April 7, 1942. J. S. KENNEY ET AL 2,278,518

APPARATUS FOR CLASSIFYING SHEETS

Filed Aug. 18, 1939 6 Sheets-Sheet 1

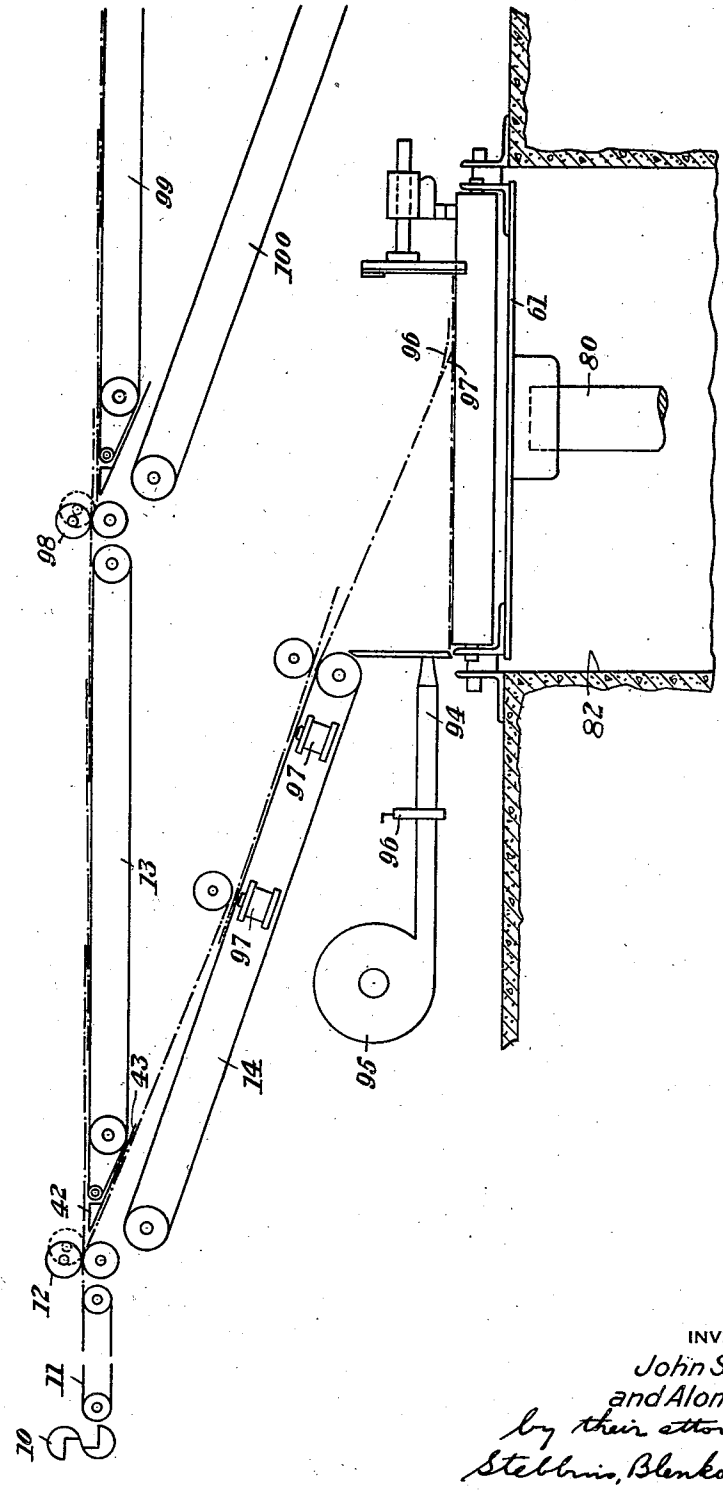

Fig. 1

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APPARATUS FOR CLASSIFYING SHEETS

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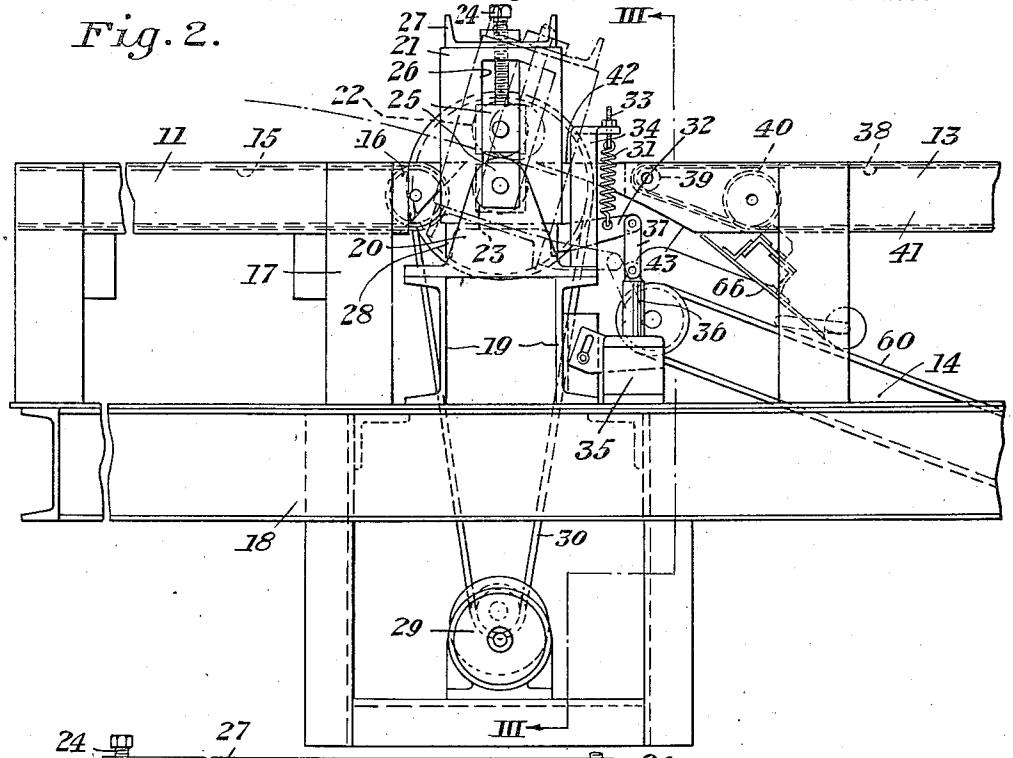
Fig. 2.



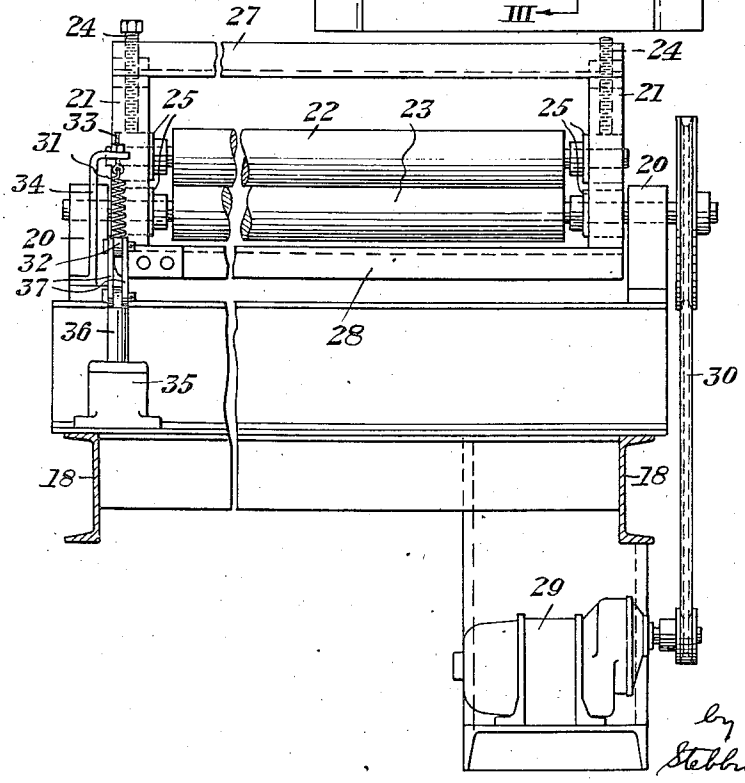


Fig. 3.

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Fig. 4.

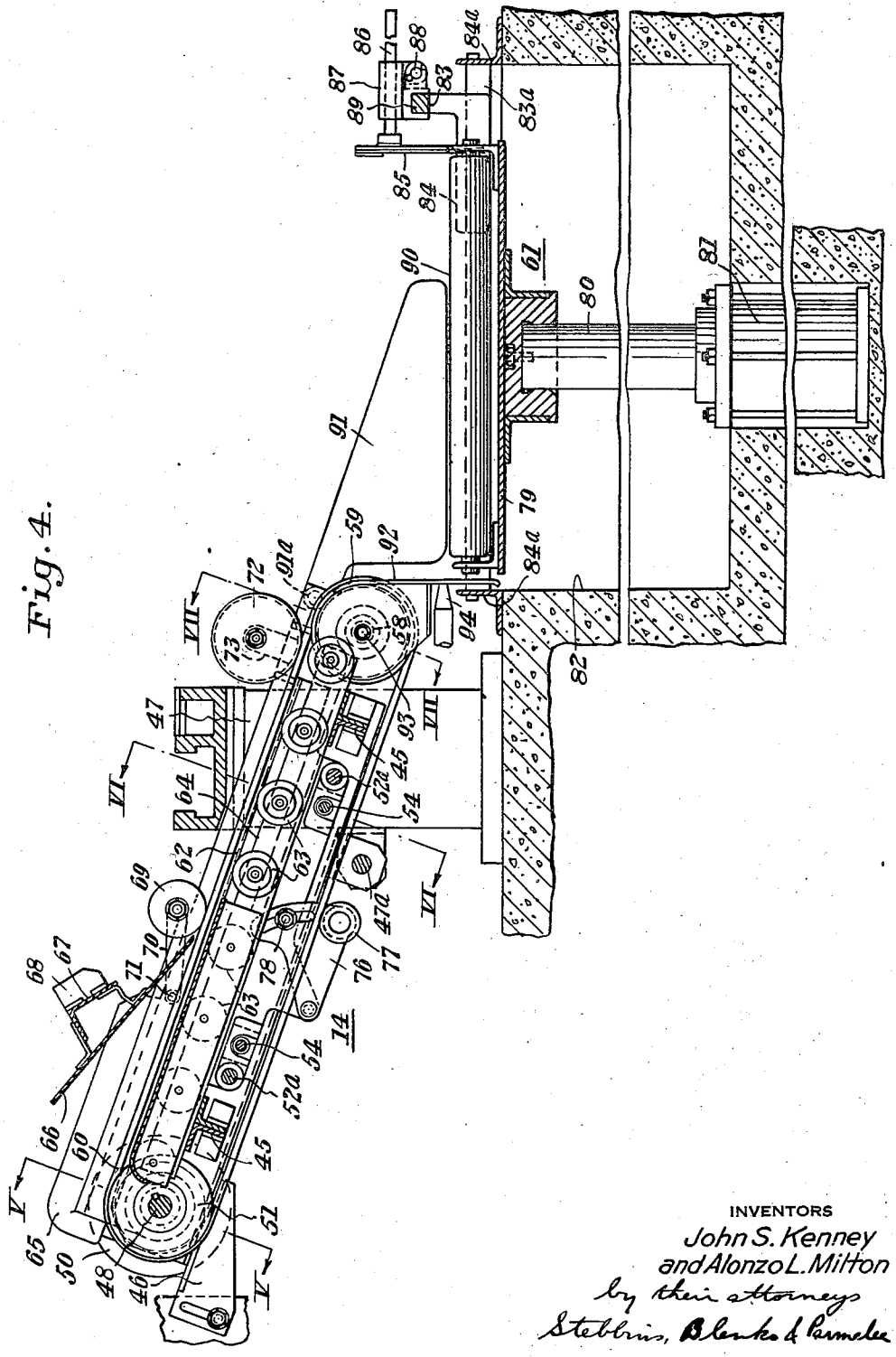

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Fig. 5.

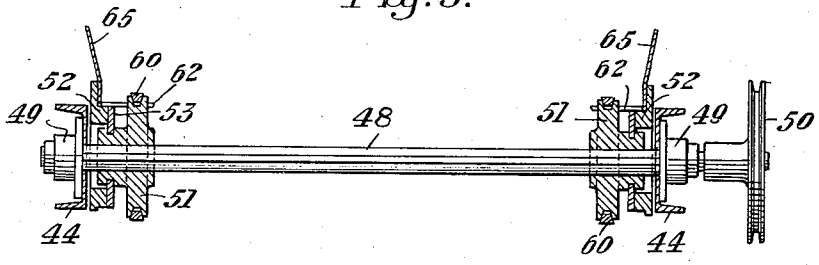


Fig. 6.

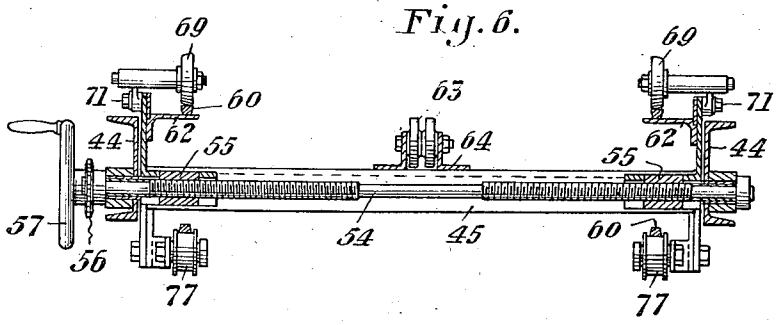
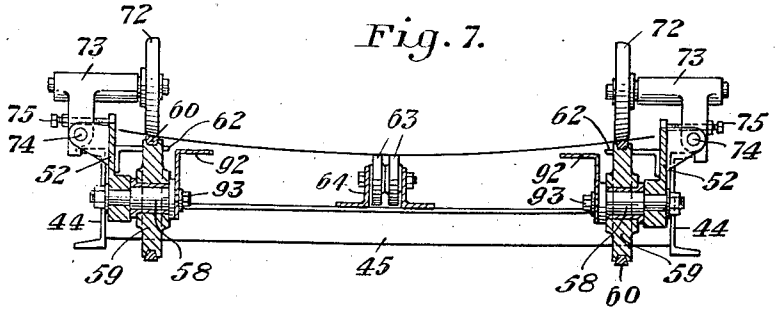


Fig. 7.



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APPARATUS FOR CLASSIFYING SHEETS

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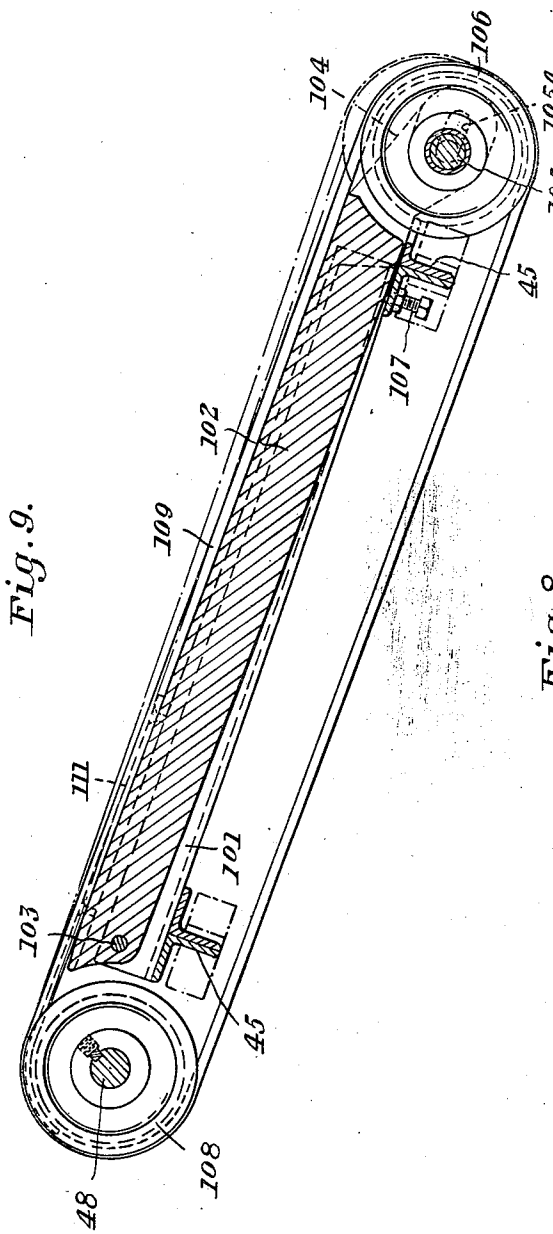

Fig. 9.

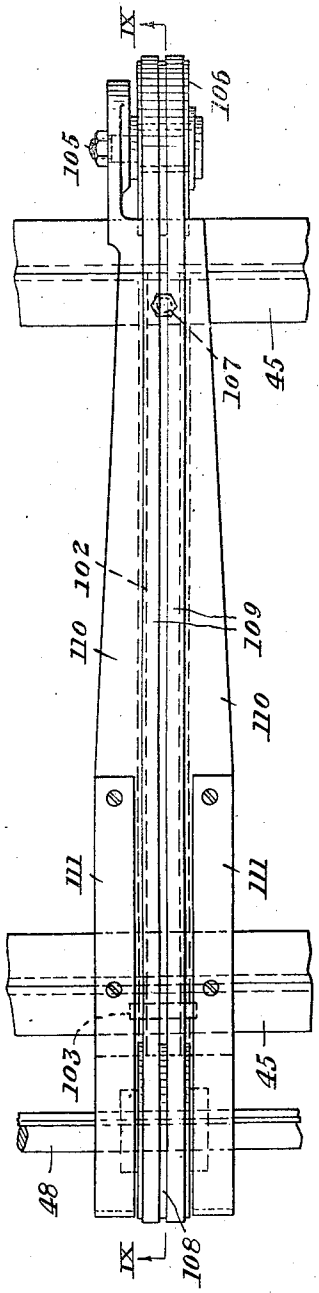

Fig. 8.

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Fig. 10.

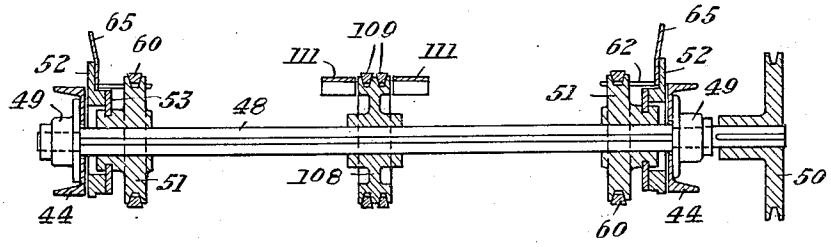


Fig. 11.

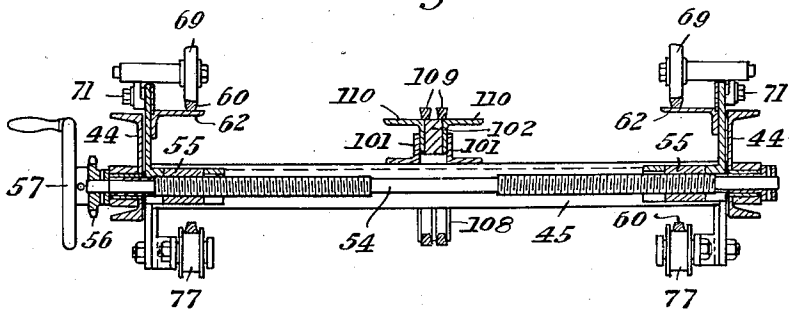
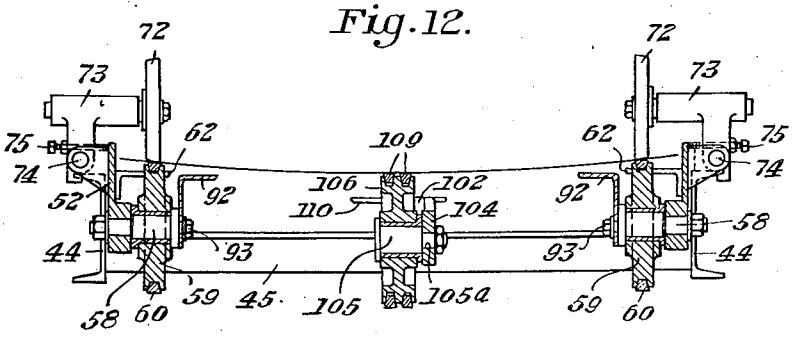


Fig. 12.



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2,278,518

UNITED STATES PATENT OFFICE

2,278,518

APPARATUS FOR CLASSIFYING SHEETS

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Application August 18, 1939, Serial No. 290,802

5 Claims. (Cl. 271—64)

This invention relates to the handling of sheets and particularly to the disposition of sheets sheared from a continuous strip, according to the gauge of the individual sheets.

Sheet classifying apparatus of various kinds has been known heretofore. A recent example is disclosed in Kaufman Patent 2,146,581 which embodies a tiltable deflector for directing sheets of different gauges along different paths for piling separately. It is an object of this invention to improve generally on sheet classifiers as known heretofore and, in particular, to provide a classifier which flattens any burr formed at the edges of the sheets during shearing. A further object of the invention is to provide a classifier capable of effecting "shingling" of the sheets or disposing the sheets in partly overlapping relation to facilitate piling. We also aim to provide a mechanism whereby sheets may be piled without scratching the surface of the top sheet of the pile.

In a preferred embodiment of our invention, we provide a conveyor system having one or more sets of tiltable pinch rolls and means for so actuating the pinch rolls as to deflect off-gauge sheets from the normal path of travel. The pinch rolls flatten any burrs existing on the edges of the sheets and also roll out any creases or buckles therein. A conveyor for receiving the off-gauge sheets is driven at reduced speed in order that sheets delivered thereto may be "shingled," i. e., laid thereon in partly overlapping relation with the leading end of each sheet overlying the trailing end of the preceding sheet. The conveyor is preferably sloped at a relatively steep angle to obtain certain advantages which will be explained more fully hereinafter. Other objects and advantages of the invention as well as the details of the construction and operation thereof will be explained in the course of the following description which refers to the accompanying drawings illustrating a preferred embodiment. In the drawings,

Fig. 1 is a diagrammatic view illustrating generally the arrangement and cooperation of the several elements of the apparatus;

Fig. 2 is a partial side elevation showing the tiltably mounted pinch rolls and mechanism for actuating them, other elements being indicated diagrammatically;

Fig. 3 is a transverse section taken substantially along the line III—III of Fig. 2;

Fig. 4 is a central, longitudinal section through the conveyor and piler for the off-gauge sheets;

Figs. 5, 6 and 7 are transverse sectional views taken along the correspondingly numbered lines of Fig. 4;

Fig. 8 is a partial plan view of a modified detail;

Fig. 9 is a sectional view taken along the line IX—IX of Fig. 8 with parts in elevation; and

Figs. 10 through 12 are sectional views corresponding to Figs. 5 through 7 showing the detail illustrated in Figs. 8 and 9.

Referring now in detail to the drawings and, for the present, to Fig. 1, the strip to be sheared, e. g., cold rolled steel strip, is fed from a pay-off reel through an edge-trimmer and an electro-limit gauger as well as a leveler. None of this apparatus is illustrated in the drawings since its construction and arrangement in shearing lines is well understood. The strip is then advanced to a shear 10 illustrated schematically in Fig. 1 as a flying shear, which cuts the strip into sheets of predetermined length. A conveyor 11 of any suitable type receives the sheets from the shear 10 and advances them to a tilting pinch roll stand 12. After passing between the rolls of the stand 12, the sheets are fed onto a conveyor 13 or onto a downwardly tilted conveyor 14, depending on the thickness of the sheet.

The apparatus which has been referred to generally above and is illustrated schematically only in Fig. 1, is shown in greater detail in Figs. 2 through 7, to which reference is now made for a complete description. The conveyor 11 comprises belts 15 trained over pulleys 16 journaled in a conveyor frame indicated generally at 17. The frame 17 is carried on a sub-frame 18. The conveyor 11 may be driven by any convenient means (not shown).

Cross channels 19 on the frame 18 support bearing blocks 20. Pinch roll housings 21 are provided with upper and lower pinch rolls 22 and 23 and screw-downs 24. The rolls 22 and 23 are journaled in bearing chucks 25 slidable in windows 26 formed in the housings 21. The necks of the bottom roll 23 are elongated and are journaled in the bearings 20. The housings 21 are connected by upper and lower cross channels 27 and 28. The assembly of the housings, the upper pinch roll and the cross channels is thus tiltable on the necks of the bottom pinch roll 23. This roll is driven by a motor reducer unit 29 through a belt and pulley or other suitable form of drive 30.

The housings 21 are normally maintained in the position illustrated in solid lines in Fig. 2 by a tension spring 31. The spring engages a lever 32 projecting laterally from one of the housings

21 and an eye-bolt 33 adjustably supported on a bracket 34 mounted on one of the bearings 20.

A solenoid 35 is secured to the sub-frame 18 or other suitable support and has a core 36 reciprocable therein. A connecting link 37 is pivoted to the core 36 and lever 32. Energization of the solenoid 35 thus causes the core 36 to be pulled down and the housings 21 and the upper pinch roll journaled therein to be tilted to the position shown in chain lines in Fig. 2. When the solenoid 35 is de-energized, the spring 31 restores the pinch rolls to their solid line position.

Energization of the magnet 35 is controlled by the aforementioned electro-limit gauger through suitable relays and connecting circuits, in a known manner and a detailed showing thereof is therefore omitted. It will be understood that the gauger and the intermediate relays operate to shift the pinch rolls from one delivery position to the other in accordance with the gauge of the strip approaching the shear. The relays introduce a time-delay such that the solenoid 35 is energized or remains de-energized, according to the gauge of a particular portion of the strip, at the proper instant to cause that portion of the sheet, when it reaches the pinch rolls, to be diverted onto the off-gauge conveyor 14 or fed directly onward to the correct-gauge conveyor 13. For the present, it will be assumed that the gauger causes energization of the solenoid to deflect over-gauge sheets as well as under-gauge sheets onto the conveyor 14.

The conveyor 13 is generally similar in construction to the conveyor 11 including belts 38, traversing pulleys 39 and 40 journaled in a supporting frame 41 and driven by any convenient means. The conveyor 13 also includes a fixed V-shaped guide 42 which may conveniently comprise an edged blade extending between the side members of the frame 41 with its edge projecting toward the bite of the pinch rolls of stand 12. The guide 42, as clearly shown in Fig. 2, directs downwardly onto the conveyor 14, the sheets discharged by the pinch rolls when in their chain line position. When the pinch rolls are in the solid line position, however, the guide 42 serves to direct the forward edge of a sheet being discharged onto the belts 38 of the conveyor 13. A guide sheet or plate 43 extends downwardly from the guide 42 and forms a continuation of its lower surface.

The construction of the conveyor 14 is shown in detail in Figs. 4 through 7. The conveyor comprises a frame including side channels 44 connected by cross members 45. Adjacent their upper ends, the channels 44 rest on brackets 46 adjustably secured to one of the channels 19. Adjacent their lower ends, the side channels are pivoted to a supporting standard 47 as at 47a by means of brackets and a cross shaft. A cross shaft 48 is journaled in bearings 49 secured to the channels 44 near the upper ends thereof. A driving pulley 50 is secured to one end of the shaft 48 whereby the latter may be driven from any convenient power source. Sheaves 51 are splined on the shaft 48.

Adjustable side plates 52 extend along the side channels 44 and have yoke plates 53 secured thereto which enter grooves on the hubs of sheaves 51. The side plates 52 are adjustable toward and from each other, being slidable on cross bars 52a extending between thte side channels 44. As shown in Figs. 4 and 6, screw shafts 54 have their end portions threaded in opposite directions for cooperation with nuts 55 positioned in recesses formed on the side plates 52. The shafts 54 are connected by a chain and sprocket drive 56 and one of them is provided with a hand wheel 57.

Adjacent their lower ends, the side plates 52 have stub shafts 58 extending inwardly therefrom. Sheaves 59 are journaled on the shafts 58 in alinement with the sheaves 51 on the shaft 48. Belts 60 trained over the sheaves 51 and 59 provide a sloping conveyor surface whereby sheets discharged by the pinch roll stand 12 are carried downwardly onto a pile support indicated generally at 61. Angles 62 extend inwardly from the side plates 52 and provide a supporting track for the belts 60 between the sheaves around which they travel.

Auxiliary supporting rollers 63 are journaled on shafts carried by a pair of angles 64 disposed centrally of the conveyor 13 and supported on the cross members 45. The tops of the rollers 63 are slightly below the upper runs of belts 60 so that the sheets are bowed as shown in Fig. 12 while passing over the conveyor 14. Downwardly converging side guides 65 are secured to the side plates 52 adjacent their upper ends. A top guide 66 in the form of a plate inclined downwardly toward the belts 60 is supported thereabove on a cross angle 67 secured by brackets 68 to any suitable support such as the frame 41. Hold-down disks 69 are journaled on links 70 pivoted to the side plates 52 as at 71. These disks function by reason of their own weight and that of the links 70 to hold the sheets against the belts 60 to prevent slippage.

Disks or rollers 72 are journaled in brackets 73 adjacent the lower ends of the side plates 52 for a similar purpose. The brackets 73 are pivoted to the side frames at 74 and are subject to a constant angular torque tending to urge the disks against the belts. This torque is producerd by the weight of the brackets or by coil springs (not shown). Movement of the disks towards the belts is limited by adjustable stop screws 75 engaging the side plates 52.

Brackets 76 pivoted to the side plates 52 intermediate their ends have belt-tightening pulleys 77 journaled thereon. These brackets are held in adjusted position by bolts 78 extending through holes in the side plates and through arcuate slots in the brackets 76.

The pile support 61 comprises a platform 79 mounted on a piston 80 reciprocable in a cylinder 81 whereby the platform may be raised and lowered in a well 82. A bridge member 83 extends across the well having feet 84 secured to cross bars 83a. The bars 83a are notched into rails 84a extending along opposite sides of the well. A stop plate 85 has slide rods 86 reciprocable through bearings 87. The bearings 87 are pivoted at 88 to slides 89 adjustable along the bridge member 83. Rollers 90 journaled on the platform 79 constitute the actual pile support. The platform 79 is lowered progressively as the pile builds up on the roller table 90 and the pile, when completed, may easily be pushed along the roller table after the platform has been raised to floor level.

Side guides 91 cooperate with the stop 85 in maintaining the sheets in alinement as deposited by the conveyor 14. The guides 91 are pivoted to the side plates 52 at 91a so they may be lifted up to clear a pile of sheets on the roller table 90 on lateral movement of the pile. Rear guide plates 92 extend downwardly from the

sheaves 59, being secured to the stub shafts 58 by screws 93.

A nozzle 94 is positioned adjacent the lower end of the conveyor 14 and is directed toward the stop 85. The nozzle is connected to a source of air under pressure such as a blower 95 (Fig. 1). A blast gate 96 controls the flow of air through the nozzle for a purpose which will appear shortly.

The operation of the mechanisms described above will now be explained. As already stated, in one embodiment of the invention, the solenoid 35 is energized by the electro-limit gauger whenever an off-gauge sheet enters the pinch roll stand 12, whether the sheet is below or above the normal gauge for which the gauger is adjusted. So long as the gauge of the strip being sheared into sheets is within the limits of established tolerance, the pinch roll stand is not actuated and delivers the sheets supplied thereto by the conveyor 11 successively to the conveyor 13. The belts 38 of the conveyor 13 are driven at a speed less than the peripheral speed of the pinch rolls of stand 12 so that sheets delivered successively thereto lie in shingled relation as indicated in Fig. 1.

When an off-gauge sheet approaches the pinch roll stand, the latter is tilted by energization of the solenoid 35 and the leading edge of the sheet is discharged from the pinch rolls beneath the guide 42. It will be understood that energization of the solenoid is maintained for the minimum time necessary for the edge of a sheet to pass the edge of the guide 42 and preferably longer, i. e., until the sheet has been substantially fully discharged from the pinch rolls. After passing the guide 42, the leading edge of the sheet engages the guide plate 43 and the top guide 66 successively and is guided thereby downwardly onto the belts 60 of the conveyor 14.

The conveyor 14 is disposed at a relatively steep angle to the horizontal, e. g., 20° which is greater than the angle of repose of the sheets when deposited on the belts 60. The belts are driven at a speed 10–50% less than the peripheral speed of the pinch rolls whereby the sheets are slowed down when deposited thereon. The hold-down disks 69 prevent slippage of the sheets along the belts 60 and the center rollers 63 cooperate with the belts in supporting the sheet. It will be understood that the side plates 52 are initially adjusted in accordance with the width of the sheets being handled. The side guides 65 cooperate with the top guides 66 to center the sheets on the belts 60. Instead of the hold-down disks 69, we may employ other means of braking the sheets such as magnets 97 located as shown diagrammatically in Fig. 1 and effective to attract the sheets into frictional engagement with the belts 60.

The speed of the belts 60 is so regulated, relative to the average frequency of the delivery of off-gauge sheets, that the leading edge of a succeeding off-gauge sheet engages the previously delivered off-gauge sheet before the trailing edge of the latter has passed beyond the point at which the leading edge of the succeeding sheet comes in contact therewith. Off-gauge sheets are thus delivered successively to the conveyor 14 in "shingled" relation, i. e., with the leading edge of each sheet overlapping the trailing edge of the preceding sheet. This relation is shown in Fig. 1.

The "shingled" off-gauge sheets progress downwardly along the conveyor 14 with the belts 60, being held against the latter by the disks 72 as they approach the lower end of the conveyor. The sheets are eventually discharged from the conveyor onto the pile support 61. The air blast created by the nozzle 94 and the blower 95 deflects the leading edge of each sheet upwardly as shown at 96, to prevent scratching the surface of a previously deposited sheet which would be caused if the sheet being discharged were permitted to strike the sheet previously discharged at an angle as indicated at 97. The air blast being confined between the guides 91, the descending sheet and the stop plate 85, floatingly supports the leading end of the sheet until the trailing end has passed off of the conveyor after which the entire sheet settles gently onto the pile, being accurately alined by the guides 91 and 92 and the stop 85.

By the embodiment of the invention described, it is possible to classify the sheets accurately, piling the off-gauge sheets on the support 61, the sheets of correct gauge being delivered by the conveyor 13 to another pile support, either similar to that shown at 61 or of any other suitable character. According to a slight modification of the apparatus described, it is possible not only to separate the off-gauge sheets from the correct gauge sheets but also to separate the over-gauge sheets from the under-gauge sheets. The additional apparatus necesary in this modification is similar to that which has already been described and is illustrated diagrammatically at the right in Fig. 1. It includes a second pinch roll stand 98 similar to that shown at 12 and disposed at the delivery end of the conveyor 13. Conveyors 99 and 100 similar to the conveyors 13 and 14 cooperate with the pinch roll stand 98. The belts of both these conveyors are driven at a speed less than that of the converyor 13 and the peripheral speed of the rolls of the stand 98.

In the modified system, the electro-limit gauger is set to energize the solenoid for operating the pinch roll stand 12 to deflect over-gauge sheets onto the conveyor 14 and to energize the solenoid for operating the stand 98 to deflect under-gauge sheets onto the conveyor 100. It will be understood that the time-delay interposed by the intermediate relays between the measuring operation and the solenoid energization will be different for the two stands of pinch rolls because they are located at different distances from the point of measurement. The conveyor 13 is driven at a speed substantially equal to the peripheral speed of the rolls of stand 12 so the sheets lie on the conveyor in spaced relation.

The correct gauge sheets will be delivered from the pinch roll stand 12 onto the conveyor 13 and from the stand 98 onto the conveyor 99. Since the belts of the latter are driven at a speed below that at which the sheets are discharged by the pinch rolls, successive sheets are "shingled" on the conveyor 99 as illustrated in Fig. 1, in the same manner that the over and under-gauge sheets are "shingled" on the conveyors 14 and 100, respectively. The conveyor 99 delivers the correct gauge sheets to a pile support and the conveyor 100 delivers the under-gauge sheets to a different pile support. These supports may be similar to that shown at 61 and no further showing thereof is required.

The modified construction illustrated in Figs. 8 through 12 comprises a central sheet support adapted to be substituted for the rollers 63 and having certain advantages over the latter. As shown in the drawings, angles 101 extend in

spaced parallel relation between the cross members 45 and are secured thereto. A bracket bar 102 is pivoted between the angles 101 adjacent their upper ends on a pin 103. The lower end of the bracket is offset as at 104 and is provided with a stub shaft 105 on which a sheave 106 is journaled. The shaft 105 is adjustable longitudinally of the bracket in a slot 105a. A screw 107 threaded through one of the angles composing the lower cross member 45, bears on the bottom of the bracket bar 102. By turning the screw 107 in or out, the lower end of the bracket bar 102 may be raised or lowered

A sheave 108 is keyed to the cross shaft 48 in alinement with the sheave 106 and conveyor belts 109 are trained around the two sheaves. Angles 110 are secured to the bracket bar 102. Skids 111 are secured to the angles 110 and overhang the shaft 48.

As above stated, the belts 109 and associated elements are substituted for the roller 63 and serve to support the mid-portion of the sheets passing successively over the conveyor 14. Since the sheave 108 is keyed to the driven shaft 48, the belts 109 are driven at the same speed as the belts 60. By adjusting the screw 107, furthermore, the sheave 106 may be raised or lowered to provide the desired convex or concave bowing of the sheets passing along the conveyor, somewhat as illustrated in Fig. 12. Since the belts 109 are driven, in contrast with the rollers 63 which are idlers, the modified construction is characterized by an improved conveyor action particularly as regards the "shingling" of successive sheets. The transverse bowing of the sheets tends to give them rigidity in a longitudinal direction.

It will be apparent that the invention is characterized by numerous advantages over methods and apparatus known heretofore for classifying sheets according to gauge. In the first place, the pinch rolls employed to direct the sheets along different paths may be of hardened metal, e. g., steel, whereby they serve to knock down or flatten any burrs formed at the edges of the sheets by the shears or edge trimmer. This produces a better quality sheet. It also makes tinning easier and reduces the amount of coating metal used. The pinch rolls also flatten any creases or buckles which may appear in the sheets. A further advantage of the invention is the "shingling" of the sheets prior to piling. "Shingled" sheets can be piled much better and much faster than unshingled sheets. In handling the latter, particularly at high delivery speeds, the leading edge of one sheet will frequently strike the trailing end of the preceding sheet, thus fouling the machine and necessitating a shut-down.

A further advantage of the invention is the preventation of scratching of the top sheet on a pile by the next sheet delivered thereto which is accomplished by the air jet to cushion and deflect each sheet as it is discharged onto the pile.

The steeply sloped conveyors 14 and 100 have special advantages. They require less floor space than substantially horizontal conveyors and can usually be incorporated in a shearing and classifying line much more readily than a substantially horizontal conveyor. A further advantage is that the sheets are less liable to buckle or break when delivered onto a piler at an angle, than if they are discharged horizontally. The pile guides cause the sheets to build up in accurately superposed position on the pile supports.

Although we have disclosed but a preferred form of apparatus with a slight modification, it will be understood that changes in the apparatus and procedure described and illustrated may be made without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. Sheet-classifying apparatus comprising spaced bearings, a roll journaled therein, spaced housings journaled on the necks of said roll, a second roll journaled in said housings and cooperating with said first-mentioned roll, means for driving said rolls, conveyors extending in different directions from points adjacent the discharge side of said rolls, and means for tilting said housings to cause sheets discharged by said rolls to be delivered to said conveyors selectively.

2. Sheet-classifying apparatus comprising spaced housings, a pair of pinch rolls journaled in said bearings, means supporting said housings for angular movement about the axis of one of said rolls, conveyors extending in different directions from points adjacent the discharge side of said rolls, and means for tilting said housings to cause sheets discharged by said rolls to be delivered to said conveyors selectively.

3. Sheet-classifying apparatus comprising spaced housings, a pair of substantially horizontal pinch rolls journaled in said housings, means supporting said housings for angular movement about a substantially horizontal axis through the housings, conveyors extending in different directions from points adjacent the discharge side of said rolls, and means for tilting said housings about said axis to cause sheets discharged by said rolls to be delivered to said conveyors selectively.

4. Sheet-classifying apparatus as defined by claim 3 characterized by means normally biasing said housings to a position for delivering said sheets to one of said conveyors.

5. In a sheet classifier, a stand of delivery pinch-rolls mounted for tilting movement between at least two delivery positions, a conveyor adapted to receive sheets from said rolls in one position, a conveyor at an angle to said first-mentioned conveyor adapted to receive sheets from the rolls in another position, means for shifting said stand from one position to the other, one of said conveyors being driven at a speed less than the peripheral speed of the rolls, and being so disposed relative thereto that sheets are deposited on said one of said conveyors with the leading edge of one sheet overlying the trailing edge of the preceding sheet.

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