July 28, 1942. C. L. TAYLOR 2,291,261

APPARATUS FOR CLASSIFYING SHEET MATERIAL

Filed Jan. 21, 1939 6 Sheets-Sheet 1

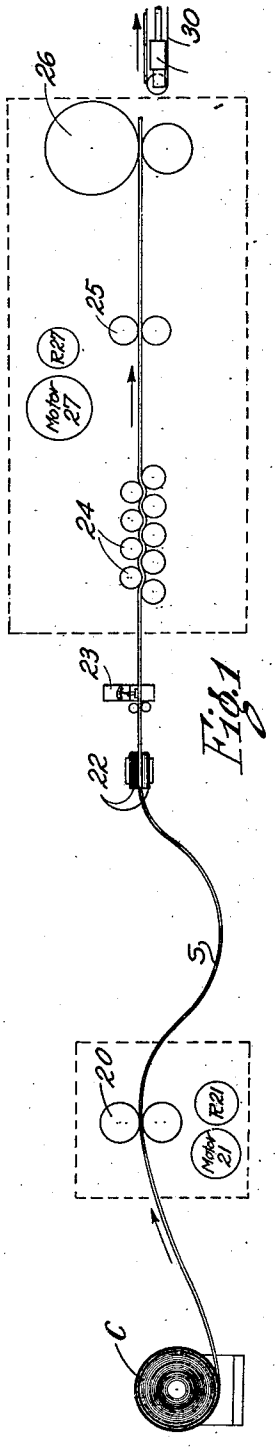

Fig. 1

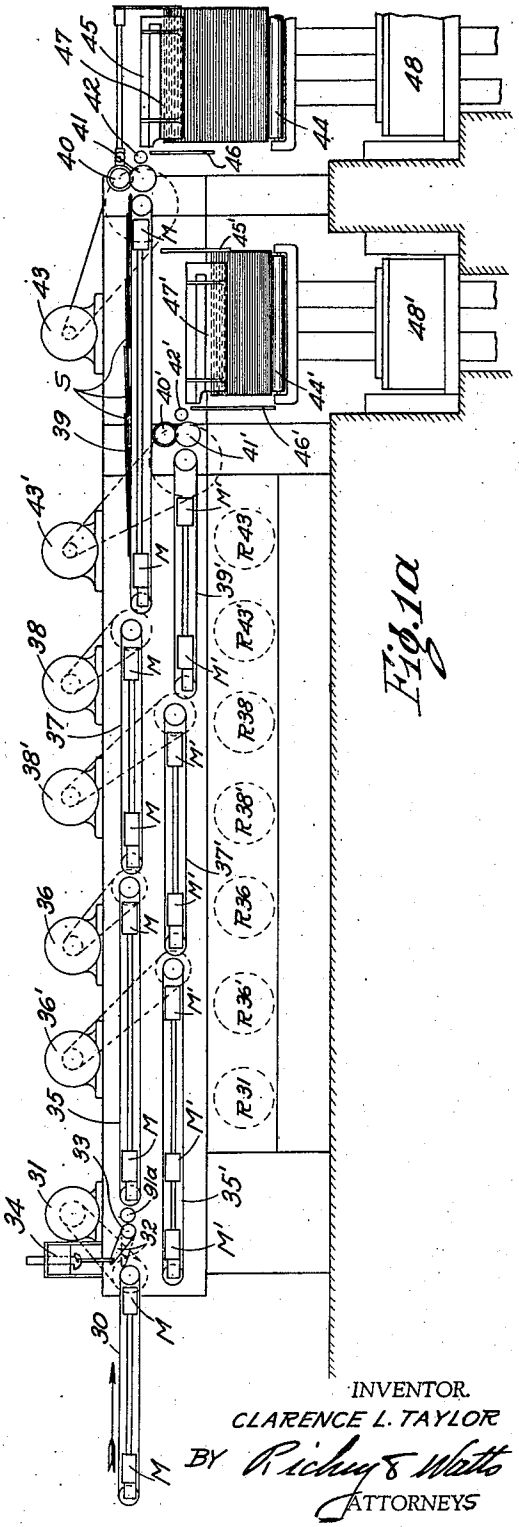

Fig. 1a

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Filed Jan. 21, 1939 6 Sheets-Sheet 2

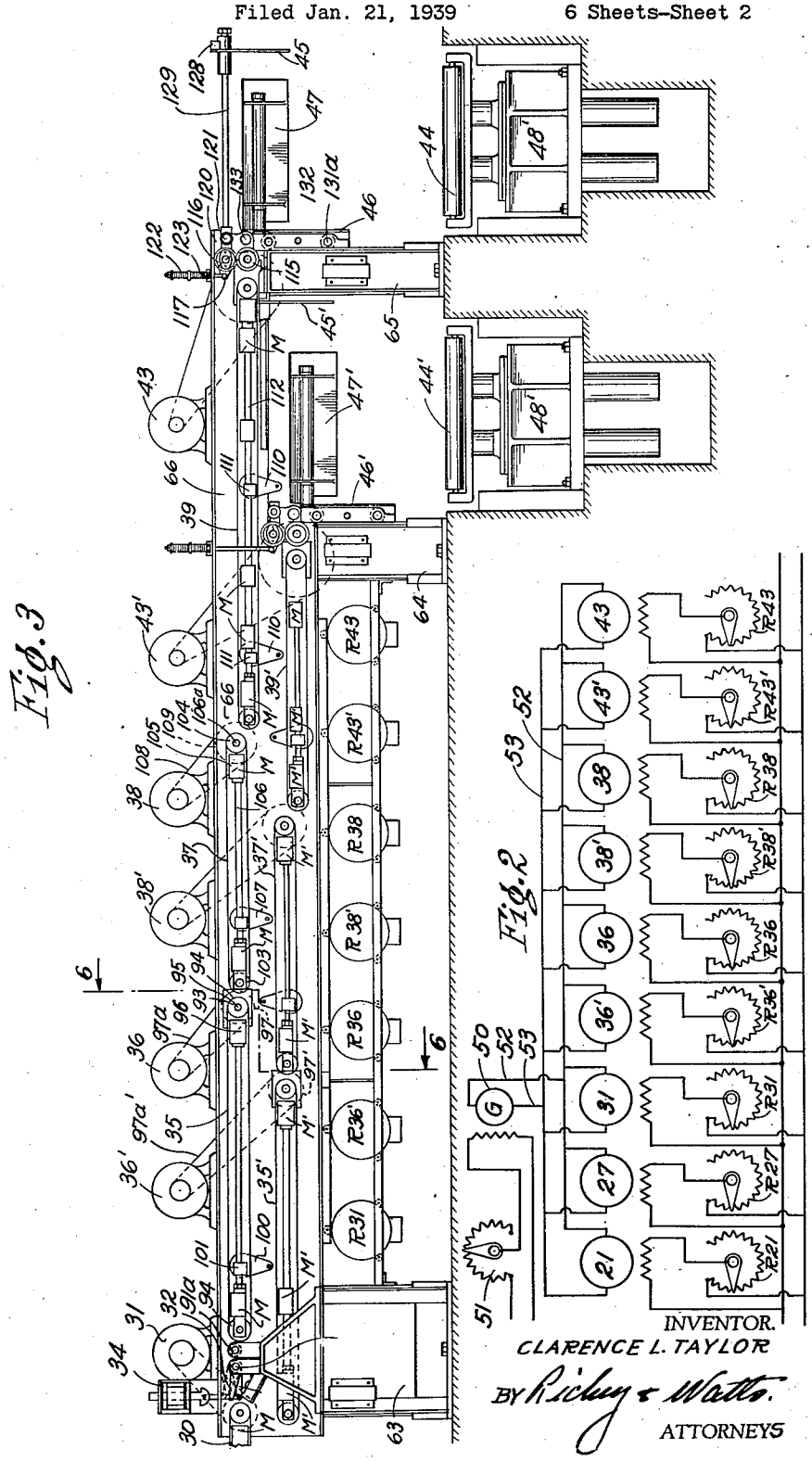

Fig. 3

Fig. 2

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APPARATUS FOR CLASSIFYING SHEET MATERIAL

Filed Jan. 21, 1939 6 Sheets-Sheet 3

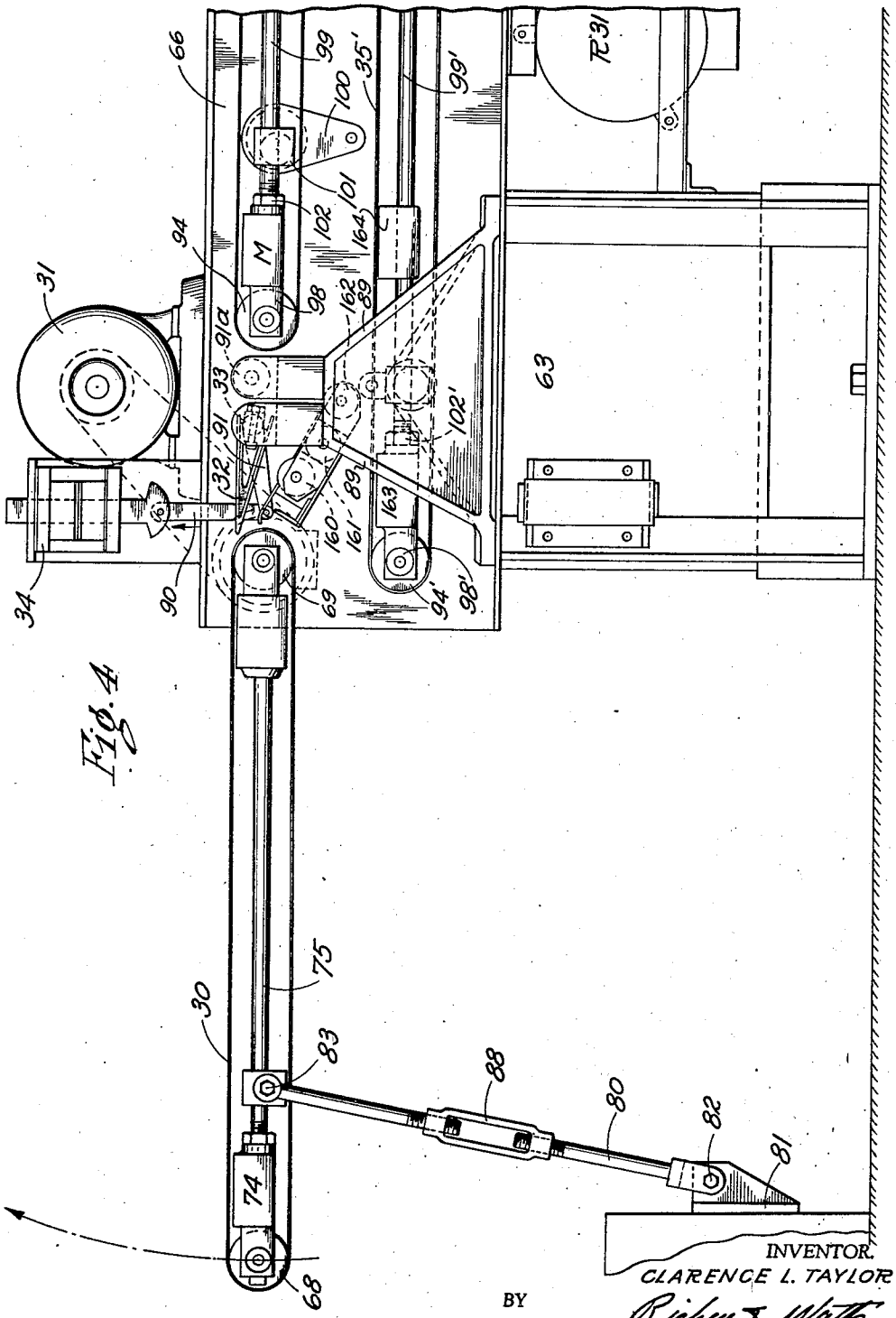

Fig. 4

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July 28, 1942. C. L. TAYLOR 2,291,261

APPARATUS FOR CLASSIFYING SHEET MATERIAL

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Fig. 5

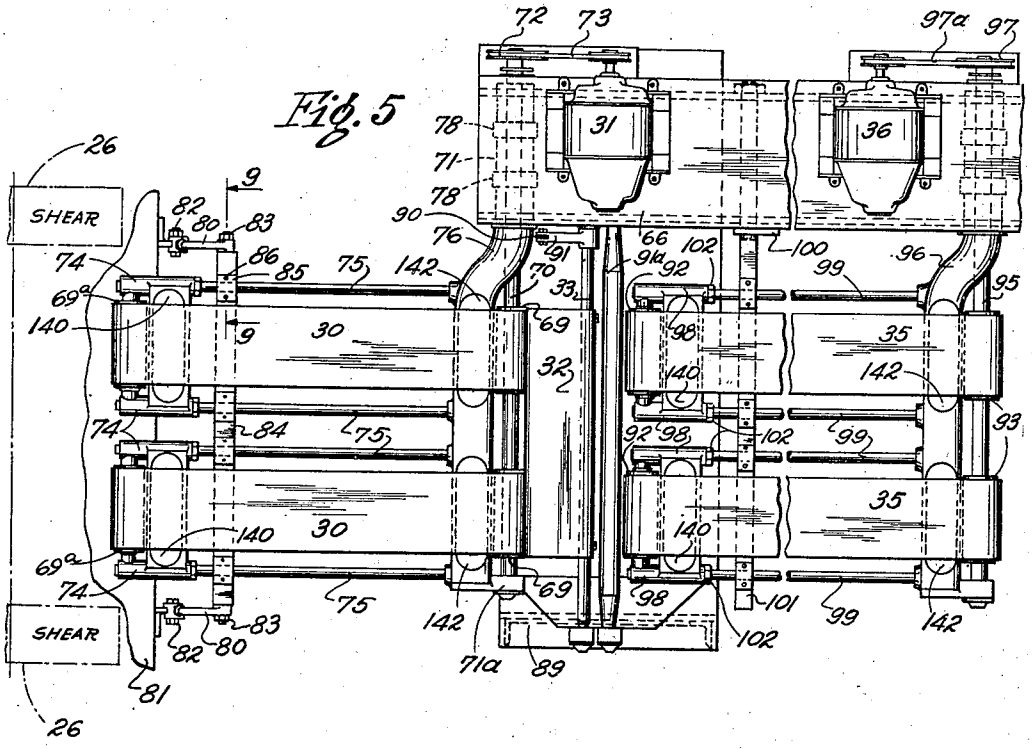
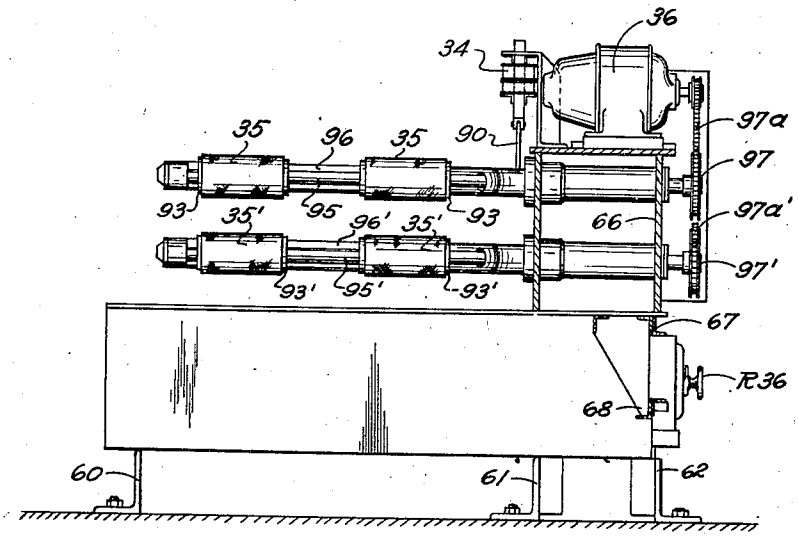


Fig. 6



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APPARATUS FOR CLASSIFYING SHEET MATERIAL

Filed Jan. 21, 1939 6 Sheets-Sheet 5

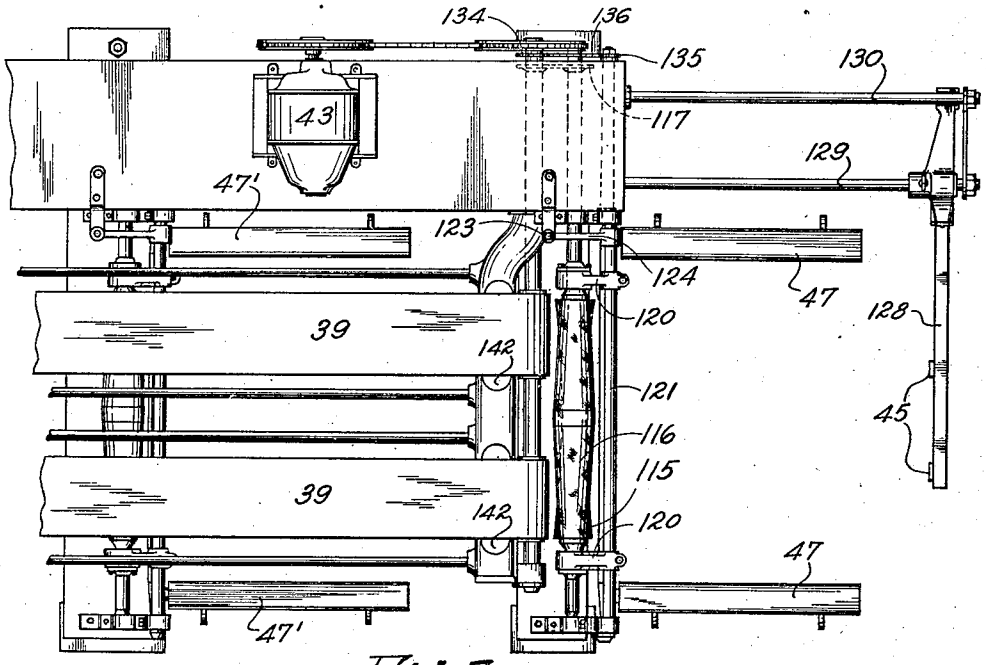

Fig. 7

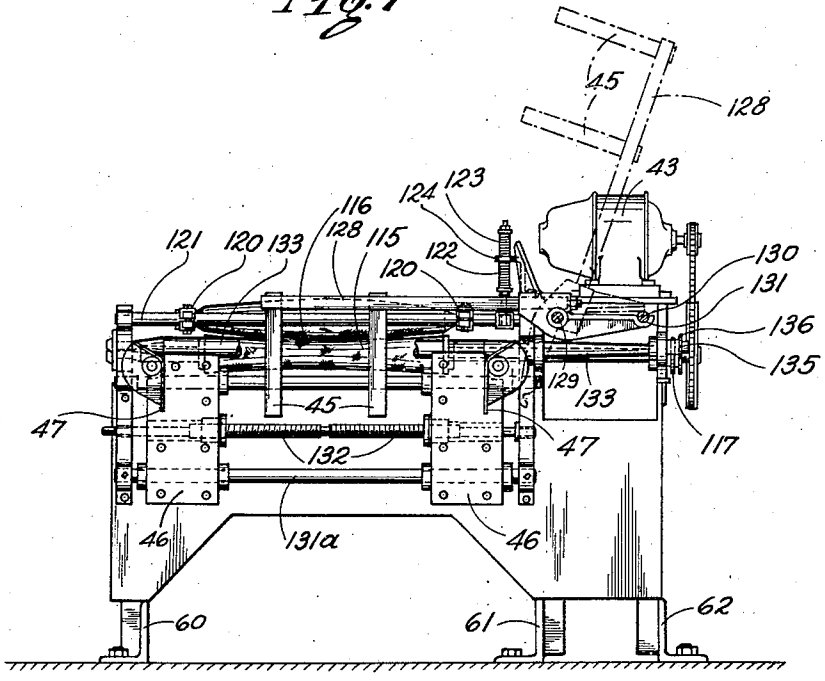

Fig. 8

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July 28, 1942. C. L. TAYLOR 2,291,261

APPARATUS FOR CLASSIFYING SHEET MATERIAL

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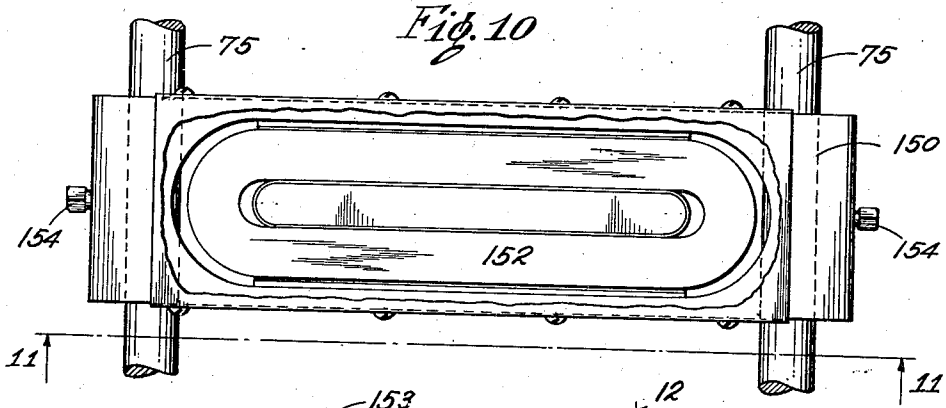
Fig. 10



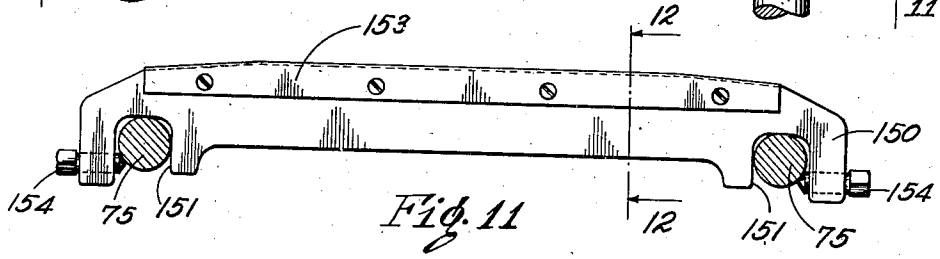


Fig. 11

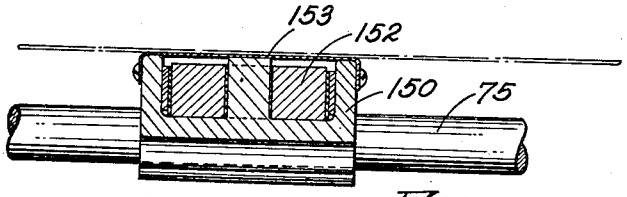


Fig. 12

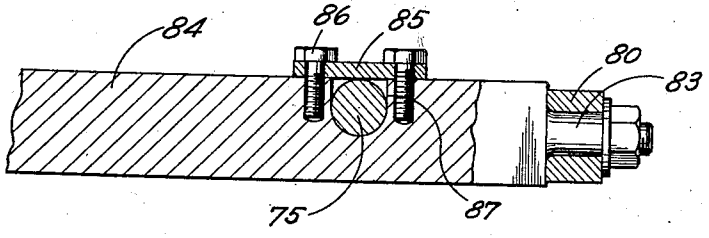


Fig. 9

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Patented July 28, 1942

2,291,261

UNITED STATES PATENT OFFICE

2,291,261

APPARATUS FOR CLASSIFYING SHEET MATERIAL

Clarence L. Taylor, Youngstown, Ohio, assignor to The Aetna-Standard Engineering Company, Youngstown, Ohio, a corporation of Ohio

Application January 21, 1939, Serial No. 252,152

7 Claims. (Cl. 198—41)

This invention relates to classifiers for gauging sheet materials and separating the gauged sheets in accordance with variations in their thickness. The invention is described herein in its application to the production of tin plate but it is to be understood that the invention may be used in conjunction with other materials and that the description of the preferred form of my invention contained herein is given only by way of example.

Users of tin plate require that the thickness of the sheets furnished them be maintained within very close tolerances. Sheets that are too thick or too thin are likely to result in defective products or in the breaking of the dies of the can making machinery. Therefore it is essential for manufacturers of tin plate accurately to classify the sheets in accordance with their thickness to insure delivery of sheets of proper gauge to their customer. For the sake of economy it is essential that the classifier apparatus operate at high speed without damaging the sheets and that the classifier accurately pile or stack the sheets so that they can be handled conveniently.

Accordingly it is an object of my invention to provide a classifier which will meet the above noted requirements. A further object is to provide a classifier which can be readily adjusted to handle different sizes of sheets and to operate at different speeds. Another object is to provide a high speed apparatus for continuously shearing sheet material such as tin plate into sheets of predetermined length, classifying the sheets and separately stacking the classified sheets. A further object is to provide such an apparatus which is adapted to operate accurately at high speeds without damaging the material. Another object is to provide a classifier of simple and sturdy construction, and in which the parts are readily accessible for replacement and repair.

Various other objects of my invention will become apparent from the following description of a preferred embodiment thereof, reference being made to the accompanying drawings. The essential characteristics are summarized in the claims.

In the drawings, Figures 1 and 1*a* diagrammatically illustrate a classifier made in accordance with my invention showing the arrangement of the associated equipment; Figure 2 is a diagram showing a preferred wiring arrangement for the electrical controls for the classifier and associated equipment; Figure 3 is a side elevation of the classifier, some of the parts being omitted for convenience of illustration; Figure 4 is a fragmentary side elevation on an enlarged scale showing the entering end of the classifier; Figure 5 is a plan view of the feed end of the classifier showing approximately the same portion of the machine that is illustrated in Figure 4; Figure 6 is a vertical section taken along line 6—6 of Figure 3; Figure 7 is a plan view of the delivery end of the classifier; Figure 8 is an end elevation of the delivery end; Figure 9 is a detail of a portion of the belt supporting mechanism; and Figures 10, 11 and 12 are details illustrating the construction of the magnets employed in the classifier to prevent the sheets from flying through the air.

My apparatus is particularly adapted for use in conjunction with modern tin mills of the continuous type in which the metal is delivered after the rolling operation in the form of bright annealed electrolytically cleaned coils of tin plate which require only to be sheared to the proper length and classified according to thickness before being shipped to the customer. Ordinarily there are slight, but important, variations in the thickness of the rolled strip, and it is because of these variations that the sheets must be classified and sheets of the desired thickness separated from those sheets of greater or lesser thickness.

In Figures 1 and 1*a* I have diagrammatically illustrated a preferred layout of my apparatus for shearing and classifying strips of tin plate formed on a continuous mill. As shown in the drawings, a strip S of tin plate is fed from a coil C by a suitable uncoiling device through an edge trimmer indicated at **20**. This is driven by an electric motor **21** which exerts sufficient tension to unwind the strip from the coil. Beyond the edge trimmer the strip is allowed to sag, as shown, to give a little slack in the strip to take care of fluctuations in the speed of the following apparatus, and is then passed through felt pads indicated at **22** which function to remove dust and chips from the strip. Then the strip is automatically gauged by a continuous gauging device **23** preferably of the type manufactured by the Pratt & Whitney Company and known as the "Electro Limit."

From the gauge **23**, the strip passes through a roller leveler indicated diagrammatically at **24**, pinch rolls **25**, and thence to the rotary shear **26**, the roller leveler, pinch rolls and shear being driven by a single motor **27**. Change speed gears (not shown) are incorporated in the drive of the shear **26** so that the shear can be adjusted to cut different lengths of sheets. The construction and arrangement of the gears, shear and associated

mechanism are well known in the art and form no part of the present invention and accordingly will not be described further herein.

From the shear **26**, the sheets are delivered to the classifier proper which is illustrated somewhat diagrammatically in Figure 1*a*. The details of the classifier will be described later, but for the present it will be sufficient to state that the sheets are deposited on a conveyor belt **30** driven by a motor **31**. The speed of the belt is greater than the peripheral speed of the shear and the lineal speed of the strip entering the shear so that the sheared sheets will be longitudinally separated as they are deposited on the belt. For example, if the strip entering the shear is moving at a speed of say 600 ft. per minute, the belt **30** may be operated at a speed of about 1,000 ft. per minute, it being desirable to space the ends of successive sheets a distance of approximately 1 ft. Obviously the difference in speed between the belt **30** and the strip necessary to accomplish the desired spacing depends upon the length of sheets being cut by the shear.

After leaving the belt **30**, the sheets if they are of proper gauge pass over the flipper or deflector **32** which is pivotally mounted on a shaft **33** and arranged to be raised or lowered by a solenoid **34** controlled by the continuous gauge **23**.

The gauge **23** and the control circuit for operating the solenoid **34** do not per se form a part of this invention, a suitable type of gauge being disclosed in United States Patent No. 2,007,840. For the purposes of this specification, it will suffice to say that a suitable type of gauge comprises two small rollers which are adapted to be in continuous contact with opposite sides of the strip to be gauged, which holds them apart its own thickness. Any variation in strip thickness will result in a variation in the distance between the two rollers. The relative movement of the two rollers controls the position of an armature disposed between two coils of an inductive bridge. Thus movement of the armature will change the characteristics of the bridge, thus changing the flow of current in the electrical circuits including the bridge. Such changes are reflected in an indicating instrument which shows variations in thickness of the strip from the predetermined standard, and the changes in electric current may also be employed to control various instrumentalities such as the solenoid **34**.

In the present instance the circuit is arranged so that the solenoid **34** is energized to raise the flipper **32** and thus deflect the sheets downwardly beneath the flipper in the event that the thickness of the strip material varies from a predetermined standard an amount in excess of the established tolerances. The necessary delay between the passage of the strip through the gauge and the operation of the solenoid and flipper is maintained by a tachometer generator which synchronizes the time delay between gauging the strip and sorting the sheets with the speed of the shear and strip. Thus if the strip becomes too thick in passing through the gauge, the solenoid will not be operated immediately but its operation will be delayed until a sheet cut from the thicker portion of the strip reaches the zone immediately ahead of the flipper **32**.

So long as sheets of proper thickness are being delivered the solenoid will not be energized, the flipper will remain in substantially horizontal position and the sheets will pass over the flipper and be delivered to the belt **35**. The sheets upon delivery to the belt **35** may be traveling at very high speeds on the order of 1,000 ft. per minute. Necessarily the speed must be reduced gradually in order to make is possible to accurately stack the sheets without damaging their edges. Therefore the belt **35** is driven by the motor **36** at a reduced speed, say 820 ft. per minute, if the belt **30** has been operating at 1,000 ft. per minute. From the belt **35** the sheets pass to belt **37** where the speed is further reduced. In the example given, this belt may be driven at the speed of the shear, say 600 ft. per minute, the drive being accomplished by the motor **38**. Thus on belt **37**, the sheets will be closely spaced.

From the belt **37**, the sheets are discharged onto the final belt **39** disposed at a slightly lower level than belt **37** and driven at considerably slower speed. In the example given the speed of the belt **39** may be about 240 ft. per minute. Because of this very considerable reduction in speed, it will be evident that the sheets will be discharged into belt **39** in overlapping relationship. That is to say, they will be shingled as diagrammatically indicated in Figure 1*a* of the drawings.

From the belt **39** the sheets are passed between rolls **40** and **41** and over roll **42**, all of which are driven in synchronism with the belt by the motor **43**, and discharged onto the elevating platform **44**. The construction and arrangement of the discharge mechanism and guides **45**, **46** and **47** associated with the platform form an important part of my invention and will be described in detail below. The platform **44** is arranged to be raised or lowered by any suitable elevating mechanism indicated in general at **48**, and in operation the platform is gradually lowered as sheets are discharged thereon.

In the event that a sheet of incorrect thickness is delivered onto belt **30**, then by the control mechanism briefly described above the solenoid **34** will be energized to raise the flipper **32** to the dotted line position of Figure 1*a* of the drawings as the sheet approaches the solenoid. Thus the sheet will be deflected downwardly to the belt **35'** disposed beneath belt **35**. Sheets of incorrect gauge are then carried along belts **37'** and **39'** similar to belts **37** and **39** previously described; the belts being driven by motors **36'**, **38'** and **43'**. The discharge mechanism includes rollers **40'**, **41'**, **42'** and elevating platform **44'** with associated guides **45'**, **46'** and **47'**, the platform being raised and lowered by the elevating mechanism **48'**.

Sheets of tin plate, being very thin and light, are extremely difficult to handle at high speeds. In previous types of machines difficulties frequently occurred not only because of the tendency of the sheets to become diverted in their travel through the machines so that the edges of the sheets were not parallel with the line of travel, but also because at high speeds such as those at which my machine is adapted to operate the sheets have a tendency to sail through the air instead of remaining in position on the belts. The planing of the sheets in prior types of machines prevented their operation at speeds approaching the speed of operation of my machine as the flying sheets of tin plate were extremely dangerous to the operators of the machines. To overcome this difficulty, I employ electro-magnets disposed beneath the conveyor belts and functioning to retain the sheets in position on the belts. The magnets are indicated at M in Figure 1*a*, and the construction and

mounting arrangement of the magnets will be described in greater detail below.

Preferably the apparatus should be readily adaptable for use in classifying sheets of tin plate of different lengths, widths and gauges. Thus the controls must be flexible so that the speeds of the various elements may be easily varied in order to obtain proper operating conditions. So far as I am aware the best operating speeds for each particular size of sheet can only be determined experimentally. Therefore a control system by means of which various speeds can be obtained readily without stopping the machine is essential to efficient operation of the machine. To attain this end, I preferably provide individual motor drives for the belts, the shear and the edge trimmer as described above and provide each motor with an individual speed control so that its speed can be varied independently of the speed of every other motor. Further all of the motors may be stopped and started simultaneously and the speed of all of the motors may be varied simultaneously by means of Ward-Leonard control system.

The wiring arrangement for this control is shown diagrammatically in Figure 2 in which the Ward-Leonard, or variable voltage, generator is indicated at 50. The field current on the generators is controlled by the rheostat 51 which varies the output of the generator. The current generated is delivered through conductors 52 and 53 to armatures of the motors 21, 27, 31, 36, 36', 38, 38', 43 and 43' which are all connected in parallel with the result that if the rheostat is adjusted, for example, to increase the field current of the generator the speed of all of the motors will be increased, and conversely if the generator field is weakened the speed of all of the motors will be reduced. Individual control to separately adjust the relative speeds of the motors is attained by the motor field rheostats R—21, R—27, and R—31, R—36, R—36', R—38, R—38', R—43 and R—43', respectively, which are carried by the frame of the classifier. Weakening the shunt fields of the motors by means of the rheostats increases their speed, and strengthening the fields reduces their speed. By this arrangement very flexible control is obtained. The speeds of all of the motors can be adjusted to best advantage by the various field rheostats and the entire machine can be stopped or started or varied in speed during operation by rheostat 51 without changing the individual setting of the field rheostats. By this control scheme not only can the machine be operated to best advantage but also no time is wasted when the machine must be stopped, for instance to supply a new coil of material, as the entire apparatus can be stopped by the rheostat 51 and immediately started again with all of the various motors operating at correct relative speeds.

Referring to Figures 3 to 8, inclusive, it will be seen that the mechanism is supported on a suitable floor or base by frame members 60, 61 and 62 and suitable vertical frame members 63, 64 and 65 which are duplicated on opposite sides of the machine. The motors and associated driving mechanism are supported by a girder or beam 66 which extends longitudinally of the machine along one side thereof and which is supported by the upright members 63, 64 and 65. It will be noted that the girder 66 is a box construction and as shown particularly in Figure 6 supports all of the driving mechanism and the belts, except for the supports furnished immediately adjacent the upright members 63, 64 and 65. Beneath the girder 66, longitudinally extending members 67 and 68 are provided which function to support the field rheostats R—31, etc. for controlling the speeds of the individual motors, the backs of these rheostats being shown in Figure 3. By this construction, the driving mechanism and controls are all concentrated along one side of the machine, making them readily accessible to the operators, while the opposite side of the machine is open except in the immediate vicinity of the vertical supports 63, 64 and 65. Thus the conveyor belts are readily accessible and can be replaced easily without tearing down the machine and because of its open construction the operation of the machine can be clearly observed so that any necessary adjustments can be made.

As previously pointed out, the sheared sheets are discharged from the shear 26 onto the conveyor belts 30 which operate on rollers or pulleys 69 and 69*a*, the pulleys 69 being driven by a shaft 70 while the pulleys 69*a* are idlers. The shaft 70 is supported by bearings 71 and 71*a* mounted in bracket 76 at opposite sides of the machine, and at its end is provided with a sprocket 72 so that it may be driven by the motor 31 through the chain 73.

In order to provide means whereby the level of the belts 30 may be adjusted to accommodate the belts to variations in the level of the pass line through the shear, the bearings for the pulleys 69*a* are supported by suitable brackets 74 on longitudinally extending rods 75, which are in turn mounted on the transversely extending bracket 76 supported by bearings 78 in the girder 66 (see Figures 4, 5 and 6). The end portion of the bracket 76 is concentric with the shaft 70 and the bearings 71 are disposed within the end of the bracket 76. Thus the bracket and arms 75 may be rotated about the axis of shaft 70 to raise and lower the belts 30 without changing the distance between the pulleys 69*a* and the pulleys 69.

The belts 30 are supported at the desired level, either at or slightly below the pass line of the shear, by rods 80 pivotally mounted at their lower ends to a suitable frame member or support 81 as at 82. At their upper ends, the rods are pivotally connected as at 83 to a transversely extending bar 84 extending within the belts 30 and channeled to receive the rods 75, the bar being cut away preferably as indicated at 87 in Figure 9 and being provided with suitable mechanism whereby the bar may be clamped to the rods 75, such as a cover plate 85 secured in clamping engagement with the rod 75 by screws 86. It will be evident that by loosening the screws 86, the bar 84 can be slid along the bars 75 in either direction to raise or lower the pulleys 68 supporting the belts 30. Further adjustment of the level of the pulleys 69*a* and belts 30 can be made by means of turn buckles 88 which are preferably incorporated in the supporting rods 80. By this means the belts 30 can be adjusted vertically to a sufficient extent to insure that the sheets will be properly delivered by the shear. As noted above, the belts 30 are preferably driven at a higher speed than the peripheral speed of the shear so that the sheets are spaced apart as they are deposited thereon.

From the belt 30 the individual sheets pass either above or below the flipper or deflector 32,

depending upon whether the sheets are of standard thickness or not. The deflector 32 is mounted upon a shaft 33 which is supported for rotation by suitable bearings in the girder 66 and in the bracket 89, mounted upon the frame member 63. The deflector 32 is rotated from one position to another by the solenoid 34 through a connecting rod 90 and crank arm 91 keyed to the shaft 33, the solenoid being actuated in response to changes in strip thickness as described above. As long as strip of standard thickness is being fed through the gauge, the deflector 32 remains in its lower position as shown in Figure 4 of the drawings, but if the thickness of the strip varies either above or below the standard thickness by an amount exceeding the established tolerances the deflector 32 will be raised to the dotted line position shown in Figure 1a to deflect the sheets downwardly onto the lower series of belts.

Assuming that the sheets delivered to the belts 30 are within the established tolerances, then the sheets will be delivered over deflector 32 to the belts 35, a roller 91a being interposed between the deflector and the belts to reduce the friction on the sheets in traveling between the successive belts.

The belts 35 are carried by pulleys 93 and 94, the arrangement being generally similar to the supporting mechanism described in conjunction with the belts 30; i. e., the pulleys 93 are driven by a shaft 95 which extends through and is supported by a bracket 96, similar to the bracket 76, and mounted in suitable bearings carried by the girder 66. The end of the shaft 95 is provided with a sprocket 97 so that the shaft may be driven through the chain 97a by motor 36. The idler pulleys 92 are supported by suitable bearings carried by brackets 98 mounted on rods 99 which are supported by the transversely extending bracket or arm 96.

To provide for vertical adjustment of the belts 35, a bracket 100 mounted on the girder 66 and supporting a bar 101 generally similar to bar 84, is employed. The rods 99 and pulleys 92 may be raised and lowered by rotating the bracket 100 about its pivot and sliding the bar 101 along the rods. Only a small amount of adjustment is provided for the level of the belt 35 as no great range of adjustment is required.

The tension on the belts 35 can be adjusted by moving the brackets 98 along the rods 99 by means of nuts 102 in threaded engagement with the rods. A similar scheme is employed for adjustment of the tension on the belts 30.

As previously noted, only sheets of standard gauge are carried by belts 35, the velocity of the sheets as they are delivered to belts 35 is substantially the velocity of the belts 30, for example about 1,000 ft. per minute, and the slowing down of the sheets so that they can be stacked accurately and without damage is started on the belts 35. Thus the belts 35 may be operated at a speed of about 800 ft. per minute. From the belts 35 the sheets are delivered to belts 37 where the velocity is further reduced, preferably to such an extent that the sheets are deposited on the belt with very little space between the sheets. The belts 37 are carried by pulleys 103 and 104 and supported by a transversely extending bracket 105, rods 106 and adjusting bracket 107, all substantially identical with the mechanism described for supporting the belts 35. The driven pulleys 104 are keyed to shaft 106a which is driven by motor 38 through chain 108 and sprocket 109.

The belts 37 deliver the sheets to belts 39 which are driven by motor 43 through mechanism similar to that previously described at a velocity less than the velocity of belt 37 and less than the peripheral speed of the shear. The belt is preferably disposed at a lower level than the belt 37, so that the sheets are deposited thereon in overlapping or shingled relationship as indicated in Figure 1a and carried thereby in this shingle arrangement to the piler mechanism at the delivery end of the machine. The pulleys for supporting the belts 39 and the associated brackets are similar in all material respects to the mechanism described previously with respect to belts 35 and 37 except that two brackets 110, similar to the brackets 100 and 107 previously described, are employed in conjunction with two bars 111 for supporting the longitudinally extending bars 112, because the belts 39 are considerably longer than the belts 35 and 37, the additional length being necessary to convey the sheets beyond the piler mechanism for the off-gauge sheets which have been deflected by the flipper 32.

The velocity of the belts 39 may be, for example, about half the peripheral speed of the shear, thus reducing the speed of the sheets to such an extent that they can be piled accurately without damaging the sheets. The piling apparatus is illustrated particularly in Figures 3, 7 and 8. As illustrated, the sheets in their shingled arrangement on belts 39 are passed between the concave and convex fabric rolls 115 and 116, the roll 115 being driven by a chain 117 and suitable sprockets at substantially the speed of the belt 39. The rolls 115 and 116 are constructed of cotton or other suitable material much in the manner of buffing wheels and are given concave and convex contours so that the sheets passing between the rolls are bent in such a manner that their upper surfaces are concave, thus increasing the rigidity of the sheets and preventing their forward ends from bending downwardly until the rear portions of the sheets have been released from the rolls.

To provide adequate pressure between the rolls 115 and 116, the upper roll 116 is supported by bearings mounted on brackets 120 carried by a rotatably mounted shaft 121. The adjustable springs 122 and 123, mounted on the main frame and engaging above and below lever 124 rigidly connected to shaft 121, maintain the roll 116 in engagement with roll 115 with the desired pressure.

The sheets as they are discharged immediately assume their previous flat condition and are projected forwardly and downwardly onto a suitable platform 44 which may be elevated by the elevating mechanism 48 to a position so that the top of the pile of sheets is within the area enclosed by the side guides 47 and the members 45. The position of the elevator may be manually controlled by any ordinary means, the practice being to gradually lower the platform as sheets are deposited thereon.

The stops or guides 45 are carried by an arm 128 adjustably mounted on rods 129 and 130 supported by the main frame structure. The arm 128 is pivotally and slidably mounted on rod 129, and the end of the arm engages the underside of rod 130 as indicated at 131. Thus the arm can be slid along to vary the position of the stop for different size sheets and also can be

swung upwardly and out of the way as indicated in dotted lines in Figure 8.

The side guides 47 may be moved toward or away from each other along a supporting rod 131a by screws 132 extending transversely of the end of the main frame member, the sheets being guided laterally by the side guides and being projected against the end guide or stop member 45 with the result that a straight pile of sheets is formed.

To insure that each sheet will be projected with sufficient velocity from the pinch rolls 115 and 116 to cause it to abut the end guide 45 and also to straighten out any sheets that may be slightly deflected in their travel through the machine, I preferably employ a roller 133 of polished steel driven by sprockets 134 and 135 and chain 136 at substantially the same velocity as the belt 39. The sheets dropping from the grip of the pinch rolls are given a slight forward impetus by the roller which is sufficient to straighten out the sheets and give them sufficient velocity to cause them to be piled in a straight pile with their forward edges abutting the stop 45.

As described in conjunction with Figures 1 and 1a, magnets are preferably employed to control the passage of the sheets through the machine and to hold the sheets down on the various conveyor belts. These magnets are disposed beneath the belts and are of generally two types. At the forward end of each belt, a magnet is provided which is incorporated in the bracket supporting the forward pulley. For example, the forward magnets for the belts 30 and 35 are set in recesses indicated at 140 in the brackets 74 and 98, respectively. Throughout the machine magnets for the remaining belts are similarly disposed.

Likewise magnets are provided adjacent the rear pulleys of each belt, the coils for these magnets being set in recesses 142 in the supporting brackets such as brackets 76 and 96.

The magnets intermediate the ends of the belts are preferably constructed so that they may be adjusted to the most desirable position as illustrated in Figures 10, 11 and 12. As shown, the magnets may comprise body portions 150 provided at their ends with grooves 151 adapted to receive the belt supporting bars such as the bars 75 for the belts 30 or the bars 99 which support the belts 35. The body portions are provided with oval recesses to receive the magnet coils 152, the recesses being closed by the cover plates 153. The magnets may be slid to any desired position along the belt supporting rods and may be retained in their adjusted position by set screws 154. Current may be supplied to all of the magnets by any convenient conductors (not shown). The magnets function to hold the sheets in engagement with the various belts, thus preventing the sheets from planing and also assisting in preventing the sheets from being twisted or turned in their passage through the machine.

As previously described in connection with Figure 1a, the flipper 32 is raised by the solenoid 34 whenever a sheet of incorrect gauge is approaching the flipper so that any such sheets will be deflected downwardly under the lower series of belts 35', 37' and 39' and finally discharged onto the elevating platform 48'. The arrangement of the belts and their driving mechanism is in all material respects the same as the arrangement of the upper series of belts described in detail above, and the description will not be repeated here. Corresponding parts in the lower series of belts are marked with reference characters corresponding to those applied to the upper series.

It is to be noted, however, that a series of conveyor rollers 160, 161 and 162 (see Figure 4) are mounted in suitable bearings on opposite sides of the frame structure and disposed generally beneath the deflector 32 so that the downwardly deflected sheets will be conveyed across the rollers and deposited on the first lower belt 35'. The forward magnet 163 beneath the belt 35' assists in holding the sheets in the proper course, and preferably one of the adjustable magnets is positioned as indicated at 164 beneath the belt 35' at about the point where the downwardly deflected sheets will strike the belt. By this arrangement, rapidly moving sheets can be deflected and properly deposited on the lower belt 35' without damage to the sheets and without danger of the sheets being displaced from their proper paths in passing through the machine.

By reason of its various novel features, my apparatus can accurately classify sheet material at very high speed. Because of my convenient control system, the various instrumentalities making up my apparatus can be readily adjusted to operate at the most efficient speeds, and also all of the driving motors can be simultaneously started and stopped and their speed adjusted by a single control. Because of my arrangement of belts and magnets, material is handled without damage thereto and without danger of the sheets flying through the air. The apparatus is of simple and sturdy construction, and as one side of the apparatus is open for substantially the entire length of the machine the belts can be readily removed and replaced when necessary and required adjustments can be made with a minimum loss of time. The piling apparatus can be adjusted readily to accommodate different sizes of sheets, and for all sizes within the range of adjustment the sheets are accurately and uniformly piled without damage thereto.

In the foregoing specification I have described in detail a preferred form of my invention. Various changes and modifications can be made therein without departing from the spirit and scope of my invention, and it is therefore to be understood that my patent is not limited to the preferred form described herein or in any manner other than by the scope of the appended claims.

Reference is hereby made to my divisional application, Serial No. 446,683 filed June 12, 1942, containing claims directed more particularly to the piling mechanism disclosed in this application; and to my divisional application, Serial No. 446,684, filed June 12, 1942, and containing claims directed more particularly to structural features of the apparatus disclosed in this application.

I claim:

1. In an apparatus for conveying thin sheets of ferrous material at high speed, a series of conveyor belts operating in the same direction, said belts operating at progressively slower speeds, and the receiving end of one of said belts being disposed below the discharge end of the immediately preceding belt, and magnets disposed beneath the upper reaches of said belts adjacent the ends thereof for holding said sheets on the upper reaches of said belts at substantially the same speed as the belts and to prevent said sheets from planing through the air.

2. In an apparatus for conveying thin sheets of ferrous material at high speed, at least two generally horizontal conveyor belts adapted to carry sheets of ferrous material upon their upper

reaches, the receiving end of the second belt being disposed at a level below the level of the discharge end of the first belt, means for driving said belts in the same direction, said first belt being driven at a higher speed than said second belt whereby the sheets are deposited on said second belt in overlapping relationship, and means for causing sheets discharged from said first belt to be deposited accurately in the desired relationship on said second belt and for preventing such sheets from planing through the air comprising magnets disposed beneath the upper reach of said first belt adjacent the discharge end thereof and beneath the upper reach of said second belt adjacent the receiving end thereof.

3. In an apparatus for conveying thin sheets of ferrous material at high speed, at least two generally horizontal conveyor belts adapted to carry sheets of ferrous material upon their upper reaches, the receiving end of the second belt being disposed at a level below the level of the discharge end of the first belt, means for driving said belts in the same direction, said first belt being driven at a higher speed than said second belt whereby the sheets are deposited on said second belt in overlapping relationship, and means for causing sheets discharged from said first belt to be deposited accurately in the desired relationship on said second belt and for preventing such sheets from planing through the air comprising a magnet disposed beneath the upper reach of said second belt adjacent the receiving end thereof.

4. In an apparatus of the type described, the combination of two belts adapted to convey thin ferrous sheets at high speed, means for driving said belts in the same direction, the first belt being adapted to deliver sheets to the second belt, and the second belt being driven at a slower speed than the first belt, and means for causing sheets to travel in the desired position on said belts and to prevent the sheets from planing through the air at high operating speeds comprising magnets disposed beneath the upper reach of the first belt adjacent the discharge end thereof and beneath the upper reach of the second belt adjacent the receiving end thereof.

5. In an apparatus for conveying thin sheets of ferrous material at high speeds having a first belt conveyor, a deflector, and an upper belt conveyor and a lower belt conveyor both operating in the same general direction as said first belt conveyor, said deflector being disposed between said first belt conveyor and said upper and lower belt conveyors and guiding sheets delivered thereto to either said upper belt conveyor or said lower belt conveyor; the combination of means for driving said conveyors at high rates of speed, and means for preventing sheets from planing through the air at high operating speeds and for insuring accurate positioning of the sheets on said upper and lower conveyors comprising a magnet disposed beneath the upper reach of said first belt conveyor adjacent the delivery end thereof, a magnet disposed beneath the upper reach of said upper belt conveyor adjacent the receiving end thereof, and a magnet disposed beneath the upper reach of said lower belt conveyor at the zone where said conveyor receives sheets from said deflector.

6. In an apparatus for conveying thin sheets of ferrous material at high speeds having a first belt conveyor, a movable deflector, and a second belt conveyor operating in the same general direction as said first belt conveyor, the receiving end of said second belt conveyor being disposed at a level different from the level of the delivery end of said first conveyor, said deflector being disposed between said first belt conveyor and said second belt conveyor and being adapted selectively to guide sheets delivered thereto to said second belt conveyor; the combination of means for driving said conveyors at high rates of speed, and means for preventing the sheets from planing through the air at high operating speeds and for insuring accurate positioning of the sheets on said second conveyor comprising a magnet disposed beneath the upper reach of said first belt conveyor adjacent the delivery end thereof, and a magnet disposed beneath the upper reach of said second belt conveyor at the zone where said conveyor receives sheets from said deflector.

7. In an apparatus for conveying thin sheets of ferrous material at high speeds having a first belt conveyor, a deflector, and an upper belt conveyor and a lower belt conveyor both operating in the same general direction as said first belt conveyor, said deflector being disposed between said first belt conveyor and said upper and lower belt conveyors and guiding sheets delivered thereto to either said upper belt conveyor or said lower belt conveyor; the combination of means for driving said conveyors at high rates of speed and means for preventing sheets from planing through the air at high operating speeds and for insuring accurate positioning of the sheets on said upper and lower conveyors comprising a magnet disposed beneath the upper reach of said upper belt conveyor adjacent the receiving end thereof, and a magnet disposed beneath the upper reach of said lower belt conveyor at the zone where said conveyor receives sheets from said deflector.

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