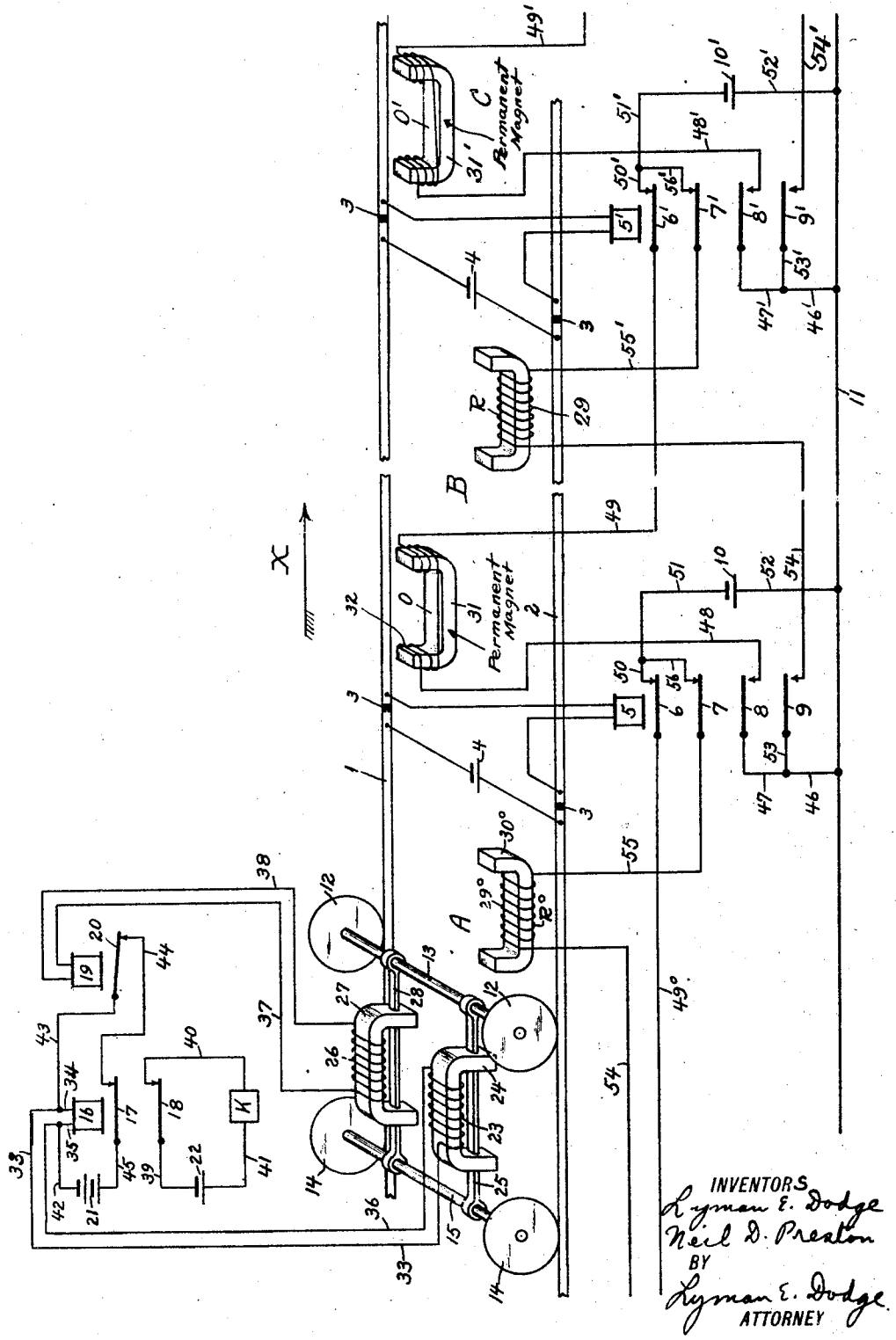
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AUTOMATIC TRAIN CONTROL SYSTEM

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AUTOMATIC TRAIN-CONTROL SYSTEM

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This invention relates to automatic train control systems and more particularly to the means used in such systems for transmitting the impulses necessary for the proper control of the train from the right of way to said train, and also the trackway circuits for governing the operation of this impulse transmitting means in accordance with traffic conditions.

In certain types of automatic train control systems the apparatus on the train or vehicle which controls the movement thereof is set into operation when it is desirable to control the train, and this apparatus continues in operation until the desired control of the train has been accomplished, whereupon it becomes necessary to reset or restore this apparatus to its initial or normal condition ready for the next operation. In other words, train control systems of this type may be said to have a cycle of operation, and for this reason require for their proper control the transmission of two different kinds of impulses, namely, an operating or initiating impulse which serves to set the train control apparatus into operation, and a re-setting or releasing impulse which serves to restore the train control apparatus to its initial condition. One example of systems of this type is shown and described in the patent to P. J. Simmen, No. 1,150,309, dated August 17, 1915; but it is to be understood that this invention is not limited to this system alone, but may be used with systems of any type or form which are characterized by a cycle of operation.

The primary object of this invention is an arrangement and construction of parts in automatic train control systems whereby the operating and releasing impulses necessary for the control of systems having a cycle of operation may be obtained inductively without mechanical or electrical contact between a part on the train with the devices along the track, and whereby these impulses are properly controlled in accordance with traffic conditions.

Other objects and advantages will appear as the description of the invention progresses, and the novel features of the invention will be particularly pointed out in the appended claims.

In describing the invention in detail reference is had to the accompanying drawing in which is illustrated a preferred physical embodiment of the invention and in which the figure is a diagrammatic view showing a portion of a railroad track and a vehicle or train thereon, together with the parts and electrical connections carried on the train and located along the track.

Referring to the accompanying drawing, the numerals 1 and 2 designate the track rails of an ordinary railroad track, the separate rail sections of these track rails being suitably bonded together in the well known manner and being divided at intervals by insulating joints 3 into track sections or blocks according to the well known practice in block signaling systems. Only one complete block B with the adjacent ends of the blocks A and C is shown in the accompanying drawing, but it is to be understood that the entire length of the railroad protected by the system is similarly divided into blocks. The normal direction of traffic over the portion of track illustrated is from left to right in the direction indicated by the arrow X. Since the parts associated with the different blocks are the same, the corresponding parts will for the sake of convenience be given corresponding reference characters with distinguishing exponents added thereto.

To one end of each block a track battery 4 is connected across the track rails 1 and 2; and adjacent to the opposite end of each block a track relay 5 is connected across the track rails 1 and 2, the track batteries 4 and the track relays 5, together with the track rails 1 and 2 of each block, constituting the well known normally closed track circuit, the operation of which will be understood by those skilled in the art of railway signaling without further explanation. Each of the track relays 5 is provided with a number of contact fingers 6, 7, 8 and 9 which are illustrated according to established convention and which for convenience will be hereinafter termed armatures; and associated with each block and preferably located adjacent to the

track relay end of that block is a source of current, as a battery 10, and extending throughout the length of the track is a continuous conductor 11, commonly termed a common wire, which serves as a part of a number of trackway circuits.

The train or vehicle is shown diagrammatically as comprising two pairs of wheels 12—12 and 14—14 connected by the usual axles 13 and 15, these pairs of wheels and axles being intended to represent those of the single car or single railway vehicle or of a number of cars constituting a train.

The movement of the train is automatically controlled by some suitable train control apparatus, and since the particular construction of this train control apparatus forms no part of the present invention and since it may take various forms, this apparatus is illustrated conventionally and designated by the character K. As described hereinbefore, the train control apparatus K is of the type having a cycle of operation; and according to the arrangement of controlling circuits illustrated, the apparatus K is in its initial or idle condition when supplied with current, is set into operation when this supply of current is cut off, and is again restored to its initial condition when the supply of current is re-established. The apparatus K is controlled by a control relay 16, having two armatures or contact fingers 17 and 18, and this control relay 16 is in turn controlled by an operating relay 19 having a single armature or contact finger 20. For supplying electrical energy to the parts of the system carried on the vehicle there are shown two sources of current, as batteries 21 and 22, it being apparent, however, that other means for generating or supplying electrical current may be used, as will be apparent to those skilled in the art.

The impulses necessary for the proper control of the train control apparatus K are transmitted according to this invention from the right of way or the railroad track to the vehicle or train inductively and without mechanical or electrical contact between a part carried by the train with devices located along the track; and the particular type of inductive device used to obtain this impulse may take various forms, but in the construction illustrated, a coil 23, with a soft iron core 24, is supported upon a bar 25 of wood, brass or other suitable non-magnetic material which is carried by the vehicle, being shown diagrammatically as connected to the axles 13 and 15. Another coil 26 having a soft iron core 27 is supported in the same way on a bar 28 connected to the axles 13 and 15, the coils 23 and 26 being located adjacent to opposite sides of the vehicle. At the exit end of each track section or block is supported in any suitable manner on the ties of the track an electrical magnet R, hereinafter termed the releasing magnet, which comprises a winding or coil 29 and a soft iron core 30, this releasing magnet R being so located with reference to the track rails 1 and 2 that the core 24 of the coil 23 on the train passes directly over said releasing magnet when the train passes the point at which said releasing magnet is placed. Located adjacent to the entrance end of each track section or block is an operating or initiating magnet O comprising a permanent magnet 31 so located with reference to the track rails 1 and 2 that the core 27 of the coil 26 on the train passes directly over said permanent magnet when the train passes the point at which said magnet is placed. This permanent magnet 31 is provided with windings or coils 32, hereinafter termed demagnetizing coils, which are so proportioned and arranged, that, when energized from current derived from one of the sources of current 10, the magnetic flux set up by said demagnetizing coils 32 will neutralize or nullify the permanent magnetic flux so that said permanent magnet 31 becomes inert and incapable of affecting the corresponding impulse device carried by the train.

The coil 23 on the train is connected by conductors 33, 34, 35 and 36 to the winding or coil of the control relay 16, and the coil 26 is connected by conductors 37 and 38 to the winding of the operating relay 19. The other electrical connections between the parts on the train and between the parts along the track will not be set forth in detail since these electrical connections and the different circuits established will be set forth at length in the following description of the operation.

Operation.—In the accompanying drawing the parts of the system carried on the train are shown in the idle or normal position in which the movement of the train is not restrained, and disregarding for the present the manner in which these parts are caused to assume this normal position the operation as the train enters the block B for this assumed traffic condition will be explained, and from this explanation it will be readily apparent how the parts of the system on the train are caused to assume their normal position. With the parts of the system on the train in the normal position, since the coil 26 is not in proximity to one of the operating magnets O, there is no current flowing through the operating relay 19 and the armature 20 of this relay is in its lower position. With the operating relay 19 deenergized and the armature 17 of the control relay in its upper position, a circuit for maintaining the control relay 16 energized is established and may be traced as follows:

Circuit number one

Commencing at the battery 21, conductors 42 and 35, relay 16, conductors 34 and 43, ar-

mature 20 of the relay 19 in its lower position, conductor 44, armature 17 of the relay 16 in its upper position, and conductor 45 back to the battery 21.

When the armature 18 of the control relay 16 is in its upper position, the train control apparatus K is supplied with current from the battery 22 flowing in a circuit which may be traced as follows:

Circuit number two

Commencing at the battery 22, conductor 39, armature 18 of the control relay 16 in its upper position, conductor 40, apparatus K, and conductor 41 back to the battery 22.

For the first condition of the traffic to be considered, assume that the train under consideration is in the block A, and about to enter the block B, as shown in the drawing; that said train has found the trackway heretofore unobstructed and is traveling unrestrained by the train control apparatus K; and further assume that neither the block B nor C is occupied by another train. Under these conditions the track relays 5 and 5^1 of these respective blocks B and C are energized and the armatures of said relays are in their upper position as shown in the drawing. When the first pair of wheels 12—12 and axle 13 of the train enter the block B, the track relay 5 is shunted and its armatures drop for the reasons clearly understood by those skilled in the art of railway signaling, so as to establish a circuit for energizing the demagnetizing coils 32 of the operating magnet O, said circuit being traced as follows:

Circuit number three

Commencing at the common wire 11, conductors 46 and 47, armature 8 of the track relay 5 in its lower position, conductor 48, coils 32, conductor 49, armature 6^1 of the track relay 5^1 in its upper position, conductors 50^1 and 51^1, battery 10^1, and conductor 52^1 back to the common wire 11.

As the train passes the operating magnet O no effect is produced, since the flux of the permanent magnet 31 is neutralized by the energized demagnetizing coils 32; and consequently, the train continues with the train control apparatus K unchanged. In this way, the train is permitted to proceed when the next block in advance is not occupied by another train.

For the next traffic condition to be considered, assume that the train under consideration is in the block A, as shown in the accompanying drawing, that this train has heretofore found the track unobstructed and is traveling unrestrained by the train control apparatus K; and further assume that while the block B is not occupied by a train, another train does occupy the block C. Since the block C is occupied, the correspnding track relay 5^1 is deenergized so that the circuit number three hereinbefore traced, for energizing the coils 32 of the operating magnet O in the block B, is broken at the armature 6^1 of the said relay, so that the flux of the permanent magnet 31 is not neutralized. Consequently, when the train passes this operating magnet O, the flux of the permanent magnet 31 induces a momentary current in the coil 26 on the train which energizing the operating relay 19, thereby raising the armature 20 of said relay and interrupting the circuit number one for normally energizing the control relay 16, whereupon the armatures 17 and 18 of said control relay 16 drop to their lower position. The dropping of the armature 17 of the train control relay 16 opens another break in the normally closed circuit number one for said control relay, so that after the momentary current in the coil 26 has ceased and the armature 20 of the operating relay 19 returns to its lower position, the circuit number one remains broken. The dropping of the armature 18 of the control relay 16 interrupts the circuit number two for supplying current to the train control apparatus K, thereby initiating the operation of said train control apparatus. In this way, the apparatus K is set into operation at or near the entrance to a block when the next block in advance is occupied by another train; and the apparatus K operates to so control the movement of the train that it will be brought to a stop by the time it reaches the end of the block it has just entered, or to a predetermined low speed.

Assuming that the movement of the train has been so controlled and that the train is traveling at a low speed when it passes the releasing magnet R^1 at the end of the block B, it is apparent that if the other train still occupies the block C, the apparatus K should not be restored but should be allowed to remain effective to control the movement of the train; but on the other hand, if the other train which occupied the block C when the train under consideration entered the block B, has in the meantime moved out of the block C, it is proper and in fact highly desirable in order to obtain the best facility of movement of trains that the apparatus K should be restored to the initial or idle condition so that the train carrying said apparatus may accelerate at least part way through the block C instead of being compelled to come to a stop or to continue its further traveling at the predetermined low speed. In one case, when the block C is occupied, the armature 7^1 of the track relay 5^1 is in its lower position and establishes a break in the circuit for energizing the releasing magnet R so that this releasing magnet is inert and has no effect on the train control apparatus on the train and leaves this apparatus still in operation. In the other case, when the block C is not occupied at the time the train

under consideration reaches the end of the block B, the armature 9 of the track relay 5 is in its lower position due to the presence of the train itself in the block B, and the armature 7^1 of the relay 5^1 is in its upper position, so that a circuit for energizing the coil 29 of the releasing magnet R is established and may be traced as follows:

Circuit number four

Commencing at the common wire 11, conductors 46 and 53, armature 9 of the relay 5 in its lower position, conductor 54, coil 29 of the releasing magnet R, conductor 55^1, armature 7^1 of the relay 5^1 in its upper position, conductors 56^1 and 51^1, battery 10^1, and conductor 52^1 back to the common wire 11.

The coil 29 of the releasing magnet R being energized, when the coil 23 carried on the train passes over said releasing magnet, a momentary current is induced in said coil 23, which eenrgizes the control relay 16 and raises its armatures; and since the armature 20 of the operating relay 19 is in its lower position at the time, said control relay 16 is maintained energized due to the establishing of the maintaining circuit number one hereinbefore traced. The energization of the control relay 16 and the raising of the armature 18 again supplies current to the train control apparatus K, thereby restoring the parts of said apparatus to their normal or idle position ready for the next operation.

If, when the train under consideration enters the block C and passes the operating magnet O^1, the next block in advance of the block C (not shown) is occupied, as for instance, by the train which was assumed to formerly occupy the block C, then the deenergizing coils 32 of this operating magnet O^1 are not energized and the train control apparatus K is set into operation again when the train passes said operating magnet in the same way as previously described.

From the foregoing it can be seen that there is provided by this invention a construction and arrangement of parts whereby the train control apparatus on a train is set into operation at or near the entrance to each block in case the next block in advance is occupied by another train; that if said train control apparatus has been set into operation and the train has reached the end of that block, said apparatus K will be restored or released providing the other train has in the meantime moved out of the next block in advance but will not be restored providing this next block in advance is still occupied. Consequently, according to this invention, automatic train control systems having a cycle of operation may be properly controlled in accordance with traffic conditions.

It should be noted that normally there is no current flowing in the demagnetizing coils 32 of the operating magnets O or the coils 29 of the releasing magnets R, and that current is not supplied to these coils until a train enters the corresponding block and shunts the corresponding track relay, thereby obtaining a great saving of current. Various changes may be made in the particular embodiment of the invention illustrated without departing from the invention, and various signals and other devices which may be advantageously used in connection with the automatic control of trains may be combined with this system. In some cases, it may be desirable to supply the operating and releasing magnets with alternating current instead of direct current so that the movement of a train over these magnets is not necessary to obtain an impulse; and this modification will be readily apparent to one skilled in the art, being merely the substitution of a transformer or other source of alternating current for the batteries shown. The operating magnet O for each block may be placed either at the entrance to that block or at some distance from the entrance depending on the length of the block and other factors which may require an earlier or latter application of the brakes.

Although I have particularly described the construction of one physical embodiment of my invention, and explained the operation and principle thereof; nevertheless, I desire to have it understood that the form selected is merely illustrative, but does not exhaust the possible physical embodiment of the idea of means underlying my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In an automatic train control system, in combination: a vehicle a track for said vehicle divided into track circuit blocks; train control apparatus carried on the vehicle; an initiating control device and a releasing control device on the vehicle for governing said train control apparatus; a permanent magnet associated with each block for operating said initiating control device; demagnetizing coils for each of said permanent magnets; a controlling circuit for the demagnetizing coils of each permanent magnet controlled by the block next in advance of the corresponding block; and an electro-magnet at the exit end of each block controlled by the next block in advance and operating when energized to control said releasing control device on the vehicle to restore said train control apparatus to its initial condition.

2. In an automatic train control system in combination: a vehicle and a track therefor divided into blocks each provided with a track circuit; automatic train control apparatus on the vehicle; a stick relay for governing said apparatus; separate impulse receiving devices on the vehicle for controlling the pick up and stick circuits of said relay;

and separate impulse transmitting devices associated with each block and controlled by the track circuit of the block next in advance for cooperating inductively with the respective impulse receiving devices on the vehicle.

3. In a train control system the combination with a braking system on the train, of means for imparting impulses thereto from the right of way, comprising a compound magnet located along the track for causing a brake application, said compound magnet comprising a permanently magnetized yoke and a neutralizing coil, an electromagnet also located along the right of way and in advance of the permanent magnet for resetting parts on the train, and a common control for simultaneously energizing the coils on the compound and electro-magnets.

4. In an automatic train control system for railroads having tracks divided into blocks each provided with a normally closed track circuit, automatic train control apparatus on a vehicle adapted to be put into condition to control the movement of the vehicle and to continue in such condition until reset, relays on the vehicle for conditioning said apparatus and for resetting it, separate impulse receiving means on the vehicle controlling said relays, a permanent magnet on the track in each block, said magnet being adapted to cooperate with one of said impulse receiving means to condition the train control apparatus for operation, coils associated with each permanent magnet and adapted when energized to render it ineffective to influence its corresponding impulse receiving means, an energizing circuit for the coils of each permanent magnet controlled by the track circuit of the block next in advance of the corresponding block, an electromagnet on the track at the exit end of each block for influencing the other impulse receiving means and cause resetting of the train control apparatus, and an energizing circuit for each electromagnet controlled by the block next in advance of the corresponding block.

5. In an automatic train control system for railroads having tracks divided into blocks each provided with a normally closed track circuit, a permanent magnet on the track in each block and having coils associated therewith for neutralizing its external field, an electromagnet at the exit end of each block, energizing circuits for the coils of the permanent magnet and the electromagnet of each block controlled by the track circuit of the next block in advance, normally energized brake control apparatus on a vehicle, a normally closed control circuit for said apparatus, a normally energized stick relay on the vehicle controlling said circuit, separate impulse receiving means on the vehicle influenced independently by the permanent magnets and the electromagnets, a stick circuit for said relay opened when one of the impulse receiving means is influenced from the track by a permanent magnet, and a pickup circuit for the stick relay governed by the other impulse receiving means.

6. In an automatic train control system for railroads having tracks divided into blocks each provided with a normally closed track circuit, normally energized brake control apparatus on a vehicle, a normally energized relay and a normally deenergized relay acting to govern said apparatus, separate impulse receiving means on the vehicle controlling said relays, a permanent magnet and an electromagnet associated with each block and adapted to influence said impulse receiving means separately, electrically controlled means associated with each permanent magnet for rendering it ineffective to influence its corresponding impulse receiving means, and means controlled by the track circuit of each block for energizing the electromagnet of the next block in the rear and also the means associated with the permanent magnet of that block.

7. In a train control system, a track impulse device in each block, controllable by a preceding block for establishing a local magnetic field when said preceding block is occupied, braking means, brake controlling means inductively influenced by the track impulse device for initiating the operation of said braking means, and track actuated means for restoring to normal the brake-controlling means.

8. In a train control system, the combination with a braking mechanism, of a traffic controlled track magnet positioned substantially at the entrance to a block in a right of way, resetting means positioned substantially at the exit end of said block, train-carried mechanism movable within the field of said track magnet and influenced by the magnetic flux thereof for effecting the operation of said braking mechanism, and train-carried resetting means movable relatively to said wayside resetting means whereby parts on the train influenced by the track magnet may be reset by the co-operation of said wayside resetting means with said train-carried resetting means.

9. A train control system comprising, the combination with a vehicle and a trackway therefor divided into blocks, a permanent magnet on the trackway near the entrance to each block adapted to establish a local external magnetic field projecting upwardly from the trackway between pole pieces of opposite magnetic polarity, a winding associated with said magnet and creating when energized a magneto-motive-force co-acting with that of the permanent magnet to suppress said external magnetic field, a circuit and a source of current for automatically energizing said

winding of the magnet of each block provided the next block in advance is not occupied, an electro-magnet at the exit end of each block for establishing whenever energized a local magnetic field similarly projecting upwardly from the trackway but in a different vertical plane, a circuit for each electro-magnet including a source of current and automatically closed only if the next block in advance of the corresponding block is not occupied, and automatic brake applying apparatus on a vehicle including receiving means separately and independently influenced by the magnetic fields of said permanent magnets and said electromagnets through an intervening air gap, said apparatus having its operation initiated by the fields of the permanent magnets and being restored to normal by the fields of the electro-magnets.

10. In a system for automatically controlling the brakes of railway vehicles, in combination with a vehicle and a track therefor divided into blocks each having a normally closed track circuit, a permanent magnet on the track near the entrance to each block adapted to provide a local magnetic field extending upward between two pole pieces of opposite magnetic polarity, a winding associated with said magnet and acting when energized to create a magneto-motive-force co-acting with that of the magnet to suppress said external field, a circuit and a trackway source of current for energizing the winding of the permanent magnet of each block governed by the track circuit of the next block in advance and closed only if that block is not occupied, an electromagnet at the exit end of each block in the rear of the permanent magnet for the block next in advance and adapted if energized to establish a local magnetic field similarly projecting upward, a circuit and a trackway source of current for energizing the electromagnet of each block governed by the track circuit of the block next in advance and closed only if that block is not occupied, brake control apparatus on the vehicle, a normally energized stick relay on the vehicle maintaining said apparatus inactive, a stick circuit for said relay, receiving means on the vehicle influenced by the magnetic field of an active permanent magnet through an intervening air gap for breaking said stick circuit, other receiving means on the vehicle influenced by the magnetic field of an energizing electromagnet for restoring said relay, said permanent magnets and electromagnets being located in the trackway with their magnetic fields between their pole pieces in different vertical planes and cooperating separately with their respective receiving means on the vehicle, whereby the field of a permanent magnet is incapable of influencing said other receiving means to restore said relay.

11. In an automatic train control system, in combination: a vehicle; a track for said vehicle divided into track circuit blocks, train control apparatus carried on the vehicle, an initiating control device and a releasing control device on the vehicle for governing said train control apparatus; a permanent magnet associated with each block for operating said initiating control device; coils associated with and modifying the effect of each of said permanent magnets, a controlling circuit for said coils controlled in accordance with conditions in an advance block, and an electromagnet near the exit of each block controlled in accordance with conditions in an advance block and operating when energized to control said releasing control device on the vehicle to restore the said train control apparatus to its initial condition.

12. In an automatic train control system for railroads having tracks divided into blocks each provided with a normally closed track circuit, normally energized brake control apparatus on a vehicle, a normally energized coil, and a normally deenergized coil acting to govern said apparatus, separate impulse receiving means on the vehicle controlling the effect of said coils, a permanent magnet and an electromagnet associated with each block and adapted to influence said impulse receiving means separately, electrically controlled means associated with each permanent magnet for rendering it ineffective to influence its corresponding control means, and means controlled in accordance with conditions in an advance block for energizing the electro-magnet of the next block in the rear and also the means associated with the permanent magnet in that block.

13. In an automatic train control system, in combination: a track divided into blocks, a vehicle; automatic mechanism on the vehicle adapted to exert a continuing control over the movement of the vehicle after its operation has been initiated until it is reset; separate initiating and resetting impulse transmitting devices associated with each block; said impulse devices each comprising a magnetic core and a coil, said initiating device of each block being located at an intermediate point in that block and being effective only for a limited distance of movement of the vehicle at that point, the resetting device of each block being located near its entrance end and being encountered by a passing train prior to entering that block; means for rendering the controlling condition of the resetting impulse device of each block dependent on the presence or absence of a train in that block; means for rendering the controlling condition of the initiating impulse device of each block dependent on the presence or absence of a train in the next block in advance; and separate receiving means on the vehicle selectively responsive through an intervening air gap to

said initiating and resetting impulse devices for controlling said mechanism.

14. In an automatic train control system, in combination: a trackway divided into blocks; automatic train control apparatus carried by the train and having a cycle of operation; means on the train for restoring said apparatus to its normal condition; means on the train for setting said apparatus into operation; and two separate impulse transmitting devices each comprising a magnetic core and winding and being associated with each block for selectively controlling said means on the vehicle inductively through an intervening air-gap, one of said impulse transmitting devices being responsive to traffic conditions in the corresponding block, and the other being responsive to traffic conditions in the next block in advance.

15. In an automatic train control system, in combination: a vehicle and a track therefor; automatic train control apparatus on the vehicle adapted to subject the vehicle to a continuing restriction of its movement after its operation has been initiated until reset; a circuit on the vehicle acting when energized to cause resetting of said apparatus another normally energized circuit on the vehicle acting when opened to initate the initial operation of said apparatus; and impulse transmitting means comprising devices on the vehicle cooperating selectively with devices along the track through intervening air-gaps for controlling the flow of current in said circuits in accordance with the extent of unoccupied track in advance of each particular trackway device, said car-carried devices each having a partial magnetic circuit in which a change of magnetic flux is produced by the co-operating track device.

16. In an automatic train control system, a vehicle and a track therefor divided into blocks each provided with a normally closed track circuit, separate impulse devices associated with each block and adapted to transmit inductively through an air-gap to a passing vehicle distinctive controlling impulses, each of said impulse devices comprising a magnetic core affording a partial magnetic circuit and a coil magnetically associated therewith, an energizing circuit for the rear impulse device of each block controlled separately by the track circuit of that block, and a control circuit for the advance impulse device of each block controlled separately by the track circuit of the next block in advance.

17. In an automatic train control system, a vehicle and a track therefor divided into blocks, automatic train control apparatus for the vehicle adapted to exert a continuing influence upon the movement of the vehicle after set into operation until reset, said apparatus having a tendency to assume an active controlling condition, separate initiating and resetting impulse devices associated with each block and capable of transmitting to a passing vehicle inductively through an air-gap initiating and resetting impulses, said impulse devices each comprising a magnetic core and a winding, the resetting impulse device being first encountered by a vehicle traveling in the normal direction of traffic, control circuits for energizing said resetting and initiating impulse devices of each block both automatically opened if the next block in advance is occupied, and control means on the vehicle responsive to said impulses for initiating the operation of said apparatus and restoring it to normal.

18. In an automatic train control system, a vehicle and a track therefor divided into blocks, automatic train control apparatus for the vehicle adapted when set into operation to continue in operation until restored, impulse transmitting means associated with each block and comprising separate trackway impulse devices each having a magnetic core and winding and being adapted to transmit distinctive controlling impulses inductively to the passing vehicle, one of said trackway devices first encountered by the vehicle traveling in the normal direction of traffic having its controlling condition governed separately in accordance with traffic conditions in the corresponding block, the other advanced trackway impulses device having its controlling condition dependent upon traffic conditions in the block next in advance of the corresponding block, and control means on the vehicle selectively responsive to said distinctive controlling impulses for governing separately the initiation and restoration of said apparatus.

19. In an automatic train control system, a vehicle and a track therefor divided into blocks, separate initiating and resetting impulse devices associated with each block, the initiating impulse device of each block being controlled in accordance with traffic conditions in the next block in advance and the resetting device in accordance with traffic conditions in the corresponding block, automatic train control apparatus on the vehicle, circuit on the vehicle for governing said apparatus, one of said circuits being automatically rendered incapable of controlling said apparatus after it has once been set into operation until after the other circuit has been energized, and receiving means on the vehicle having partial magnetic circuits inductively influenced by said track impulse devices through an intervening air-gap for separately controlling the energization of said circuits dependent upon the controlling condition of said impulse devices.

20. In an automatic train control system, the combination with a railway track divided into blocks, automatic train control appara-

tus on a vehicle, a normally energized stick relay on the vehicle for governing said apparatus, said relay having an energizing stick circuit including contacts of the relay itself closed only if it is energized, a pick-up circuit for energizing said relay when it is de-energized, impulse receiving means on the vehicle governing said circuits of said relay, and separate impulse devices on the track associated with each block and controlled separately by track circuits of different blocks for co-operating inductively with said vehicle carried receiving means through an intervening air gap to influence selectively the said pick-up and stick circuits of said relay.

21. In an automatic train control system, a vehicle and a track therefor divided into blocks, impulse transmitting means partly on the vehicle and partly along the track acting by electro-magnetic induction in coils having partial magnetic circuits and comprising trackway elements of two different control characteristics, one effective only if energized and the other when de-energized, the trackway element of the first characteristic being located at the entrance to the corresponding block and being controlled in accordance with traffic conditions in that block, the trackway element of the other characteristic associated with each block being controlled in accordance with traffic conditions in the next block in advance, the trackway element of the first mentioned characteristic at the entrance to a block being encountered first by a passing vehicle, and automatic train control apparatus on the vehicle governed by said impulse transmitting means and automatically set into operation and reset by said trackway elements.

22. In an automatic train control system, a vehicle and a track therefor divided into blocks each provided with a normally closed track circuit, an initiating impulse device near the entrance end of each block, a resetting impulse device at the exit end of each block, said impulse devices being located differently with respect to the center line of the trackway and selectively co-operating with impulses receiving means on the vehicle inductively through an air-gap to provide distinctive controlling effects on the vehicle and circuits including a source of current and controlled by the track circuit of the next block in advance for energizing with direct current said initiating and resetting impulse devices of each block.

23. In an automatic train control system, a vehicle and a track therefor divided into blocks each provided with a normally closed track circuit, automatic train control apparatus on the vehicle adapted when set into operation to continue in operation until restored, control circuits for each block each including a source of direct current and governed by the track circuit of that block, control means on the vehicle, and impulse devices associated with each block and governed by said circuits of the next block in advance for selectively influencing said control means inductively through an air-gap at predetermined control points, and thereby independently governing the initiation of the operation of said apparatus and the restoration thereof at the beginning and end of said block respectively depending upon the presence or absence of other vehicles in the next block in advance.

24. In an automatic train control system for railroads provided with blocks, train control apparatus on a vehicle adapted when set into operation to remain in operation until restored, impulse devices on the track each comprising a magnetic core and a winding thereon, and means including said trackway impulse devices for setting said apparatus into operation at a predetermined control point in the progress of a vehicle through a block when the next block in advance is occupied, and for restoring said apparatus to normal at the entrance to an unoccupied block.

25. In an automatic train control system for railroads provided with blocks, the combination with train control apparatus on a vehicle adapted when set into operation to continue in operation until restored, of an electro-magnet on the track located near the entrance to each block and passed by a vehicle prior to its entrance to that block, a control circuit and a source of current for energizing said electro-magnet of each block if that block is not occupied, and means on the vehicle responsive to the magnetic field of said track electro-magnets for restoring said apparatus to normal.

26. In an automatic train control system of the intermittent inductive type, the combination with a railway track divided into blocks each having a normally closed track circuit and track relay, of brake control apparatus on a vehicle acting when once set into operation to continue in operation until restored, and impulse devices on the track each comprising a magnetic core and control coil and co-operating with vehicle impulse receiving means inductively through an intervening air gap for setting said apparatus into operation, upon passage of the vehicle by a predetermined control point in each block, if the track relay of the block next in advance is then deenergized, and for resetting said apparatus at the exit end of each block if the track relay of the block next in advance is energized, whereby said apparatus on the vehicle is automatically set into operation upon approach to a block occupied by another train and is automatically reset at the entrance to an unoccupied block.

27. In an automatic train control system for railroads divided into blocks of differ-

ent lengths, the combination with automatic train control apparatus on a vehicle adapted when set into operation to remain in operation until restored, of influence communicating means partly on the vehicle and partly along the track and co-operating intermittently and inductively through intervening air-gaps at a predetermined control point in each block to set said apparatus into operation when the next block in advance is occupied, said means being incapable of restoring said apparatus to normal, separate inductive influence communicating means for restoring said apparatus to normal at the entrance to an unoccupied block both of said influence communicating means associated with each block being normally deenergized and being energized by the entrance of a train into that block if the next block in advance is not occupied.

28. In a system for governing train movement on railroads provided with blocks each having a track relay, the combination with brake control apparatus on a vehicle adapted when set into operation to continue in operation until restored, a resetting track device at the entrance to each block and adapted when energized to communicate an influence to the passing vehicle for restoring the brake control apparatus thereon to the initial condition, an energizing circuit for said device governed by the track relay of the block at the entrance to which said device is located, another initiating track device at an intermediate point in each block adapted when deenergized to communicate a different and distinctive influence to the passing vehicle for setting the brake control apparatus thereon into operation, said resetting device and initiating device each comprising a magnetic core and a winding thereon and being located differently with respect to the center line of the trackway, and an energizing circuit for the initiating device of each block governed by the track relay of the next block in advance of that block.

29. In a system for governing train movement on railroads provided with blocks each having a track relay, the combination with brake control apparatus on a vehicle adapted when set into operation to continue in operation until restored, a normally energized relay on the vehicle acting when deenergized to set said apparatus into operation, said relay when once de-energized remaining deenergized until a pick-up circuit therefor is energized, means on the vehicle and on the trackway co-operating inductively through an air gap for deenergizing said relay at a control point in each block when the next block in advance is occupied, and means comprising other separate inductively co-operating track and vehicle carried devices for energizing said pick-up circuit and thereby restoring said apparatus to its initial condition.

30. In a system for governing train movement on railroads provided with blocks each having a track relay, the combination with brake control apparatus on a vehicle adapted when set into operation to continue in operation until restored, a stick relay governing said apparatus and adapted when energized to hold or restore it to the normal inactive condition, a stick circuit and a pick-up circuit for said relay, said stick circuit including a vehicle-carried source of current and contacts operated by said relay itself, an initiating track device and cooperating vehicle carried means adapted to break said stick circuit when the track device is deenergized, another track device and separate cooperating vehicle carried means adapted to energize said pick-up circuit when that another track device is energized, said track devices being located differently with respect to the center line of the track and co-operating with said vehicle-carried means inductively through an intervening air gap, and track circuit controlled means for governing the energization of said track devices.

31. In a system for governing train movement on railroads provided with blocks each having a track relay, the combination with brake control apparatus on a vehicle adapted when set into operation to continue in operation until restored, and automatic means partly on the vehicle and partly on the track and comprising track devices located differently with respect to the track rails for respectively initiating the operation of the brake control apparatus and restoring it to the initial condition said track devices each providing a uni-directional magnetic field when active.

32. In a system for governing train movement on railroads provided with blocks each having a track relay, the combination with brake control apparatus on a vehicle adapted when set into operation to continue in operation until restored, a track device comprising a permanent magnet and neutralizing coils and cooperating with a vehicle carried receiving element to initiate said apparatus when its coils are deenergized and not when energized, another track electro-magnet cooperating with a separate vehicle carried receiving element and located differently with respect to the track rails than the first mentioned track device for restoring the said apparatus to its initial condition.

33. In an automatic train control system, car equipment comprising, brake control apparatus acting when once set into operation to continue in operation until restored, a relay governing said apparatus, a stick circuit for said relay including contacts closed only if said relay is energized, pick-up circuit for said relay for energizing it when it is de-ener-

gized, and separate normally closed vehicle-carried circuits including magnetic cores and windings for controlling said stick and pick-up circuits for the relay in response to voltages induced in said windings.

34. In a train control system, brake control apparatus on a vehicle, control means on the vehicle for said apparatus including separately movable elements and electro-responsive devices respectively operating said elements, impulse receiving windings on the vehicle connected to said electro-responsive devices, track elements having magnetic cores and coils thereon and located differently with respect to the track rails for separately inducing current in said receiving windings to cause independent movement of said elements, and track circuit controlled means for governing the operating conditions of said track elements.

35. In a train control system, the combination with brake control apparatus on a vehicle continuing in operation until restored, a circuit on the vehicle governing the initiation of the operation of said apparatus, another circuit governing the restoration of said apparatus to the normal inactive condition, separate receiving elements on the vehicle controlling the energization of said circuits, and track devices disposed differently on the trackway with respect to the track rails at predetermined control points for separately and distinctively influencing said elements inductively through an intervening air gap intermittently at said control points, each of said track devices having a magnetic core and a winding, energized only under clear traffic conditions.

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