METHOD FOR DEPOSITING MAGNETICALLY SUSCEPTIBLE WORKPIECES AT PRESELECTED LOCATIONS

Filed Oct. 22, 1965 3 Sheets-Sheet 1

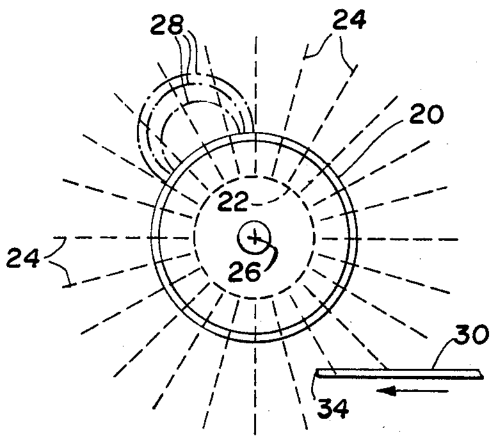

Fig.1.

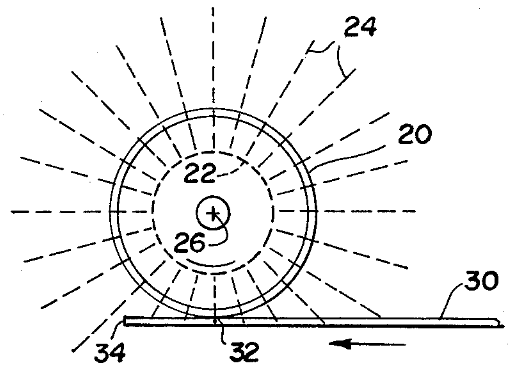

Fig.2.

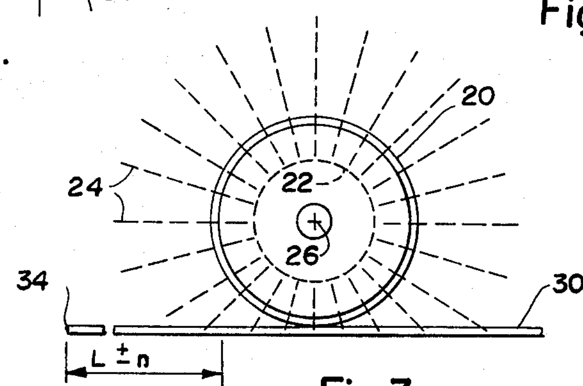

Fig.3.

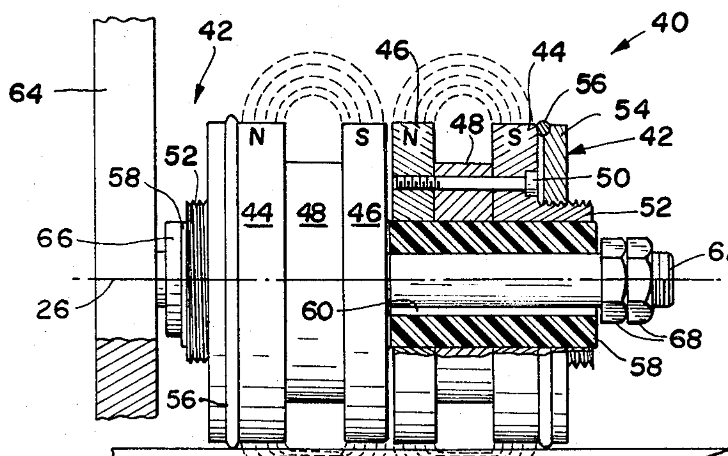

Fig.4.

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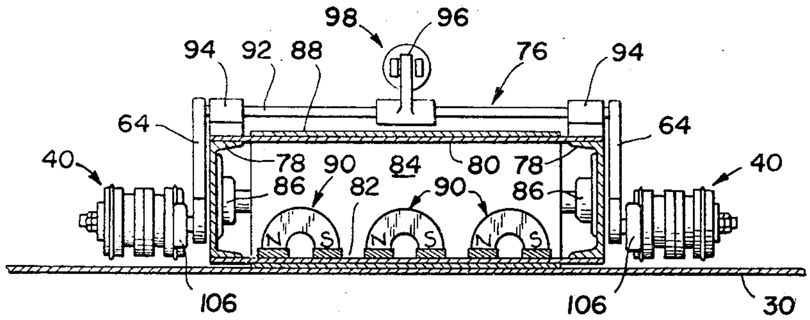

Fig.5.

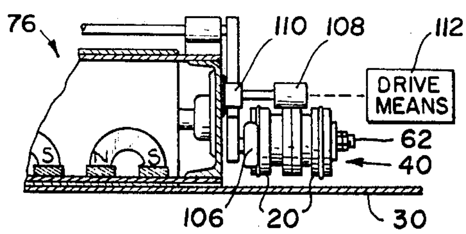

Fig.7.

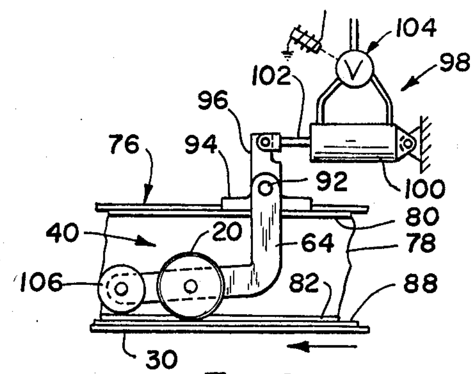

Fig.6A.

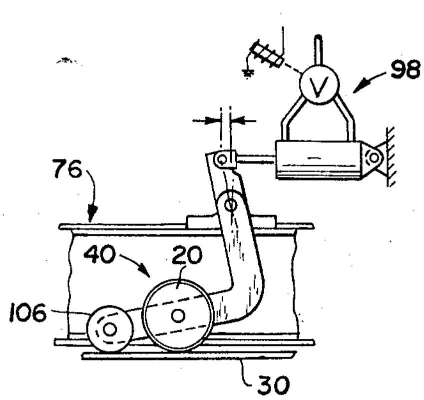

Fig.6B.

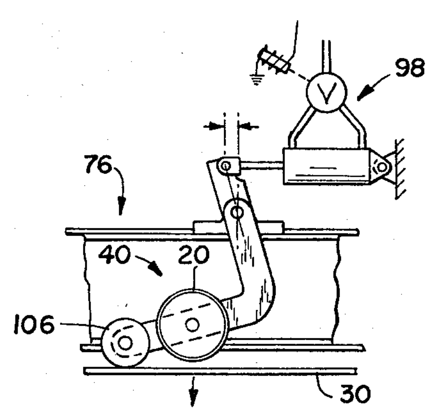

Fig.6C.

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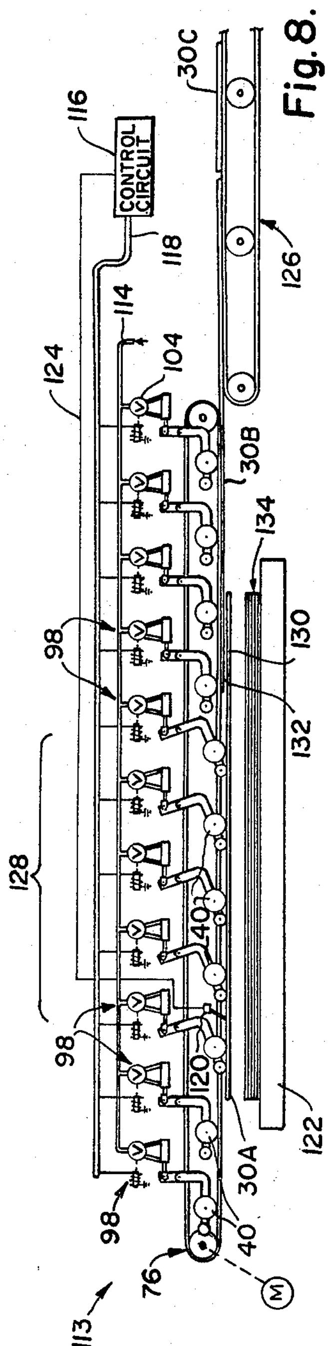

Fig.8.

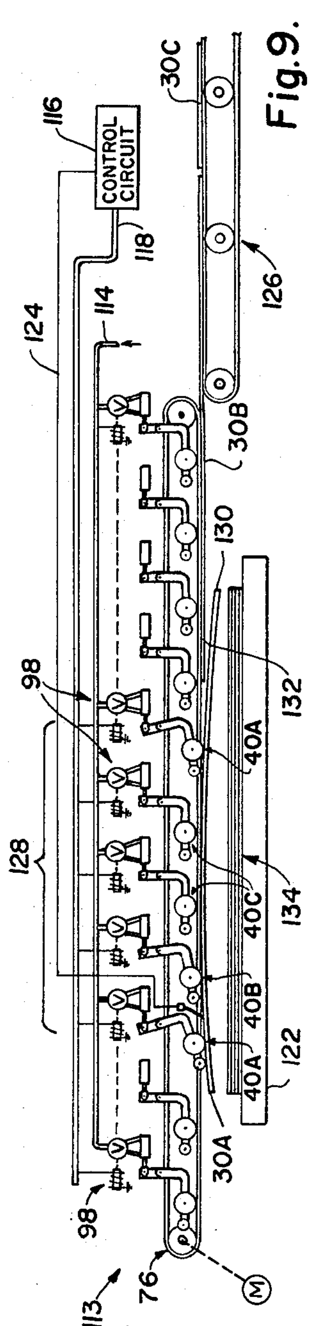

Fig.9.

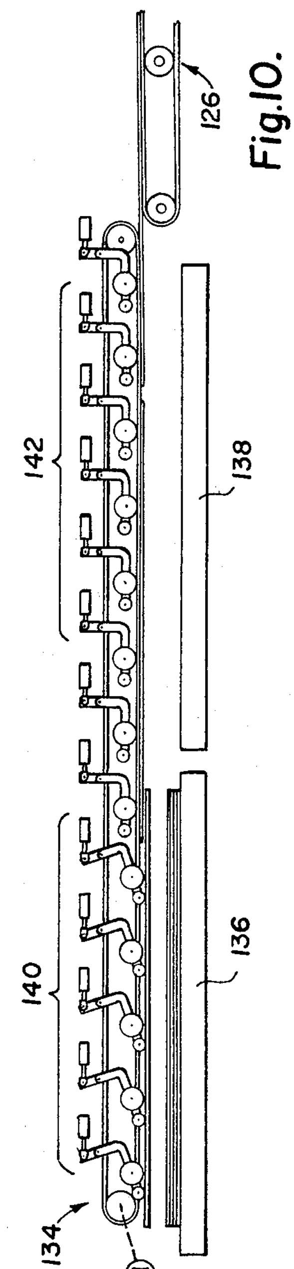

Fig.10.

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3,385,596
METHOD FOR DEPOSITING MAGNETICALLY SUSCEPTIBLE WORKPIECES AT PRESELECTED LOCATIONS

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Filed Oct. 22, 1965, Ser. No. 500,954
10 Claims. (Cl. 271—46)

ABSTRACT OF THE DISCLOSURE

This patent discloses methods for stacking workpieces, such as sheets or pipe, of magnetically susceptible material, such as steel. The workpieces are accurately stopped, without the use of a physical abutment, by being brought into contact with a plurality of magnet-containing rollers, preferably undriven, so as to be decelerated to a stop while in rolling contact with the rollers by absorption of kinetic energy of the workpiece in cutting magnetic lines of flux, whereafter a force is exerted on the workpiece to disengage it from the rollers. The patent further describes force-applying means that act, e.g., on a sheet in such manner that air is trapped under its middle to cushion its descent to the pile or stack being formed.

This invention relates to a method for depositing workpieces at a preselected location at the exit end of a conveyor, and more particularly to a method for depositing magnetically susceptible workpieces, such as steel sheets, at said location wherein the workpieces are conveyed successively at a relatively high rate of speed and decelerated substantially to a stop prior to their deposition at said location.

A large number of sheet handling devices are known which are adapted to receive sheet material from a conveyor and either stack the sheets one above the other or place them on a second conveyor for transfer, for example, in a different direction to equipment which subjects the sheet to further processing operations. In the case of magnetically susceptible sheets, sch as steel, these handling devices have conveniently employed magnetic rollers to facilitate suspending the sheets over the desired location prior to depositing them at said location. Examples of these types of sheet handling devices will be found in U.S. Patents Nos. 2,005,200 and 2,015,809. An additional example of a sheet handling device of this type will be found in our copending U.S. patent application Ser. No. 365,615, filed May 7, 1964, now U.S. Patent No. 3,224,757, entitled "Magnetic Sheet Transferring Apparatus" and assigned to the assignee of the present invention.

In operation, it is necessary for the above cited devices and most other similar devices to decelerate the sheet substantially to a stop prior to depositing it at said location. As is known, various methods have heretofore been employed for decelerating and stopping the sheets. For example, in the case where the sheets are conveyed at a relatively slow speed, it is conventional to provide an abutment positioned to be engaged by the forward edge of the sheet for stopping the sheet. The abutment is positioned so that the sheet will fall after being stopped, to the desired location at substantially the same position as the previously stopped sheets. However, even at relatively slow speeds, the forward ends of the sheets were deformed when the sheet struck the abutment. The forward end portion of the sheet normally could not be used and was cut off.

To overcome the edge deformation problem, the abutment was yieldably supported so as to absorb some of the kinetic energy of the sheet thereby reducing, although not completely eliminating, the sheet edge deformation. In another sheet handling device wherein the sheets were received at a still higher velocity, conventional automobile or truck tires were employed, not too successfully, to protect the sheets against the forward edge deformation.

In a further attempt to eliminate the edge deformation problem, the abutment was removed and each sheet was released at a preselected time interval relative to the aforesaid desired location. Upon release, the sheet floated or fell to the stack. The most obvious problem associated with this method is timing the release of the sheet. The most obvious disadvantage of this method is that the exposed face of the uppermost sheet in the stack will be defaced when the falling sheet strikes and slides over the exposed face.

Presently, there exists sheet handling apparatus which, as stated, is capable of receiving steel sheets traveling at 250 feet per minute maximum, and stack them without substantial marring. Although the sheet transfer speed of 250 feet per minute appears to be relatively high, present plans call for sheet transfer speeds up to 1500 feet per minute and higher. It should be readily apparent, therefore, that discharging sheets from a conveyor for stacking or for further transfer, without marring or deforming the sheets is a real problem.

Accordingly, as an overall object, the present invention seeks to provide a novel method for depositing workpieces at a preselected location.

Another object of the invention is to provide a novel method for depositing workpieces at a preselected location without marring or deforming the sheets.

Still another object of the invention is to provide a method whereby sheets are accurately deposited relative to the previously deposited sheets, at a preselected location.

A further object of the invention is to provide a novel method whereby sheets traveling at relatively high rates of speed are deposited at a preselected location, accurately and without marring or deforming the sheets.

In the practice of the method of the invention, magnetically susceptible sheets are conveyed successively by conventional means, such as a conveyor, to a preselected location adjacent the exit end of the conveyor. As each successive sheet passes into the region of said preselected location, it also passes through magnetic fields radiating from magnetic rollers positioned adjacent thereto. Each successive sheet is therefore attracted into tangential contact with the rollers and is decelerated substantially to a stop by absorption of its kinetic energy in cutting the magnetic lines of flux of the magnetic fields. After each sheet has been decelerated, a force is applied thereto to disengage the sheet from the rollers and cause successive ones of the sheets to be placed at said location.

In the preferred form of the invention, the rollers are initially spaced from each successive sheet and are moved into engagement with the sheet being decelerated to move the same toward the preselected location while the sheet is decelerated substantially to a stop.

In another embodiment of the invention, certain of the rollers employed to decelerate the sheet are moved toward the preselected location prior to moving the remaining ones of the rollers. In this manner, the sheet is arched prior to being disengaged from the rollers whereby the arched sheet takes advantage of trapped air to cushion its engagement with the sheet subsequently deposited at the preselected location.

In still another embodiment of the invention, the rollers are initially spaced from each successive sheet and are driven at a speed such that its rim speed is substantially equal to the linear velocity of the magnetically susceptible sheets. The rollers are then moved into engagement with the sheet being decelerated to move the same toward the preselected location while the sheet is decelerated substantially to a stop. By virtue of the fact that the rim speed of the rollers is substantially equal to the linear speed of the sheets, the initial engagement therebetween will not cause marking of the sheets.

The present invention is particularly adapted for stacking or placing sheets of magnetically susceptible material at a preselected location. However, it is to be understood that the method of the invention may be employed to deposit other magnetically susceptible workpieces of which steel pipe is but one example.

The above and other objects and advantages of the present invention will become apparent from the following detailed description by reference to the accompanying drawings, in which:

FIGURE 1 is a schematic side view of the roller having magnet means arranged to produce a magnetic field extending completely around its circumference;

FIG. 2 is a schematic side view, similar to FIG. 1, illustrating the initial tangential contact of a magnetically susceptible sheet with the roller;

FIG. 3 is a schematic side view, similar to FIG. 1, illustrating the effect of the magnetic field in stopping the magnetically susceptible sheet;

FIG. 4 is a front view, partially in cross section, illustrating a roller of the type described in conjunction with FIG. 1;

FIG. 5 is a cross-sectional view, taken transversely across a conventional magnetic conveyor, provided with rollers of FIG. 3;

FIGS. 6A, 6B and 6C are fragmentary side views of the conveyor of FIG. 5, illustrating certain successive steps in the method of the invention;

FIG. 7 is a fragmentary cross-sectional view, similar to FIG. 5, illustrating a means for driving the rollers;

FIG. 8 is a side elevation view of apparatus, similar to that of FIG. 5, illustrating one embodiment of a method for stacking magnetically susceptible sheets;

FIG. 9 is a side elevation view of apparatus, similar to that of FIG. 5, illustrating an alternative embodiment of a method for stacking magnetically susceptible sheets; and

FIG. 10 is a side elevation view of apparatus, similar to that shown in FIG. 5, illustrating a method for stacking magnetically susceptible sheets alternately at two spaced, preselected locations.

Referring now to FIG. 1, there is schematically illustrated a roller **20** carrying magnet means **22** arranged to produce magnetic lines of flux or force indicated by the dashed lines **24**, radiating about a central axis **26** of the roller **20**. The magnetic means **22** preferably comprise a permanent magnet although electromagnets may be used with equal utility. The magnetic means **22** is preferably arranged such that the magnetic lines of flux **24** radiate in a torus-like configuration about the axis **26**. That is to say, the magnetic lines of flux **24** extend in the direction of the central axis **26**. The magnetic means **22** could, instead, be arranged to produce magnetic lines of flux which radiate in a series of cycloids such as illustrated by the dash-dot lines **28**. The magnetic lines of flux **28** would extend transversely of the central axis **26**.

As will become apparent, a plurality of the rollers **20** are used to decelerate a magnetically susceptible sheet substantially to a stop prior to placing the sheet at a preselected location. The rollers **20** are preferably supported in a manner such that they are substantially freely rotatable about the central axis **26** during deceleration of the sheet.

In FIG. 1, there is shown a fragment of a magnetically susceptible sheet **30** which is moving, in the direction indicated by the arrow, into the field of influence of the magnetic lines of flux **24**. It is to be understood at this time, that the sheet **30** must be magnetically sus-

ceptible, that is, capable of being attracted by a magnet, in order that the principles of the present invention may be practiced for stacking or placing the sheets **30** at a preselected location. Consequently, the sheet **30** may comprise, for example, ferromagnetic substances such as iron, nickel and cobalt. The sheets **30** may also be comprised of substances which are normally non-magnetic but which are rendered magnetically susceptible by addition of sufficient amounts of a ferromagnetic substance. Therefore, the phrase "magnetically susceptible sheets" as used in the specification and the appendant claims, is intended to include any and all substances which are capable of being attracted by a magnet.

Returning now to FIG. 1, the sheet **30** is shown spaced from the roller **20**. As the sheet **30** enters the field of influence of the magnetic lines of flux **24**, it will be subjected to a force which tends to pull the roller **20** and the sheet **30** toward each other. In accordance with the present invention and for reasons to be described later in the specification, it is preferred to hold the sheet **30** in the plane illustrated and to move the roller **20** into engagement with the sheet **30**. In FIG. 2, the sheet **30** is shown in tangential contact, as at **32**, with the roller **20**. A number of the magnetic lines of flux **24** permeate the sheet **30** thereby attracting and maintaining the sheet **30** in tangential contact with the roller **20**. Inasmuch as the sheet **30** is in contact with the roller **20**, the roller **20** will be caused to rotate in a counterclockwise direction by the movement of the sheet **30** to the left of FIG. 2.

It has been discovered that the magnetically susceptible sheet **30** can be decelerated from a relatively high rate of travel, as illustrated in FIG. 2, to a stop, as illustrated in FIG. 3, by passing the sheet **30** in tangential rolling contact with a plurality of the magnetic rollers **20**. The sheet **30** can be stopped within a relatively short distance and with great accuracy relative to a preselected location at which the sheet is to be deposited. For example, it us assume that the relative positions of the roller **20** and the sheet **30** as shown in FIG. 2 represent the instant at which the roller **20** contacts the sheet **30**; and let us assume that the relative positions of the roller **20** and the sheet **30** as shown in FIG. 3 represent that instant at which the sheet is decelerated to a stop. Consequently, in FIG. 2 the leading edge **34** of the sheet **30** can be used as a reference point which during deceleration of the sheet **30** will move through a distance, indicated in FIG. 3, by the dimension line labeled L plus or minus n. The distance L plus or minus n represents the stopping distance or sheet travel during deceleration of the sheet to a stop. The letter L represents the average or mean stopping distance while the letter n represents the average variation in the stopping distance. Thus, for a given type of magnetically susceptible sheet, for example, sheets of carbon steel, the stopping distance is generally indicated by $L+n$. The variation in stopping distance occurs, for example, because of variations in permeability from sheet-to-sheet; because of variations in friction normally associated with rotatable rollers; and because of a small amount of slippage which occasionally occurs between the sheet **30** and the roller **20**.

Although the manner in which the magnetic rollers function to absorb the kinetic energy of the sheet, is not completely understood, one possible explanation is as follows. As the sheet **30** moves relative to the axis **26**, see FIG. 2, the rollers **20** will rotate in a clockwise direction whereby successive ones of the magnetic lines of flux **24** will be cut by the sheet **30**. Consequently, circulating currents (eddy currents) will be in induced in the sheet **30**. As is known, energy is required to induce eddy currents in a conducting material. Furthermore, there are resistance losses accompanying these eddy current which dissipate a portion of the energy in the form of heat. In the case of the moving sheet **30**, its kinetic energy supplies the energy necessary to induce the eddy currents created as the sheet **30** cuts the magnetic lines of flux. The kinetic energy of the sheet **30** is, therefore, absorbed and dissipated in the form of heat. By increasing the number of magnetic rollers, the amount of kinetic energy absorbed can, of course, be increased. Consequently, it can be said that the sheet 30 is decelerated to a stop by absorption of its kinetic energy in cutting the aforesaid magnetic lines of flux.

Reference is now directed to FIG. 4 whrein thre is illustrated a roller assembly 40 constructed to produce magnetic lines of flux radiating in a torus-like configuration about its axis. The roller assembly 40 comprises two magnetic rollers 42, both of which are identical in construction. Each of the magnetic rollers 42 comprises pole pieces 44, 46 having a magnetic disc 48 interposed therebetween. A plurality of bolts 50 retain the pole pieces 44, 46 and the magnetic disc 48 in the sandwiched configuration illustrated. The pole piece 44 has a threaded hub 52 on which is threaded a disc 54. Interposed between the outer edges of the disc 54 and the pole piece 44 is an O-ring 56. The O-ring 56 is compressed between the pole piece 44 and the disc 54 whereby its outer peripheral edge is extruded beyond the outer surface of the disc 54 and the pole piece 44. The overall arrangement is such that the magnetically susceptible sheet 30 will contact only the outer peripheral edge of the O-ring 56 and thereby be maintained spaced from the pole pieces 44, 46. This construction, of course, prevents marking the sheets 30 by preventing contact between the hard metal pole pieces 44, 46 and the surface of the sheet 30.

Extending through the pole pieces 44, 46 and the magnetic disc 48 is a cylindrical bearing member 58 having a bore 60 extended axially therethrough. The cylindrical bearing member 58 preferably is formed from plastic material such as nylon or Teflon, but, could, instead, be formed from other suitable bearing forming materials.

Extending through the bores 60 of the cylindrical bearing members 58 is a shaft 62 having one end secured to an arm 64. The shaft 62 includes a radial flange 66 which is positioned between the arm 64 and the bearing member 58 of the inner magnetic roller 48. The opposite end of the shaft 62 is threaded and receives suitable fasteners, such as bolts 68, which serve to retain the magnetic rollers 42 on the shaft 62.

The inner diameter of the bores 60 is preferably greater than the outer diameter of shaft 62, thereby permitting each of the magnetic rollers 42 to be angularly displaced relative to the central axis 26 so as to conform to any distortions in the sheet 30. Inasmuch as the inner diameter of the bore 60 is greater than the outer diameter of the shaft 62, the rollers 42 are substantially freely rotatable about the central axis 26.

As stated above and as an alternative arrangement, it is possible to arrange magnets within a roller whereby the magnetic lines of flux radiate in a series of cycloids around the periphery of the roller, as illustrated by the flux lines 28 of FIG. 1.

As an example of how the roller assembly 40 is employed to practice the method of the invention, reference is now directed to FIGS. 5 and 6A wherein two of the roller assemblies 40 are shown mounted on a concentional magnetic conveyor 76. The magnetic conveyor 76 comprises a frame formed from side channels 78 and upper and lower falls 80, 82. A roller 84, in this instance being an idler roller, is shown rotatably connected to the side channels 78 by means of journals 86. It is to be understood that a second roller, which in this instance is a drive roller, would be rotatably supported at the opposite end of the magnetic conveyor 76 and driven by a suitable drive motor. Extending along the upper and lower walls 80, 82 and around the rollers supported at the end of the magnetic conveyor 76 is an endless drive belt 88 which is preferably formed from a leather-like material rendered magnetic by the addition of ferromagnetic substances such as iron particles.

Carried within the magnetic conveyor, that is secured to the inner face of the lower wall 82, is a series of magnets 90 which are preferably of the permanent type but which could, instead, be electromagnets. The magnets 90 are so positioned across and along the length of the bottom wall 82 such that a plurality of magnetic fields are provided which attract the lower reach of the drive belt 88 into engagement with the lower wall 82. Additionally, the magnetic fields of the magnets 90 also serve to attract the magnetically susceptible sheet 30 into engagement with the drive belt 88 thereby conveying the sheet 30 along the conveyor 76 as illustrated in FIG. 6A.

As can be seen in FIG. 5, one of the roller assemblies 40 is supported on each side of the conveyor 76. Specifically, the arms 64 are secured to a common shaft 92 which is rotatably supported in pillow blocks 94 secured to the magnetic conveyor 76. A connecting arm 96 is rigidly secured to the common shaft 92, preferably at a central location thereon. Operatively connected to the connecting arm 96 is actuating means 98 which serves to rotate the common shaft 92 about its central axis thereby causing the roller assemblies 40 to be moved toward and away from the sheet 30 along an arcuate path of travel, as will be described. The actuating means 98 may comprise, for example, a pneumatic cylinder 100 of the type requiring forces to extend and retract the piston shaft 102 thereof. Associated with the pneumatic cylinder 100 is a solenoid operated control valve 104 which operates to extend and retract the shaft 102 when and as desired.

As stated above, the method of the present invention includes a step wherein a force is exerted on the sheet to disengage the sheet from the rollers. This force is conveniently provided by a stripping roller 106 carried at the end of the arm 64. The stripping roller 106 is preferably formed from materials which will not mar the sheet 30. Such materials are, for example, rubber and plastics.

The preferred embodiment of the present invention is illustrated in FIGS. 6A, 6B and 6C. In FIG. 6A, the sheet 30 is passed adjacent—beneath in this instance—the roller assembly 40. Notice that the roller 20 is vertically spaced from the sheet 30. At a preselected time, the actuating means 98 is activated to lower the roller assembly 40 into engagement with the sheet 30, as shown in FIG. 6B, whereby the sheet 30 is decelerated substantially to a stop by absorption of its kinetic energy in cutting the magnetic lines of flux, as explained above. At this time, the sheet 30 is disengaged from the magnetic conveyor 76 so that the sheet 30 is suspended entirely by means of the magnetic rollers 20. After the sheet 30 has been decelerated substantially to a stop, the downward movement of the stripping roller 106 disengages the sheet 30 from the roller assembly 40 so that the sheet 30 will drop to the preselected position.

It should be understood at this time that the roller assemblies 40 are lowered in one continuous motion from the position shown in FIG. 6A to a position corresponding substantially to that shown in FIG. 6C. Thereafter, the activating means retracts its piston shaft 102 to return the roller assembly 40 to the starting position of FIG. 6A preparatory to depositing the next successive sheet 30.

In the case where the surface of the sheet 30 is relatively easily marked, it is desirable, as shown in FIG. 7, to provide a drive roller 108 rotatably supported on the conveyor 76, as by means of a journal block 110. The drive means, schematically illustrated at 112, is used to rotate the magnetic rollers 20 at a speed such that its rim speed is substantially equal to the linear speed of the sheet 30. Thus, when the magnetic rollers 20 are lowered, their engagement with the sheet 30 is accomplished without marring the sheet 30. It is to be noted that when the magnetic rollers 20 are disengaged from the drive roller 108, they are substantially freely rotatable during deceleration of the sheet 30. The drive means 112 make take any one of a variety of forms. It may, for example, comprise a set of gears suitably connected to the drive roller 108 and arranged to be driven by the main drive of the conveyor 76. Alternatively, the shaft 62 of the roller assembly 40 may be rotatably mounted on the arm and a suitable drive arrangement provided for rotating the shaft 62. Inasmuch as the rollers 20 are freely rotatable on the shaft 62, as explained above in conjunction with FIG. 4, forced rotation of the shaft 62 will cause the rollers 20 to be rotated only when the rollers 20 are not engaged with the sheet 30. When the rollers 20 are engaged with the sheet 30, however, the magnetic attraction between the rollers 20 and the sheet 30 prevents the roller 20 from being rotated by the shaft 62.

Referring now to FIG. 8, a decelerating unit 113 is shown comprising the magnetic conveyor 76 having a plurality of the roller assemblies 40 located at uniformly spaced points along its length. An actuating means 98 is operatively connected to each roller assembly 40, as described above. The solenoid operated control valves 104 are supplied with operating fluid by means of a common conduit 114. A control circuit, indicated schematically at 116, includes a conduit 118 carrying a multiplicity of wires to the solenoids associated with the control valves 104. A sheet sensing unit 120 is mounted on the conveyor 76 at a preselected position thereon relative to, for example, the receiving table 122 which defines the aforesaid preselected location. The sheet sensing unit 120 may be of the mechanical type wherein feelers are used for sensing the leading edge of the sheet conveyed by the conveyor 76; and an electronic type employing a photoelectric cell; or any other well-known sensing unit. Additionally, the sensing unit 120 may be adjustably connected to the conveyor 76 whereby the sensing unit 120 is positioned at any desired location along the length of the conveyor, or a plurality of the units 120 may be used. Conductor 122 electrically connects the sensing unit 120 to the control circuit 116. The control circuit 116 is such that the roller assemblies may be lowered and raised individually or in preselected groups according to the length of the sheet being decelerated.

The decelerating unit 113 is positioned adjacent the exit end of a conventional sheet conveyor 126. The decelerating unit 113 is aligned with the sheet conveyor 126 so as to receive, in succession, the sheets conveyed by the conveyor 126.

In FIG. 8, a magnetically susceptible sheet 30A has been decelerated to a stop by a preselected set of the rollers, indicated by the bracket 128. Adjustment of the control circuit 116 serves to activate the appropriate ones of the actuating means 98 to lower the preselected set of rollers 128. The set of rollers 128 are being lowered and are illustrated in a position wherein the stripping rollers are about to disengage the sheet 30A from the roller assemblies.

It is to be noted at this time that the position of sheet 30A relative to the set of rollers 128 is such that a trailing end portion 130 of the sheet 30A is unsupported, that is, none of the roller assemblies 40 support the same. Furthermore, the sheet 30A has been displaced out of the plane of the subsequent sheets 30B and 30C. Consequently, during deceleration, the sheet 30A is lowered so that a leading end portion 132 of the next successive sheet 30B overlaps the trailing end portion 130 of the decelerated sheet 30A. Hence, the sheet 30B is permitted uninterrupted travel along the conveyor 76 during the time required to lower the set of rollers 128 so as to place the sheet 30A on a stack of sheets 134 and to raise the set of rollers 128 to their normal elevated position. As the leading edge of the sheet 30B reaches the first roller assembly 40 of the set of rollers 128, the set of rollers 128 are up out of the path of travel of the sheet 30B.

As a consequence of this method of placing the sheets 30 on the stack 134, the sheets 30 may be conveyed on the conveyor 126, for example, with the trailing edge of the sheet 30B adjacent to the leading edge of the sheet 30C.

An alternative embodiment of the present method is illustrated in FIG. 9. In this embodiment, certain of the roller assemblies 40 of the set of rollers 128 are lowered in advance of the lowering of the remaining roller assemblies 40 whereby the sheet being decelerated is arched. In the arched configuration, the sheet may take advantage of trapped air acting as a cushion to ease the sheet onto the stack.

In FIG. 9, for example, the control circuit 116 activates, in sequence, the actuating means 98 of the opposite end roller assembly 40A, of the roller assembly 40B and finally of the roller assembly 40C. As a result, the sheet 30A is given a downward concave, arched configuration whereby as the sheet 30A falls to the stack 134, air trapped beneath the sheet, will cushion its impact with the uppermost sheet in the stack 134. Furthermore, the trailing end portion 130 will again be displaced out of the plane of the next successive sheet 30B which, is permitted uninterrupted travel along the conveyor 76. It should be noted, however, that in this case, the trailing end portion 130 is lowered at a considerably faster rate than the trailing end portion 130 in FIG. 8. Consequently, the spacing between the trailing and leading edges of successive sheets may be considerably less than the spacing of the sheets 30 in the method of FIG. 8. In the extreme, the sheets 30B and 30C of FIG. 9 could be disposed in end-to-end abutted relation if desired.

In FIG. 10 there is illustrated a decelerating unit 134 which is similar to the units 113 of FIGS. 8 and 9, with the exception that the unit 134 is approximately twice as long as the units 113. Therefore, the decelerating unit 134 is capable of placing sheets alternately at either of the aligned receiving tables 136, 138. That is to say, a first preselected set of rollers 140 is employed to place successive sheets on the receiving table 136. Thereafter, a second preselected set of rollers 142 is employed to place the sheets on the receiving table 138 while the stacked sheets on the receiving table 136 are removed. The sets of rollers 140, 142 will be used alternately thereby providing continuous operation of the equipment delivering the sheets to the conveyor 126.

The following example is included to illustrate the speed with which magnetically susceptible sheets may be substantially stopped and placed at a preselected location and the accuracy achieved in placing the sheet at said preselected location. A carbon steel sheet was used which was 8 feet long, 4 feet wide, ⅛ inch thick and which weighed 160 pounds. This sheet was conveyed at a linear velocity of 450 feet per minute to a decelerating unit very similar to the unit illustrated in FIG. 8. The sheet was passed beneath the magnetic rollers and at a preselected time, the magnetic rollers were lowered into engagement with the sheet. This sheet was repeatedly stopped within eighteen inches of sheet travel with an accuracy of plus or minus one inch.

It is to be noted at this time, that the methods of the invention are applicable to placing sheets on other conveyors which serve to convey the sheets, for example, in a different direction to other areas of the plant for further processing operations. Furthermore, the methods of the invention are also applicable to the condition wherein the sheets are conveyed standing on one edge as opposed to being laid flat as illustrated in the drawings. Still further, the methods of the invention are also applicable to depositing other magneticaly susceptible workpieces, such as, pipes and conduits of various cross-sectional configurations. The appendant claims are intended to include all such operations.

Although the invention has been shown in connection with certain specific embodiments, it will be readily apparent to those skilled in the art that various changes may be made to suit requirements without departing from the spirit and scope of the invention.

We claim as our invention:

1. A method for placing magnetically susceptible workpieces successively at a preselected location adjacent the exit end of a conveyor adapted to convey said workpieces in succession, comprising the steps of passing

successive ones of said workpieces adjacent rollers which are disposed at said preselected location and which carry magnet means arranged to produce magnetic lines of flux radiating about the axes of the rollers, whereby each successive moving workpiece will be attracted into tangential contact with a number of the rollers and will be decelerated substantially to a stop while in rolling contact with the rollers by absorption of its kinetic energy in cutting said magnetic lines of flux, and after each workpiece has been decelerated, exerting a force thereon to disengage the workpiece from said rollers and cause successive ones of said workpieces to be placed at said preselected location.

2. The method of claim **1** wherein said rollers are freely rotatable about their axes during deceleration substantially to a stop of each successive moving sheet.

3. The method of claim **1** wherein said magnetic lines of flux radiate in a torus configuration about the axes of said rollers.

4. The method according to claim **1** wherein the axes of said rollers extend transversely of the direction of travel of said workpieces and wherein said axes of said rollers are substantially parallel to each other.

5. The method according to claim **1** wherein said workpieces comprise magnetically susceptible sheets and wherein the rollers of said number of rollers are moved such that each successive moving sheet is moved toward said preselected location while each successive moving sheet is decelerated substantially to a stop.

6. The method according to claim **1** wherein said workpieces comprise magnetically susceptible sheets and wherein certain of the rollers of said number of rollers are moved toward said preselected location prior to moving the remaining ones of the rollers of said number of rollers whereby each successive moving sheet is arched prior to being disengaged from said number of rollers.

7. The method according to claim **6** wherein each successive sheet is given a downward concave arch whereby its trailing end portion is moved downwardly out of the way of the leading edge of the next successive moving sheet.

8. The method according to claim **1** wherein initially, said rollers are spaced from each successive moving workpiece and wherein the rollers of said number of rollers are moved into engagement with each successive workpiece to move the same toward said preselected location while each successive moving workpiece is being decelerated substantially to a stop.

9. In the method for discharging magnetically susceptible workpieces at a preselected location wherein said magnetically susceptible workpieces are conveyed in succession at a high rate of travel to said preselected location, the step of stopping each successive moving workpiece prior to deposition at said preselected location by passing each successive moving workpiece adjacent freely rotatable rollers carrying magnet means arranged to produce magnetic lines of flux which radiate about the rotational axes of the rollers, whereby each successive moving workpiece will be attracted into tangential rolling contact with a number of the rollers and will be decelerated substantially to a stop while in rolling contact with said number of the rollers by absorption of its kinetic energy in cutting said magnetic lines of flux.

10. A method for placing magnetically susceptible shets successively in face-to-face contact at a preselected location adjacent the exit end of conveyor means adapted to convey said sheets such that the trailing edge of each sheet is closely adjacent the leading edge of the adjacent sheet, comprising the steps of passing successive ones of said sheets adjacent rollers which are disposed at said preselected location and which carry magnet means arranged to produce magnetic lines of flux radiating about the axes of the rollers, whereby each successive moving sheet will be attracted into tangential contact with a number of said rollers and will be decelerated substantially to a stop by absorption of its kinetic energy in cutting said magnetic lines of flux, the position of each successive moving sheet relative to said number of said rollers being such that a trailing end portion thereof is unsupported, displacing certain rollers of said number of said sheets toward said preselected location during deceleration of the sheet to move at least said trailing end portion out of the plane of the next successive sheet, whereby the leading edge of the next successive sheet will overlap the trailing end portion of the sheet being decelerated, and after each successive sheet has been decelerated, exerating a force thereon to discharge the sheet from said number of said rollers and cause successive ones of said sheets to be placed at said preselected location.

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