

Oct. 17, 1939.

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2,176,784

METHOD OF AND APPARATUS FOR GRADING MAGNETIC SHEET MATERIAL

Filed Sept. 22, 1936

3 Sheets-Sheet 1

Fig. 1

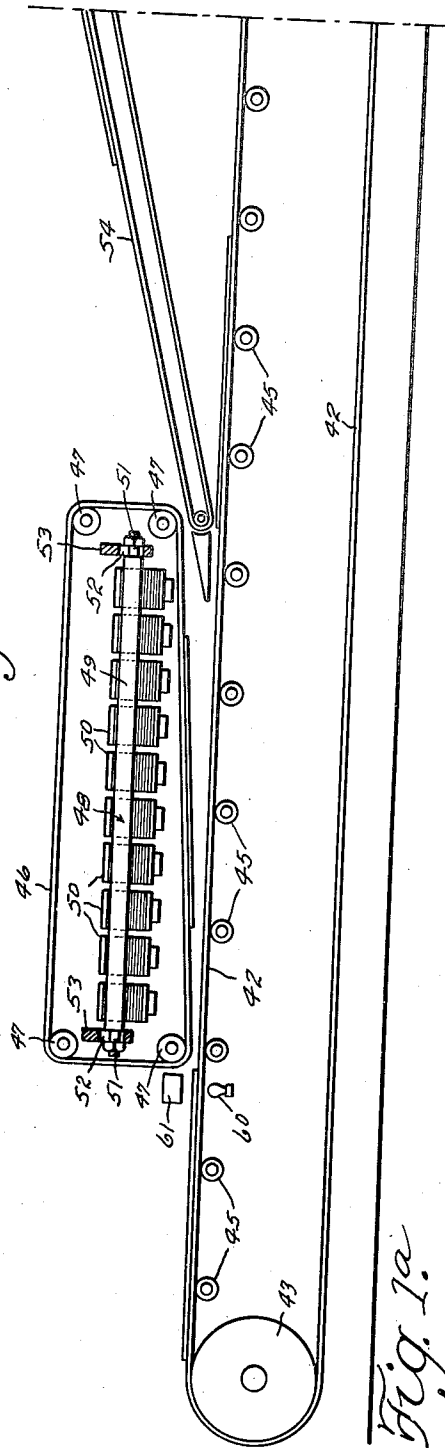
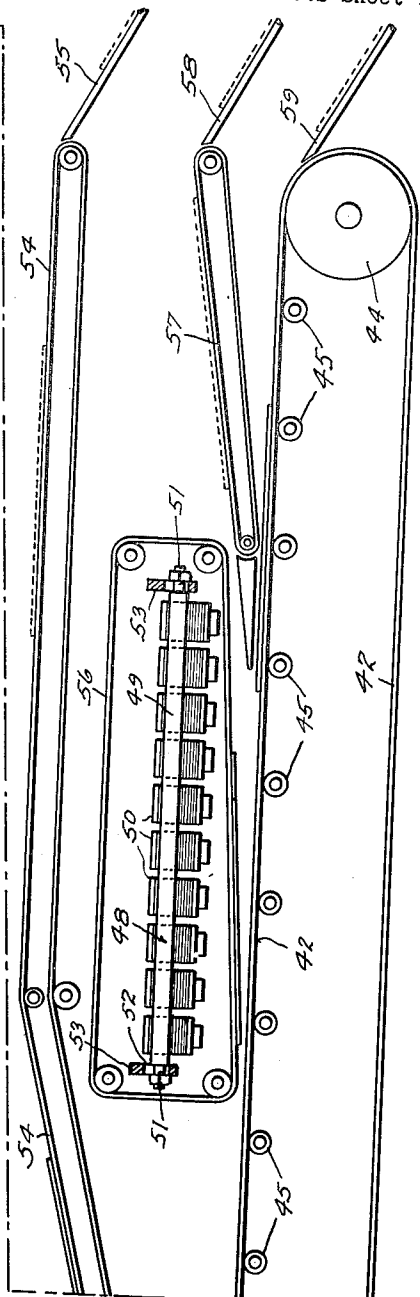


Fig. 1a



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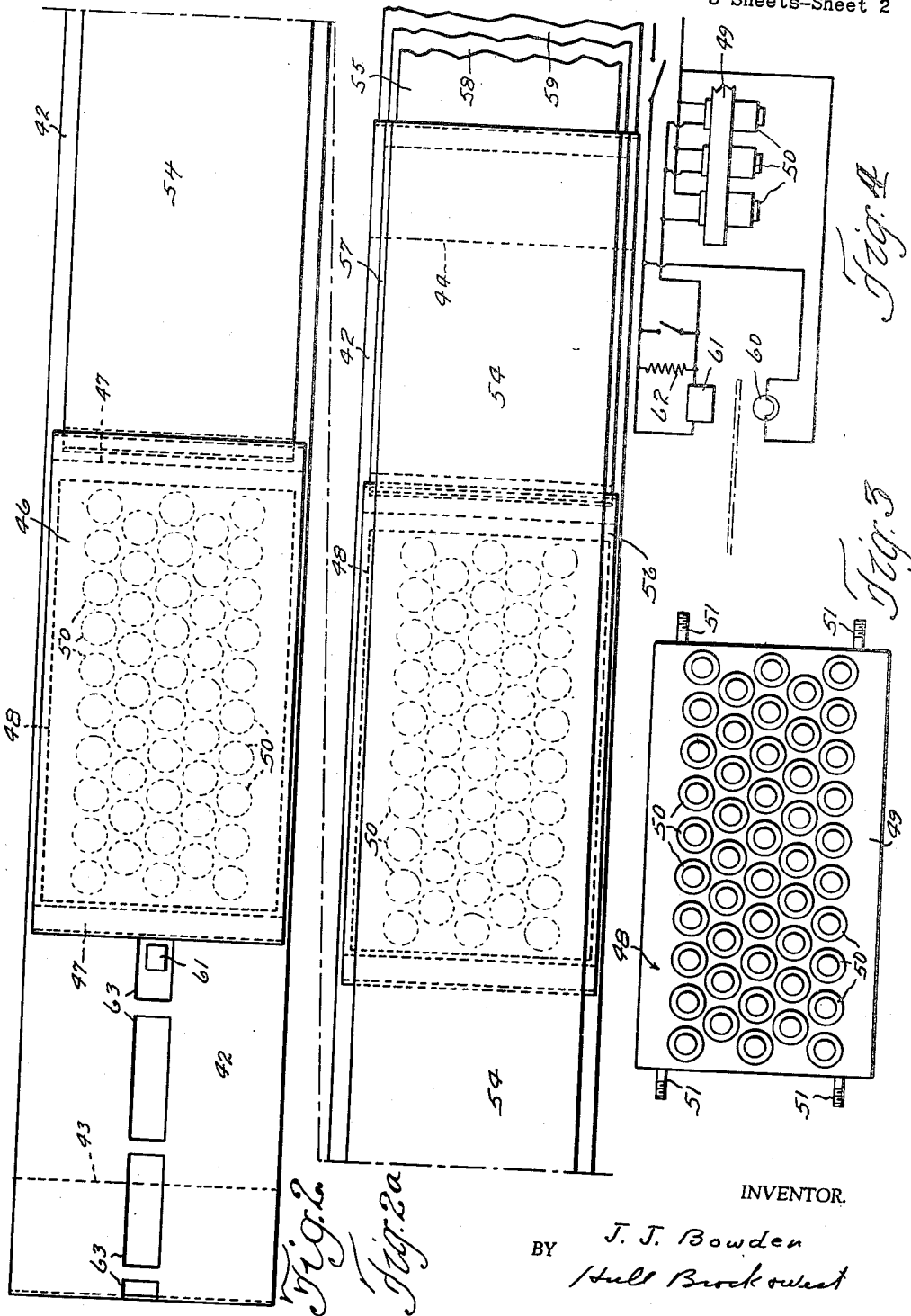
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3 Sheets-Sheet 2



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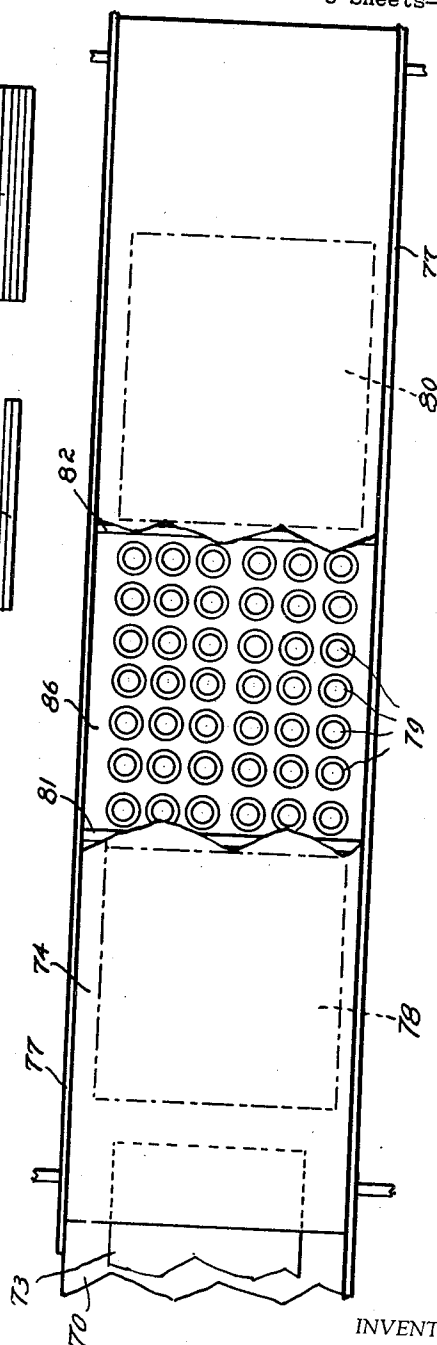
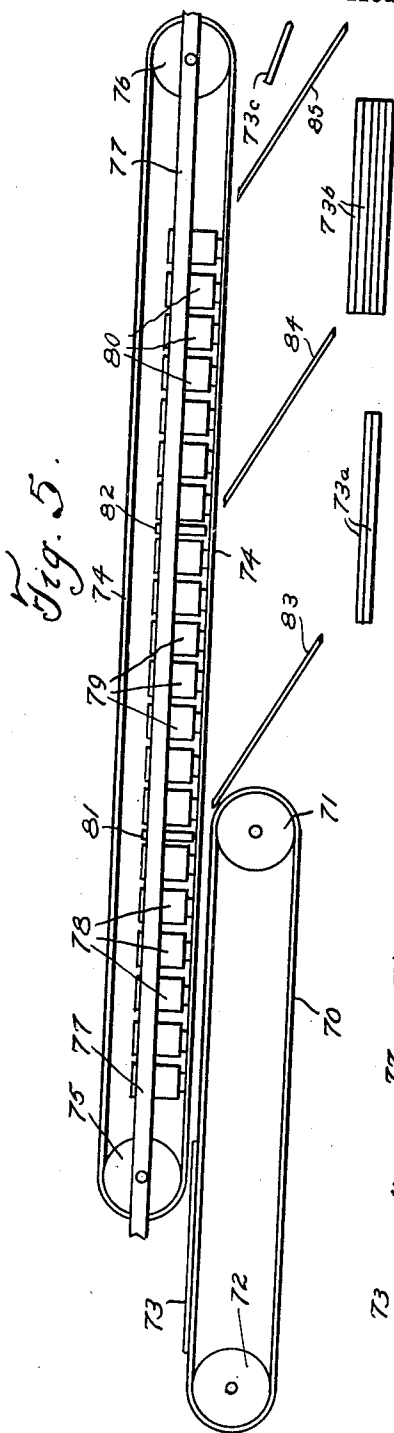
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METHOD OF AND APPARATUS FOR GRADING MAGNETIC SHEET MATERIAL

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,176,784

METHOD OF AND APPARATUS FOR GRADING MAGNETIC SHEET MATERIAL

James J. Bowden, Warren, Ohio

Application September 22, 1936, Serial No. 102,991

4 Claims. (Cl. 209—215)

This invention relates to the grading of tin plate and has particular reference to rapid separation of underweight and overweight sheets from a series passing through the machine.

In the production of tin plate for commercial use the thickness of the sheets and consequently the total weight thereof must be up to a specified requirement, otherwise the purchaser will reject the delivery. On the other hand, if the sheets are overweight, the cost of metal to the manufacturer will be greater and his profit consequently reduced. It has been found in practice that the output in the sheet mill industry necessarily contains a certain percentage both of underweight and overweight sheets and that as a practical matter some system of grading these for the removal of those falling outside the specified weight range is necessary.

The principal object of my invention is to provide a magnetic device adapted to grade tin plate and separate the underweight and overweight sheets from the sheets of proper weight by means of a construction which is simpler, more effective and less liable to get out of order than previous devices and to provide such a device capable of operating at a high speed as compared with previous devices.

A further object of the invention is to provide a device for grading sheets of magnetic material in which the force of magnetic attraction is adjusted to discriminate between sheets according to their weight and in which means are provided for determining the path of movement of a sheet of material according to the effect of the magnet on the same, that is to provide for conveying the sheet in one path if its weight is such that the magnet lifts it or retains it suspended and in a different path if its weight is such that the magnet does not lift it or retain it suspended.

A further object is to provide for application of a critical magnetic attraction on a sheet at a time when such sheet has reached a predetermined position in respect to the magnetic means, that is, at a time subsequent to its initial entrance into the sphere of magnetic influence.

A further object is to provide for exerting on the sheet a force proportional to the area of such sheet and to do so substantially independently of the total area whereby sheets of different sizes may be graded without the necessity of adjusting the machine.

Other objects will be in part apparent and in part pointed out hereinafter in connection with the accompanying drawings wherein Fig. 1 is a

diagrammatic elevational view of one end portion, and Fig. 1^a a similar view of the other end portion, of an embodiment of my invention; Figs. 2 and 2^a are fragmentary plan views of the end portions of the device shown respectively in Figs. 1 and 1^a; Fig. 3 is a fragmentary plan view of the magnetic element or assembly; Fig. 4 is a wiring diagram showing one manner of controlling the magnetic means in response to the position of the sheets to be graded; Fig. 5 is a diagrammatic, elevational view of a further modified form and Fig. 6 is a fragmentary plan view thereof.

Referring first to Figs. 1 to 4, inclusive, the numeral 42 indicates a conveyor of the endless type trained over rollers or pulleys 43 and 44. Suitable guide rollers 45 are provided for holding the upper stretch of the conveyor 42 in a plane. Positioned above the conveyor 42 is a conveyor 46 trained over suitable guide rollers or pulleys 47 one or more of which may be driven in any suitable manner as also may be those 43 and 44. Within the conveyor 46 is a magnetic assembly indicated generally by the numeral 48 and consisting of a framework 49 carrying a plurality, and preferably a large number, of magnets 50. The magnets 50 are preferably electromagnets but permanent magnets can be used. The magnets 50, if electromagnets, may be wound so as to present alternate rows of north and south poles toward the conveyor or all north poles may be presented in the same direction. The former arrangement provides a magnetic circuit of lower reluctance; the latter a slightly greater uniformity of distribution of the whole field. The framework 49 is provided with threaded studs 51 received in slots 52 in supporting elements 53 whereby the magnetic assembly may be vertically adjusted. The magnetic assembly is preferably as large as or larger in horizontal area than that of any of the sheets which it may be desired to grade, it being understood that it will be effective to grade the sheets of any smaller size. When sheets come beneath the magnetic assembly 48, if they are of sufficiently light weight, they will be attracted to and held against the lower stretch of the conveyor 46 until they can be delivered to the conveyor 54 which will deliver them to a chute 55. It is to be noted that in this case there is no abrupt change in direction in the progress of the sheet.

It is contemplated that this device will be run at a speed sufficiently great that the inertia of the sheets being graded will be considerable,

enough in fact that they will be projected from the lower reach of the conveyor 46 onto the conveyor 54 without any danger of dropping down into contact with the conveyor 42. The greater proximity of the right hand magnets due to the angle of the lower stretch of the conveyor 46 will also prevent any danger of the sheets dropping back into contact with the conveyor 42. In this case, it is contemplated that the magnets 50 will be quite strong and placed at a substantial distance from the conveyor. This minimizes the effect of warpage of the sheets and vibration of the machine or its supports. In view of the relation of the attracting force to the distance from the magnets, (inversely proportional to the square of the distance) the percentage variation in distance due to warpage or vibration may be relatively great without making much difference in the weight of sheet which can be lifted. For example, suppose the magnets are one inch from the conveyor and, due to warpage or vibration, the sheet is an average distance of one sixty-fourth of an inch closer to the magnet than it theoretically should be, then the attracting force exerted on the sheet will be only about three percent greater than if the sheet were perfectly flat. One sixty-fourth of an inch average warpage would allow for a maximum of one thirty-second of an inch at high spots. Any regular warpage, such as slight curvature due to the stock having been fed from a roll, can be compensated for by the setting of the machine; and, likewise, usually occurring irregular warpage. Sheets having an irregular warpage of, e. g., one-eighth of an inch would require positioning of the magnets at a distance of about eight inches for the same accuracy. Supported to the right along the conveyor 42 is a similar conveyor 56 provided with a similar magnetic assembly, which, on account of its identity with that shown in connection with conveyor 46, is given the same reference numerals. The operation of the assembly associated with the conveyor 56 is identical with that previously described and operated in the same manner except that it is placed somewhat closer to the conveyor 42 whereby to lift sheets of greater weight. It may be positioned at the same distance and provided with magnets of somewhat greater strength or magnets of the same inherent strength may be energized more strongly. Sheets attracted to the conveyor 56 will be delivered in the same manner to the conveyor 57 from which they will be delivered to the chute 58. Sheets of too great weight to be attracted by either of the magnetic means will be delivered from the conveyor 42 to the chute 59.

While the device of Figs. 1, 1^a may be operated with either electromagnets or permanent magnets continuously energized, the operation is somewhat more satisfactory if the magnets are intermittently varied in strength in response to the positioning of a sheet therebeneath. One means of effecting this result is to provide for weakening the current supply to the magnets 50 when a sheet is partially thereunder and increasing the current to the magnet responsive to the positioning of a sheet under or substantially under the magnetic means.

In Figs. 1, 1^a and 4 I have shown a source of light 60 and a light operated switch 61 positioned adjacent the rear edge of the magnetic means whereby, when the sheet is moved to a position beyond the light, light from the source 60 will fall upon the light responsive switch 61 and cause a circuit to be closed whereby the magnets

will be energized to full strength. In order that a sheet which may have been previously attracted to the upper conveyor may not fall back to the lower conveyor, I provide a resistance 62 in parallel with the switch 61 so that the magnets will at all times be energized sufficiently to support a sheet which has been elevated. The resistance 62 will be of such value that the sheet will not be permitted to drop and such resistance will be shunted out by the switch 61.

It is to be understood that in the operation of this device the rate of feed will be such that the successive sheets of material to be graded will be spaced a little apart from each other, sufficiently to allow the light passing between them to fall upon the light responsive switch 61. It is to be understood that the conveyor which carries the sheets will have to be provided with a transparent or translucent zone passing between the light 60 and the switch 61, or the equivalent means such as a split belt or perforations as indicated at 63 will have to be employed.

Referring now to Figs. 5 and 6, wherein is illustrated a further modified form of the invention, it will be seen that I have provided a conveyor 70, trained over pulleys 71 and 72, which may receive the sheets 73 to be graded from any suitable source and convey them beneath a conveyor belt 74 trained over pulleys 75 and 76. It is contemplated that the upper stretch of the conveyor 70 will be spaced below the lower stretch of that of 74 just slightly more than the thickness of the sheets 73. Supported immediately above the lower stretch of the conveyor 74, I provide a series of banks of magnets, three such banks being shown. These banks may be supported by longitudinally extending strips 77 which I have shown as supporting the pulleys 75 and 76. The banks of magnets 78, 79 and 80 are attached, adjustably if desired, to the strips 77 and are separated from each other by magnetic shields 81 and 82 which may be composed of soft iron of sufficient thickness to substantially isolate the banks of magnets from each other. The conveyors 70 and 74 are composed of non-magnetic material so as not to influence the magnetic effect of the banks on the sheets.

The first bank 78 is to be of such magnetic strength that it will readily elevate any and all of the sheets to be graded. The second bank of magnets 79 is to be of such strength that those sheets 73^a which are heavier than a predetermined weight will drop off and slide down the chute 83, all sheets lower than such predetermined weight being carried on into the influence of the next bank of magnets 80. The bank 80 is to be of such strength that the sheets 73^b of intermediate grade, that is, within the allowable tolerances for a particular requirement, will be discharged and slide down the chute 84. Sheets 73^c which are too light, that is, below a predetermined weight, will be carried out of the influence of the bank 80 and slide down the chute 85. The individual magnets of the various banks may be carried by a block or plate 86 suitably attached to the strips 77.

It is contemplated that the lower stretch of the conveyor 74 may slide against the lower surfaces of the magnets when the sheets are suspended by such magnets. Suitable anti-friction means may be provided if necessary to reduce friction at this point.

This application is a continuation in part of my copending application Serial No. 79,325, filed May 12, 1936.

While I have shown and described two embodiments of my invention, I wish it to be understood that the same may be realized by the use of different structures and that I am limited only in accordance with the appended claims and the prior art.

Having thus described my invention, what I claim is:

1. The process of grading according to weight sheets of material of substantially uniform magnetic susceptibility comprising subjecting such sheets first to a magnetic field capable of lifting the same, and then conveying the sheets thus lifted within the influence of a magnetic field of such strength as to release such of said sheets as are above a predetermined weight.

2. The process of grading according to weight sheets of material of substantially uniform magnetic susceptibility comprising conveying a series of such sheets one at a time within the influence of a magnetic field capable of lifting any and all of such sheets, and thereafter conveying the sheets thus lifted, one at a time, within the influence of a plurality of magnetic fields of lower and critical strength thereby to release such sheets at different points according to their predetermined weights and the strength of the magnetic fields which release them.

3. The process of grading according to weight sheets of material of substantially uniform magnetic susceptibility comprising conveying a series

of such sheets one at a time within the influence of a magnetic field capable of lifting any and all of such sheets, and thereafter conveying the sheets thus lifted within the influence of a plurality of magnetic fields of lower and critical strength such as to release such sheets according to predetermined weights and the strength of the magnetic fields which release them, such magnetic fields being sufficiently diffuse to act with approximate uniformity over the entire area of such sheets.

4. A magnetic separator for grading magnetic sheet material, comprising, in combination, a conveyor for sheets to be graded, magnetic sheet deflecting means extending along said conveyor and being of an extent to subject the major portion of the area of a sheet to its magnetic influence and being of a strength to deflect sheets of less than predetermined mass, and conveyor means for conveying deflected sheets away from said first conveyor, said magnetic deflecting means including means for normally producing a magnetic field of sufficient intensity to hold a deflected sheet against return to said first conveyor, and means responsive to the positioning of a sheet substantially entirely within the magnetic field for increasing the intensity of such magnetic field to a predetermined maximum value.

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