Sept. 10, 1968 R. H. GRADER ET AL 3,401,365

MAGNETIC TRACK CLEANER

Filed Oct. 7, 1966 2 Sheets-Sheet 1

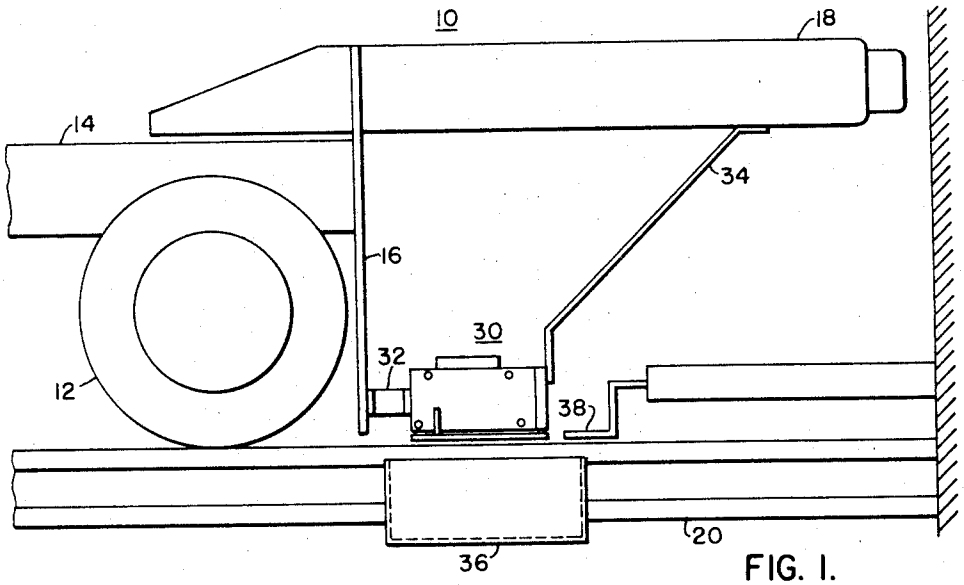


FIG. 1.

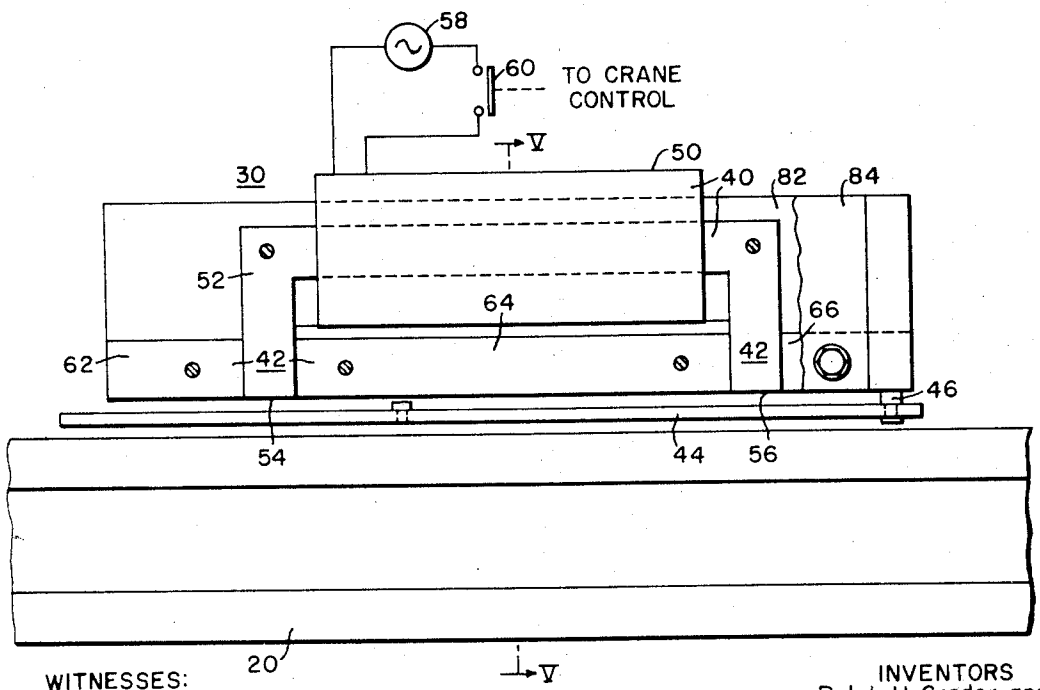


FIG. 2.

WITNESSES:

Leon M. Garman

James F. Young

INVENTORS
Ralph H. Grader and
James A. Freshwater

BY Donald R. Lackey
ATTORNEY

Sept. 10, 1968 R. H. GRADER ET AL 3,401,365

MAGNETIC TRACK CLEANER

Filed Oct. 7, 1966 2 Sheets-Sheet 2

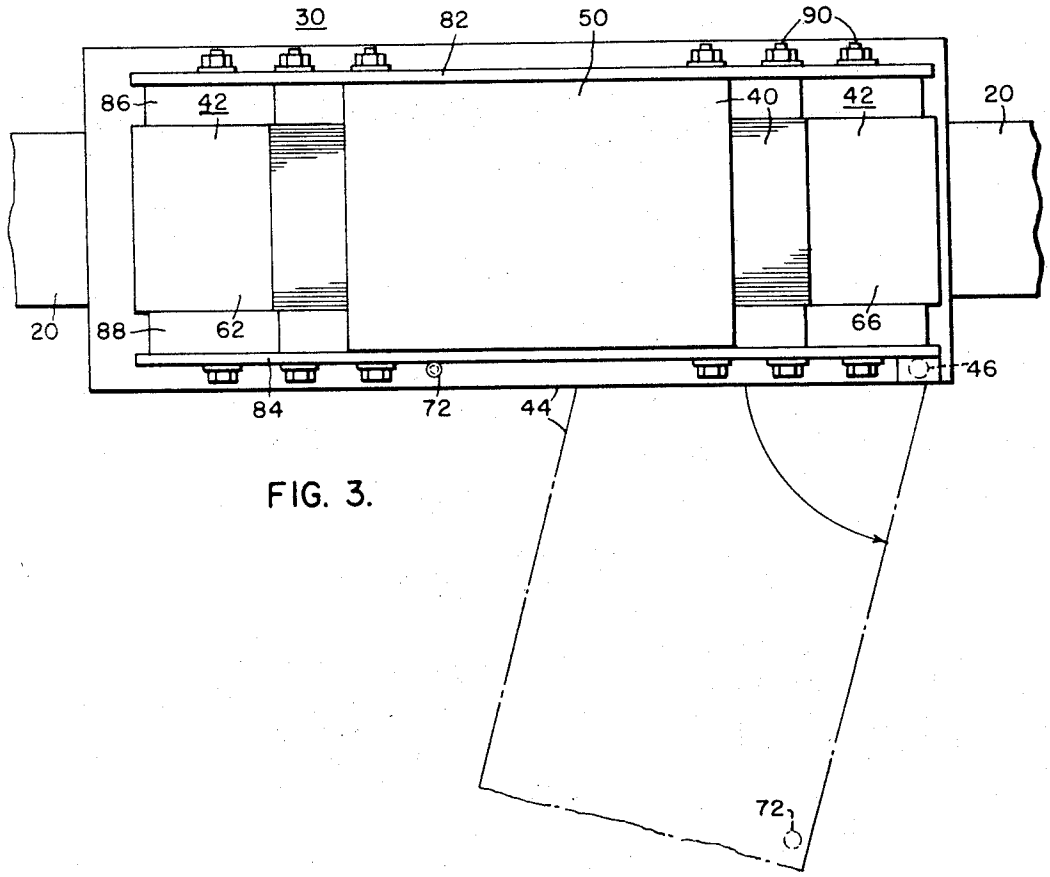


FIG. 3.

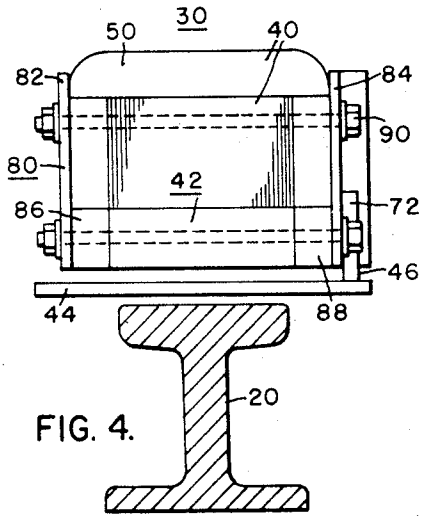


FIG. 4.

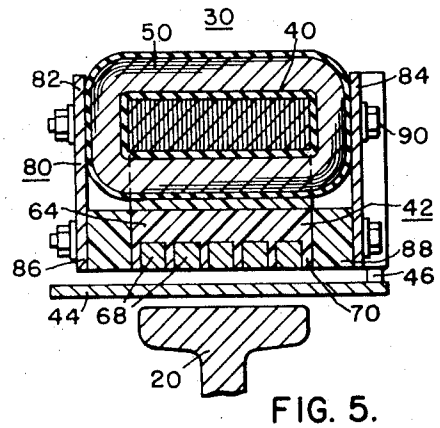


FIG. 5.

United States Patent Office 3,401,365 Patented Sept. 10, 1968

3,401,365

MAGNETIC TRACK CLEANER

Ralph H. Grader and James A. Freshwater, Muncie, Ind., assignors to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Oct. 7, 1966, Ser. No. 585,205
9 Claims. (Cl. 335—289)

ABSTRACT OF THE DISCLOSURE

A track cleaner adapted for mounting on a crane, which frees and removes magnetic particles from the crane rails. The track cleaner includes means for vibrating magnetic particles on the track, means for attracting the particles against a non-magnetic plate, and means for removing the particles from the plate and depositing them in collecting means.

This invention relates in general to track cleaners, and more particularly to magnetic track cleaners for removing magnetic particles from crane rails, and the like.

The presence of foreign magnetic particles in certain types of apparatus may be deleterious to good performance, and may even cause the apparatus to fail, especially if the apparatus is electrical.

For example, mechanical apparatus which requires very close tolerances and smooth cooperation between engaging members, requires extreme care during manufacture to prevent entry of foreign particles. Another example is electrical apparatus in general, and high voltage electrical apparatus in particular, such as transformers. The presence of small magnetic particles in high voltage electrical apparatus may weaken or lower the insulation level of the electrical insulation, resulting in eventual failure of the apparatus, with its attendant costly repairs and downtime.

With the increasing voltage levels of electrical apparatus for use in EHV (extra high voltage) power transmission systems, such as those operating at 345 kv. and higher, the problem of foreign magnetic particles becomes even more acute, as these particles circulating through the cooling and insulating fluid of the electrical apparatus may be attracted magnetically to one another, forming a "chain" which may eventually cause a flashover under the influence of the very high voltages.

In studying the sources of magnetic particles, it was found that the overhead cranes used in the manufacture of heavy apparatus, such as electrical power transformers, produce metallic magnetic flakes and particles at the interface of the crane wheels and rails, due to a lateral shear of the wheel and rail metals. These flakes or particles are very light, and easily work their way off the crane rails and rail beam, and become airborne, falling into the apparatus being manufactured below. Periodic cleaning of the crane rails and rail beams with industrial type vacuum cleaners only removes the particles which have not yet worked their way off the crane rail beam, and there is nothing to stop the particles from falling during the time between maintenance periods. Also, crane rails are relatively inaccessible, making this type of maintenance slow and costly. Therefore, it would be desirable to provide new and improved apparatus for preventing magnetic particles from crane rails from becoming airborne, which operates continuously and automatically while the crane is operating, which has a relatively low initial and operating cost, and which is substantially maintenance free.

Accordingly, it is an object of the invention to provide new and improved apparatus for removing magnetic particles produced by cranes between the cranes wheels and rails.

Another object of the invention is to provide new and improved apparatus for cleaning crane rails of magnetic particles, which operates continuously and automatically when the crane is operating.

A further object of the invention is to provide new and improved apparatus for cleaning crane rails of magnetic particles, which automatically deposits the collected magnetic particles at a predetermined collecting point.

Still another object of the invention is to provide new and improved apparatus for cleaning crane rails of magnetic particles, including those particles which are "stuck" to the rails.

Another object of the invention is to provide a new and improved rail cleaner for cranes which operates continuously and automatically while the crane is operating, has a relatively low initial and operating cost, is relatively maintenance free, and which has a high degree of effectiveness in collecting magnetic particles produced between the crane rails and crane wheels.

Briefly, the present invention accomplishes the above cited objects by providing new and improved magnetic apparatus which is mounted on the crane and disposed over the crane rails. The magnetic apparatus contains means for loosening or freeing the magnetic particles on the rails, which is activated when the crane is energized, means for attracting and holding the freed particles against a non-magnetic plate member, and means for removing the attracted particles from the plate member at a predetermined point and depositing them in collecting means.

Further objects and advantages of the invention will become apparent from the following detailed description, taken in connection with the accompanying drawings, in which:

FIGURE 1 is an elevational view of rail cleaner apparatus which may be constructed according to the teachings of the invention, disposed in operating position on a crane;

FIG. 2 is an elevational view, partially cut away, and partially schematic, of a magnetic track cleaner constructed according to the teachings of the invention;

FIG. 3 is a plan view of the track cleaner apparatus shown in FIG. 2;

FIG. 4 is an end elevational view of the track cleaner apparatus shown in FIG. 2; and

FIG. 5 is a sectional view of the track cleaner apparatus shown in FIG. 2, taken along the line V—V.

Overhead type cranes for lifting heavy components, include a movable bridge portion, which is movable on a set of rails or tracks, a trolley, which is disposed on the bridge portion, which is movable on another set of rails or tracks across the length of the bridge, and a hoist which is attached to the trolley. The invention may be used on the bridge rails, track rails, and any other tracks or rails which are to be cleaned of magnetic particles. Since track cleaners constructed according to the teachings of the invention, for any track or rail to be cleaned, would be similar, the track cleaner will be described relative to one of the bridge rails of an overhead crane.

Referring now to the drawings, and FIG. 1 in particular, there is shown a portion of a crane **10**, including one of its bridge wheels **12**, bridge structural member **14**, wheel guard **16**, bumper **18**, and crane track or rail **20**. The invention comprises a magnetic track cleaner **30**, which is disposed to move in predetermined spaced relation over track **20** as crane **10** moves along the track. If the crane design permits, track cleaner **30** may be disposed outside the bridge wheels, between the outer wheel **12** and bumper **18**, as shown in FIG. 1, with the track cleaner **30** being mounted on and suspended from the wheel guard **16** and bumper **18** by structural members

32 and 34. In this arrangement, the track cleaner does not contact track 20, but is suspended at a predetermined distance above the track.

Another suitable arrangement would be to have the track cleaner 30 ride on the track on small wheels of its own, with its wheels providing the predetermined spacing from the track cleaner to the track 20. In this instance, the track cleaner would still be mechanically associated with crane 10, and would be driven along the track by crane 10.

If the space between the bridge wheel 12 and the outer end of bumper 18 is not sufficient to mount track cleaner 30, it may be mounted in the space between the wheels of the bridge.

In the embodiment of the invention shown in FIG. 1, track cleaner 30 deposits the magnetic particles it has picked up into a receptacle or pan 36, with this function being initiated by stationary actuating arm 38 each time crane 10 reaches its normal position for change of operating personnel. Thus, the magnetic particles picked up by track cleaner 30 are deposited in receptacle 36, at least one each working shift.

A track cleaner 30 constructed according to an embodiment of the invention is shown in FIGS. 2, 3, 4 and 5, with FIGS. 2, 3 and 4 being side elevational, plan and end elevational views, respectively, and FIG. 5 being a cross-sectional view of the track cleaner taken along the line V—V in FIG. 2.

In general, track cleaner 30 includes means 40 for loosening magnetic particles from track 20, magnetic means 42 for attracting the freed particles, a plate member 44 against which the attracted particles are held, and means 46 for removing the particles from plate member 44, which may include a spring loaded pivot member, which cooperates with actuating arm 38 shown in FIG. 1, to pivot plate member 44 away from the magnetic influence of magnetic means 42. Once plate member 44 has pivoted away from magnetic means 42, as shown in dotted outline of FIG. 3, the particles will drop from plate member 44 into the receptacle shown in FIG. 1.

More specifically, means 40 for loosening magnetic particles on track 20 includes an electromagnetic coil 50, and laminated iron core 52, disposed to provide two spaced alternating current pole pieces 54 and 56. Electromagnetic coil 50 is connected to a source 58 of alternating potential, through a contact 60 which is disposed to be responsive to the crane control. Contact 60 is open when crane 10, shown in FIG. 1, is stationary. When the bridge portion of crane 10 is set in the motion, contact 60 closes, to energize electromagnetic coil 50 and induce an alternating electromagnetic field into track 20 and any magnetic particles disposed thereon. Any magnetic particles which are on track 20, even those which are "attached" to track 20, will be freed by the strong magnetic field and will bounce or dance on rail 20 until being attracted by magnet means 42.

Magnet means 42, in this embodiment of the invention, comprises three sections of permanent magnet assemblies 62, 64 and 66. Each section of permanent magnets may be constructed similar to section 64 shown in cross-section in FIGURE 5, having a plurality of spaced bar magnets 68. The permanent bar magnets 68 may be held in position by any suitable means. For example, they may be encapsulated in a resinous system 70, such as an epoxy resin. It has been found that high capacity Alnico magnets, assembled in side-by-side spaced relation as shown in FIG. 5, which will provide approximately 600 gauss at the rail or track surface when spaced ¼ inch therefrom, provides excellent results. Other arrangements of the magnets and other magnetic field strengths will perform satisfactorily, however, as the magnet arrangement and field strength are not critical. It is merely important to provide sufficient field strength to be able to attract and hold magnetic particles to plate member 44.

The function of plate member 44 is very important. It is essential for proper operation of track cleaner 30 that the magnetic particles picked up be automatically deposited in a receptacle. Thus, track cleaner 30 should be self cleaning, in order to operate continuously without maintenance. If the magnetic particles were to be allowed to contact the permanent magnets, it would be very difficult to automatically remove the particles. Therefore, the function of plate member 44 is to provide a mechanical barrier between the permanent magnets and the rail, without magnetically shielding the rail. Plate member 44, therefore, must allow the magnetic field of alternating current poles 54 and 56, and the magnetic field of the permanent magnet assemblies 62, 64 and 66, to pass through to the rail 20, and plate member 44 must not retain any magnetism. Thus, magnetic particles are attracted to the permanent magnet assemblies 62, 64 and 66, but are stopped at the plate member 44, and held against the lower surface of plate member 44 by the magnetic field of the permanent magnet assemblies.

Plate member 44, which has two major opposed surfaces, is pivotally-mounted on track cleaner 30, via pivot means 46 at one corner of the track cleaner assembly, and is urged into the position shown in solid lines in FIG. 3 by spring means (not shown) or any other suitable means. An upstanding dowel or pin 72 is disposed on plate member 44, which functions as a stop to prevent plate member 44 from being urged past its desired position relative to the remaining portion of track cleaner 30. Pivot means 46 thus pivots plate member 44 in the plane of its major opposed surfaces, away from the magnetic influence of the permanent magnet assemblies, as shown in dotted outline in FIG. 3.

Plate member 44 may be made of any suitable non-magnetic material which will not retain magnetism, and which will not act as a magnetic shield. For example, it may be made of non-magnetic metals, such as aluminum, or it may be made of non-metallic materials, such as the laminated plastics. In order to provide a close spacing between the bottom of magnet assemblies 62, 64 and 66, and the rail 20, such as .25 inch, plate member 44 should be made of a material which will retain its flatness and strength in thicknesses of .125 inch, or less. Plate member 44 should be disposed in spaced relation between rail 20 and magnet assemblies 62, 64 and 66, to allow it to freely pivot into the dotted line position shown in FIG. 3, when actuated by external means, such as actuating arm 38 shown in FIG. 1. When track cleaner 30 is adjacent the receptacle or pan 36, plate member 44 will be pivoted, in the plane of its major surfaces, over the pan, and any particles disposed against plate member 44 will fall into the pan, as they are no longer under the influence of the magnetic field provided by the permanent magnet assemblies.

The means for initiating the pivoting action of plate member 44 may act directly on plate member 44, as shown in FIG. 1, or pivot means 46 may be arranged to have an extending arm which when actuated in a predetermined manner will cause plate member 44 to pivot outwardly, and away from the permanent magnet assemblies.

To complete track cleaner 30, the various components, such as means 40 for loosening the particles, permanent magnet means 42, non-magnetic plate member 44, and pivot means 46, may all be assembled and held in a predetermined assembled position by frame 80, which may be constructed of aluminum or any other suitable material. Frame 80 includes side portions 82 and 84, and may have various spacer members, such as spacer members 86 and 88 attached thereto, with a plurality of nut and bolt combinations, such as combination 90, disposed through openings in the permanent magnet assemblies and laminated core 52, and the frame 80, which maintain the various components and frame 80 is assembled relation.

In the operation of track cleaner **30**, when the crane operator sets crane **10** in motion, auxiliary contact **60** in the crane control closes to energize electromagnetic coil **50**, and alternating current pole pieces **54** and **56** induce an alternating electromagnetic field into track **20** and any magnetic particles on the track. As track cleaner **30** is moved along track **20** with crane **10**, the first portion of the track cleaner **30** to pass over any predetermined point is a section of permanent magnets, either permanent magnet assembly **62**, or permanent assembly **66**, depending upon the direction of the crane. Thus, any loose particles are immediately picked up by the first permanent magnet section. Then, one of the alternating current pole pieces passes over the predetermined point, which vibrates and agitates any magnetic particles disposed on the track, to loosen or free them. The middle permanent magnet assembly **64** then passes over the predetermined point and picks up any particles freed by the first alternating current pole piece to pass over the point. The second pole piece then passes over the predetermined point, to again vibrate any magnetic particles stuck to the rail, by inducing an electromagnetic field into the rail and particles, in an attempt to break them free, and then the last section of permanent magnets passes over the predetermined point to pick up any particles freed by the second alternating current pole piece. Any combination of linearly disposed, alternately spaced pole pieces and permanent magnets sections may be used, but the end portions of the linear arrangement should always be the permanent magnet assemblies, in order to pick up any particles loosened by the alternating current pole pieces, regardless of the direction of crane **10** on track **20**. Thus, the simplest form of track cleaner would be a single alternating current pole piece flanked on each side by a permanent magnet assembly. Since two alternating current pole pieces are easy to form with a single electromagnetic coil and U-shaped lamination pieces, the embodiment of the invention shown in the figures is very practical.

In summary, there has been disclosed a new and improved track cleaner for cranes, and the like, which operates automatically and continuously when the crane operates, is disposed at the source of the magnetic particles, adjacent the crane wheel and track, is self-cleaning, requires substantially no maintenance, and is inexpensive to construct and operate. Further, the track cleaner is very efficient, as it provides strong alternating electromagnetic forces for vibrating the particles free from the track, in combination with strong magnetic forces from permanent magnets to collect the loosened or freed particles.

Since numerous changes may be made in the above-described apparatus and different embodiments of the invention may be made without departing from the spirit thereof, it is intended that all matter contained in the foregoing description or shown in the accompanying drawings, shall be interpreted as illustrative, and not in a limiting sense.

We claim as our invention:

1. Track cleaner apparatus for removing magnetic particles from a track, comprising first means for vibrating and freeing magnetic particles on a track, second means for magnetically attracting magnetic particles, a non-magnetic plate member having first and second major opposed surfaces, said first and second means being disposed adjacent the first major surface of said non-magnetic plate means, means holding said first and second means and said non-magnetic plate member in predetermined assembled relation, said second means attracting and holding loose particles and any particles freed by said first means, against the second major surface of said plate member, when said second major surface is disposed in predetermined spaced relation with, and moved along a track to be cleaned.

2. A track cleaner apparatus of claim **1** including third means for removing particles disposed against the second major surface of said plate means, when desired.

3. The track cleaner apparatus of claim **2** wherein said third means comprises pivot means which pivotally disposes said plate member relative to said first and second means, said pivot means being adapted to pivot said plate member away from the magnetic influence of said second means, and allow particles disposed against the second major surface of said plate means to fall therefrom, said pivot means being adapted to pivot said plate member when mechanically actuated by external means.

4. The track cleaner apparatus of claim **1** wherein said first means includes at least one magnetic pole piece disposed adjacent the first major surface of said plate member, which is excited by an electromagnetic coil adapted to be connected to an alternating potential.

5. The track cleaner apparatus of claim **1** wherein said second means includes a plurality of permanent magnet assemblies.

6. The track cleaner apparatus of claim **1** wherein said first means includes at least first and second pole pieces disposed in spaced relation adjacent the first major surface of said plate member which are excited by an electromagnetic coil adapted to be connected to a source of alternating potential, and said second means includes at least first, second and third permanent magnet assemblies, said second permanent magnet assembly being disposed between said spaced first and second pole pieces, said first permanent magnet assembly being disposed adjacent said first pole piece, and said third permanent magnet assembly being disposed adjacent said second pole piece.

7. The track cleaner apparatus of claim **1** wherein said first means includes at least one alternating current pole, and said second means includes at least two permanent magnet assemblies, with the alternating current poles and permanent magnet assemblies being linearly and alternately disposed adjacent the first surface of said plate member, and with the permanent magnet assemblies appearing at each end of the linear arrangement.

8. The track cleaner apparatus of claim **7** including means for pivoting said plate member in the plane of one of its major surfaces when mechanically actuated by external means, out of the magnetic influence of said second means, to allow any particles disposed against the second major surface of said plate member to drop into collecting means.

9. The track cleaner apparatus of claim **7** wherein said track cleaner apparatus is adapted for mounting on a crane, and including means adapted to energize said at least one alternating current pole when the crane is set into motion.

References Cited

UNITED STATES PATENTS

3,249,211 5/1966 Gray ---------- 104—279 XR

BERNARD A. GILHEANY, *Primary Examiner.*

GEORGE HARRIS. *Assistant Examiner.*