July 21, 1959 M. BAERMANN 2,895,429

FRICTION INCREASING ARRANGEMENT

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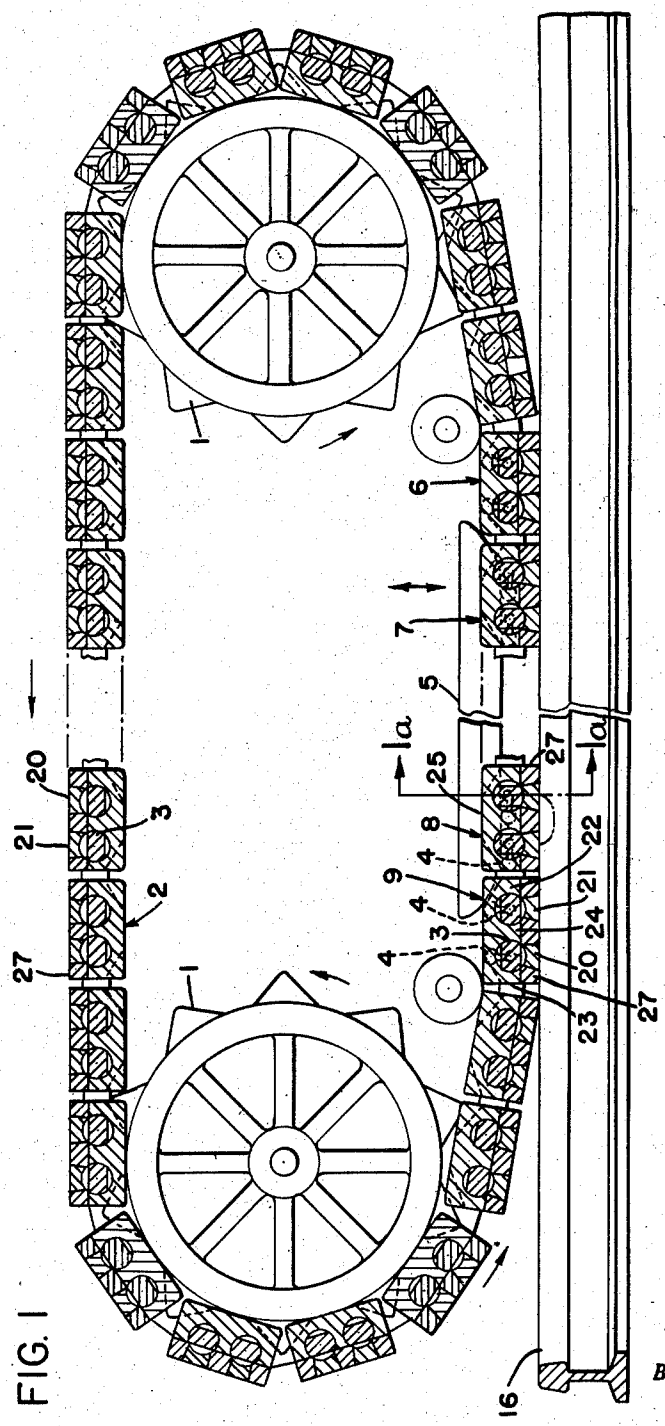

FIG. 1

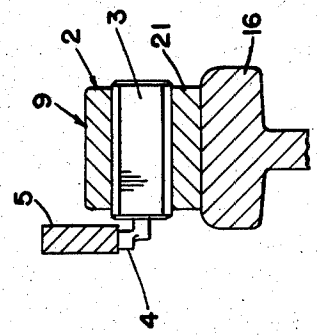

FIG. 1a

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FIG. 2

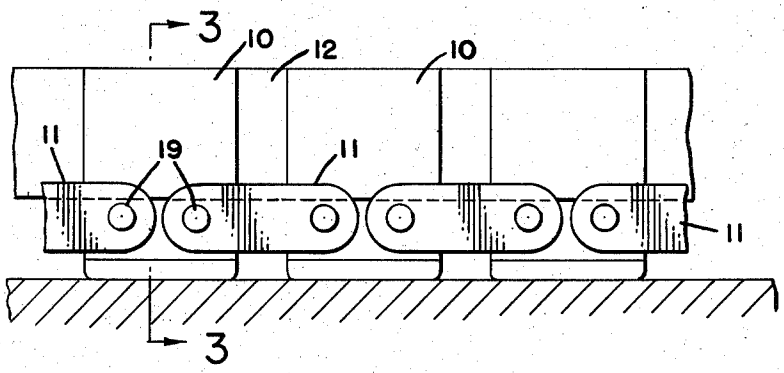


FIG. 6

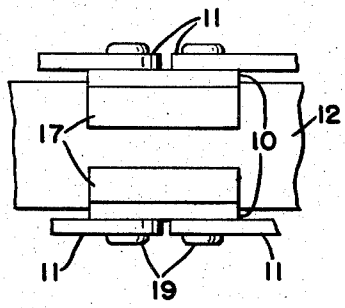
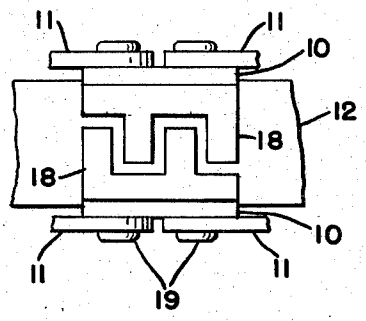


FIG. 7



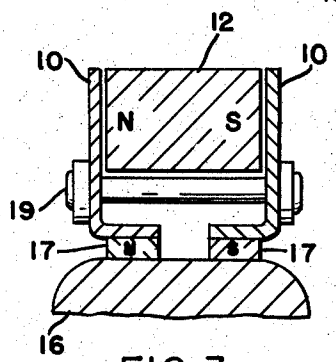


FIG. 3

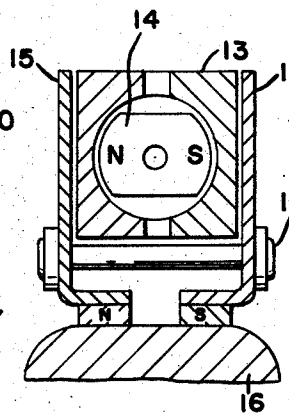


FIG. 4

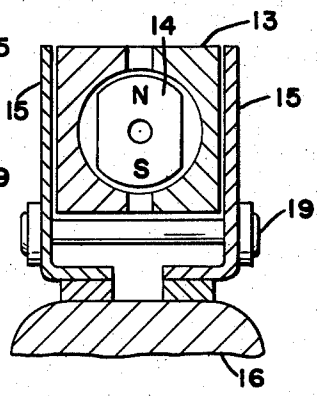


FIG. 5

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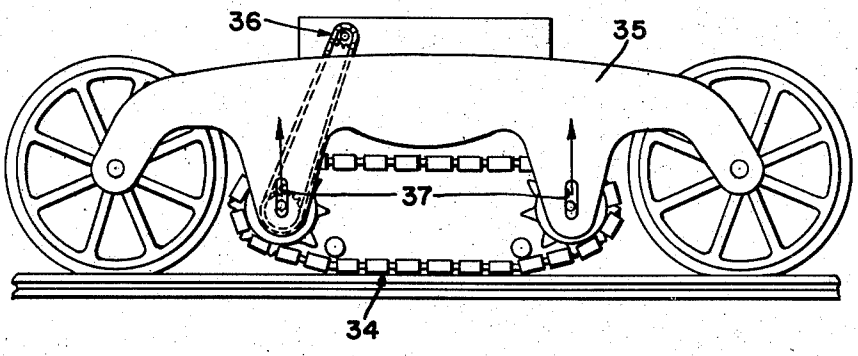
FIG. 8



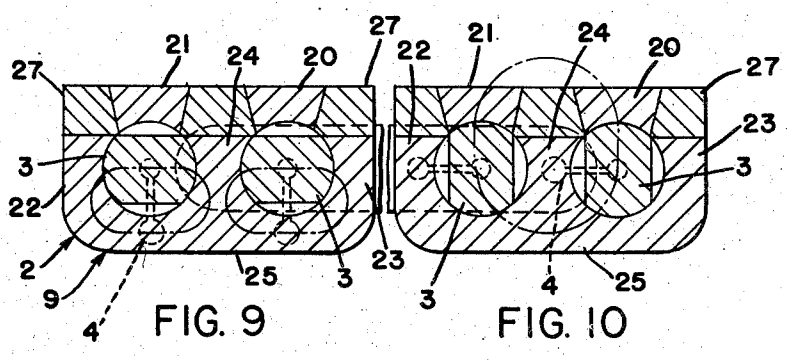


FIG. 9

FIG. 10

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FRICTION INCREASING ARRANGEMENT

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Application August 16, 1954, Serial No. 449,857

Claims priority, application Germany August 17, 1953

9 Claims. (Cl. 105—77)

The present invention relates to devices for increasing the friction between a rail and a moving means in engagement with the rail. For example, the invention is applicable to railway locomotives particularly in applications where high friction is important as in mountain or mine railways, etc.

Although devices are known for increasing the friction between rails and moving means of the above type, the known devices are extremely cumbersome, complicated, expensive, of a very low efficiency and very wasteful in operation.

One of the objects of the present invention is to overcome the above drawbacks by providing a friction increasing arrangement which is of an extremely simple, inexpensive construction and which operates reliably.

Another object of the present invention is to provide a permanent magnet system for increasing the friction between a rail and a moving means in engagement therewith.

A further object of the present invention is to provide a permanent magnet system of the above type which is energized only with respect to the portion of the moving means which engages the rail at any given instant.

With the above objects in view the present invention mainly consists of a friction increasing arrangement which includes a rail and an endless track engaging and movable along the rail and having at any given instant a portion located directly next to the rail. A permanent magnet system is associated with the track for providing magnetic attraction between the rail and only that portion of the endless track which is in engagement with the rail at any given instant.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection wtih the accompanying drawings, in which:

Fig. 1 is a schematic side elevational view of an endless track in engagement with a rail and carrying a permanent magnet system for increasing the friction between the track and rail;

Fig. 1*a* is a cross sectional view of Figure 1 taken approximately on the line 1*a*—1*a*;

Fig. 2 is a fragmentary, side elevational view of the links of an endless track constructed in accordance with an alternative embodiment of the present invention;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is a view corresponding to Fig. 3 of a different embodiment of the invention, the particular track link of Fig. 4 being shown in its energized position;

Fig. 5 shows the track link of Fig. 4 in its unenergized position;

Fig. 6 shows a track link of Fig. 2 as seen from its underside;

Fig. 7 is a view corresponding to Fig. 6 of a different embodiment of a track link;

Fig. 8 illustrates an endless track link of the type shown in either Figure 1 or 2 carried by a frame of a vehicle movable along rails for movement toward and away from the rails;

Fig. 9 shows one of the links of Fig. 1 on an enlarged scale and in its unenergized position; and

Fig. 10 shows the link of Fig. 9 in its energized position.

Referring now to the drawings, and in particular to Fig. 1, it will be seen that the invention includes a pair of sprocket wheels **1** carrying an endless track which is in engagement with the rail **16**. This endless track is made up of a plurality of pivotally interconnected links **2** each of which includes a plurality of pole shoes **20, 21** made of a magnetic material for engaging the rail **16**, as will be described below in detail in connection with Figs. 9 and 10. Each link **2** carries a permanent magnet system made up of a pair of permanent magnets **3** rotatably carried by each link **2** and each having a crank **4** connected thereto for turning the magnets **3** from an inoperative to an operative position and back to the inoperative position, the pole shoes **20, 21** of the links **2** being energized when the permanent magnets **3** are in their operative position. As is diagrammatically illustrated at the lower portion of Fig. 1, the vehicle carries a control plate means **5** located adjacent the rail **16** and having at its ends, respectively, a pair of inclined edges leading from the bottom edge of the control plate means **5**.

As the lower run of the endless track moves to the right, as viewed in Fig. 1, the cranks **4** which extend beyond the links **2** engage the left inclined face of member **5** to turn the permanent magnets **3** in a counterclockwise direction from an inoperative position to an operative position. Thus, the first link **9** has its magnets in the inoperative position while the second link **8** has its permanent magnets **3** thereof already turned to their operative position energizing magnetic portions of the link **2**. As may be seen from Figures 1, 9 and 10, each link **2** has a pair of end magnetic legs **22, 23** and an intermediate magnetic leg **24** all magnetically joined into a unitary member by a longitudinal base **25**. As shown, the pole shoes **20, 21** are located generally midway betwen, but spaced slightly beyond, the ends of the legs **22, 23, 24** and are held in position by non-magnetic portions **27**.

The magnets **3** are rotatably supported in the space defined between adjacent legs and the face of the pole shoes remote from the rail **16** on an axis parallel to the surface of the rail **16** but transverse to its longitudinal length. These magnets **3** have diametrically opposed magnetic polarity.

The link **9** has the poles of each magnet facing adjacent legs and the flux thereof is conducted from one pole to the other through the legs and the base **25** as is shown by the dot-dash lines in Figure 9. The link **8** has the magnets **3** rotated through an angle of approximately 90° so that opposite magnetic poles face the pole shoes **20, 21** respectively. Thus opposite magnetic poles face the base **25**. The pole shoes **20, 21** are thus oppositely magnetized with a return flux path through the base **25**. The magnetic flux of the poles **20, 21** passes into the rail **16** to draw the link **8** into pressure engagement with the rail **16** and increase the friction between the rail **16** and the link **8**. The same is true of link **7** and one or more links located between the links **7** and **8** of Fig. 1. Link **6** of Fig. 1 has the permanent magnets **3** thereof again in their inoperative position, these permanent magnets **3** of link **6** having turned in a clockwise direction, as viewed in Fig. 1, after leaving the control plate means **5**, the right inclined face of the latter means freeing the permanent magnets for turning movement to their inop-

erative position. The permanent magnets 3 may be constantly urged to their inoperative position by springs or the like.

Fig. 2 shows a portion of a track made up of a plurality of links each of which is made up of a pair of pole shoes 10, as shown in Fig. 3, and is interconnected by cross bolts 19 which also serve for pivotally connecting the straps 11 to the links. It will be seen from Fig. 3 that the pole shoes 10, which are provided with reinforced portions 17 directly engaging the rail 16, form between themselves a channel extending along the length of the track. A permanent magnet 12 is fixed to and stationary with respect to the vehicle and is located adjacent the rail 16 to form therewith a gap through which the links move, this permanent magnet 12 extending into the channel formed by the pole shoes 10, as is evident from Fig. 3.

According to Figs. 4 and 5 pole shoes 13 including side plates 14 similar to pole shoes 10 are held together by the cross bolts 19 to form each link of an endless track similar to that of Fig. 2. A permanent magnet 14 is turnably carried by each link between the pole shoes thereof, and this permanent magnet 14 is turnable through any suitable device, such as cranks of the type as shown in Fig. 1, for example, for movement from the position of Fig. 5, which is the unenergized position, to the position of Fig. 4 during engagement of the links with the rail 16. As may be seen from Fig. 4 the pole shoes are energized, and by turning the permanent magnet 14 from the position of Fig. 5 to the position of Fig. 4 only during engagement of the links with the rail, unnecessary energizing of the links is avoided. It will be noted that Figs. 4 and 5 show the two extreme positions of the permanent magnet system. Furthermore, it will be noted that the portions 15 of pole shoes 13 are considerably higher than pole shoes 10 of Fig. 3.

Fig. 6 shows one of the links of Fig. 2 as seen from the underside, and it will be noted that each link is provided with a pair of bottom rectangular portions to engage the rail. Fig. 7 shows a variation according to which the bottom of each pole shoe is provided with cutouts to receive projections of the adjacent pole shoe. Otherwise, the structure of Fig. 7 is the same as that of Figs. 2, 3 and 6.

Referring again to Fig. 1, the control plate 5 may be raised by any suitable means so that the magnets are not energized at all, if such operation is desired, and the control plate is of course movable back down to the position shown in Fig. 1 for successively energizing the links as they engage the rail. An arrangement for accomplishing a similar result is shown in Fig. 8 according to which the shafts of the sprocket wheels of the endless track 34, which may be identical with that of Fig. 1, are guided in vertically extending slots 37 of the frame 35 of the vehicle which moves along the rails. At least one of the sprocket wheels is driven through any suitable means such as a motor and chain drive 36. It is evident that by moving the shafts of the sprocket wheels upwardly along the slots 37, the entire track 34 may be located out of engagement with the rails to eliminate the increased friction whenever desired. This may be done, for example, simply by locating nuts on the ends of the shafts which carry the sprocket wheels and loosening these nuts, raising the shafts, and again tightening the nuts.

It is believed to be unnecessary to mention specific materials used in the structure of the invention, since such materials are known to every person skilled in the art. It should be noted, however, that it is important that those elements of the magnet circuit which come under the influence of the changing magnetic field should be made of a material having a low hysteresis loss.

Of course, it should be understood that a track of the type described above is associated with each rail and that devices such as the permanent magnet 12 and control plate 5 are associated with one or both tracks.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of friction increasing arrangement differing from the types described above.

While the invention has been illustrated and described as embodied in friction increasing arrangement for endless tracks, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in an endless chain, each link including a pair of spaced magnetically permeable pole shoes each adapted to engage said rail as said vehicle moves therealong and means for magnetizing said pole shoes with an opposite magnetic polarity whereby said shoes will be magnetically attracted to said rail, said means including a permanent magnet arranged to have the flux from the opposite poles thereof flow through said pole shoes and means for varying the amount of flux from such permanent magnet in such pole shoes.

2. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in an endless chain, each link including a pair of spaced magnetically permeable pole shoes each adapted to engage said rail as said vehicle moves therealong and means for magnetizing said shoes with an opposite magnetic polarity whereby said shoes will be magnetically attracted to said rail, said means including a permanent magnet movable from a first position where the pole shoes are oppositely magnetized to a second position where they are non-magnetized and means for moving such permanent magnet from said first position to said second position.

3. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in an endless chain, each link including a pair of spaced magnetically permeable pole shoes, each adapted to engage said rail as said vehicle moves therealong and means for magnetizing said shoes with an opposite magnetic polarity whereby said shoes will be magnetically attracted to said rail, said means including a permanent magnet rotatable from a first position where the pole shoes are oppositely magnetized to a second position where the pole shoes are non-magnetized.

4. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in an endless chain, each link including a pair of spaced magnetically permeable pole shoes, each adapted to engage said rail as said vehicle moves therealong and means for magnetizing said shoes with an opposite magnetic polarity whereby said shoes will be magnetically attracted to said rail, said means including a permanent magnet movable from a first position where the pole shoes are oppositely magnetized to a second position where said pole shoes are non-magnetized and means providing a magnetic shunt

between the poles of said permanent magnet when said permanent magnet is moved to a position where said pole shoes are non-magnetized.

5. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in an endless chain, each link including a pair of spaced magnetically permeable pole shoes each adapted to engage said rail as said vehicle moves therealong and also including a permanent magnet operatively associated with said pole shoes for energizing same with an opposite magnetic polarity and means for varying the degree of energization of said pole shoes.

6. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in a continuous chain, each link including a pair of spaced magnetizable pole shoes adapted to engage said rail as said vehicle moves therealong and also including a permanent magnet movable from a first position where the pole shoes are oppositely magnetized to a second position where said pole shoes are non-magnetized.

7. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in an endless chain, each link including a pair of spaced magnetizable pole shoes adapted to engage said rail as said vehicle moves therealong and also including a permanent magnet rotatable from a first position where one of the poles of said magnet is adjacent said pole shoe to a second position where the poles of said magnet are remote from said pole shoe.

8. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in an endless chain, each link including a pair of spaced magnetizable pole shoes adapted to engage said rail as said vehicle moves therealong, each link further including a permanent magnet movable from a position where the pole shoes are oppositely magnetized to a position where the pole shoes are non-magnetized, means supporting said links so that the pole shoes progressively engage and disengage said rail as said apparatus moves therealong and means moving said magnets to positions where said pole shoes are magnetized after engagement with said rail and de-magnetized before disengagement with said rail.

9. Apparatus for increasing the adhesion of a vehicle to magnetically permeable rails for the purpose of increasing the tractive force comprising in combination; a plurality of links arranged in an endless chain, each link including a pair of spaced magnetically permeable pole shoes each adapted to progressively engage and disengage said rail as said vehicle moves therealong, a permanent magnet fixedly mounted on said vehicle and in operative relationship with those links in engagement with said rail to magnetically energize said pole shoes with an opposite magnetic polarization and means for varying the degree of energization of said pole shoes.

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