ELECTROGRAPHIC COPYING MACHINE
7 Claims, 7 Drawing Figs.

ABSTRACT: A system for handling and transporting the intermediate web in an electrographic copying machine which utilizes an intermediate web to produce copies of graphic intelligence. The system comprises a cartridge formed of two molded shells which contain a supply of intermediate web wound between two rollers. The rollers extend beyond the sides of the cartridge and a section of the web between the rollers is disposed externally to the cartridge. The cartridge is removably mounted on a movable carriage having a flat conductive peripheral support area supporting said external web section. Means is provided to transport the carriage thus moving the supported section of web in proper sequence from an imaging system or exposure station to a development and a transfer station on the copying machine and to then return the carriage to the imaging station in order to produce the desired copies. Drive means is provided on the machine to change the section of web disposed externally to the cartridge as is needed in producing subsequent copies. The web change is accomplished by winding the web from one roller onto the other.
3,617,124

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ELECTROGRAPHIC COPYING MACHINE

This invention relates to a new and improved electrographic copying machine and in one aspect an improved mechanism for handling a photoconductive intermediate web to supply the same and to bring the web into operative contact with several stations to produce copies of an original document.

Hereinafter in prior art copying machines utilizing an intermediate web, the web has been wound between two rotatable rollers mounted directly on the copying machine. One system comprises a web supply roll, means to form a path past the various processing stations in the copying machine, a takeup roll, and a means for advancing the web between the supply and the takeup roll and in so doing to move it past various processing stations. This moving web system allows the use of generally flat processing stations which are normally less complex in nature, however, to replace an intermediate web in this system requires the awkward and tedious task of removing the roll of used intermediate paper and then loading and threading the new web through the machine and attaching the free end to the takeup roll. This task of changing rolls of intermediate web is not only time consuming, but also requires a certain level of training for the office personnel servicing the machine. Additionally, the strength of the intermediate web is a factor in limiting the speed at which the web can be moved through the machine; thus limiting the speed of copy production. Also, elaborate web handling, timing and drive mechanisms are required to advance the web past the required stations and subsequently rewind a portion of the web toward the imaging station in order to avoid wasting the length of the web between successive exposed sections.

The types of intermediate web-handling systems for electrographic copy machines include the use of an endless web, or mounting the supply and takeup rolls for the intermediate web in a support drum and threading the web from one roll to the other about a peripheral portion of the drum. The web is advanced during or after exposure to a developing position on the drum which is permanently and rotatably mounted on the copying machine. The drum rotates the exposed section of the intermediate web in an arcuate path past fixed processing stations to produce a copy of an original document. One form of such a machine is illustrated in the copending application of James G. Moxness, Harold H. Nelson, and Edward A. O'Mara, Ser. No. 640,547, assigned to the assignee of this application. The system of the Moxness et al. application removed some of the disadvantages previously involved with moving the web through the machine. However, the disadvantages of having to load, unload and thread the web, and to move the web relative to the support to achieve the exposure, development or the transfer and to time the web movement and drum movement with these process steps remained.

The electrographic copy machines utilizing an endless web are generally of the xerographic type and in these machines control of the web position or location as well as elaborate web drive and steering mechanisms are required to produce copies. These webs must also be cleaned between the production of successive copies, which presents further problems.

The present invention eliminates the disadvantages features involved with loading and unloading loose rolls of intermediate web as practiced in the prior art.

In the present invention the web handling and threading by the machine operator is reduced to a minimum. The positioning of the web on the web supply or takeup rollers so that it steers properly and without wrinkling is all handled by the web supplier as the ends of the web are secured to the rollers within the supply carriage. The process of changing the intermediate web merely requires substitution of one cartridge for another. This substitution is accomplished after opening a gate on the movable carriage by inserting the cartridge, and closing the gate.

The present machine does not require movement of the web relative to its support between or during any of the copy process steps. This reduces the chance of misalignment of the image with the receptor or copy sheet.

In the present invention, the carriage supporting the exposed section of web is movable with and not relative to the web during any of the process functions of the copy machine in making each copy. A high rate of copy production is possible without the limitations and problems previously mentioned in connection with a conveying system.

The mechanical of the present invention affords projection of the image onto the web disposed on a plane, the development is handled with the web positioned on the same plane in the same relative position to the plane, the plane is movable along a restricted path relative to the processing stations and control is easily maintained.

The inertial forces to be anticipated in a reciprocal system are effectively minimized in the present invention by a carriage drive system which provides gradual acceleration and deceleration of the ends of the path traversed by the carriage, thus allowing a high rate of copy production.

The copying machine of this invention is adapted to produce a copy of graphic intelligence via a photoconductive intermediate web material where the process includes exposure of a section of intermediate web at an imaging system or imaging station supported on the copy machine when the intermediate web material is orientated at the imaging station, developing the image at a developing station by depositing a particulate material on the image areas in the presence of an electric field when the exposed section of the web material is moved past the developing station, and transferring the particulate image-wise pattern to a receptor or copy sheet at a transferring station to produce a copy of the graphic intelligence when the developed section of web material is moved past the transfer station. The web is supplied to the machine of this invention by a carriage comprising two molded shells, two rotatable rollers and a supply of intermediate web wound between said two rollers. The rollers extend beyond the sides of the carriage and a section of the web between the rollers is disposed externally to the carriage. The carriage is removably mounted on a movable carriage having an essentially flat conductive peripheral support area supporting said external web section. Means is provided to transport the carriage thus moving the supported section of web in proper sequence from the imaging system or exposure station to the development and the transfer station on the copying machine and to then return the carriage to the imaging station in order to produce the desired copies. Drive means is provided on the machine which is coupled to the carriage in such a manner that the carriage is moved and stopped upon the carriage as needed to change the section of web in producing subsequent copies, the web change being accomplished by the web being drawn from one roller in the carriage while the used web is rewound on the other roller in the carriage.

The above and added advantages of the present invention will be more apparent after reading the following detailed description which refers to the accompanying drawing wherein:

FIG. 1 is a schematic vertical sectional view illustrating an electrographic copying machine according to the present invention;
FIG. 2 is a perspective view of the web cartridge used in the electrographic copying machine of FIG. 1;
FIG. 3 is a vertical sectional view of the cartridge of FIG. 2;
FIG. 4 is a horizontal sectional view of the electrographic copying machine taken approximately along the line 4—4 of FIG. 1;
FIG. 5 is a fragmentary front elevation view of the copying machine, with the front cover removed and with parts in section;
FIG. 6 is a fragmentary rear elevation view of the machine as shown in FIG. 5; and
FIG. 7 is a fragmentary end view of the carriage of the copy machine with the cartridge of FIG. 2 removed, and with parts in section for clarity.

Referring now to the drawing there is shown in FIG. 1 a schematic side elevation view of an electrographic copying
machine utilizing the present invention, which is designated in its entirety by the numeral 10. The machine 10 has a generally rectangular frame having a transversely extending first side 11, a second side 12, a side 13, a front side (not shown), a top 15, and a bottom plate 16 to which castors 17 for supporting the machine 10 are mounted. The machine 10 is adapted to produce a copy of graphic intelligence via a process utilizing an intermediate web 21. In producing a copy, a section 22 of the intermediate web 21, properly registered and oriented at an imaging system 23, is exposed to the imaging system 23.

The imaging system 23 comprises a transparent imaging plate 24 upon which an original document to be copied is supported, a pair of mirrors 25 for folding the light path, suitable lamps 26 for illuminating the original document on the plate 24 and a lens system 27 for projecting the image of the graphic intelligence supported on the imaging plate 24 to the section 22 of the intermediate web 21. The exposure registers a light image of the graphic intelligence from the original document onto a photographic coating on the registered section 22 of the intermediate web 21 and causes areas of differential conductivity in the coating on the intermediate web 21 which correspond to lighter and darker areas on the original document.

The intermediate web 21 utilized in this invention is contained in a cartridge 31 removably mounted on and defining with a carriage 32 an assembly which is mounted for reciprocable movement relative to the machine 10 along a straight path defined by a pair of fixed guide members or rails 29 and 30 extending between the first side 11 and the second side 12 of the machine 10. The section 22 of web 21 is exposed while the carriage 32 is disposed under the imaging system 23 adjacent the second side 12 of the machine 10. The section 22 of web 21 extends externally to the lighttight cartridge 31 and is supported externally to the carriage 32 and on the upper peripheral surface of the assembly by a conductive plate 33. After exposure, accomplished by the operator energizing a suitable control circuit, the control circuit will energize moving means which will hereinafter be described, to move the carriage 32 to carry the exposed section 22 of web 21 from the imaging system 23 past a development station 34.

As the carriage 32 passes under the development station 34 the switching circuit causes an electrical potential to be established between the development station 34 and the plate 33 on the carriage 32 to cause a dry, electrically conductive particulate material to be transferred to the imaging areas of the web section 22 in accordance with the “electrophotographic” process described in French Patent No. 1,456,993, issued Sept. 19, 1966. By the electrophotographic process, a photoresponsive sheet, for example, a photographic surface, is exposed to a light image without preliminary electrostatic charging to form a differentially conductive pattern corresponding to the light image and is then contacted with an electrically conductive developer powder while simultaneously a suitable electric potential is applied between a conductive support or backing for such imaged sheet and the powder applicator so that the imaged sheet is differentially coated with the powder corresponding to the conductive pattern thereon.

The powder applicator bearing the developer powder and the photoresponsive sheet are separated while maintaining the electrical potential between them, the electrical potential being discontinued after such separation. The resulting powder-coated photoresponsive sheet is then contacted with a receptor sheet while simultaneously being placed in a suitable electric field. The result is that a powder image of the graphic original is transferred from the photoresponsive sheet to the copy or receptor sheet and upon fusing the powder to the receptor sheet a copy of the graphic original is formed.

After the application of powder to the exposed section 22 of web 21, the carriage 32 continues toward the end of its path adjacent the side 11 of the machine 10 and subsequently reverses its direction of travel. On the return trip of the carriage 32 towards the side 12 a transfer station 35 is activated. A sheet-feeding mechanism (not shown) feeds a single sheet from a stack of copy sheets 36 which is supported on the copying machine 10. The contact is maintained by the leading edge of the exposed section 22 of web 21 and is pressed in contact with the successive portions of the coated section 22 of web 21 by the surface of a cylindrical roller 37 rotatably mounted between the backside 13 and the front side of the machine 10. Simultaneously there is applied an electrical potential between the platens 33 and the roller 37 to afford the transfer of the image from the powder image on the exposed section 22 of web 21 to the copy sheet. The sheet is then transported by a suitable machine-mounted conveyor 38 into contact with a heated fusing roll 39 rotatably mounted on the copying machine 10 parallel with roller 37 so that the powder image will be fused to the copy sheet prior to the time it is discharged from the machine 10 as a completed copy into a receiving tray 40. The carriage 32 continues to its home position from the transfer station 35 at which point the switching circuit either causes the carriage 32 to recycle if further copies of the same graphic intelligence are desired, or causes the carriage 32 to stop if a sufficient quantity of copies have been produced from the exposed section 22 of intermediate web 21. After the carriage 32 has returned to the home position subsequent to producing the appropriate number of copies from the exposed section 22 of intermediate web 21, the web is advanced to the section 22 by web-advancing means which will later be described in detail.

The copying machine is then ready to be reactivated to copy a second original.

Referring now to FIGS. 2 and 3, the intermediate web cartridge 31 is generally lighttight and is formed by two mating shells 41 and 42 which define spaced generally cylindrical cavities with a narrow connecting and supporting area between the cavities. In the cartridge 31 are supported spools 43 upon which are wound a length of the intermediate web 21. The upper shell 41 is a molded member with transversely spaced side walls 44, end walls 45, and a top wall 46. The top wall 46 is formed with two generally semicylindrical or arcuate portions connected by a planar panel to define with the side and end walls 44 and 45 half of the cavities referred to above. An outwardly extending flange 47 surrounds the open side of the shell 41 which flange has a lip 48 formed about its periphery. The lip 48 and flange 47 define a seat for receiving a planar flange 49 of the lower shell 42. The lower shell 42 has opposed transversely spaced side walls 51 shaped to join with a bottom wall 53 to form a totally sealed cavity and define the other half of the cavities. The flanges 47 and 49 and the sidewalls 44 and 51 are formed with bearing surfaces to journal two parallel shafts 58 and 59 which carry axially spaced hubs to support the spools 43 upon which the strip of intermediate web material 21 is wound. The shafts 58 and 59 extend beyond the sidewalls 44 and 51 and have ends attached to provide a half of a coupling 60 to mate with halves of couplings on the carriage 32 as will be hereinafter described to drive the shafts 58 and 59 from the carriage 32. The web 21 is threaded from one spool 43 to the other and passes out of the cartridge 31 through a slotted opening 61 located near the uppermost side of one end wall 45, over the top wall 46, and back into the cartridge onto the other spool 43 through a second slotted opening 61 located near the uppermost side of the other end wall 45. The slotted openings 61 are long narrow openings, and may be lined with a flocked material, to restrict ambient light from entering the cartridge and exposing the web in the cartridge during insertion of a cartridge or when the machine is opened for any purpose. The cartridge 31, comprising the shells 41 and 42 and the shafts 58 and 59, is symmetrical with respect to a vertical plane passing through the normally horizontal midpoint of the sidewalls 44 and 51, and is symmetrical with respect to a vertical plane passing through the normally horizontal midpoints of the end walls 45.

In the following description of the accompanying drawings, the assembly of the shaft 58 and its spool 43 will be termed a
supply roller 63 and the shaft 59 and its spool 43 will be termed a take up roller 64, with the web being transferred form roller 63 to roller 64, however, the cartridge 31 can be mounted in the carriage 32 with either shaft to the right to permit the web to be wound from the right spool 43 or first roller to the left spool 43 or second roller in the carriage and then back to the shaft 59 and turning the carriage 180° until the web is no longer usable.

As can be seen in FIGS. 1 and 5, the cartridge 31 with the supply of intermediate web 21 is received within the carriage 32 and is reciprocally movable therewith along the rails 29 and 30 to produce a copy of a document. The carriage 32 comprises half couplings to mate the half couplings 60 on the shafts 58 and 59 and has means for driven the shafts 58 and 59 to advance the web from the supply roller 63 to the take up roller 64 during operation. As is best seen in FIG. 7 the carriage 32 includes the platen 33 to define the exposure plane for the web 21 which platen 33 is supported from a rectangular rear wall 66 of a frame of the carriage 32. The rear wall 66 supports a web advancing system and is supported by a pair of wheels 67 mounted on top of the rails 29. An inverted U-shaped beam 70 is cantilever mounted on the bottom half of the wall 66 at essentially its horizontal center. At the end of the beam 70 is rotatably mounted a wheel 71 which runs on the roll 30 and in conjunction with the wheels 67 which run on the track 29 provides three point support for the carriage 32 as it traverses the 29 and 30. Additional rollers 73 are provided to insure proper lateral and vertical positioning of the carriage 32 on the tracks 29 and 30 thereby providing proper registration for the section 22 of intermediate web 21 exposed upon the platen 33.

The platen 33 is cantilever mounted perpendicular to the uppermost portion of wall 66. A transversely extending beam 75 extends from the wall 66 essentially the width of the platen 33 below the horizontal center of the platen 33, which beam 75 is connected with a web member 76 and 77 intended to help support the bottom half of the wall 66 at essentially its horizontal center. At the end of the beam 70 is rotatably mounted a wheel 71 which runs on the roll 30 and in conjunction with the wheels 67 which run on the track 29 provides three point support for the carriage 32 as it traverses the 29 and 30. Additional rollers 73 are provided to insure proper lateral and vertical positioning of the carriage 32 on the tracks 29 and 30 thereby providing proper registration for the section 22 of intermediate web 21 exposed upon the platen 33.

The platen 33 is cantilever mounted perpendicular to the uppermost portion of wall 66. A transversely extending beam 75 extends from the wall 66 essentially the width of the platen 33 below the horizontal center of the platen 33, which beam 75 is connected with a web member 76 and 77 intended to help support the bottom half of the wall 66 at essentially its horizontal center. At the end of the beam 70 is rotatably mounted a wheel 71 which runs on the roll 30 and in conjunction with the wheels 67 which run on the track 29 provides three point support for the carriage 32 as it traverses the 29 and 30. Additional rollers 73 are provided to insure proper lateral and vertical positioning of the carriage 32 on the tracks 29 and 30 thereby providing proper registration for the section 22 of intermediate web 21 exposed upon the platen 33.

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in the driving shaft 108 such that after the shaft 105 is rotated by the driving means 106 the coupling 105 is positioned so that the notch therein will make driving contact or engagement with the pin.

The driving shaft 108, which is thus part of the driving means 106 for advancing the section 23 of web 21 on the platen 33 as needed in the copying process, is journaled on a bracket 109 and is driven through a pulley 111 attached thereto and a suitable belt or chain 112 driven by a motor 113 mounted on the bracket 109, which bracket 109 is attached to the bottom plate 16.

A cartridge 31 containing the intermediate web 21 is inserted over the gate 77 when it is lowered, and over the beam 70 under the platen 33 so that the beam 75 fits between the cartridge cavities and so that the half couplings 87 and 88 on the rear wall 66 engage the half couplings 60 on the ends of the shafts 58 and 59. While the cartridge 31 is being inserted, the section of web exposed externally to the cartridge 31 is slightly larger and is directed over the rollers 97 and 98 and the platen 33. After the cartridge 31 is in position within the carriage 32 the roller 63 may be rotated slightly to take up some slack in the web and the gate 77 is raised to its vertical position. The handwheel is rotated so that the threaded shaft 96 engages the end of the beam 75 which brings the half couplings 94, in contact with the half couplings 60 which are attached to the rollers 63 and 64. The roller 63 is then supported by the journals for the rollers 63 and 64 on the carriage 32 and the rollers are now supported through the couplings by the backwall 66 and the gate 77. When the carriage 32 is in its "home" position and driving torque is supplied by the motor 113 through the coupling 105 and the gear box assembly 104, roller 97 applies frictional driving force to the intermediate web 21 causing it to be transferred from the supply roller 63 on the take up roller 64.

The tension in the intermediate web 21 to provide a wrinkle-free section on the platen 33 is provided by the restraining torque applied to the roller 97 from the friction brase assemblies incorporated in its mounting. To prevent excessive rotation of the supply roller 63 a friction brake also operates on the shaft journaling the roller 63 which engages the half couplings 60 on the supply roller 63. In order to provide appropriate takeup tension for the web 21 being wrapped on the takeup roller 64, the gear box assembly 104 provides frictional driving contact to the shaft 89 supporting half coupling 88 which drives the takeup roller 64 at a speed designed to produce a linear speed of intermediate take up greater than the linear speed of intermediate when provided by the frictional driving mechanism rotating the take up roller 64. The frictional driving mechanism rotating the takeup roller 64 is designed to produce a maximum torque insufficient to overcome the friction between the driven roller 98 and the intermediate web 21. For this reason, slippage occurs in the frictional driving mechanism turning the takeup roller 64 while still providing angular speed required for the roller 64 while it accumulates the intermediate web 21. By this advancing system the intermediate web 21 may be advanced when needed to produce the desired variety or quantity of copies with this electrographic copying machine 10.

Drive means are provided for causing the carriage 32 to traverse the rails 29 and 30 so that the section 22 of intermediate web 21 supported on the platen 33 may be moved from the imaging system 23 past the developing section 34 and then returns past the transfer station 35. With the carriage in its "home" position under the imaging system 23, the link 116 which is attached to the carriage 32 by the bar 115 is located on the periphery of the sprocket 119 at the point closest to the second side of the machine 10. When the motor 132 is activated to cause the carriage 32 to traverse the rails 29 and 30, it drives the chain 117 between the sprockets 118 and 119, thereby causing the link 116 to start on its path around sprocket 119 towing the carriage 32 by the bar 115. The immediate starting of the link 116 along its path at essentially full speed will not cause an immediate maximum velocity of the carriage 32 toward the first side 11 of the machine 10, because of the gradual increase in the component of velocity of the link 116 in the direction towards the first side 11 as the link 116 is moved along its path about the periphery of the circumferenee of the sprocket 119. This relatively gradual acceleration pattern is again repeated at the sprocket 118 where the link 116 and the carriage 32 are decelerated to zero velocity towards the first side 11 of the machine 10 while the link 116 travels the first 90° of its path around the sprocket.
118 and then the carriage 32 is gradually accelerated along the tracks towards the second side 12 while the link 116 travels the second 90° segment of its path around sprocket 118. The effect of this gradual acceleration and deceleration of the carriage 32 is to minimize the inertial forces acting throughout the traversing of the carriage 32 thereby permitting more rapid traversing of the carriage 32 upon the machine 10, which in turn permits a higher rate of copy production with a minimum of abuse to the copy machine 10.

Having thus described the present invention what is claimed is:

1. A copying machine adapted to produce a copy of graphic intelligence via an intermediate web material, said machine comprising imaging means for exposing a said intermediate web material, developing means for developing an image of said graphic intelligence on said web material, and transfer means for transferring the image on the web material to a sheet to produce a visible image of said graphic intelligence on said sheet, the improvement comprising:

   a carriage assembly mounted on said machine,

   a cartridge assembly removably mounted on said carriage assembly for storing a supply of web material, said cartridge assembly comprising:

   a shell,

   a first roller mounted rotatably in said shell,

   a second roller rotatably mounted in said shell parallel to said first roller, and

   a strip of web material being attached at its respective ends to, and extending between, said first roller and said second roller with respective portions of said web being wound on said first roller and on said second roller, and with a section of at least one surface of said web material extending between said wound portions being exposed externally to said shell,

   means mounted on said carriage assembly for moving said web material between said first roller and said second roller thereby changing the section of web material exposed externally to said cartridge, and

   moving means mounted on said machine for providing relative movement between said exposed section of web material on said cartridge and at least said developing means and said transfer means.

2. A copying machine according to claim 1 wherein said imaging means, said developing means and said transfer means are attached in fixed relationship to said machine and said moving means comprises fixed guides and means for mounting said carriage assembly for movement along said fixed guides so that a said section of intermediate web material exposed externally to said cartridge is brought in proper sequential disposition with said imaging means, said developing means and said transfer means.

3. A copying machine according to claim 2 wherein said fixed guides and said means mounting said carriage assembly afford straight line reciprocal movement along a path which when traversed places the section of web material exposed externally to said cartridge in sequential disposition with said imaging means, said developing means and said transfer means.

4. A copying machine according to claim 3 wherein said fixed guides are a pair of parallel rails mounted on said copying machine.

5. A copying machine according to claim 3 wherein said moving means comprises:

   an endless tracking member, a track attached to said machine, said track having two legs positioned essentially parallel to the path traversed by said carriage assembly with the adjacent ends of said two legs of said track joined by an arc shaped track section having a radius equal to one-half the separating distance of said two legs, said track supporting and restraining said endless tracking member along said track,

   a link rotatably attached between one point on said tracking member and said carriage assembly, the point of attachment between said link and said carriage assembly being positioned at a point essentially half the distance between said track legs, and

   a driving means for moving said tracking member along said track thereby moving said carriage assembly along the straight line path traversed by said carriage assembly, said arcuate track being traveled by said link attachment point on said tracking member in changing directions, thus serving to minimize the rate of acceleration and deceleration of the carriage assembly in the direction parallel with the line of travel of said carriage assembly during the time the direction of travel of said carriage assembly is reversed.

6. A copying machine according to claim 3 wherein said web moving means mounted on said carriage assembly for moving said web material between said first roller and said second roller comprises a motor attached to said copying machine which drives a coupling which couples with said web moving means on said carriage assembly when said carriage assembly is positioned under said imaging means to move said web material between said first roller and said second roller as required in the operation of said copying machine.

7. A copying machine according to claim 1 wherein said carriage assembly comprises a frame member, said frame member comprising a planar web support for positioning a section of said web material extending between said rollers, a main rectangular support wall supporting said web support, a movable gate opposite said support wall affording insertion of said cartridge assembly, and support means affording movement of said carriage assembly relative to said developing means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,617,124 Dated November 2, 1971

Inventor(s) Orville C. Haugen and Emil J. Kvaal

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 14, change "minimizer" to -- minimized --.

Column 3, line 2, change "20" to -- 10 --, and line 49, change "tropowder" to tro-powder --.

Column 5, line 21, change "rails" to -- rail --; line 27, after "the" (second occurrence) add -- rails --; line 29, after "the" (second occurrence) change "tracks" to -- rails --, and line 47, change "coupling" to -- couplings --.

Signed and sealed this 20th day of June 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR. ROBERT GUTTSCHALK
Attesting Officer Commissioner of Patents