

April 13, 1937.

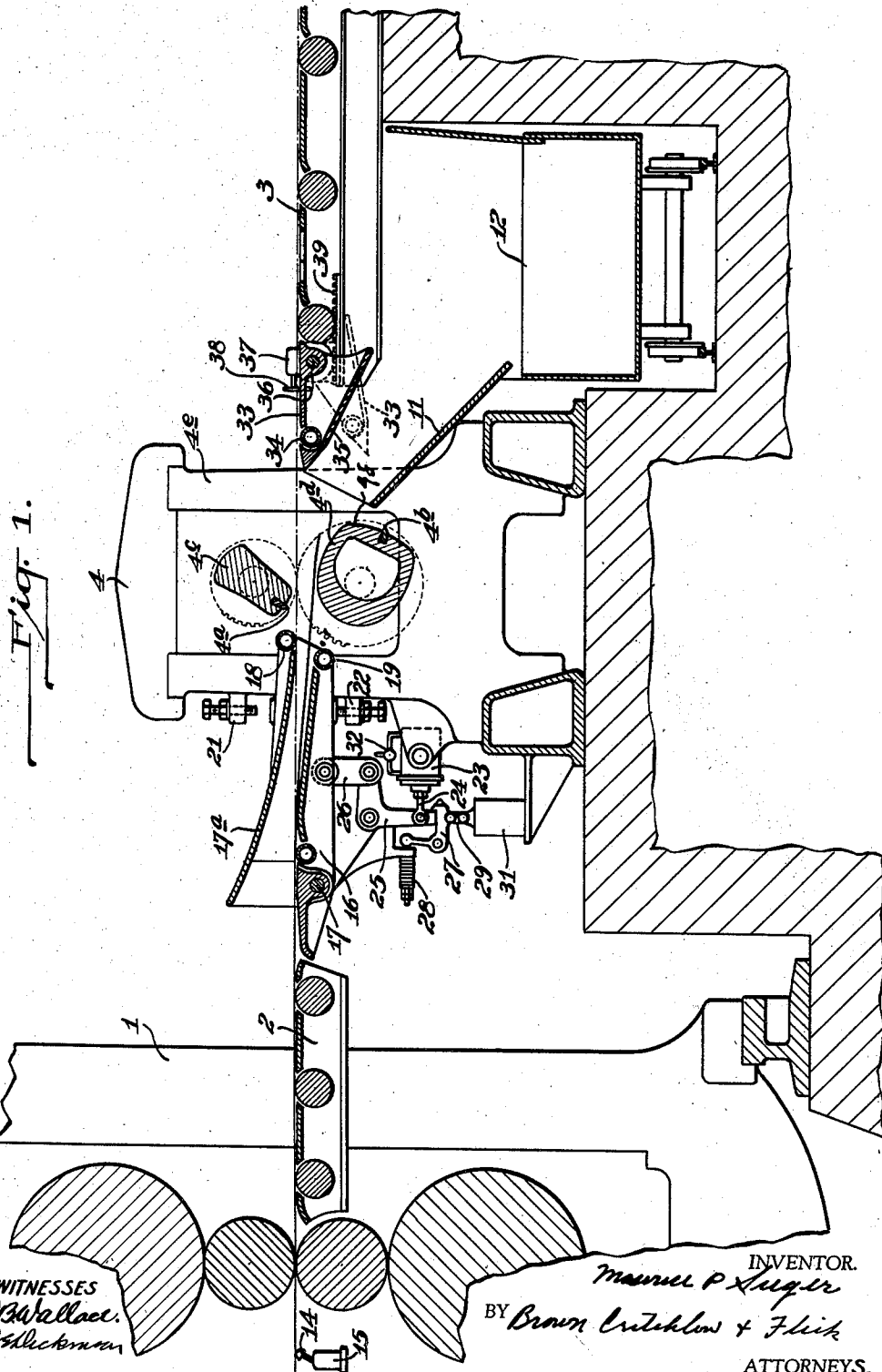
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2,076,969

METHOD AND APPARATUS FOR SHEARING STRIP MATERIAL

Filed Nov. 10, 1936

4 Sheets-Sheet 1



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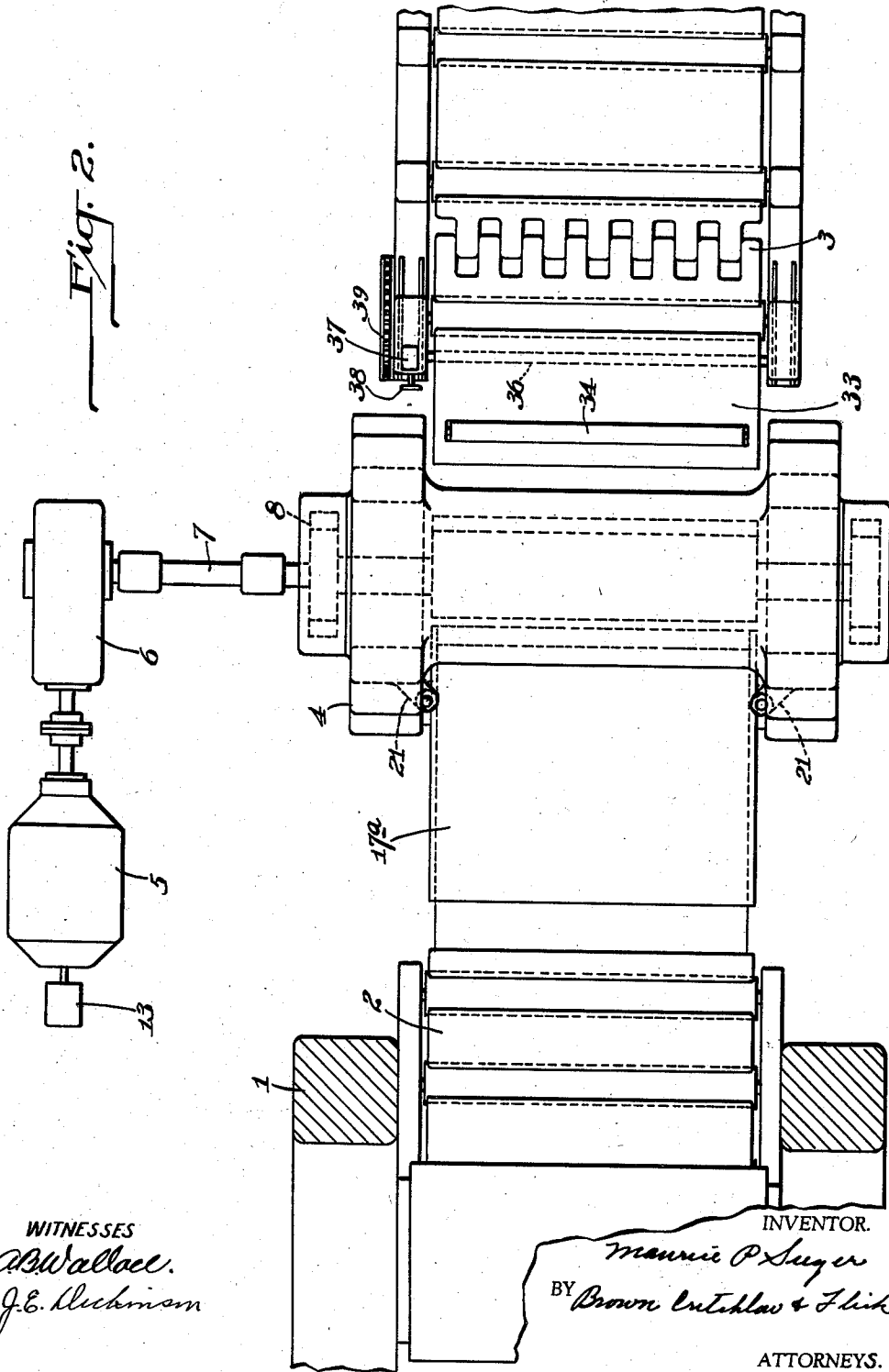
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METHOD AND APPARATUS FOR SHEARING STRIP MATERIAL

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Fig. 2.



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METHOD AND APPARATUS FOR SHEARING STRIP MATERIAL

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Fig. 4.

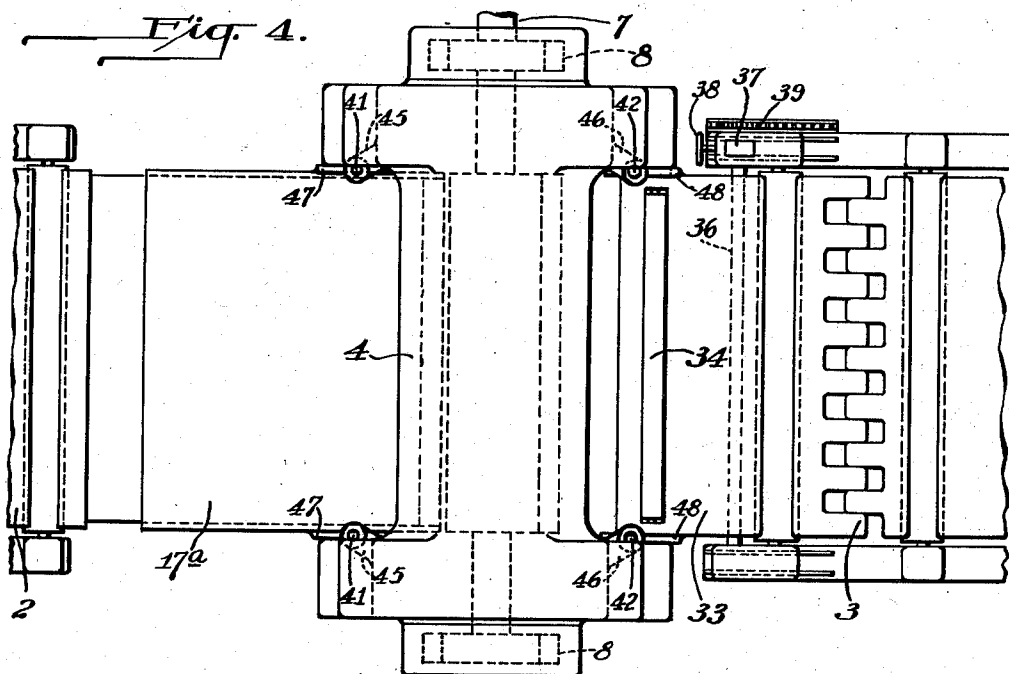
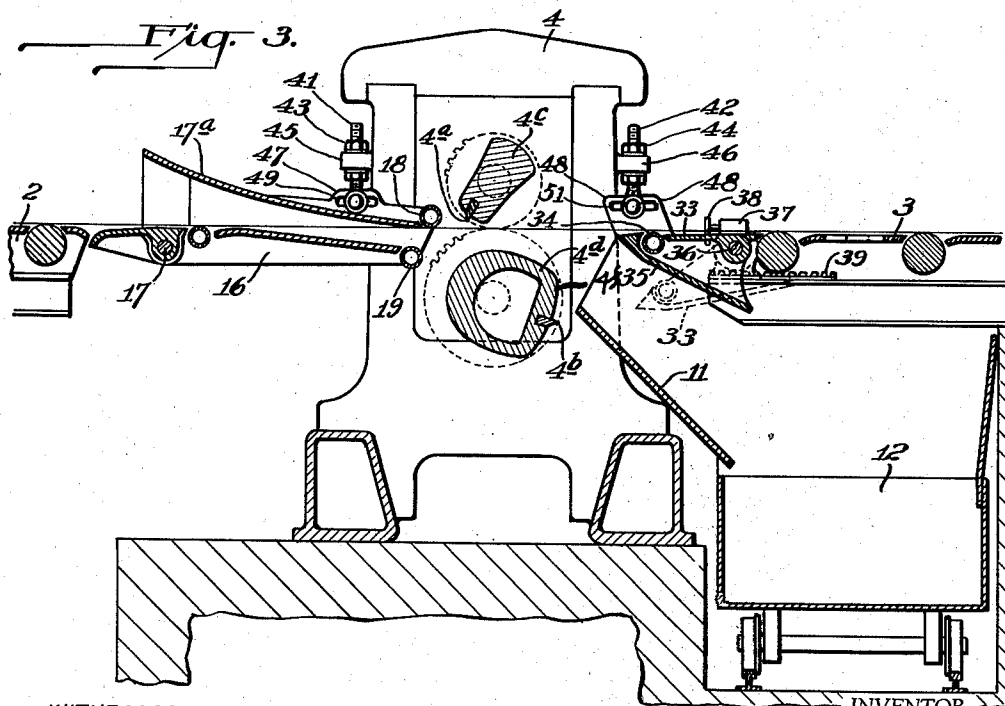


Fig. 3.



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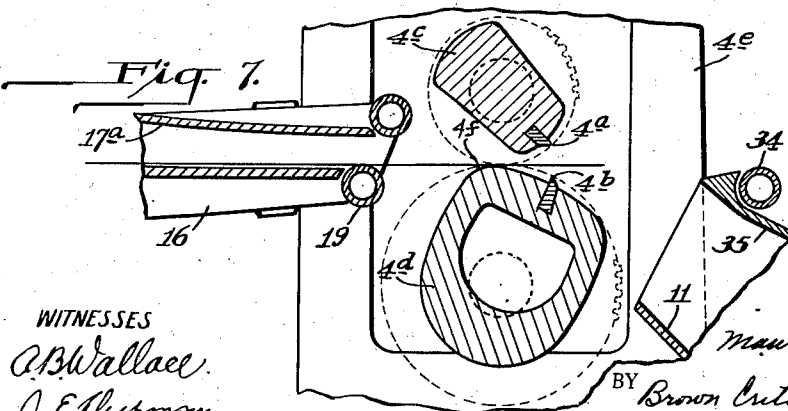
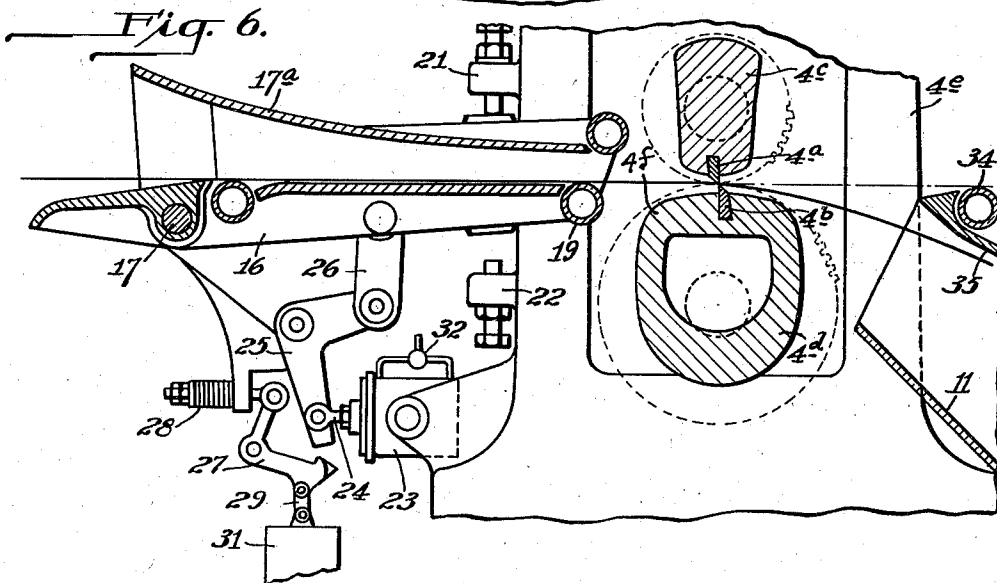
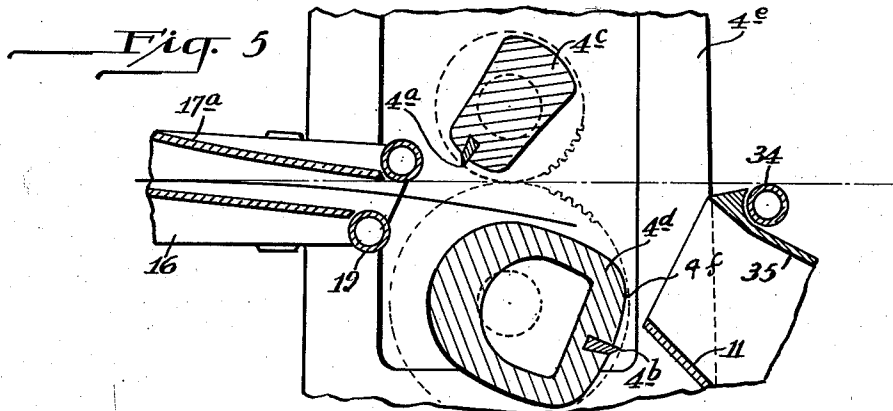
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METHOD AND APPARATUS FOR SHEARING STRIP MATERIAL

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,076,969

METHOD AND APPARATUS FOR SHEARING
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Application November 10, 1936, Serial No. 110,057

21 Claims. (Cl. 164—68)

This invention relates to an improvement in method and apparatus for manipulating and shearing strip material while in motion, and while not necessarily so limited has to do more particularly with the shearing of metallic strip and especially with the removing and disposing of the crop ends of such strip as it issues from a rolling mill or like work device.

These ends which develop during the rolling operation have to be removed at some time or other before the processing of the strip is finished, and for many purposes it is desirable that they be removed and disposed of as the strip issues from the last pass of the hot finishing mill. If removed at such point not only is their subsequent useless processing and handling eliminated, but also any necessity of separating them from the usable strip at a further point in the finishing operation is avoided. In addition, and what is possibly most important, it facilitates the entering of the strip in the subsequent processing apparatus which is often accompanied with difficulties because of their deformities if the leading crop ends are not removed.

The removal and disposal of these crop portions at such point, however, presents a considerable problem because of the relatively high speed at which the strip is usually traveling at this point, and because apparatus can not be used for this purpose which may in any way so obstruct the delivery of the strip as to produce cobbles. This is especially true of the removal and disposal of the front end crops as they must be gotten out of the way in an exceedingly rapid and skillful manner in order to avoid interfering with the progress of the rest of the strip.

Heretofore, although other means have been attempted, the prevailing practice has been to permit these cropped ends to be carried along the strip-conveying table after they are cut off, and to station a number of table men equipped with hand tools along the table to pull them out of the line of travel. Such practice is both undependable and dangerous as well as relatively expensive as compared to the use of automatic means for accomplishing such end.

With the foregoing in mind it is an object of this invention to provide for transversely shearing strip material while it is in motion and for separating from the main body thereof certain of the lengths which are sheared off.

A more particular object is to provide for removing and disposing of the crop ends of metal strip and particularly the crop on the leading end as it is delivered from a rolling mill without

interfering with the normal travel of the strip. Another object is to provide for doing this automatically and in such a way as to minimize the possibility of cobbles being produced by the apparatus used.

Still another object is to provide an apparatus for this purpose in which, with the exception of the cutting blades, it is unnecessary to move any of its parts during the cutting and separating operation.

These and various other objects, as well as the various other novel features and advantages of the invention, will be apparent when the following detailed description is read in conjunction with the accompanying drawings of which Figs. 1 and 2 comprise a section and plan view, respectively, of a rolling mill and run-out table including a shearing and crop-disposing apparatus constructed in accordance with this invention; Figs. 3 and 4 views similar to Figs. 1 and 2 of a modified form of the invention; and Figs. 5, 6 and 7 schematic views, respectively, showing various operating positions of the principal moving parts of the shear and the apparatus for disposing of the crop ends illustrated in Figs. 1 to 4.

Referring in detail to these drawings, and first more particularly to Figs. 1 and 2, the numeral 1 designates a rolling mill, and in this instance the last stand of a tandem-type finishing mill. Following this is the customary run-out table comprising sections 2 and 3 upon which the strip issuing from the mill is discharged and conveyed to the coiling, piling or other strip-handling apparatus associated with the mill but not shown.

Arranged in this table, and preferably adjacent the mill although it may be otherwise located if so desired, is a flying shear 4 constructed to practice this invention. When so arranged the table section 2 constitutes a feed table and the section 3 a run-out table for this shear which, as shown in Figs. 1 and 2, comprises a pair of transversely extending cooperating cutting blades 4a and 4b mounted in suitable carriers 4c and 4d. These are in turn rotatably supported in a housing 4e and connected to be driven by a motor 5 or other source of power supply through the agency of a gear change unit 6 and spindles 7, the latter being equipped with intermeshing gears bearing the same ratio as the blade carriers for insuring the proper registration of the blades when effecting a cut.

One feature of this shear which distinguishes it from the conventional form of rotary shear, is that the lower carrier is so designed that it will only engage the strip during a small portion of

its revolution. Within a given range of positions it is spaced sufficiently below the line of support of the run-out table to permit the leading end of the strip, if otherwise unsupported when it passes thereover, to pass under the leading end of the table 3 adjacent the discharge side of the shear where, after being sheared off, it is allowed to fall onto a chute 11 which is provided for guiding it into a dump-car or collector 12.

Another feature of the lower blade carrier 4d is embodied in the small portion thereof located directly back of the cutting blade and, although it may take other shapes than that shown, is preferably made in substantially the form of a cylindrical segmental section and adapted to engage the forward end of the strip after a cut and guide it onto the run-out table 3 where it and the subsequent portions of the strip are conducted.

To operate the shear in the manner outlined, the blade carriers 4c and 4d are brought to rest in a preselected position each time the shear is stopped, and started in timed relation with the entry of the strip between the blades so as to both control the length of the first cut and insure the blades being in such a position when the strip enters the shear that the first cut will fall below the run-out table. In some instances the shear may not be started until the strip is past the cutting blades and in others it may be started sometime before the strip reaches the shear. In the first case the carriers must be stopped in a position which will allow the leading end of the strip to pass below the run-out table as it enters the shear, and in the second case they must be started in such timed relation with the strip that irrespective of where they start from, the lower carrier will be in a position when the strip enters the shear that it will allow the first cut to fall into the crop collector. In all cases the shear is started so that the first cut is on the first revolution of the lower carrier after the strip enters the shear. While any suitable control system may be used for so controlling the shear, the systems disclosed in United States Patents Nos. 1,894,815 and 1,959,852 are recommended, and in view thereof it is deemed unnecessary to illustrate and describe a control in detail, although as a part thereof a limit switch 13 is shown connected to the motor 5 for regulating the stopping of the shear and a flag switch 14 in front of the mill 1 at an appropriate place in the path of the strip to effect the starting of the shear by the passing of the strip thereover as it is delivered to the shear.

In the form of shear illustrated, it is contemplated that the first cut will be made the first time the cutting blade 4b on lower carrier 4d is moved to intersect the normal path of travel of the strip or, in other words, the plane of support of the run-out table after the strip enters the shear. This eliminates any possibility of the leading end of the strip being thrown up onto the run-out table by the lower carrier before the crop end is removed. Furthermore, by permitting the carrier to be stopped in a wide range of positions, provision is made so that for different strip speeds the shear is afforded different lengths of time for starting whereby its speed at the instant of cutting can be varied, which is desirable as it is preferable for the cutting blade to be moving at substantially the speed of the strip at the instant of cutting.

The length of the first cut, as previously stated, is controlled by starting the shear in timed relation with the movement of the strip into it, and

to vary these lengths various adjustments in the control may be provided. For example, an adjustable time delay starting relay 15 as indicated may be disposed for operation by the limit switch 14 and set to produce any time of starting desired.

In accordance with known practice the blade carriers of the shear may be designed to produce a cut on each complete revolution of both, on each complete revolution of one carrier and a plurality of revolutions of the other, or, as shown, they may be so proportioned that they will produce cuts after a predetermined plurality of revolutions of both. The latter makes it possible to produce cuts much larger than the circumference of the larger carrier while at the same time permitting the blades to be moved at a speed approximating the speed of the strip when a cut is made, which is desirable.

With the latter type of carrier arrangement as in the others, the blade carriers are stopped after each cut so as to produce the first cut in the manner previously outlined, that is, on the first revolution of the lower carrier after the strip enters the shear, which means that in the case of cropping the two ends of coils it is stopped after the front end cut and before a subsequent cut is made and brought to rest in its original starting position which in some cases, of course, requires reversing its operation to return it to such position. All of this is contemplated by the control systems disclosed in the aforementioned United States patents. Furthermore, irrespective of what their relative sizes may be, the carriers are preferably so designed that they are as near as possible evenly balanced about their center of rotation to prevent the development of any undue strains when they are rotated.

To insure the front end of the strip passing under the run-out table 3 and into the crop catcher when desired, irrespective of the weight and speed of the strip, the feed table 2 is spaced a sufficient distance from the run-out table 3 so that the action of gravity on the strip will cause it to fall below the end of table 3 by the time it reaches that point. In this space in front of the shear an apron or guide 16 is provided which is pivotally supported adjacent the run-out table on a shaft 17. Normally this guide is positioned so that it, engages the strip only when it falls below the plane of the run-out table, and then only in such a way as to prevent the end thereof from striking the lower blade carrier in case it tends to do so as it enters the shear. As shown, this apron 16 is provided with a throat-forming cover 17 and a pair of rollers 18 and 19 located at the outer ends of the cover and the apron proper. The purpose of this cover is to further insure the passing of the front end of the strip below the run-out table 3 before the first cut is made, and onto the run-out table 3 thereafter. To so function it may be adjusted so that its upper roller 18 is slightly below the normal path of the strip so that in the event the strip is either turned up or tends to pass onto the run-out table 3 it will be engaged by this roller 18 and deflected under table 3.

For most purposes such apron may be retained in a fixed adjusted position at all times, such position being determined by the upper and lower stops 21 and 22 provided on the face of the shear housing for such purpose. For some purposes, however, it may be desirable to position the apron in one position when guiding the front

end of the strip under the run-out table 3 and then after the first cut raise it so as to assist in guiding the remainder of the strip onto the top of the run-out table 3. To provide for this, a pressure cylinder 23 is provided, which is equipped with the usual plunger and piston rod 24. In the embodiment shown this piston rod is connected to the lower end of a pivotally supported bell-crank 25 which has its upper end pivotally connected by a link 26 to the apron 16. Through such an arrangement, when the piston is in its outermost position shown in Fig. 1, it causes the inner end of the apron 16 to be held in its lower position, and when at the inner end of its stroke, as shown in Fig. 6, it causes the inner end of the apron to be raised to its upper position.

The limits of this movement are determined by the position of the stops 21 and 22, while the movements themselves are controlled by the application of the pressure to the piston in the cylinder 23 and a latch 27 which is arranged to releasably engage the lower end of the crank 25. As shown, the latter is normally biased to its locking position by a spring 28 and connected at its lower end by means of a connection 29 to a releasing solenoid 31 or equivalent mechanism. To control the operation of this solenoid it may be connected to the limit switch 13, in a circuit not shown in such a manner that it will be released at approximately the time the first cut is made. Previous thereto, however, by means of a hand control 32 or automatic means not shown also connected with the limit switch 13, a pressure is applied to the cylinder 24 so that when the latch 27 is released the plunger in the cylinder 23 will operate immediately to throw the apron to its upper position. In a like manner the solenoid 31 may be similarly energized before a succeeding piece of strip enters the shear such, for example, as when the shear is stopped. After a strip has passed out of the shear, the pressure in the cylinder 24 is reversed to return the apron to its lower position in readiness for the next strip, a control which may also be obtained by the limit switch 13.

To assure the aforementioned operation of the latch 27, it is provided with an inclined surface on its lower end which adapts it to permit the lower end of the crank 25 to displace it when the latter is moved outwardly as the apron is lowered, whereby allowing it to function even though it is raised before the apron is lowered. As will be appreciated, only a single set of these apron-manipulating elements may be used or they may be provided in duplicate.

To further assist in insuring the contemplated operation of the invention, an adjustable apron 33 is provided on the end of the run-out table 3 adjacent the shear, and equipped with a roller 34 on its upper face for supporting the strip and directing it onto the table 3 after the first cut. It also has a downwardly inclined guide 35 on its under side for deflecting the front end crops into the crop collector. To guide the leading end of the strip onto the run-out table after the first cut, in case it droops enough between the blade carrier and the run-out table 3, so that it will not otherwise pass onto the table 3 when it reaches that point, the apron 33 is adapted to be tilted, as indicated by the dotted lines in Fig. 1. To permit this adjustment, the outer end is mounted on a shaft 36, and the latter equipped with a gear unit 37 and an adjusting hand-wheel 38 which need only be turned properly to raise

or lower the apron. As a further feature the latter apron is also mounted for movement longitudinally of the table to permit variations in the spacing of it from the shear which may be desirable for different types of material, a rack and pinion element 39 being provided for effecting the latter adjustment.

In the normal operation of the apparatus, carriers 4a and 4b are either held in some such position as shown in Fig. 5, or are caused to be in such a position when the strip is fed thereinto. In any event as soon as the front end of the strip is at the proper point, the blade carriers are started and shear off the forward end of the strip on the first revolution of the lower carrier after the strip enters the shear, as indicated in Fig. 6. The continued rotation of the carrier after this cut, as shown in Fig. 7, brings the portion 4f of the lower carrier into contact with the strip and tosses the end thereof upwardly onto the apron 33 and thence onto the run-out table 3, an operation which is repeated when the strip is cut into lengths each time a cut is made. When only the ends of the strip are to be removed the shear is stopped after the first cut, returned to its original position of rest, and then restarted to cut the trailing crop.

Referring to Figs. 3 and 4, a modified form of the invention is shown which differs from that previously described only in the construction of the mechanism employed for adjusting the two aprons 16 and 33 provided between the shear and the run-out tables 2 and 3, and to avoid repetition, the parts of the latter which are identical with those of the first are designated by the same reference characters. As shown in these latter drawings, threaded screws 41 and 42 are the only means employed for supporting and adjusting the two aprons 16 and 33, being threadably engaged at their upper ends in adjusting sleeves 43 and 44 which are rotatably supported in brackets 45 and 46 secured to the shear housing 1. At their lower ends they are connected to brackets 47 and 48 provided on the sides of the aprons by means of pins disposed in slots 49 and 51, the slot in the latter bracket being made sufficiently long to accommodate the horizontal adjustment of the apron 33 as well as the vertical adjustment. By such means, as is apparent, only manual adjustment is afforded and when used, no parts other than the shear blades are moved during the shearing operation.

It will be appreciated from the foregoing that when it is desired not to use the shear, the forward apron 16 and the rearward apron 33 may be adjusted as to definitely insure the strip passing onto the run-out table.

It will be further appreciated that the run-out apron 33 may be equipped with an operating mechanism such as shown in Figs. 1 and 2, and so controlled as to dispose of the trailing end crop, the disposal of which is not provided for by the apparatus heretofore discussed. Another way of disposing of these latter crops is to provide a guide such as the apron 33 with lifting means and locating it in the run-out table sufficiently far enough away from the shear so that it can be used to trap the latter crops as they pass down the table.

According to the provisions of the patent statutes, I have explained the principle and mode of operation of my invention, and have illustrated and described what I now consider to be its best embodiment. However, I desire to have it un-

derstood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

5 I claim:

1. In a shearing apparatus for transversely cutting strip material while in motion, a feeding and a run-out conveyor for conducting the strip therethrough, a flying shear provided with superposed blade carriers equipped with cooperating cutting blades disposed between said conveyors, the lower of said carriers being so designed that when in a certain position it will permit the strip to pass thereover below the line of support of said conveyors and under the run-out conveyor, and means for engaging the strip entering the shear after a cut is made and guiding it onto the run-out table.

2. In a shearing apparatus according to claim 1, means for causing the blade carriers to be brought to rest in a preselected position each time the shear is stopped.

3. In a shearing apparatus according to claim 1, means for starting the shear in timed relation with the movement of the strip into the shear and in such a way that the leading end will pass under the run-out table when sheared off.

4. A shearing apparatus according to claim 1 in which the lower blade carrier is provided with means for guiding the strip entering the shear after a cut is made onto the run-out conveyor.

5. A shearing apparatus according to claim 1 employing a flying shear of the rotary type in which the lower blade carrier is so shaped that in a certain angular position it will permit the strip entering the shear to pass over it below the line of support of the conveyors.

6. In a shearing apparatus according to claim 1, guiding means between said feeding conveyor and said shear for insuring the passage over the lower carrier and under the run-out conveyor of that portion of the strip removed by the first cut.

7. In a shearing apparatus according to claim 1, means between said feeding conveyor and said shear for insuring the passage over the lower carrier and under the run-out conveyor of the portion of the strip removed by the first cut, and means for adjusting the operative position of said latter means.

8. In a shearing apparatus according to claim 1, means between said feeding conveyor and said shear for guiding the strip between the blade carriers, and power means for actuating said last mentioned guiding means to different operative positions.

9. In a shearing apparatus according to claim 1, means between said feeding conveyor and said shear for guiding the strip between the blade carriers, power operated means for actuating said guiding means to different operative positions, and adjustable means for determining the limits of movement of said guiding means.

10. In a shearing apparatus according to claim 1, means between said feeding conveyor and said shear for guiding the strip between the blade carriers, power operated means for actuating said guiding means to different operative positions, and automatically operated means for controlling the movement of said guiding means.

11. In a shearing apparatus according to claim 1, means between the shear and the run-out table

for assisting in getting the strip onto the run-out table.

12. In a shearing apparatus according to claim 1, means between the shear and the run-out table for assisting in deflecting under the table the material removed by the first cut.

13. In a shearing apparatus according to claim 1, means between the shear and the run-out table for assisting in guiding the strip onto the run-out table, and means for adjusting said latter means.

14. In a shearing apparatus according to claim 1, a pivoted guide between the shear and the run-out table for assisting the strip onto the run-out table, and means for adjusting said means toward and from the shear.

15. In a shearing apparatus according to claim 1, means between the shear and the feeding conveyor for guiding the strip through the blade carriers, and means between the shear and the run-out conveyor for assisting in guiding the strip onto the latter conveyor.

16. In a shearing apparatus according to claim 1, means between the shear and the feeding conveyor for guiding the strip between the cutting blades, power means for moving said guiding means into different operative positions, means for causing said blade carriers to come to rest at a preselected position each time they are stopped, means for starting said shear in timed relation with the movement of the strip onto the shear, and means operated in timed relation with the shear for controlling the operation of said power actuated guiding means.

17. In a shearing apparatus for transversely shearing strip material while in motion, a pair of cooperating cutting blades, conveyors on opposite sides thereof for delivering the strip to and carrying it away from said blades and so spaced from each other as to normally permit the strip to pass from the first conveyor below the second, means for operating said cutting blades to sever the strip, and means associated with the lower blade for engaging the front end of the strip after a cut and deflecting it up onto the discharge conveyor.

18. In a shearing apparatus, a rotary type transversely cutting flying shear having a lower blade carrier which in certain angular positions lies well below the line of intersection of the cutting blades, a delivery table in front of said shear and a run-out table back of it, said tables being so spaced that strip passing from the delivery table through the shear is normally caused by gravity to fall below the supporting surface of the run-out table before it reaches the latter table, means for rotating said carriers to produce cuts, and means on the lower carrier for causing the end of the strip following a cut to pass up onto the run-out table.

19. In a shearing apparatus, a flying shear comprising a pair of rotary blade carriers equipped with cooperating transversely extending cutting blades, a feeding conveyor for delivering the strip to the shear, a run-out conveyor for carrying the strip away from the shear, said conveyors being so spaced as to normally permit the strip from the feeding conveyor to pass due to gravity under the run-out conveyor, an adjustable guide between the shear and the feeding conveyor which is operative to insure the front end of the strip passing over the lower blade-carrier and under the run-out table, power means for moving said guide from one position to another, means operated with the shear for controlling said power

means, a second guide arranged between the shear and said run-out conveyor, for assisting in deflecting the material removed by the first cut of the shear under the run-out conveyor and in
5 guiding the rest of the strip up onto it, means for adjusting the forward end of said latter guide with respect to the plane of support of the run-out conveyor, means for stopping the blade carriers of said shear in a preselected position, and
10 means for starting the shear in timed relation with the movement of the strip into the shear.

20. The method of shearing elongate strip material and separating the first cut from the rest of the strip while the strip is in motion which
15 consists in delivering the strip to the cutters along a given plane to a point spaced in front of the cutters, allowing it to preliminarily fall below said

delivery plane before and as it passes through the cutters and then after the first cut is made deflecting the strip following such cut upwardly and supporting it in a plane above that followed by the portion removed by said cut.

21. A shearing apparatus for transversely cutting strip material while in motion, comprising a flying shear provided with a pair of superposed blade carriers equipped with cooperating cutting
10 blades, the lower of said carriers being adapted when in a certain position to permit the strip to pass thereover and below the cutting plane of the shear, and means for engaging the strip entering the shear after a cut is made and guiding it forward in or above the horizontal plane in which
15 the cut is made.

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