No. 896,740.

PATENTED AUG. 25, 1908.

W. C. MAYO.

ELECTRIC TRACK BRAKE.

APPLICATION FILED NOV. 22, 1907.

3 SHEETS—SHEET 1.

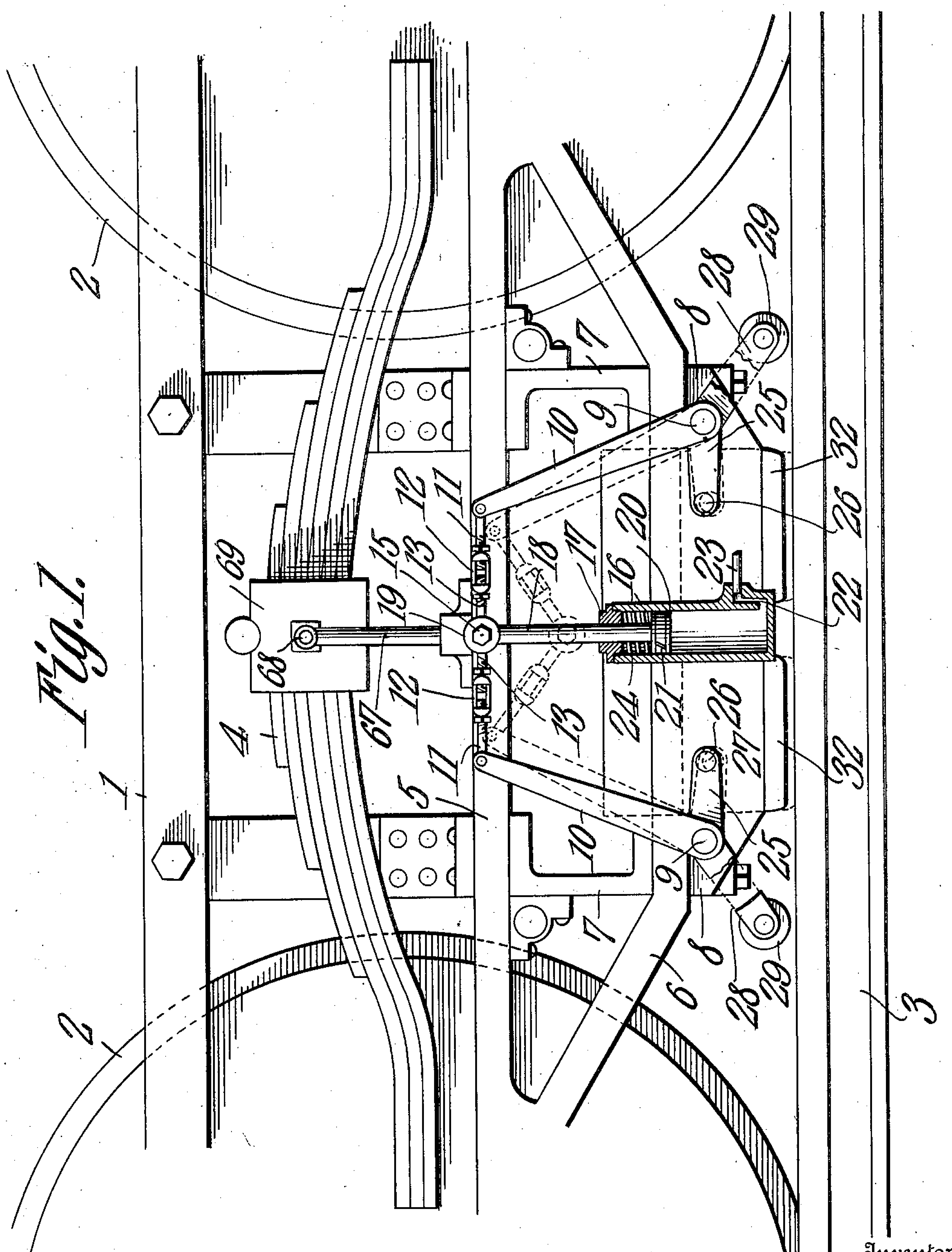

Fig. 1.

Witnesses

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3 SHEETS—SHEET 2.

Fig. 2.

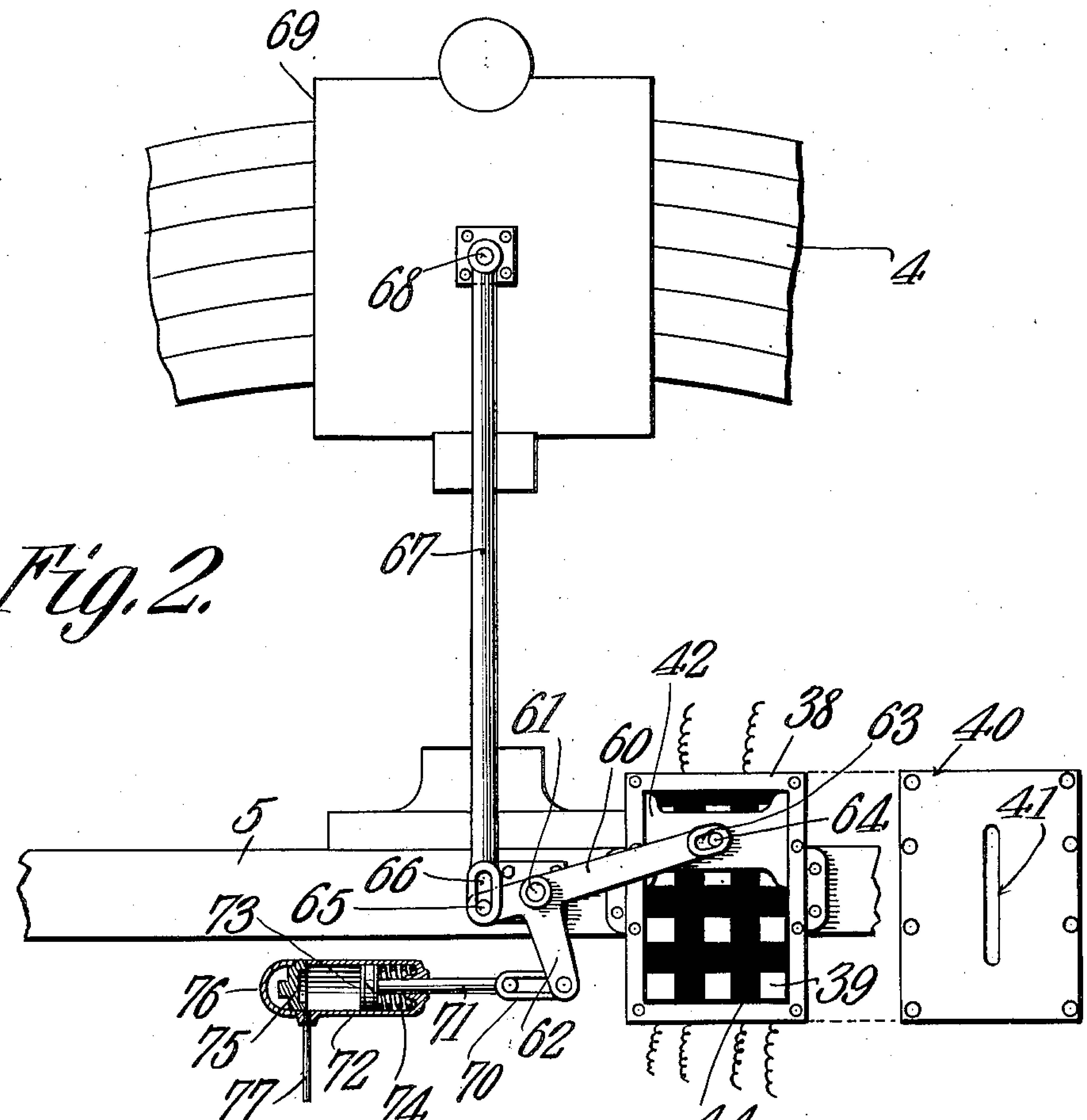
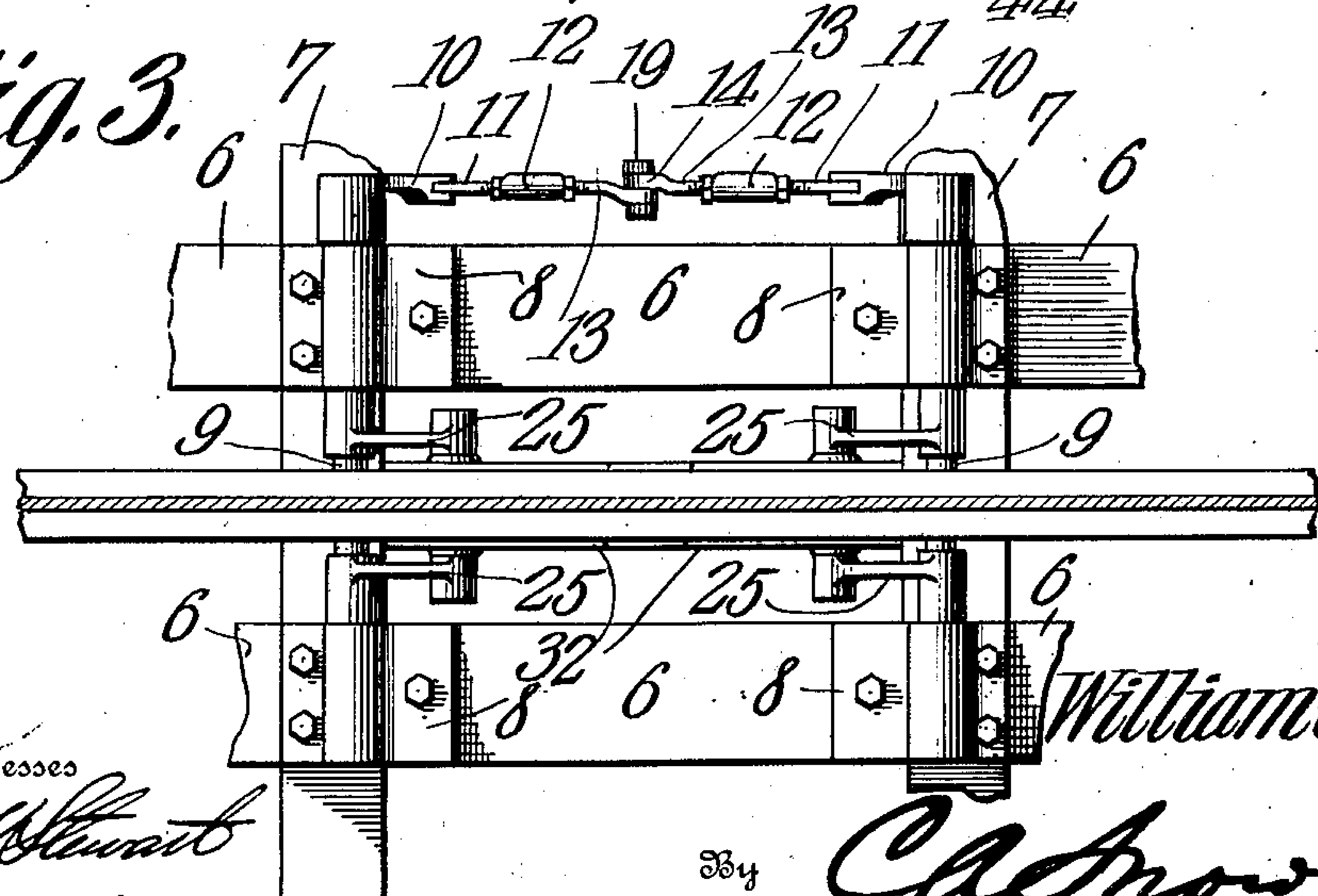


Fig. 3.



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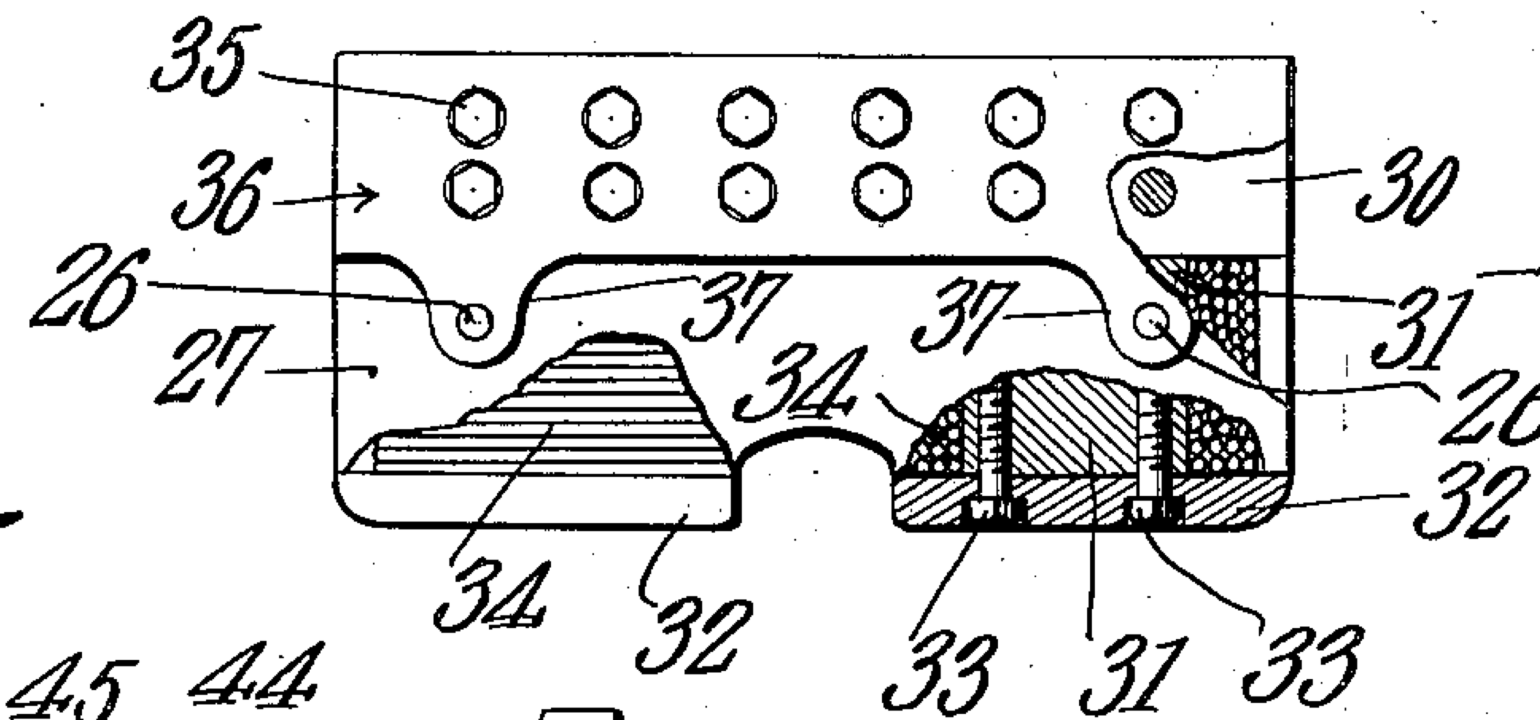
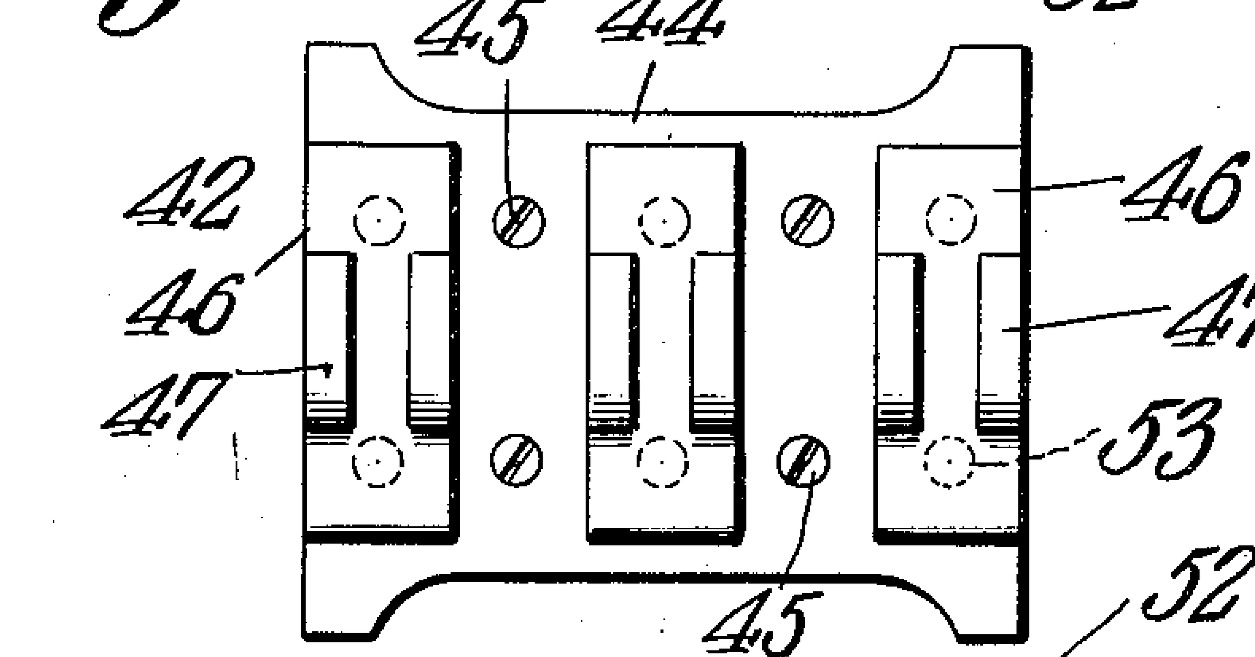


Fig. 4.

Fig. 5.



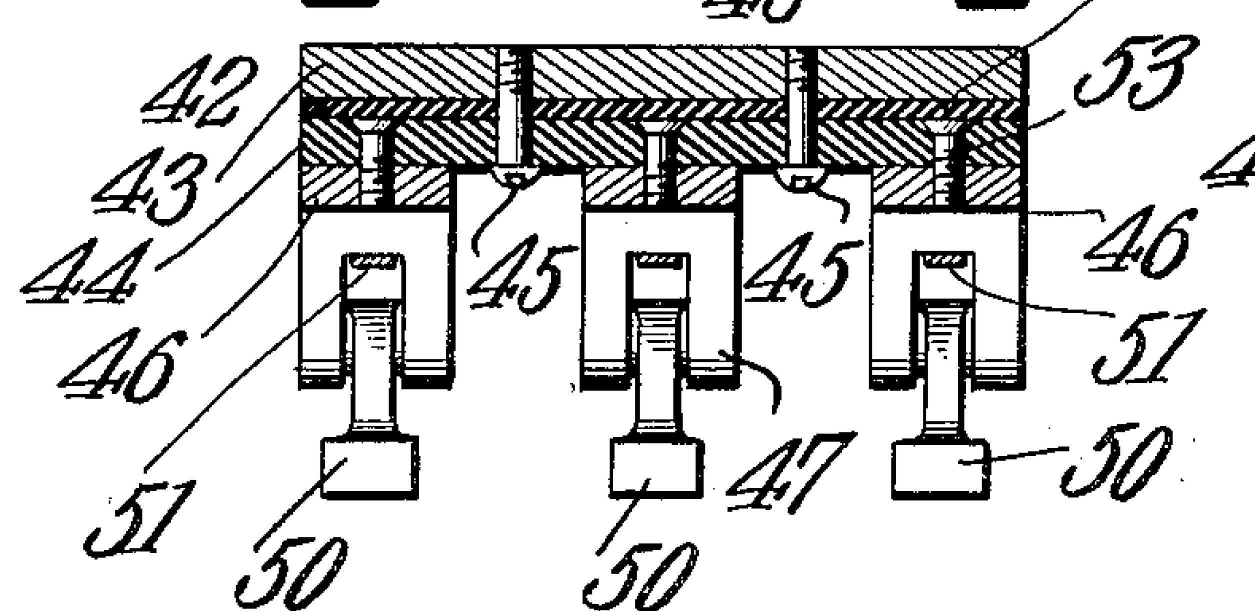
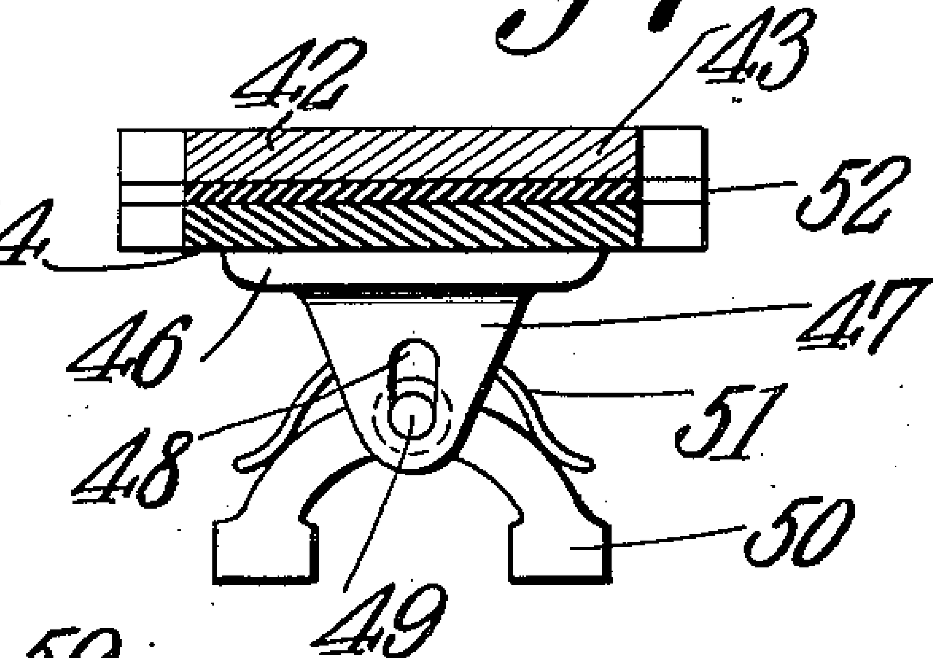


Fig. 6.

Fig. 7.



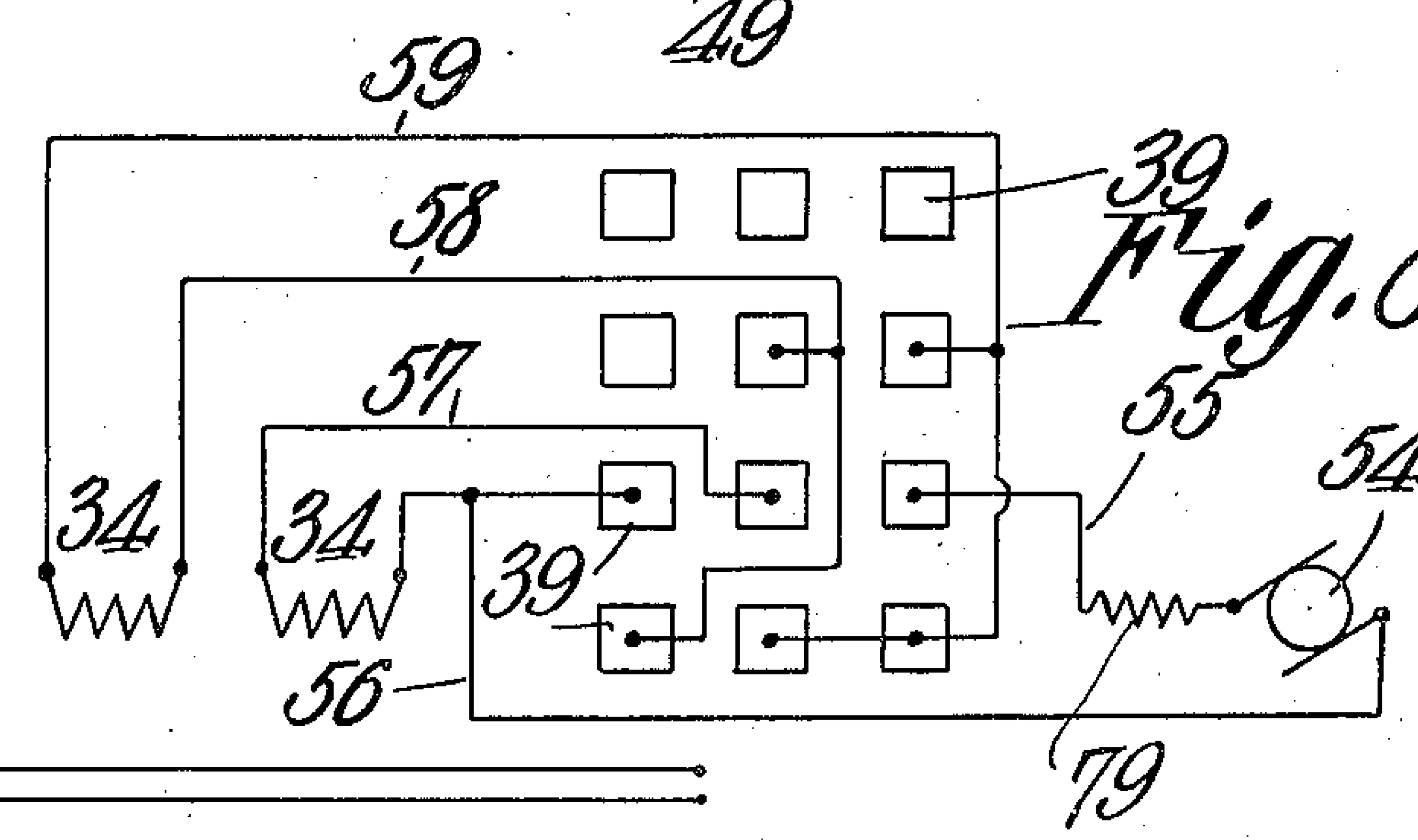


Fig. 8.

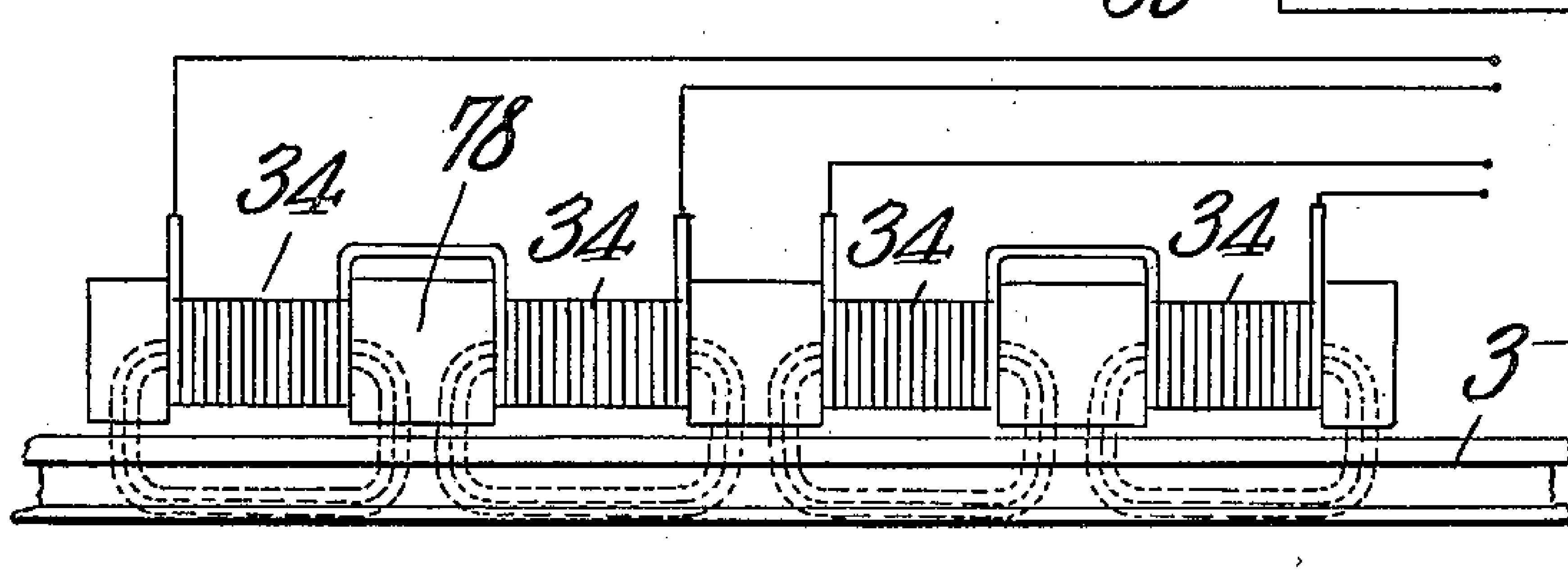


Fig. 9.

Inventor

William C. Mayo.

Witnesses

E. H. Stewart

F. T. Chapman

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Attorneys

UNITED STATES PATENT OFFICE.

WILLIAM C. MAYO, OF EL PASO, TEXAS, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, OF TWO-THIRDS TO HIMSELF, AND GEORGE E. BRIGGS, OF BARSTOW, TEXAS, AND ONE-THIRD TO JOHN HOULEHAN, OF EL PASO, TEXAS.

ELECTRIC TRACK-BRAKE.

No. 896,740. Specification of Letters Patent. Patented Aug. 25, 1908.

Application filed November 22, 1907. Serial No. 403,362.

To all whom it may concern:

Be it known that I, William C. Mayo, a citizen of the United States, residing at El Paso, in the county of El Paso and State of Texas, have invented a new and useful Electric Track-Brake, of which the following is a specification.

This invention has reference to improvements in electric track brakes designed not only to operate as a brake for stopping trains, but also as a means for holding a train or car to the tracks when rounding a curve and tending under the action of centrifugal force to lift away from the track.

The invention is designed for use on cars or trains of any character whatsoever, but more particularly in connection with railroad cars, or trains made up of cars constructed in accordance with a motor car system which I have in part devised. The said system is designed for city, suburban and interstate traffic, and the cars are to maintain high speed not only on straight lines, but on curves.

In the case of high speed cars or trains, the ordinary brakes are usually sufficient, but, on occasions, an emergency stop is necessary and must be accomplished in a shorter space of time than can be accomplished by the ordinary brakes.

To this end, the invention comprises a track brake shoe or shoes acting by magnetic attraction to cause the shoe to grip the rail magnetically with a force commensurate with the current applied, and this may be used in conjunction with the ordinary air brakes, or independently thereof.

When a moving car enters upon a curve, the tendency of the car is to maintain its straight course and leave the curved track. If the speed be slow, this tendency to leave the track is readily overcome by the engagement of the wheel flanges with the rail. If the curves be located where the usual speed is comparatively great, then the tendency of the car or cars to leave the track is overcome by setting the track on an incline with the outer track the higher, but this tilting of the track will only be effective up to a certain critical speed.

By the present invention, the cars are enabled to take curves with the same high speed that they travel along straight lines, and there is no necessity of slowing down on approaching curves in streets where the track must, of necessity, have the outer and inner rails of the same altitude. Again, where it is desired to maintain a very high speed on tracks where the curves have been built for a lower maximum speed, the cars or trains may take the curves at a high speed without danger of leaving the track.

By the present invention, the electric shoes are normally maintained within very close relation to, but out of actual contact with, the rails. When a shoe is energized, and therefore becomes magnetic, the rail acts as an armature of infinite length along which the shoe may travel as long as it is out of physical contact with the rail without appreciable resistance, except at the rail joints, where the decreased cross sectional area of rail produces a slight increase in the magnetic reluctance. But this is not, in practice, of sufficient importance to be taken into consideration. When the air gap between the magnetic pole or poles of the shoe and the rail is small, the resistance offered by the energized shoe to a movement tending to draw it away from the rail, and so increasing the air gap, will be very materially resisted, and it is upon this fact that the part of the invention now being considered is based.

Now, on rounding a curve, the tendency of the car is to tip toward the outer rail with the engaging portions of the wheels and rails acting as a fulcrum, and thereby tending to lift the inner truck wheels away from the inner rails. Also, the bodies of the cars tend to rock on a longitudinal axis, compressing the springs toward the outer rail of the track and expanding the springs toward the inner rail of the track, that is, permitting the inner springs to rise. By the present invention, this rocking of the car on entering a curve is utilized to operate an electric switch or controller which will cause the energization of the brake shoe or shoes adjacent to the inner rail of the curve to an extent commensurate with the sharpness of the curve and the extent or degree of rocking of the car body. Thus, when the car enters a long, easy curve, the car body will rock but little, and the inner brake shoe will be energized in a manner to exert comparatively little pull upon the rail. When the car enters a sharper curve, the car body rocks to a greater extent, and the brake shoe is energized to a greater extent, and so on, through the range of control provided, up to the point where the brake shoe is most strongly energized. This action is entirely automatic, and, while track brake shoes are provided on each side of the truck, only one shoe is active at a time, in the manner just described, but when the shoes are operated for braking purposes to retard or stop the progress of the train, then both shoes are energized by currents supplied through instrumentalities which permit the brake shoes to come into actual contact with the rails.

The invention will be best understood, however, from a consideration of the following detail description, taken in connection with the accompanying drawings, forming part of this specification, in which drawings,

Figure 1 is a side elevation, partly in section, of a portion of a car truck showing the electric track brake shoe applied thereto. Fig. 2 is a view on a larger scale, and partially diagrammatic, showing the controlling mechanism for each of the brake shoes. Fig. 3 is a bottom plan view of a portion of the structure shown in Fig. 1 and showing the under side of the tread of a portion of the track with the rail web in section. Fig. 4 is a detail view of one of the brake shoes. Figs. 5 to 7 are views of the multiple brushes for the controller. Fig. 8 is a diagram of the electric circuits. Fig. 9 is a diagrammatic representation of another form of the electric track brake shoe.

Referring to the drawings, there is shown a truck frame 1 with a pair of wheels 2 resting upon a rail 3 which may, for the purposes of the invention, be considered as the inner rail of the curve. The truck is shown with one of the side springs 4 movable up and down under the stress of the car body, as will hereinafter appear. The truck is shown with a side truss composed of an upper member 5 and a lower drop member 6, between which engage channel girders 7. This truck forms the basis of another application for Letters-Patent. The shoe may, however, be used on any style of truck. Bolted to the lowest truss member 6 below the channel girders 7 are journal boxes 8 in which are mounted rock-shafts 9, 9. Fast upon the corresponding end of each shaft is an arm 10 projecting upwardly and at its free end having pivoted thereto a screw stud 11 to the threaded end of which latter there is applied a turn-buckle 12. The turn-buckles in turn engage the threaded ends of other screw studs 13 having their free ends formed into eyes 14 brought together and there secured by a pivot bolt 15. The stud bolts 11 and 13 and connecting turn-buckles 12 constitute links connecting the upper ends of the arms 10 together, the two links being, themselves, pivotally connected together at the ends remote from the arms 10 by the pivot pin 15.

Fast upon the outer truss member 6 midway of its length, and beneath the pivotal connection 15 of the links joining the arms 10, is a cylinder 16 closed by a screw plug 17 centrally perforated for the passage of a piston rod 18 the upper end of which is bifurcated and formed into eyes 19 straddling the eyes 14 and connected thereto by the pivot pin or bolt 15. Within the cylinder 16, the piston rod 18 carries a piston 20 suitably provided with a packing ring 21 which may be of the usual type or may be in the form of the usual leather cup packing. Entering the lower end of the cylinder is a conduit 22 connected to a pipe 23 coming from the auxiliary reservoir or train pipe of the air brake system of the car or train. Above the piston, between the same and the plug 17, is a helical spring 24 of such power as to balance a certain air pressure within the cylinder upon the other side of the piston from that engaged by the spring 24. The purpose of this piston will appear further on.

Midway between the truss members 6, the shafts 9 each carry two spaced rock arms 25, the free ends of which latter engage studs 26 projecting from opposite sides of the casing 27 of an electric track brake shoe, to be presently described. Further, the rock shafts 9 each carry an arm 28 in line with the respective rail 3, and these arms terminate in rollers 29, to be hereinafter referred to.

As shown more in detail in Fig. 4, the electric brake shoes consist of a yoke 30 to which are secured suitable cores 31 terminating in extended pole pieces 32, which may be secured to the cores 31 by bolts 33 having their heads suitably countersunk in the pole pieces to provide against wear, since the exposed faces of the pole pieces are designed to engage the tread of the rail and operate as brake shoes. The cores 31 are surrounded by coils 34 suitably wound for the purposes of the invention. The casing 27 is held in place and the cores 31 are secured to the yoke 30 by bolts 35 passing through cheek plates 36 on which are formed ears 37 engaged by the studs or pivot pins 26, so that the entire brake shoe is carried by the arms 25 and is movable with these arms. The pole pieces constituting the brake shoes may be replaced when worn.

Suitably secured to the truss, say the member 5, is a box 38 in which are placed three series of contact blocks 39 each series containing four blocks. These numbers and arrangement of the blocks are taken as illustrative only and may be varied as the exigencies of practice may demand. This box is provided with a cover 40, shown displaced in Fig. 2, and in this cover there is a longitudinal slot 41. Housed within the box is a bridging contact 42, best shown in Figs. 5, 6 and 7. This contact 42 comprises a plate 43 which may be of metal or any other suitable material with which is connected another similar plate 44 of insulating material by means of screws 45. Secured to and equally spaced upon the insulating plate 44 are three brackets 46 each terminating in two parallel ears 47 each longitudinally slotted, as shown at 48, in which slot plays the pivot pin 49 of a fork bridging conductor 50 held normally with the pivot pin at the end of the slot 48 remote from the base of the bracket by a spring 51, which may be an ordinary leaf spring, as indicated, or may be any other suitable type of spring. The plate 44 is separated from the plate 43 by an insulating plate 52 which serves to cover the heads of screws 53 used to connect the brackets 46 to the plate 44. The contact 42 is so placed in the box 38 that each bridging conductor 50 moves along a series of contact blocks 39, and this conductor 50 has sufficient span to connect two contiguous blocks 39 of a series. The circuit connections are shown diagrammatically in Fig. 8 where the main current supply in indicated as a dynamo 54. In the dynamo lead 55 may be included a magnetic blow-out coil housed in the controller box and adapted to the controller in the usual manner.

In the general system to which this invention relates, a suitable dynamo, always running and consequently always in condition to furnish current, is carried by a car or train, and since the system contemplates the use of the prime mover upon the car in the form of a gasolene or other explosive engine, also designed to be constantly running, a dynamo is a ready means for furnishing current when needed. Of course, when the invention is used upon cars not primarily furnished with current generators, storage batteries or other suitable sources of current may be employed. When the invention is used upon electrically driven cars or trains, then the prime source of current may be drawn upon for the purposes of the present invention. In such case the motor cars may be arranged with a reversing controller to convert them into dynamos for the time being so that failure of power or loss of the trolley will not subject the car to danger by eliminating the safety feature of the shoe. The conversion of the motor temporarily into dynamos in such a case is a usual operation and hence needs no further description.

Now, considering the diagram of Fig. 8, it will be seen that the dynamo lead 55 connects to the third block from the top of the right hand series, and the other dynamo lead 56 connects to the third block from the top of the left hand series and is continued beyond this block to one of the coils 34 of the brake shoe. The other side of this coil is connected by a conductor 57 with the third block from the top of the intermediate series. The other coil 34 is connected by a conductor 58 to the second block of the intermediate series, and the lowermost block of the left hand series. The other side of the coil 34 is connected by a conductor 59 to the second block from the top of the right hand series and also the lowermost blocks of the right hand and intermediate series. It will be seen that the uppermost blocks of all three series and the second block from the top of the left-hand series are dead or open circuit blocks. These blocks might, therefore, be omitted, except that they serve as wearing blocks.

Referring to Fig. 2, it will be seen that there is mounted upon the truss member 5 a lever 60 of the first order by means of a pivot pin 61, and this lever is provided with an arm 62 extending at right angles to the main portion of the lever in a plane cutting the pivot pin 61. The long end of the lever is formed with an elongated slot 63 in which engages a pin 64 fast on the bridging contact 42 and extending through the slot 41 in the cover 40. In the short end of the lever 60 there is a pin 65 engaging in a slot 66 in the end of a link rod 67 the other end of which is pivotally secured, as shown at 68, to a clip frame 69 surrounding the spring 4 midway of its length.

The arm 62 is connected by a link 70 to the free end of the piston rod 71 entering a cylinder 72 and there carrying a suitably packed piston 73, between which latter and the end of the cylinder through which the piston rod extends, there is confined a helical spring 74. The other end of the cylinder is closed by a plug 75 and protecting cap 76, and into this last-named end of the cylinder 72 there enters a pipe 77 coming from the train pipe or auxiliary reservoir of the air-brake system.

It will be understood that the blocks 39 and bridging conductors 50 may be made of copper or phosphor bronze, or any other good conducting material, and further, in practice the controller has its blocks so spaced that the controller cannot short circuit the leads 55 and 56 when passing from series to multiple or the reverse.

Under normal conditions, the bridging contact 42 is in the uppermost position with the bridging conductors 50 resting with one side on the inactive contact blocks, so that no current flows to the coils 34. In this position of the parts, the links connecting the upper ends of the levers 10 are in line one with the other, and the springs 24 and 74 are in the compressed position due to the air pressure from the train pipe of the air brake system. These are the conditions which are present when the car or train is moving at any speed on a straight track. Now, let it be supposed that the car or train enters upon a curve. The tendency of the car is, of course, to follow the straight course, but this is resisted by the engagement of the flanges of the wheels with the rails, and so the car is constrained to follow the curve. However, the body of the car has a certain independent movement with respect to the trucks because of the spring connections, and therefore the body of the car will rock to a certain extent upon a longitudinal axis, compressing the outer springs, that is, the springs adjacent to the outer rail of the curve, while the springs on the other side of the car at the inner side of the curve are relieved from pressure. Now, because of this rocking movement, the rod 67 on that side of each truck corresponding to the inner rail of the curve will be lifted, and, engaging the pin 65 of the lever 60, will move the lever about its fulcrum 61 and thus carry the bridging contact 42, so that the bridging conductors or shoes 50 are moved from the first and second blocks of each series to the second and third blocks thereof. This will couple up the dynamo to the two coils 34, so that the latter are in series with the dynamo. Now, for the purposes of the invention, the coils 34 are so proportioned as to produce the greatest magnetic effect upon the brake shoes when the coils are connected up in multiple with the dynamo. Consequently, when connected up in series, their magnetic effect, while still considerable, is, of course, proportionately less than when they are connected up in multiple.

Under practical conditions, the pole pieces 32 constituting the brake shoes are arranged in close relation to, but still out of contact with, the rails. When, then, the coils 34 are energized, as described, there is a vigorous pull exerted upon the rails by the brake shoes, resisting any tendency to increase the distance between the brake shoes and the rails. The movement of the brake shoes along the rails in the direction of the length of the rails, while the brake shoes are out of contact with the rails, is not at all resisted, except, perhaps, by the rail joints where there is more or less magnetic reluctance. However, the effect of the joint is so small as to be practically negligible.

Now, assume that the speed of the train and the sharpness of the curve is such as to cause a great, or comparatively great, rocking of the car. Under these conditions, the bridging conductors or shoes 50 are carried to a position to bridge the third and fourth contact blocks of each series of blocks 39, in which position the coils 34 are coupled up in multiple with the dynamo and therefore produce their greatest magnetic effect upon the brake shoes.

Assuming that the car bodies and trucks are suitably secured together by king-bolts, with nuts or keys, then any force tending to cause the car body to overturn on entering a curve will act in like manner on the trucks. These forces tend to overturn the car about the bearing points of the outer truck wheels upon the outer rail, the car body acting upon the trucks through the king-bolt. Now, since only the inner side of the car body, that is, the side corresponding to the inner side of the curve, lifts when the car enters the curve, consequently, only the inner shoes of each truck are energized, it being understood that there are electric shoes on each side of each truck and the shoes are independently energized in the manner described. By properly proportioning the electric brake shoes, there may be produced a pull upon the rails which will be greater than any force tending to lift the inner wheels of the truck off the rails, and, consequently, a curve may be taken at high speed without danger of the car or train leaving the track, due to the action of centrifugal force, and this may be done even with flat tracks or tracks where the outer rail has been elevated only for comparatively low speeds. It is of course evident that the action of the car in hugging the track on rounding curves is entirely automatic, whether the curve entered upon is easy or sharp.

It is to be observed that the lower end of the rod 67 is provided with a slot 66 for the pin 65. This permits the depressing of the springs by the load of the car without bringing strain to bear upon the parts. Furthermore, a slot in the link 70 permits the movement of the bridging contact 42 throughout its entire range without affecting the piston 72.

When the electric track shoe is energized, its tendency is, of course, to move toward the track, but this is resisted by the link connections of the upper ends of the levers 10, since, under the conditions present when the shoe is working automatically on curves, these links are in line one with the other and effectively lock the shoes against up and down movement.

Under some conditions a single pair of coils for each brake shoe may be found insufficient. Then the coils may be divided up as diagrammatically shown in Fig. 9, where the coils are indicated as wound upon a longitudinal series of cores between heads 78, the coils being properly arranged to produce consequent poles in the said heads, and these heads then constitute the brake shoes, which latter in practice may be formed of removable wearing plates for the heads. In the particular form shown in Fig. 9 there are two groups of two coils each, each group corresponding to one coil 34 of the structure shown in Fig. 4, and these coils are coupled up to the controlling device as though there were but two coils. The paths of the magnetic flux are diagrammatically illustrated by dotted lines.

The reason for using track brake shoes, as indicated in Fig. 9, will be apparent from a consideration of the following. The traction of the electro-magnetic brake shoe depends upon the impressed voltage, the hot resistance of the winding, the ampere turns, the cross sectional area, the length, and the material of the magnetic circuit, the length of the air gap and the state of the pole pieces and the armature surface, the latter being the rail. In any given case the several conditions may be varied at pleasure except the cross sectional area of the rail, the value of which must be taken as that of the smallest rail over which the car runs or possibly an average slightly above this. To make the conditions clear, it is advisable to take an example from actual practice. Assume a seventy foot Pullman car weighing with ballast and full passenger load about forty tons with the center of gravity at an appropriate distance above the rails and considering the greatest speed at which the car may travel and the sharpest curve it will be called upon to negotiate, then it will be found that the cross sectional area of a ninety pound rail is entirely inadequate even when the maximum magnetic density is 90,000 lines per cubic inch, with an air gap of about one-fourth inch, and assuming a single pair of coils in the brake magnet of each truck. For the case under consideration it is found that the cross sectional area of an adequate armature is three times the actual cross sectional area of the rail. Hence, since one is forced to adopt a magnetic circuit of only one-third the calculated cross sectional area requisite for the purpose, then it is necessary in order to get the requisite area to have at least three magnetic circuits one after the other along the length of the rail, or possibly four or five or more if it be found necessary in practice. In Fig. 9 four such magnetic circuits are illustrated.

With modern high speed, heavy weight equipments, there is difficulty in stopping high speed trains within a sufficiently short distance to insure the average safety to life and property present with the lower speed trains. All high speed brake equipments depending on wheel brakes are limited as to the pressure of the brake shoes by the fact that the wheels must not be locked against movement or the braking power is materially reduced. Now, let it be assumed that a quick stop is required and the engineman or motorman makes an emergency application with the brakes, which means a reduction of twenty pounds or more in the train pipe pressure of the air brake system. This means that there is a corresponding decrease in pressure on the air side of the pistons 20 and 73. The springs 24 and 74 are compressible only under an air pressure of about fifty pounds to the square inch, and, consequently, when the train pipe pressure is reduced twenty pounds or more corresponding to an emergency reduction, these springs will act to drive their respective pistons against the reduced air pressure. Hence the auxiliary brake produced by the shoe is not effective on a service application, but only on emergency application. Under the action of the spring 24, the piston rod 18 is moved into the cylinder 16 and draws the links connecting the upper ends of the levers 10 out of alinement and toward the cylinder. This, of course, will draw the upper ends of the levers 10 toward each other, and so move the brake shoes down toward the tracks until in contact therewith. At the same time, the spring 74 acting upon the piston rod 71 has, through the link 70 and arms 62, caused the lever 60 to move about its pivot and so propelled the bridging contact 42 to first couple up the coils 34 in series and then in multiple, if the movement has been great enough. Now, since the brake shoes are in physical contact with the rails, the magnetic attraction is not only greatly increased, but the frictional resistance to the movement of the shoes along the rail is also very great. The braking power of the wheel brakes is thus most materially augmented. It is to be observed that when the electric brake shoes are acting in conjunction with the wheel brakes on an emergency application, all the brake shoes on both sides of the car, and in the case of a train on both sides of all the cars, are operating synchronously with the wheel brakes of the air brake system.

It may be found, in practice, that under certain conditions, the enormous increase of braking power, due to the electric shoes in physical contact with the rails, is too great for the equipment, and must, for such equipment, be made less quickly effective. This may be done in various ways, as by suitably proportioning the magnets or connecting the coils up in series, or multiple-series, for the emergency brake, or in other ways known to electrical engineers, and since this is a constructive detail which can be provided for only when the particular conditions are known, it is not thought needful to illustrate any of these known methods for producing the desired result.

Under sudden stoppage, such as just described, there may be a tendency for the car to lift from the track. This is prevented by providing the movement of the electric brake shoes only a little in excess of the distance necessary to bring the shoes into engagement with the rails, and this excess movement need not exceed about a quarter of an inch. Should, then, the car tend to lift, it can only rise about one quarter of an inch before further rise is resisted by the powerful adhesion of the charged brake shoes with the track, and this slight rise is insufficient for the wheel flange to escape from the rails. With an equipment provided with the electric brake shoes, the several parts are designed with a view of resisting the sometimes heavy strains brought to bear upon them.

The rollers 29, before referred to, are designed to prevent the magnets constituting the track brake shoes from pulling against the truck springs, commonly employed but not shown in the drawings, to an extent sufficient to make contact with the rails when acting automatically to prevent the trucks from leaving the rails on curves. If under certain working conditions these rollers are found unnecessary, they may be omitted.

It will be understood that the coils 34 adjacent to each other may be so wound that the coils produce opposed magnetic poles to be bridged by the rails, which arrangement, of course, will give the best magnetic effect, producing consequent poles, as shown at Fig. 9.

While I have described the coils 34 as coupled up in either series or multiple, it is evident that where a sufficient number of coils are used or the windings are suitably subdivided, the coils may be combined in multiple-series, or still other combinations may be made to further modify the magnetic effect.

As already stated, there is provided a magnetic blow-out coil in the controller for extinguishing the arc when the circuit is broken, as the controller changes to its several positions. This blow-out coil is indicated at 79 in Fig. 8.

I claim:—

1. An electro-magnetic shoe for railway cars, having two or more coils for magnetizing the shoe, and means for coupling the coils in series or multiple to control the magnetic effect.

2. An electro-magnetic shoe for railway cars, having two or more coils for magnetizing the shoe, and means for coupling the coils first in series and then in multiple to control the magnetic effect.

3. An electro-magnetic shoe for railway cars, having two or more coils for magnetizing the shoe, and means for varying the order of coupling of the coils to the source of electricity to control the magnetic effect of the coils.

4. An electro-magnetic shoe for railway cars, having two or more coils for magnetizing the shoe, and a controller for the coils having two sets of circuit terminals, a bridging conductor for electrically uniting the terminals to couple the coils in series, and a third set of circuit terminals coacting with the second set to couple the coils in multiple when the second and third sets are bridged by the bridging conductor.

5. An electro-magnetic shoe for railway cars, having two or more coils for magnetizing the shoe, and a controller for the coils having contact blocks connected to a source of electric current and to the coils so that when suitably bridged the coils are connected in multiple or series to the source of power, and bridging shoes for the blocks movable over the same and insulated from each other.

6. A means for preventing railway cars from leaving the track on entering curves, comprising electro-magnetic shoes carried by the car in operative relation to the rails, and means responsive to the rocking of the car on entering a curve for coupling the shoes to a source of electric current.

7. A means for preventing railway cars from leaving the track on entering curves, comprising electro-magnetic shoes carried by the car in operative relation to the rails, and means responsive to the rocking of the car on entering a curve for coupling the shoes on that side of the car corresponding to the inner rail of the curve to a source of electric current.

8. A means for preventing railway cars from leaving the track on entering curves comprising electro-magnetic shoes carried by the car truck in operative relation to the rails, means for electrically connecting the shoes to a source of electric power, and connections between said electric coupling means and parts of the car movable with relation to the truck for energizing the shoes when the movable part of the car rises upward with relation to the truck.

9. A means for preventing railway cars from leaving the track on entering curves comprising electro-magnetic shoes carried by the car truck in operative relation to the rails, a controller for each shoe for coupling the same to a source of electric power, said controller being carried by the same relative part as the respective shoe, means for moving the controller to different operative positions, and connections btween the controller operating means and a movable part of the car for actuating the controller by the rocking of the car on entering a curve.

10. A means for preventing railway cars from leaving the track on entering curves, comprising an electro-magnetic shoe carried by the car truck in operative relation to a track rail, a controller for varying the electro-magnetic effect of the current upon the shoe, said controller also being carried upon the same relative portion of the truck as the shoe, a bridging member for the controller movable across the same for coupling the shoe to the source of electric power, a lever for moving the bridging member of the controller, and a connecting link between the lever and a part of the car participating in the rocking movement of the car when the latter enters on a curve.

11. A means for preventing railway cars from leaving the track on entering curves, comprising an electro-magnetic shoe carried by the car truck in operative relation

to a track rail, a controller for varying the electro-magnetic effect of the current upon the shoe, said controller also being carried upon the same relative portion of the truck as the shoe, a bridging member for the controller movable across the same for coupling the shoe to the source of electric power, a lever for moving the bridging member of the controller, and a connecting link between the lever and a part of the car participating in the rocking movement of the car when the latter enters on a curve, said connecting link having a pin and slot union with the lever.

12. In a railway car, an electrically energized track shoe, means for controlling the action of the electrical energy upon said shoe, and pneumatic means connected with the air brake system of the car for bringing the shoe into braking relation with the rails, and at the same time energizing the shoe when the air brake system is in emergency.

13. In a railway car, an electro-magnetic rail shoe movable into and out of contact with the rail, means responsive to air pressure for locking the shoe out of contact with the rail and for permitting it on a reduction of pressure to move into contact with the rail, means for cutting the shoe into and out of circuit with a source of electric power, connections between said circuit controlling means and a portion of the car capable of rising and falling with relation to the truck, and means responsive to variations in air pressure also connected to said circuit controlling means.

14. In a railway car, an electro-magnetic rail or track shoe, and pneumatically controlled means for moving the shoe into and out of contact with the rail.

15. In a railway car, an electro-magnetic rail or track shoe movable into and out of contact with the rail, a pneumatic cylinder arranged for connection to the train pipe or auxiliary reservoir of the air-brake system of the car, a piston within the cylinder, a spring within the cylinder acting on the piston in opposition to the air pressure, and connections between the piston and the brake shoe.

16. In a railway car, an electro-magnetic rail or track shoe movable into and out of contact with the rail, levers carrying said shoe, a cylinder adapted to be connected to the train pipe or auxiliary reservoir of the air brake system of the car, a piston in said cylinder, a spring acting on said piston in opposition to the air pressure, a piston rod connected to the piston, and link connections between the piston rod and the levers, said link connections being movable into alinement by the normal pressure in the train pipe or auxiliary reservoir.

17. In a railway car, an electro-magnetic rail or track shoe movable into and out of contact with the rail, levers carrying said shoe, a cylinder adapted to be connected to the train pipe or auxiliary reservoir of the air brake system of the car, a piston in said cylinder, a spring acting on said piston in opposition to the air pressure, a piston rod connected to said piston, and link connections between the piston rod and levers, each link being adjustable as to length.

18. In a railway car, an electro-magnetic rail or track shoe movable into and out of contact with the rail, a cylinder adapted to be connected to the train pipe or auxiliary reservoir of the air brake system of the car, a piston in said cylinder, connections between the piston and the shoe for moving the same into and out of contact with the rail, and a spring acting on the piston in opposition to the air pressure and adjusted to respond to an emergency reduction of air pressure.

19. In a railway car, an electro-magnetic rail or track shoe movable into and out of contact with the rail, pneumatically operated means for causing the movement of the track shoe, a controller for regulating the magnetic intensity of the track shoe, and pneumatically operated means responsive to a reduction in air pressure for moving the controller into active position when the air pressure is reduced.

20. In a railway car, an electro-magnetic rail or track shoe movable into and out of contact with the rail, a controller for connecting and disconnecting the shoe from a source of electric power, a pneumatic means for moving the shoe into and out of contact with the rail, said pneumatic means being in constant communication with the train pipe or auxiliary reservoir of the air brake system of the car, and a pneumatically operated means controlling the movement of the circuit making and breaking device for the shoe, said last-named pneumatic means being in constant communication with the train pipe or auxiliary reservoir of the air brake system of the car.

21. In a railway car, an electro-magnetic rail or track shoe movable into and out of contact with the rail, a controller for connecting and disconnecting the shoe from a source of electric power, a pneumatic means for moving the shoe into and out of contact with the rail, said pneumatic means being in constant communication with the train pipe or auxiliary reservoir of the air brake system of the car, a pneumatically operated means controlling the movement of the circuit making and breaking device for the shoe, said last-named pneumatic means being in constant communication with the train pipe or auxiliary reservoir of the air brake system of the car, and means responsive to an emergency reduction of air pressure in the

train pipe or auxiliary reservoir of the air brake system for moving the shoe into contact with the track and simultaneously energizing the shoe.

22. In a railway car, an electro-magnetic rail or track shoe movable into and out of contact with the rail, means for varying the order of coupling of the coils of the shoe to a source of electricity to control the magnetic effect of the coils, connections between the controller device and a part of the car movable relatively thereto and responsive to the rocking of the car on entering a curve, a pneumatic cylinder in constant communication with the train pipe or auxiliary reservoir of the air brake system of the car, a piston in said cylinder, connections between said piston and the electric controlling means for the shoe, said connections being unresponsive to the movements of the car on entering a curve, a spring controlling the piston in opposition to the air pressure and active only on an emergency reduction of the air pressure, another cylinder in constant communication with the train pipe or auxiliary reservoir of the air brake system of the car, a piston in said cylinder, connections between said piston and electro-magnetic track shoe, said connections being movable to a locked position under the normal train pipe pressure, and a spring acting on the last-named piston in opposition to the air pressure and active when the air pressure has been lessened by an emergency reduction.

23. An electro-magnetic shoe for railway cars provided with a number of pole pieces and coils, the latter wound to produce consecutive poles in operative relation to the rail and extending longitudinally of the rail to include a length of rail commensurate with the cross sectional area thereof and the maximum load to be placed upon the magnet.

24. In a railway brake, an electrically energized track shoe, a controller for coupling up the energizing coils of the shoe in different relations, and a blow-out coil coacting with the controller to eliminate arcing at the controller segments.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

WILLIAM C. MAYO.

Witnesses:
WM. ADAMS,
G. W. DYER.