July 8, 1941. R. B. POGUE ET AL 2,248,383

BRAKING ARRANGEMENT

Filed Dec. 6, 1939 5 Sheets-Sheet 1

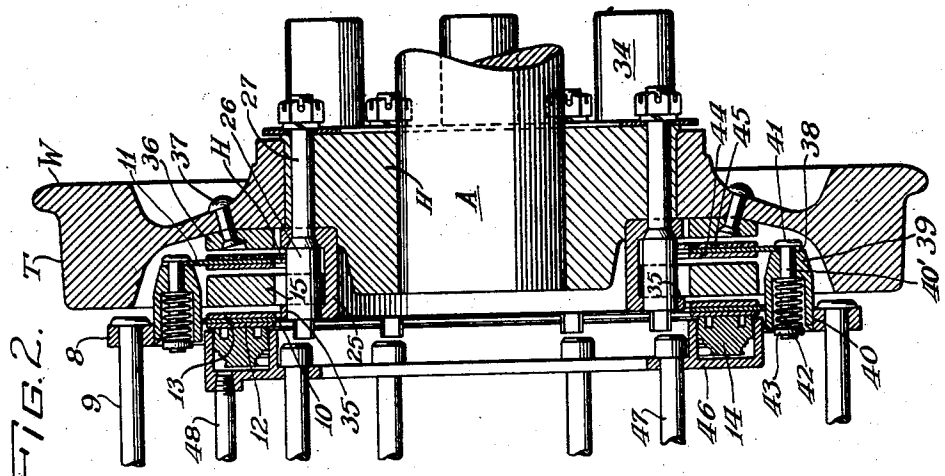


FIG. 2.

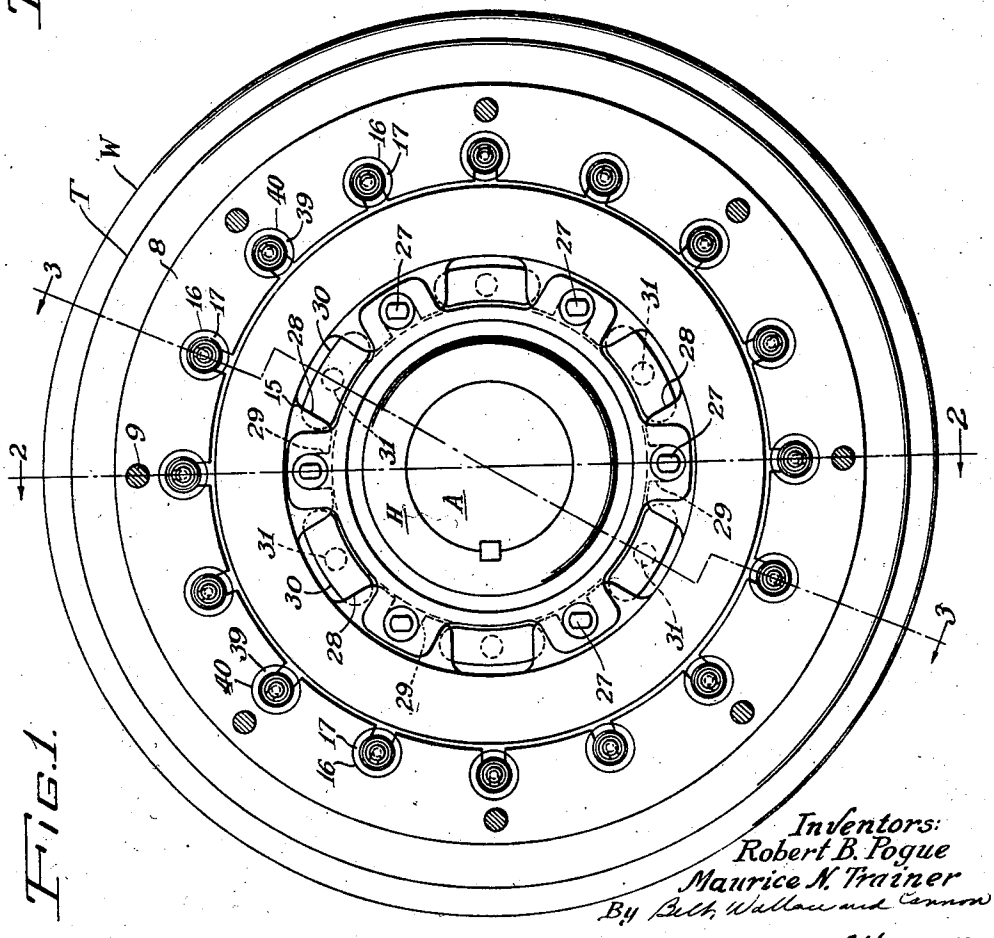


FIG. 1.

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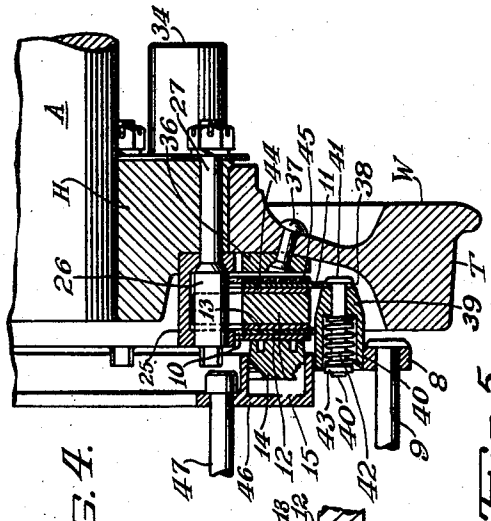


FIG. 4.

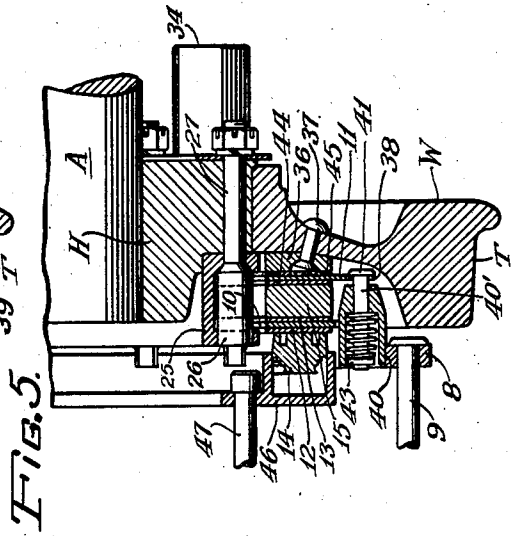


FIG. 5.

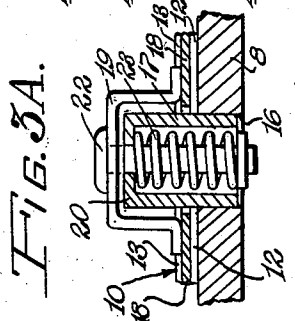


FIG. 5A.

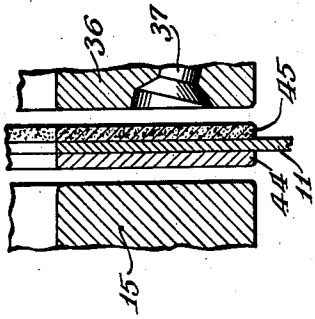


FIG. 6.

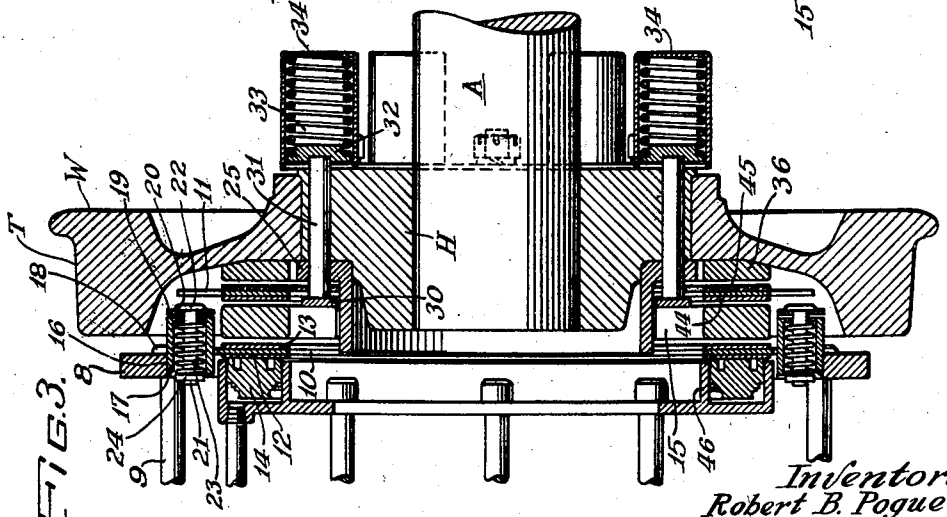


FIG. 3.

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BRAKING ARRANGEMENT

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Fig. 7.

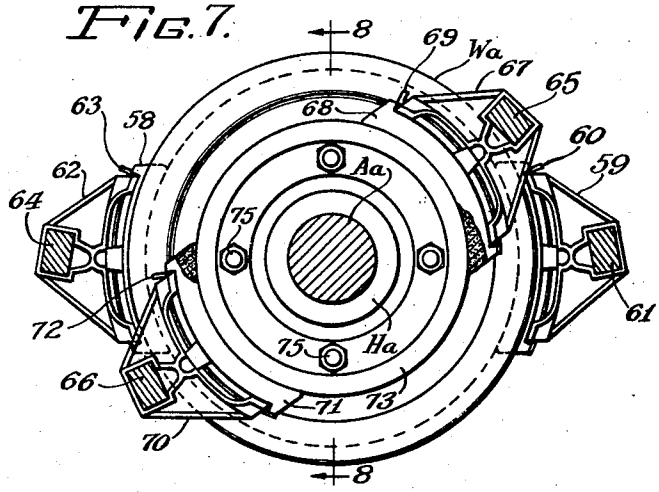


Fig. 8.

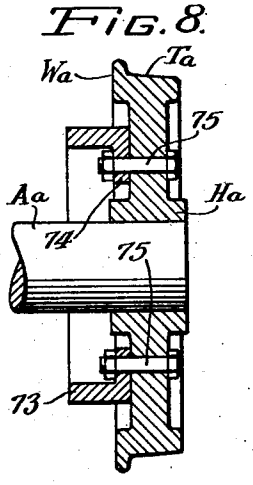


Fig. 9.

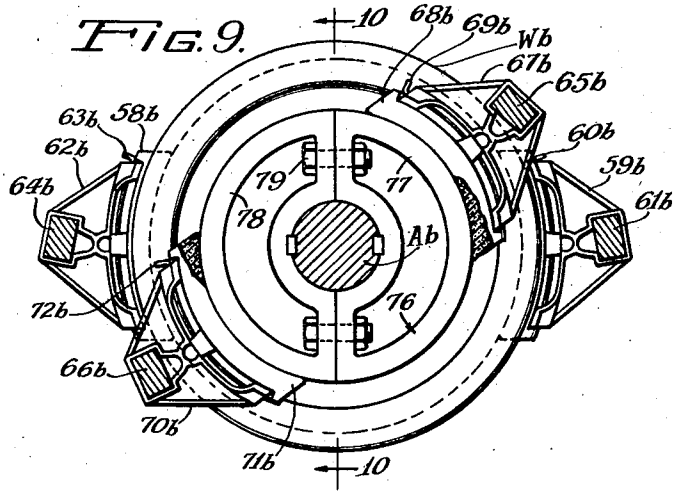


Fig. 10.

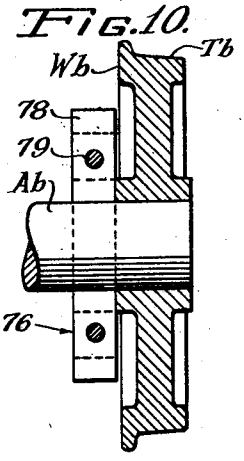
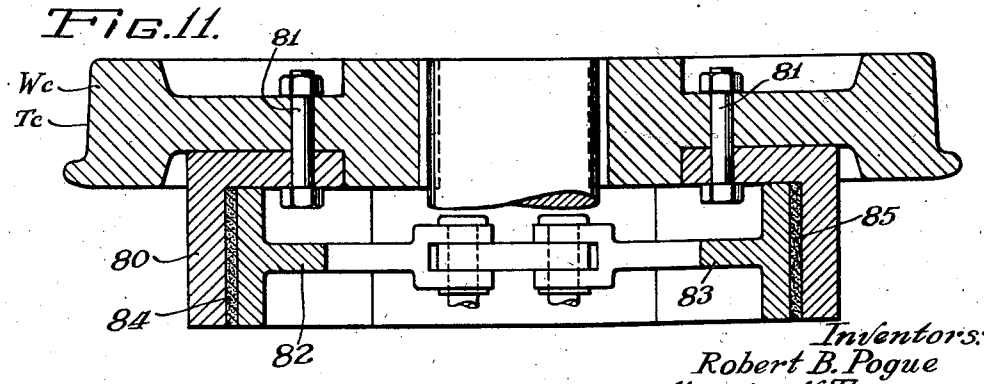


Fig. 11.



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BRAKING ARRANGEMENT

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FIG. 13.

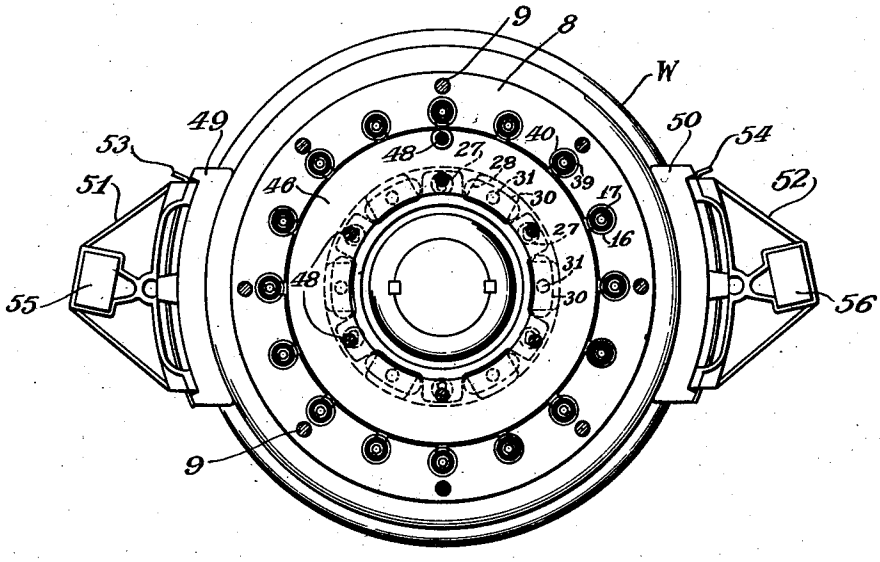
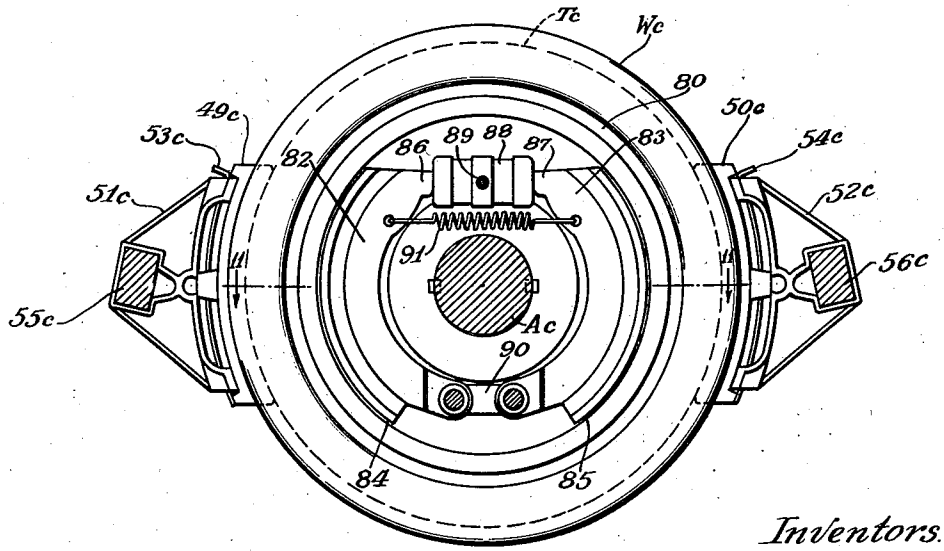


FIG. 12.



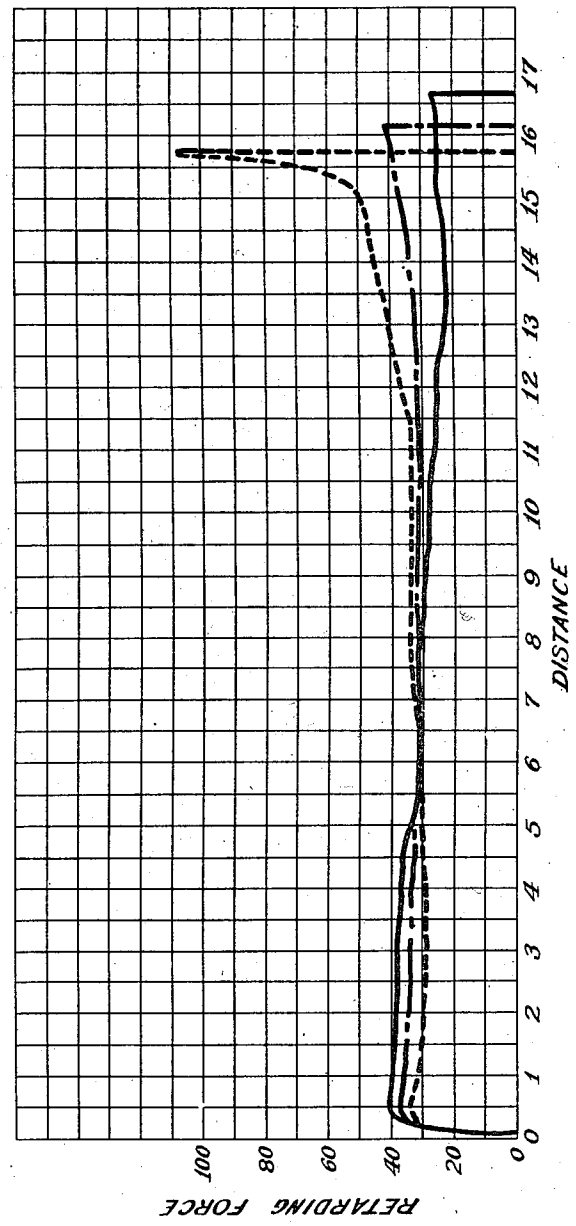
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BRAKING ARRANGEMENT

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Fig. 14.



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Patented July 8, 1941 2,248,383

UNITED STATES PATENT OFFICE

2,248,383

BRAKING ARRANGEMENT

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Application December 6, 1939, Serial No. 307,746

9 Claims. (Cl. 188—33)

This invention relates to the art of braking and more particularly to the braking of railway equipment.

Heretofore it has been customary to effect braking operations on railway equipment by forcing shoes, usually of cast iron, against the peripheries or treads of wheels on the equipment and while this has been and still is a satisfactory way in which to effect such operations, it has been observed that there is an appreciable increase in the effective retarding force of braking equipment, during the latter stages of deceleration effected thereby, where a metal-to-metal engagement or contact is relied upon to effect a deceleration as is the case in those instances where cast iron shoes have been applied to the steel or chilled iron peripheries of wheels of railway equipment.

Furthermore, there have been instances where shoes of a composition friction material, consisting largely of asbestos or like fibrous material and friction imparting and controlling ingredients bonded together by an organic binder or binders or the like, have been employed to effect decelerations, but it has been observed that there is a decrease in the effective retarding force of braking equipment, during the latter stages of deceleration effected thereby, where a composition friction material-to-metal engagement or contact is relied upon to effect a deceleration as is the case in those instances where shoes of such friction material have been applied to the steel or chilled iron peripheries of wheels of railway equipment.

Thus since the effective retarding force tends to increase during the latter stages of a deceleration effected through the medium of a metal-to-metal engagement and since the effective retarding force tends to decrease during the latter stages of a deceleration effected through the medium of friction material-to-metal engagement, a mean or substantially uniform effective retarding force may be realized if a deceleration is effected through the medium of both a metal-to-metal engagement and a composition friction material-to-metal engagement, and so to do constitutes the primary object of the present invention.

Particularly in those instances where braking operations entail the dissipation of appreciable energy in the form of heat, it has been observed that, if this is effected through the medium of a metal-to-metal engagement, in some instances there may be a depositing of metal from one of the members entering into such engagement onto the other of such members, and if both a metal-to-metal engagement and a composition friction material-to-metal engagement are utilized and such depositing of metal should take place and the apparatus was so arranged that metal so deposited could move into engagement with the composition friction material, there might be such tearing or abrasion of the composition friction material that its usefulness would be materially impaired or at least this condition would give rise to an excessive and objectionable rate of wear, and thus still another object of our invention is to enable both a metal-to-metal engagement and a composition friction material-to-metal engagement to be utilized to effect decelerations but to so arrange the apparatus that the metal-to-metal engagement and the composition friction material-to-metal engagement will be independent of each other.

As has been explained, railway equipment has heretofore included shoes which could be arranged to be applied to peripheries or treads of wheels on the equipment. Furthermore, in some instances so-called disc brakes have been employed, usually consisting of a plurality of alternately arranged rotor and stator discs, the rotor discs, in one way or another, being connected to the wheels of the equipment to rotate therewith and the stator discs being connected to the frames of the equipment either directly or indirectly so as to be properly retained in position. Suitable means usually pneumatically-operated, have been employed to force the rotor and stator discs into face-to-face engagement to thereby effect deceleration of the equipment on which such brakes have been included. Inasmuch as the application of shoes to the wheels of equipment is an eminently satisfactory way of effecting decelerations and since it has been found that shoes of cast iron are admirably suited for such usage and since disc brakes afford an admirable way of providing a composition friction material-to-metal engagement, it is yet another object of this invention to equip railway equipment with braking devices consisting of shoes, preferably of cast iron, engageable with the peripheries of wheels on the equipment and also disc brake arrangements, including composition friction material-to-metal engagements, and still another object of this invention is to enable shoes of composition friction material to be substituted for the cast iron shoes which have heretofore been employed and in such instances to afford a metal-to-metal engagement between at least certain of the rotor and stator

elements of disc brake structures included in braking arrangements embodying both disc brake structures and shoes engageable with the peripheries of wheels.

While the use of shoes engageable with the peripheries of wheels on railway equipment together with a disc brake arrangement constitutes a suitable way in which both a metal-to-metal engagement and a composition friction material-to-metal engagement may be independently afforded for the purpose of effecting decelerations on railway equipment or the like, it will be understood that resort may be had to other arrangements and so to do is among the objects of our invention.

Included among objects ancillary to the immediately foregoing object is to not only apply shoes to the peripheries of wheels of railway equipment or the like but also to apply shoes to flanges secured to the wheels and having surfaces arranged in substantially parallel relation with the treads of the wheels or to the peripheries of discs arranged to be rotatable with the wheels, and yet another object, ancillary to the foregoing, is to enable a drum and shoe braking arrangement to be employed along with shoes engageable with the peripheries of wheels or with the peripheries of flanges secured to the wheels or the peripheries of discs arranged to be rotatable with the wheels or other kindred combinations of such nature that at least selected braking arrangements will consist of at least two different braking means, in one of which a metal-to-metal engagement may be afforded and in the other of which a composition friction material-to-metal engagement may be afforded.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments and the principle thereof and what we now consider to be the best mode in which we have contemplated applying that principle. Other embodiments of the invention embodying the same or an equivalent principle may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings,

Fig. 1 is a side elevation, in which certain parts are broken away, of a wheel suitable for use on railway equipment and which has a typical disc brake arrangement associated therewith;

Figs. 2 and 3 are sectional views taken substantially and respectively on the lines 2—2 and 3—3 on Fig. 1;

Fig. 3A is a fragmentary view illustrating the specific structure of one of the mounting elements;

Figs. 4 and 5 are fragmentary sectional detail views, similar to Fig. 2, illustrating different stages of engagement between the rotor and stator elements of the disc brake therein illustrated that may be effected in the course of operation of such a brake;

Fig. 6 is a still further fragmentary view, drawn to an enlarged scale, of a portion of the apparatus illustrated in Figs. 2, 4 and 5;

Fig. 7 is a side elevational view of a wheel suitable for use on railway equipment and having a flange secured thereto affording a surface against which shoes may be applied;

Fig. 8 is a sectional detail view taken substantially on the line 8—8 on Fig. 7;

Fig. 9 is a view, similar to Fig. 7, but showing, in place of the flange arrangement, a disc adapted to rotate with the wheel therein illustrated;

Fig. 10 is a sectional detail view taken substantially on the line 10—10 on Fig. 9;

Fig. 11 is a sectional detail view taken substantially on the line 11—11 on Fig. 12;

Fig. 12 is a side elevational view of a wheel, suitable for use on railway equipment, having a drum and shoe brake associated therewith;

Fig. 13 is a side elevational view illustrating the manner in which shoes would be associated with the wheel and disc brake arrangement shown in Fig. 1; and

Fig. 14 is a view including friction curves illustrating the effective retarding force realized in decelerations effected by the use of a metal-to metal engagement, a composition friction material-to-metal engagement, and a combination of metal-to-metal engagement and composition friction material-to-metal engagement.

It is to be understood that the various braking arrangements shown in the accompanying drawings and hereinafter described are illustrative of typical embodiments of our invention and it is also to be understood that resort may be had to a wide variety of arrangements that will afford a brake arrangement comprising one set of elements affording a metal-to-metal engagement and yet another set of elements, independent of the first set, affording a composition friction material-to-metal engagement, and thus while in the following description the arrangements illustrated in the accompanying drawings are described in detail, it is to be understood that such detailed description is primarily for the purpose of explaining the present invention and is not, therefore, to be taken as a limitation of our invention particularly since one skilled in the art will be able from the following description to carry our invention forward into other and further embodiments thereof.

The disc brake illustrated in the accompanying drawings is associated with a wheel W, Figs. 1 to 5, inclusive, and 13. This disc brake embodies a part afforded by the wheel and while this arrangement is advantageous, it will be understood that this is not a necessary arrangement. The hub H of the wheel W is mounted on an axle A that is to be journaled in a manner (not shown) conventional on railway equipment.

The disc brake includes a supporting ring 8 to which the stator discs of the brake are connected in a manner presently explained. The ring 8, by means of bolts 9 in this instance, is adapted to be connected to the frame of the equipment on which the wheel W is included, usually in an indirect manner. For example, bolts 9 or the like may be used to connect the ring 8 to the conventional oil box (not shown) associated with the wheel W.

The illustrated disc brake includes two stator discs generally indicated by 10 and 11 in the form of rings made from suitable steel. The disc 10 has cast iron facings or shoes 12 and 13 thereon. The facing 12 is mounted on one face of the disc 10 at the marginal portion near the periphery thereof and in position to have the operating piston 14, presently explained, bear thereagainst. The facing 13 is provided on the opposite face of the disc in alignment with the facing 12 and in position to engage one face of the rotor disc 15 described hereinafter. The cast iron facings 12 and 13 may be provided on the disc 10 in a wide variety of ways and inas-

much as this invention does not primarily pertain to the particular arrangement of the disc brake, no detailed description of the manner in which such facings are provided in the disc is presented herein.

A plurality of uniformly and circumferentially spaced openings 16, Figs. 1 and 3, are provided in the ring 8 near the inner periphery thereof and spring housings 17 are mounted therein. Ears 18, Figs. 3 and 3A, are provided at spaced intervals about the periphery of the disc 10 and brackets 19, connected to these ears, have foot portions thereon extended over the heads 20 of the spring housings 17, which heads are disposed in spaced relation with the ring 8. Pins 21 extend through the spring housings 17 and have the heads 22 thereof urged against the aforesaid foot portions on the brackets 20 by the effect of springs 23 that are disposed about the pins 21 in the housings 17 and which extend between the housing heads 20 and collars 24 fast on the pins. The effect of such spring action is to urge the facing 12 on the disc 10 at all times toward the adjacent face of the piston 14.

A flanged ring 25 of substantially U-shaped cross section (see Fig. 2) is fast to the hub H on the side of the wheel W whereat the brake is to be arranged, this ring being held in position by the formed heads 26 on bolts 27 passed through the hub H parallel to the axle A and which bolts are spaced circumferentially one from the other as best shown in Fig. 1. The rotor disc 15, to which reference has been made hereinabove, is disposed outwardly of the flanged ring 25 and the enlarged heads 26 of the bolts 27, this disc being in the form of a ring and preferably being made from suitable steel. As best shown in Fig. 1, the disc or ring 15 has lugs 28 extending from the inner periphery thereof and which have bifurcations 29 therein that embrace the enlarged heads 26 of the bolts 27 whereby a sliding support is afforded for the disc 15.

Pads 30 are provided on pins 31, Figs. 1 and 3, and these pads, as shown in Fig. 1, bear against adjacent portions of adjacent lugs 28, the pins 31 being passed through the hub H in uniformly circumferentially spaced relation, the pins 31, as best shown in Fig. 1, being disposed between, and preferably being uniformly spaced from, adjacent bolts 27.

By referring to Fig. 3 it will be seen that the ends of the pins opposite the pads 30 are connected to spring followers 32 acted on by springs 33 confined in spring housings 34 secured to the hub H at the end thereof opposite that at which the ring 25 is provided. The effect of the springs 33 acting through the spring followers 32, pins 31 and pads 30 is to urge the lugs 28 into engagement with the flange lugs 35, Fig. 2, on the ring 25 and this disposes the disc 15 in its inoperative and at rest position shown in Fig. 2.

Another rotor disc 36, in the form of a ring made from suitable steel, is fast to the wheel W, as by rivets 37 or the like, outwardly of the flanged ring 25 and when the parts are in their at rest position there is appreciable space between adjacent faces of the rotor discs 15 and 36 and the stator disc 11 is arranged in this space.

The stator disc 11 has lugs 38 thereon that extend over the end portions of spring housings 39, Figs. 1 and 2, fast in openings 40 provided in the ring 8 intermediate the openings 16, the openings 40 preferably being uniformly spaced from adjacent openings 16. Pins 40', pass through the spring housings 39 and have heads 41 thereon that engage the faces of the lugs 38 opposite the faces thereof disposed toward the adjacent ends of the spring housings 39. Springs 42 are confined in the spring housings 39, between the heads of such housings and collars 43 fast on the pins 40', and the effect of these springs 42 is to dispose the stator disc 11 in the position in which it is shown in Fig. 2, the engagement of the lugs 38 with the ends of the spring housings 39 effecting such positioning.

A facing 44 of cast iron is provided on the face of the disc 11, disposed toward the adjacent face of the stator disc 15 and with which this facing is to cooperate. This facing 44, as in the case of the facings 12 and 13 on the disc 10, is suitably connected to the disc 11.

Another facing 45 is provided on the disc 11 on the face thereof opposite that on which the facing 44 is provided and in position to cooperate with the rotor disc 36. In accordance with this invention the facing 45 is made of composition friction material preferably consisting largely of asbestos, friction imparting and controlling ingredients and a suitable binder such as an artificial resin or the like. The facing 45 is connected to the disc 11 in any suitable manner as by being riveted thereto.

The operating piston 14 to which reference has been made hereinabove is preferably circular in outline so as to be complementary to the facing 12. This piston is mounted in a complementary cylinder 46 which, by means of bolts 47 or the like, is secured to the same support as that to which the supporting ring 8 is connected. An air line 48 leads to the cylinder 46 from the usual source of air under pressure provided on railway equipment and the supply of air under pressure to the cylinder 46 through the air line 48 is controlled in the manner conventional on railway equipment.

As can be seen by referring to Fig. 13, the wheel W has shoes 49 and 50 associated therewith to be engageable with the tread thereof. The shoes 49 and 50 are respectively fast to conventional heads 51 and 52 and preferably these shoes are detachably and respectively connected to the heads by means of removable keys 53 and 54 or the like. The heads 51 and 52 are respectively carried by brake beams 55 and 56. In accordance with our invention, the shoes 49 and 50 are preferably of cast iron and, as is well understood in the art, suitable means, usually pneumatically-operated, are associated with the brake beams 55 and 56 and through the intermediary of such pneumatically-operated means the shoes 49 and 50 are forced against the tread or tire of the wheel W to thereby effect deceleration.

Thus when a deceleration is to be effected air under pressure is admitted to the cylinder 46 through the air line 48 and thereupon the piston 14 is caused to so move through the cylinder 46 that the stator disc 10 is urged toward the rotor disc 15 which, since it is connected to the wheel W, will be rotating with the wheel. Such movement of the stator disc 10 is resisted by the springs as 23 but in the course of this movement the facing 13 is brought into engagement with the adjacent face of the disc 15 and thereupon deceleration of the wheel W is initiated and at this same time the shoes 49 and 50 will move into engagement with the tread or tire T so that deceleration of the wheel W is initiated through

the intermediary of the brake couple afforded by the shoes 49 and 50 engaging the tread or tire T and the disc brake arrangement associated with the wheel W.

In most instances where a deceleration of the wheel W is to be effected, the admission of air into the cylinder 46 will not only be sufficient to overcome the effect of the springs 23 but will also be sufficient to overcome the effect of the springs 33. Therefore, after the facing 13 has been engaged with the adjacent face of the disc 15, the disc 15 will be moved in such manner that the face thereof opposite that engaged by the facing 13 will be engaged with the facing 44 on the stator disc 11, which further augments deceleration of the wheel W, the parts being shown in these positions in Fig. 4. It will be understood that as the disc 15 is forced into engagement with the facing 44 the shoes 49 and 50 will be more firmly pressed against the tire T and therefore deceleration of the wheel W is further augmented.

In the present arrangement of the disc brake, the engagement of the facing 13 with the adjacent face of the disc 15 and the engagement of the other face of the disc 15 with the facing 44 affords cast iron-to-steel engagements or, in other words, metal-to-metal engagement. If all of the interengaging faces in the disc brake afforded metal-to-metal engagement, a deceleration accruing from the admission of air under pressure into the cylinder 46 in such a way as to bring about interengagement of the various potentially engageable faces, the resulting acceleration would exhibit friction characteristics such as are depicted by the broken line (— —) curve in Fig. 14, it being understood that in such a deceleration the shoes 49 and 50 would be maintained ineffective for the chart shown in Fig. 14 is merely tpypical of decelerations that may be effected by the use of either an arrangement affording nothing but metal-to-metal engagement or an arrangement affording composition friction material-to-metal engagement and, further, a deceleration which will accrue when the disc brake arrangement is arranged in the manner above described and shown in the accompanying drawings.

By referring to the broken line curve in Fig. 14 which, as stated, is typical of a deceleration effected by the disc brake herein shown and described but arranged to afford only metal-to-metal engagement, it will be seen that, after a slight increase in friction immediately following the initiation of the deceleration, the friction levels out and remains more or less constant until near the end of the deceleration when the friction materially increases. This is contrary to the usual desideratum for it is normally advantageous to have a decrease in friction or else to maintain the friction uniform in the latter portions of a deceleration. However, the frictional characteristics depicted by the broken line curve in Fig. 14 is typical in a deceleration effected through the intermediary of metal-to-metal engagement between relatively movable parts in a braking arrangement.

Now again if the shoes 49 and 50 are prevented from engaging the tread or tire T and if the various facings as 13 and 44 are of composition material as is the facing 45 in the illustrated form of the disc brake, and air under pressure is admitted into the cylinder 46 and engagement of the various interengageable contact faces is brought about, then a deceleration would be effected in which the friction characteristics would be substantially as depicted by the full line curve of Fig. 7. It will be seen by reference to this curve that subsequent to a slight increase in friction, immediately after the initiation of the deceleration, the friction levels off for a short time and thereafter starts to decrease, and such decrease in friction becomes more marked as the deceleration proceeds and is particularly appreciable during the latter stages of the deceleration. This is typical of decelerations in those instances where composition friction material-to-metal engagement is relied upon.

However, in accordance with our invention, we utilize both metal-to-metal engagement and a composition friction material-to-metal engagement and in the present instance such composition friction material-to-metal engagement is afforded by the facing 45 and the disc 36. It will be noted that in the disc brake this composition friction material facing is included along with facings which afford metal-to-metal engagement. The facing 45 is arranged to engage the adjacent face of the metallic rotor ring 36 as the last stage of increase of braking effect in the course of operation of the illustrated disc brake, such engagement being shown in Fig. 5. Here again if the shoes 49 and 50 are prevented from engaging the tire T so that deceleration of the wheel W will be effected solely by the disc brake arrangement, a deceleration will accrue which will exhibit friction characteristics such as are depicted by the dot-dash line (— —) curve in Fig. 14. By referring thereto it will be seen that, after a slight increase in friction immediately following the initiation of deceleration, the friction levels out and remains substantially uniform throughout the deceleration, and such results accrues from the fact that the tendency of the friction to increase in those instances where metal-to-metal engagement is relied upon is offset by the tendency of the friction to decrease in an instance where composition friction material-to-metal engagement is relied upon, and thus the dot-dash line curve in Fig. 14 is illustrative of the desideratum toward which the present invention is directed.

Now referring back to the deceleration effected by the admission of air into the cylinder 46 to bring about the condition illustrated in Fig. 4, it will be understood that when further air is admitted to the cylinder 46 to effect further operation of the disc brake and further air is then also admitted into the means effecting engagement of the shoes 49 and 50 with the wheel W, then the shoes 49 and 50 will be even more firmly pressed against the tire T of the wheel W, and such admission of air into the cylinder 46 brings about the condition shown in Fig. 5 wherein the composition friction material facing engages the metallic rotor ring 36. At this time, however, there will be, through the intermediary of the arrangement illustrated in Figs. 1 to 6, inclusive, and 13, both metal-to-metal engagement and composition friction material-to-metal engagement, and the utilization of such independent engagements to effect deceleration of the wheel W will result in there being substantially uniform friction throughout each deceleration for the reasons hereinabove explained.

It will be understood that while the use of conventional shoes engageable with the tire or tread of a wheel along with a disc brake affords a convenient way of enabling independent metal-to-metal and composition friction material-to-

metal engagements to be utilized to effect decelerations, other arrangements may be resorted to and one such other arrangement is shown in Figs. 7 and 8.

In Figs. 7 and 8, the wheel W*a* is arranged to have shoes **57** and **58**, preferably of cast iron, bear against the tread or tire T*a* thereof. The shoe **57** is detachably connected to a conventional head **59** by the removable key **60** or the like and the head **59** is carried by a brake beam **61**. The shoe **58** is detachably connected to a conventional head **62** by means of a removable key **63** or the like and the head **62** is carried by a brake beam **64**. It will be noted that the brake beams **61** and **64** and therefore the shoes **57** and **58** are arranged to extend on opposite sides of the horizontal center plane of the wheel W*a* and that other brake beams **65** and **66** are also provided, the brake beam **65** being arranged to lie above the aforesaid horizontal center plane and the brake beam **66** being arranged to lie below such center plane, the brake beams **65** and **66**, however, being arranged in diametrical relation with respect to each other and the wheel W.

The brake beam **65** has a conventional head **67** connected thereto and a shoe **68**, preferably of composition material as explained hereinabove, is detachably connected to the head **67** by means of a removable key **69** or the like. The brake beam **66** carries a conventional head **70** to which a shoe **71**, also preferably of composition friction material, is detachably connected by means of the removable key **72** or the like. The operative faces of the shoes **68** and **71** are adapted to bear on the periphery of an annular flange **73** which includes a radially directed rib **74** that is adapted to rest against the inwardly disposed face of the wheel W*a* intermediate the hub H*a* of the wheel and the tread or tire T*a* thereof, the hub H*a* being fast to the axle **8***a*. The flange **73** is firmly connected to the wheel W*a*, in the present instance, through the intermediary of bolts **75** passed through the rib **74** and the web of the wheel W, which web of course interconnects the portion affording the tread or wire T*a* with the hub H*a*.

If resort is had to an arrangement such as that shown in Figs. 7 and 8, conventional pneumatically-operated means (not shown) will be associated with the brake beams **61**, **64**, **65** and **66** whereby these brake beams and therefore the shoes carried thereby may be forced toward the tread or tire T*a* and the periphery of the flange **73**. In the illustrated instance the shoes **57** and **58**, which engage the tread or tire T*a*, are of cast iron while the shoes **68** and **71**, which engage the periphery of the flange **73**, are of composition friction material, and thus by this arrangement a braking apparatus is afforded which includes both a metal-to-metal engagement and a composition friction material-to-metal engagement and, in accordance with our invention, the metal-to-metal engagement is afforded independently of the composition friction material-to-metal engagement. Furthermore, while the shoes **57** and **58** have been described as being of cast iron and the shoes **68** and **71** have been described as being of composition friction material, it will be understood that, if desired, the arrangement would be reversed so that the shoes **57** and **58** would be of composition friction material and the shoes **68** and **71** would be of cast iron but in no instance should a shoe as **58** be of metal when its cooperating shoe as **57**, in this instance, is of composition material for this will give rise to condition which must be avoided to insure that deposit metal from the metallic shoe will not impair operation of the composition shoe.

Still another somewhat analogous arrangement is shown in Figs. 9 and 10, and parts shown in these views which correspond to parts shown in Figs. 7 and 8 have corresponding reference characters applied thereto, but in Figs. 9 and 10 the suffix *b* is applied to such reference characters. The primary difference between the arrangement shown in Figs. 7 and 8 and the arrangement shown in Figs. 9 and 10 is that, in place of the flange **73** secured to the wheel, a disc **76** is provided which is secured to the axle A*b*, said disc consisting of two substantially semicircular portions **77** and **78** that are respectively keyed to the axle A*b* and which have the flat faces thereof engaged one with the other and said portions **77** and **78** are firmly connected together as by bolts **79**.

Other than the just described difference, what has been said with respect to the arrangement shown in Figs. 7 and 8 applies with equal force to the arrangement shown in Figs. 9 and 10.

Still another arrangement to which resort may be had is shown in Figs. 11 and 12 and by referring thereto it will be seen that the wheel W*c* is arranged to have shoes **49***c* and **50***c* engaged therewith, the arrangement in so far as these shoes are concerned being similar to that shown in Fig. 13 and parts in Fig. 14 which correspond to parts shown in Fig. 13 have identical reference characters applied thereto but with the suffix *c* added, and, further, it will be understood that what has been explained with reference to the shoe arrangement included in Fig. 13 applies with equal force to that shown in Fig. 14.

However, with respect to the invention shown in Figs. 11 and 12, a drum **80** is fast to the wheel W*c* by means of bolts **81** or the like and brake arms or shoes **82** and **83** are arranged interiorly of the drum and have facings or linings **84** and **85** of composition friction material respectively provided on the faces thereof adapted to engage the inner periphery of the drum **80**. The shoes **82** and **83** respectively include toe portions **86** and **87** that are adapted to bear on pistons (not shown) in the cylinder **88** to which air under pressure is admitted through the line **89**. When air under pressure is admitted into the cylinder **88** the aforesaid pistons are forced outwardly of the cylinder and act on the toe portions **86** and **87** to thereby force the linings **84** and **85** on the shoes **82** and **83** into engagement with the inner periphery of the drum whereby deceleration is effected. The ends of the shoes **82** and **83** opposite those provided with the toe portions **86** and **87** are interconnected by the link arrangement **90**. Furthermore, the toe portions **86** and **87** are urged toward the aforesaid pistons by the spring **91**, it being understood that the shoes **82** and **83** are forced outwardly against the action of such spring **91**.

It will be seen that the arrangement shown in Figs. 11 and 12, like the arrangements hereinabove described, affords a brake arrangement that includes both a metal-to-metal engagement and a composition friction material-to-metal engagement, and it will be seen that such different engagements are afforded independently of each other. Thus in a deceleration effected by forcing the shoes **49***c* and **50***c* into engagement with the tread T*c* and the engagement of the composition friction material linings **84** and **85**

with the inner periphery of the drum 80, the friction will be substantially uniform throughout the deceleration for this arrangement utilizes, as has been stated, the different types of engagements which exhibit, particularly during the latter stages of the decelerations effected thereby, opposite characteristics whereby when both such engagements, which is to say, a metal-to-metal engagement and a composition friction material-to-metal engagement, are utilized, a desirable and substantially uniform friction is realized throughout a deceleration.

It will be understood that while we have herein shown and described several arrangements for affording independent metal-to-metal engagement and composition friction material-to-metal engagement in a braking arrangement, resort could be had to other arrangements and the herein illustrated arrangements could be arranged other than in the manner herein shown and described. Such other arrangements will be readily apparent to one skilled in the art when the invention is considered in light of the foregoing description. It will be understood that if resort is had to alterations of the arrangements herein shown and described or that if the herein shown and described arrangements are utilized, there will nevertheless be the provision of independent metal-to-metal engagement and composition friction material-to-metal engagement and it is to the utilization of such independent engagements in a braking arrangement that our invention is primarily directed.

Thus while we have shown and described selected embodiments of our invention it is to be understood that these are capable of variation and modification and we therefore do not wish to be limited to the precise details set forth but desire to avail ourselves of such changes and alterations as fall within the ambit of the following claims.

We claim:

1. In a disc brake including a plurality of rotor and stator discs having interengageable facings, certain of such interengageable facings being constructed and arranged to afford a metal-to-metal engagement when engaged one with the other and other of such interengageable facings being constructed and arranged to afford a composition friction material-to-metal engagement when engaged one with the other, the interengagement of the aforesaid facings one with the other affording substantially uniform friction throughout a deceleration effected by such engagement.

2. In a disc brake including a plurality of rotor and stator discs having interengageable facings, certain of such interengageable facings being constructed and arranged to afford a metal-to-metal engagement when engaged one with the other and other of such interengageable facings being constructed and arranged to afford a composition friction material-to-metal engagement when engaged one with the other, the interengagement of the aforesaid facings one with the other affording substantially uniform friction throughout a deceleration effected by such engagement, and means for effecting interengagement of said interengageable facings to thereby effect a deceleration.

3. In a disc brake including a plurality of rotor and stator discs having interengageable facings, certain of such interengageable facings being constructed and arranged to afford a metal-to-metal engagement when engaged one with the other and other of such interengageable facings being constructed and arranged to afford a composition friction material-to-metal engagement when engaged one with the other, the interengagement of the aforesaid facings one with the other affording substantially uniform friction throughout a deceleration effected by such engagement, and means for first effecting operative braking interengagement of selected of the interengageable facings and for thereafter effecting operative braking interengagement of other of such facings to thereby effect a deceleration.

4. In a disc brake including a plurality of rotor and stator discs having interengageable facings, certain of such interengageable facings being constructed and arranged to afford a metal-to-metal engagement when engaged one with the other and other of such interengageable facings being constructed and arranged to afford a composition friction material-to-metal engagement when engaged one with the other, the interengagement of the aforesaid facings one with the other affording substantially uniform friction throughout a deceleration effected by such engagement, and means for first effecting operative braking interengagement of the facings affording a metal-to-metal engagement and for thereafter effecting operative braking engagement of the facings affording a composition friction material-to-metal engagement to thereby effect a deceleration and insure substantially uniform friction characteristics throughout such deceleration.

5. In combination with a rotatable member adapted to be decelerated and having the periphery thereof arranged to afford spaced positions axially thereof whereat shoes may be applied thereagainst, said member also being arranged to present a metallic face to shoes applied against the periphery thereof, at least one metallic shoe mounted to be engageable with the periphery of the rotatable member at one of the positions whereat shoes may be applied to such periphery, and at least one shoe of composition friction material mounted to be engageable with the periphery of the rotatable member at another of the positions whereat shoes may be applied to such periphery, said shoes being applied to the aforesaid positions to effect deceleration of said rotatable member.

6. In combination with a wheel or the like adapted for use on railway equipment or the like and which is adapted to be decelerated and which is constructed and arranged to afford a metallic surface, such as the tread of the wheel, against which at least one shoe may be applied and also to afford another metallic surface, in axially spaced relation with the first surface, against which at least one other shoe may be applied, at least one metallic shoe mounted to be engageable with one of the metallic surfaces on said wheel or the like, and at least one shoe of composition friction material mounted to be engageable with another of the metallic surfaces on said wheel or the like, said shoes being applied to said surfaces to effect deceleration of said wheel or the like.

7. In combination with a wheel or the like adapted for use on railway equipment or the like and which is adapted to be decelerated and which is constructed and arranged to afford a metallic surface, such as the tread of the wheel, against which at least one shoe may be applied and which also has a flange secured thereto to afford another metallic surface against which a

shoe may be applied, at least one metallic shoe mounted to be engageable with one of the metallic surfaces on said wheel or the like, and at least one shoe of composition friction material mounted to be engageable with another of the metallic surfaces on said wheel or the like, said shoes being applied to said surfaces to effect deceleration of said wheel or the like.

8. In combination with a wheel or the like adapted for use on railway equipment or the like and which is adapted to be decelerated and which is constructed and arranged to afford an annular metallic surface against which at least one shoe may be applied and which also has another annular metallic surface against which a shoe may be applied, at least one metallic shoe mounted to be engageable with one of the metallic surfaces on said wheel or the like, and at least one shoe of composition friction material mounted to be engageable with another of the metallic surfaces on said wheel or the like, said shoes being applied to said surfaces to effect deceleration of said wheel or the like.

9. In combination with a wheel or the like adapted for use on railway equipment or the like and which is adapted to be decelerated and which is constructed and arranged to afford a metallic surface, such as the tread of the wheel, against which at least one shoe may be applied and which also has a drum connected thereto to be rotatable therewith and which affords a metallic surface against which a shoe may be applied, at least one metallic shoe mounted to be engageable with one of the metallic surfaces on said wheel or the like, and at least one shoe of composition friction material mounted to be engageable with another of the metallic surfaces on said wheel or the like, said shoes being applied to said surfaces to effect deceleration of said wheel or the like.

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