig. 1^a.)

In case the train breaks apart and the cars become separated from each other and the circuits on the main-line wires are broken no current can be transmitted upon them. Hence I have provided an independent sub-system to avoid as far as possible the dangers resulting from such separation. To effect this object I provide means by which the brakes of each separated car, and all the cars composing the train, whether detached from the engine or not, may be instantaneously applied. This system consists of the following elements of construction: first, a continuous rope H⁵ and fixed pulleys H⁷ H⁷; second, a movable pulley H⁶ on switch-lever H; third, spring with catch H and H to release the same by hand; fourth, movable contact *h*; fifth, battery B⁶ and fixed contacts *h*² *h*³; sixth, transmitting-wire 8, connecting fixed contact *h*³ of one pole of battery B⁶ by branch wires 8^a 8^a 8^a with the circuit-connecting poles of all divisions of battery B; and, seventh, branch wire 8^b for return current to the movable contact *h*' at boss of lever H, and when connected in circuit to fixed contact *h*² to complete the independent circuit, the operation of said sub-system being as follows: The circuits being broken, as previously referred to, on the main-line wires and the cars separated, the strain or pull upon the rope H⁵, by the act of separation, engaging and passing over the fixed pulleys H⁷ H⁷ and under and engaging the movable pulley H⁶ on each car, the switch-lever will be drawn up over the catch H⁵ at one end and will be forced down at the other end to contact with the fixed contact *h*', thereby

closing the circuit through battery B⁶, (the current connecting the opposite pole thereof,) and by fixed contact h³ and wire 8 and branch wires 8^a 8^a 8^a 8^a, thereby connecting in circuit the motor and all the poles of all divisions of battery B through the same to and through the motor to branch return-current wire 6^f to wire 8^b, thence to the contact of lever H to contact with contact-pole h³ of battery B⁶, thus completing an independent circuit and supplying the electro-motive force to each motor, and by the mechanism employed applying the brakes and retaining the pressure of the entire electro-motive force of the battery until released by hand on each car. The running of the current through all parts of the motor has been already fully described, as in the case of braking from the locomotive by the engineer, both being precisely the same to, through, and from the motor, in the latter the current running on branch wire 8^b from 6^f to the movable contact h¹ to fixed contacts h² and h³ of both poles of battery B⁶ to complete the independent circuit, and, as well known, great danger and the most serious results arise from the collision of detached and separated cars. This sub-system is an important feature of the invention.

It may be noted that at the moment the motor starts to rotate, the first revolutions will meet with but little resistance, as when the first pressure is made upon the rope connecting the truck-levers the electro-motive force has only the slack to take up and the resistance of the springs to overcome. The operating-force which applies the brake-shoes to the wheels is made when the full force of each division of the battery is brought into action and the magnets of the motor are fully charged for work. It is also an important factor in the application that the brake-shoes may be set back from the tread of the wheels as far as desirable in practical use, so as to prevent any pressure upon the wheels when the brakes are not being applied. The release of the brakes does not depend exclusively upon the retraction-springs, spring of the levers, and the "back action," but upon all these combined with the reversal of the motor and worm-shaft, and the retraction-springs and back action have only to overcome the "opposition" or opposing force of a pulley and flexible connections released from the tension of braking, so that practically the brake-shoes are simultaneously and instantaneously released from the tread of the wheels throughout the train, and the braking is done with the most perfect equality of pressure upon all the wheels upon all the cars in the train.

It will be observed that I combine the operation of the brakes on the locomotive by means of the switch-board, its movable and fixed contacts, and connecting-wires with the brakes of all the cars composing the train, so that by one manipulation or movement of the movable contact thereon the brakes are si-

multaneously set on the locomotive and all the cars throughout the train, and by the reverse movement and contact the brakes are simultaneously and correspondingly released. The special object of this combined system and mode of operation is to practically avoid as far as possible one of the most serious causes of disaster, which results from a divided system—that is, when one manipulation is required to operate the brakes of the locomotive and another to operate the brakes of the train, requiring two manual applications instead of one. In a recent disaster the brakes of the locomotive were instantly applied, but the engineer had no time to operate the brakes of the cars, so that the cars unbroken rushed upon the locomotive, upon which the brakes had been applied, and the engine was whirled over endwise to the great destruction of property and the loss of human life. The engineer had no time to manipulate the brakes of the cars and a fearful disaster was the consequence of this divided system. The number of cells to be employed in the battery for this work should have about two volts of electro-motive force, and the cells need not exceed ten ampere hours, as the battery is in use at each application less than five seconds, so that a charge of the battery to ten hours would give over six hundred applications.

I have made the working battery, as shown, of twelve cells divided into four divisions in multiple or parallel, and each division in series of three cells, which with a motor of one-horse power I deem sufficient for the purposes required.

What I claim, and desire to secure by Letters Patent, is—

1. In an electric train-brake for railroad-cars, the herein-described system for applying and releasing the brakes of a train of cars from the locomotive, which system is composed of the following elements: a switch-board on the locomotive, movable and fixed contacts, and transmitting-wires, and on each car storage-batteries, a reversible electromotor, reversing-switch, a solenoid to operate the same, and connecting-wires, in combination with a worm-shaft connected with and operated by said motor, a traversing lug-nut on said shaft, tension or drawing rods, and heading connecting the ends of said rods, a wire rope or flexible connection connecting said heading with a movable pulley, said pulley engaging on the upper circle a wire rope connecting the long ends of the truck-levers, and two fixed pulleys, one on each side of the movable pulley engaging the said last-named wire rope on the under circle of said fixed pulleys, truck-levers, brake-beams, and brake-shoes, substantially as shown and described, and for the purpose set forth.

2. In an electric train-brake, the herein-described sub-system for applying and releasing the brakes on each car of the train in cases of emergency, which sub-system is com-

posed of the following elements: a continuously-connected rope, one end fastened at the locomotive and the other end to the rear end of the last car of the train, and on each car
 5 fixed and movable pulleys, said fixed pulleys engaging said rope on the upper circle, and said movable pulley engaging said rope on the under circle, a switch-lever near one end of which is pivoted said movable pulley to operate said switch, and at the other
 10 end an elastic movable contact, a spring and catch to hold the lever in contact, in combination with fixed contacts, current-transmitting wires, storage-batteries, a reversible motor and connections, a switch-lever and handle for reversing the motor, a spring and hook to hold the same in contact till released by hand, a worm-shaft and connections with motor, a traversing lug-nut on
 20 said shaft, tension or drawing rods and heading, a movable pulley, a wire rope connecting said pulley with said heading, fixed pulleys, a flexible connection engaging said pulleys and connecting the long arms of the truck-levers, and the truck-levers and brake-beams, and brake-shoes, substantially as described and shown, and for the purpose set forth.

3. The herein-described electric brake system for a train of cars, including a motor for
 30 actuating the brakes, and an electrically-operated switch for reversing said motor on each car, and a switch-board on the engine for controlling the motors and the reversing-switches of the train.

4. The herein-described electric brake system for a train of cars, including a motor for actuating, and an electrically-operated switch for reversing said motor on each car, a switch-board on the engine for controlling the motors and the reversing-switches, and means
 40 for manually operating each reversing-switch.

5. The herein-described electric brake system for a train of cars, including a motor on each car for actuating the brakes thereof,
 45 having a switch on the engine for controlling said motors, and means connecting with said switch, including a cord extending throughout the whole of the train, whereby all of the brakes can be applied from any car of the
 50 train.

6. In a brake system, the combination, with the brakes of a car, of a flexible connection between the longer arms of the brake-levers nearest the ends of the car engaging two pulleys with fixed pivots or journals, a movable pulley engaging said flexible connection on the side opposite the said fixed pulleys and between the fixed pulleys, a movable pulley having attached thereto a connection with the heading, the drawing-rods, the traversing lug-nut, the screw-shaft, and the sprocket-wheels and chain with the shaft of the armature of the motor, substantially as described and shown.

7. In a brake system, the combination, with a motor and a revolving screw operated thereby, of a fixed sleeve, a traversing nut, a sleeve

secured thereto telescoping within the fixed sleeve, and guides preventing the rotation of said nut and its attached sleeve, substantially
 70 as described.

8. The combination, with the brake-levers and brake-shoes, of the fixed pulleys, the movable pulley, the worm-shaft, traversing nut, and the connection between the nut and movable pulley, substantially as described.
 75

9. The herein-described coupling for electric wires between cars, consisting of the insulated blocks having registering contact-points and the spring-key for holding them in
 80 engagement and in proper relative relation with each other, substantially as described.

10. The herein-described coupling for electric wires between cars, consisting of the insulated blocks having registering contact-points on each of the headings on the ends of the wires passing into said blocks having a retaining depression or socket, and the spring-key having its retaining web adapted to enter said depression or socket.
 85

11. The combination, with the switch-board, having a swinging arm connected with one pole of the source or sources of electricity and insulated contact-points connected with the opposite pole or poles, of an independent
 95 lever carrying a segmental contact-piece for connection with the same pole or poles as the said swinging arm, adapted to simultaneously contact with all of said contact-points, substantially as described.
 100

12. In a switch-board, the combination, with a series of contact-points arranged on a curved line, of a lever carrying a curved contact-plate adapted to contact simultaneously with all of said contact-points, substantially
 105 as described.

13. The combination of a direct acting and moving switch-lever pivoted to the center-post of a switch-board having fixed contacts both for setting and releasing the brakes,
 110 connecting-wires, storage-batteries and connections, solenoid, switch-lever, a reversible electromotor, sprocket-wheels, sprocket-chain, screw-shaft, traversing lug-nut, drawing-rods and heading at one end of said nut and at the other end a tubular covering for said screw-shaft, said covering having a heading with two lugs or projections upon opposite sides to each other adapted to traverse
 115 endwise in two channels or recesses provided therefor, and a larger and stationary tube, in the end of which the lug-heading is located and into which it telescopes in applying the brakes, substantially as described and shown.
 120

14. The combination of the screw-shaft, the traversing lug-nut, the movable tubular covering, the lug-heading, and the stationary tube having recesses to guide said lug-heading to prevent turning with the screw-shaft when in motion for setting and releasing the
 125 brakes, substantially as shown and described.

15. In an electric train-brake for railroad-cars, the combination of a switch-board having a movable and limited contact in two di-

reactions for setting and releasing the brakes, fixed contacts, main-line transmitting-wires and couplings for running currents and completing circuits, branch wires for connecting same on each car with the source of electrical energy, storage-battery, electromotor and connections, screw-shaft and connections with motor, traversing lug-nut, drawing-rods, flexible connections with truck-levers, and pulleys to operate the same, substantially as described and shown.

16. A sub-system for setting and releasing the brakes by hand on each car and automatically in case the train breaks apart accidentally, consisting of the following elements, viz: a continuous rope made fast on the locomotive at one end and on the rear end of the last car, and passing through the train, a movable pulley and fixed pulleys, a switch-lever, a movable contact, fixed contacts, and wires connecting one of said fixed contacts with the poles in electric circuit of the main working-battery wires connecting said battery with all parts of the motor to energize the same, wires connecting the motor after the current has passed through it with the movable contact on the boss end of the switch-lever to complete an independent circuit, substantially as described and shown.

17. The combination of a switch-board having fixed contacts, a center post for return current to complete circuit, a movable segmental-plate contact, a switch-lever, a continuous rope connected therewith to operate the same, a retraction-spring, a plate spring and catch, said contact covering all four of the fixed contacts on the switch-board, a wire connecting said contact-plate with the center

post of switch-board, transmitting-wires, couplings, movable and fixed pulleys, main storage-battery, reversible electromotor and connections, and return-current wires, screw-shafts, traversing lug-nut, drawing-rods, wire rope connected to a movable pulley, fixed pulleys, and a flexible connection between and with the truck-levers to actuate the same and set the brakes, substantially as described and shown.

18. In an electric train-brake, a switch-board having movable and fixed contacts for the transmission of the current and for opening and closing circuits, in combination with a switch-lever and continuous rope connected therewith to operate the said lever, a segmental contact-plate also connected with said lever, a current-wire connecting said segmental plate with the center post of the switch-board, a plate spring and catch, and a signal-bell, substantially as described and shown.

19. The combination of the screw-shaft, the traversing lug-nut, a movable tubular covering for said screw-shaft, a heading and lugs connected therewith, a stationary tube of larger size having recesses or channels for the traverse of said lugs, into which tube the smaller tube telescopes, an electric motor and connections with said screw-shaft to actuate the same, substantially as described and shown.

In testimony whereof I affix my signature in presence of two witnesses.

AUGUSTIN I. AMBLER.

L. P. WHITAKER,
J. D. KINGSBURY