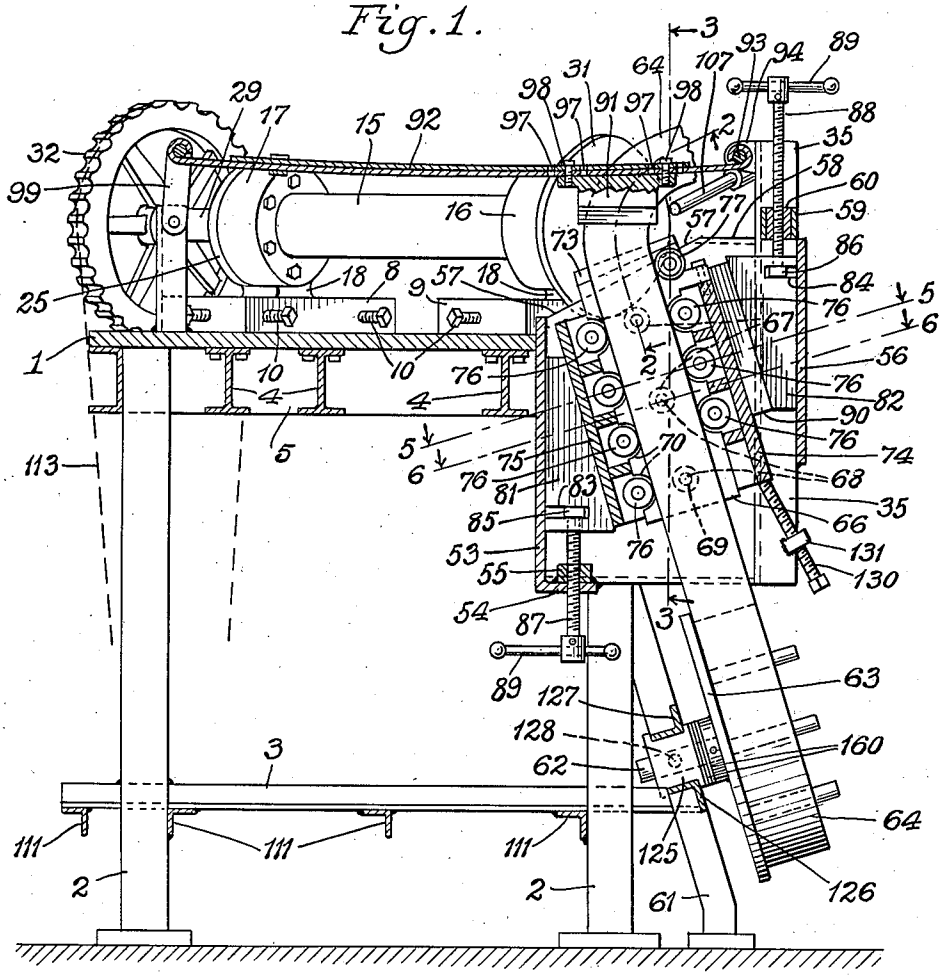
Dec. 14, 1943. H. O. FULSON 2,336,602

APPARATUS FOR ROLLING HELICOID CONVEYER FLIGHT

Filed Nov. 10, 1941 4 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

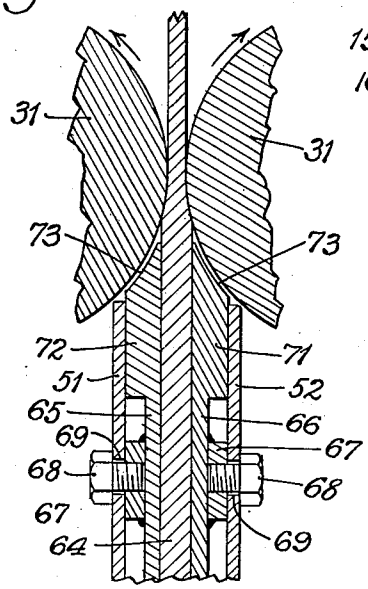


Fig. 3.

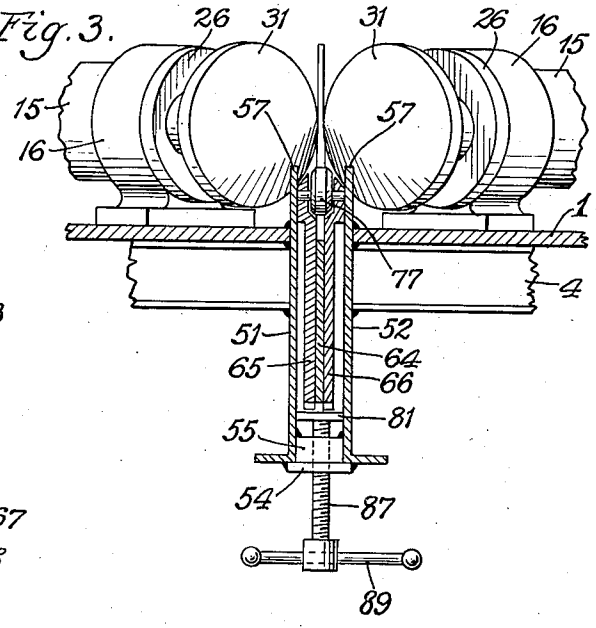


Fig. 4

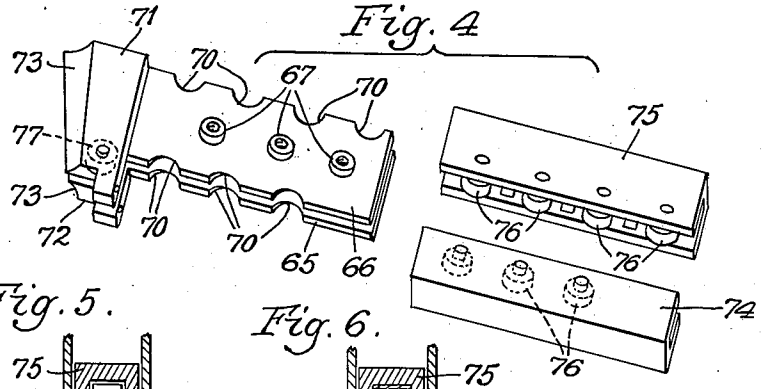


Fig. 5.

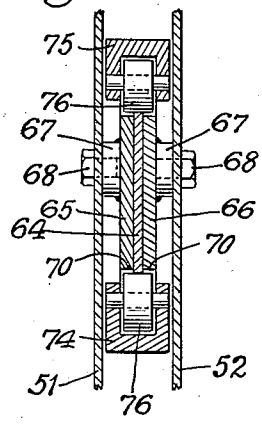
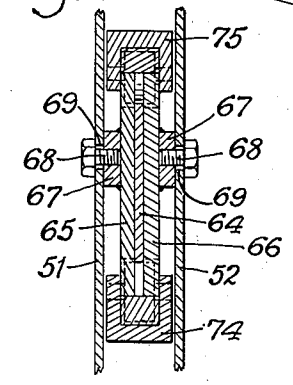


Fig. 6.



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APPARATUS FOR ROLLING HELICOID CONVEYER FLIGHT

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Fig. 7.

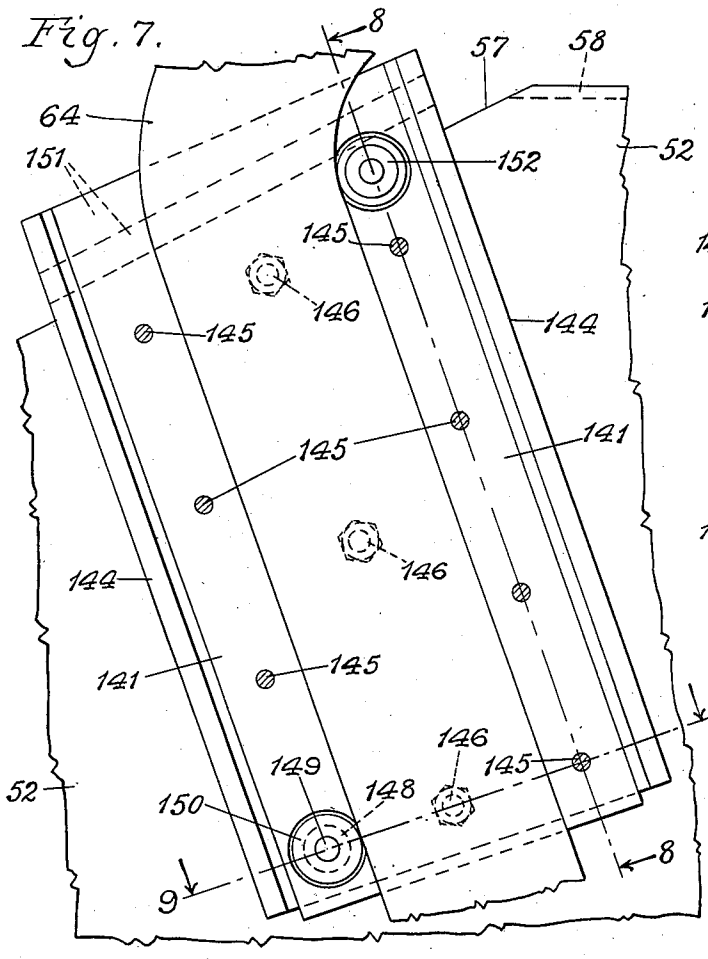


Fig. 8.

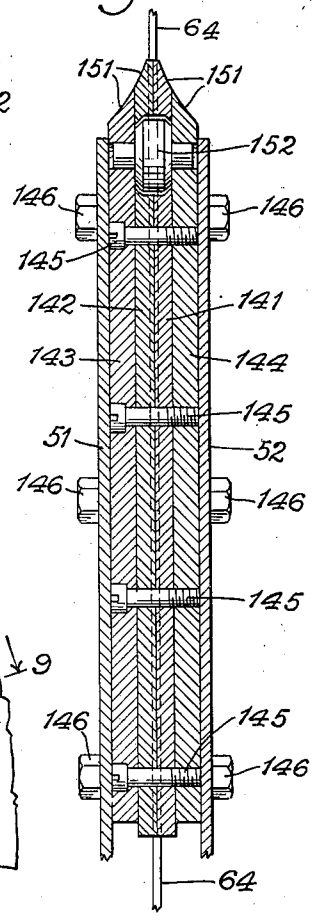
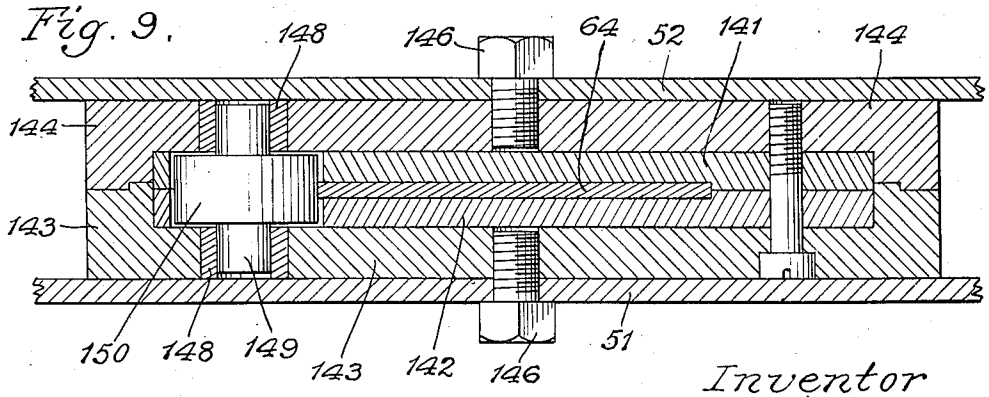


Fig. 9.



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APPARATUS FOR ROLLING HELICOID CONVEYER FLIGHT

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Fig. 10.

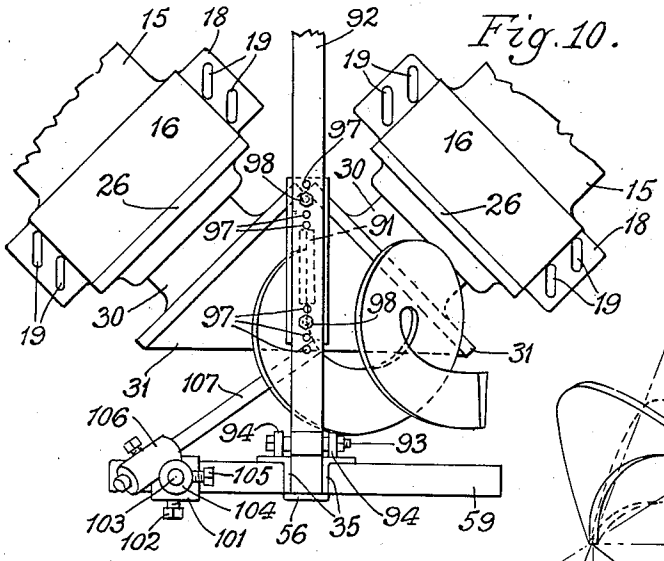


Fig. 13.

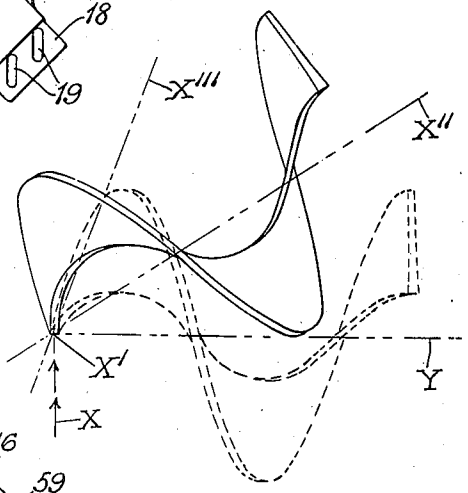


Fig. 11.

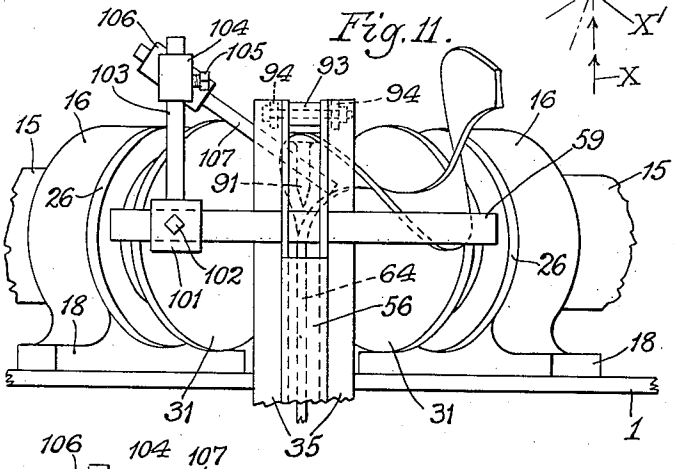


Fig. 14.

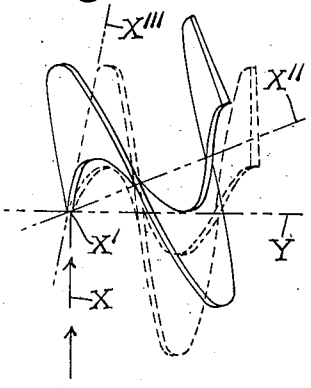
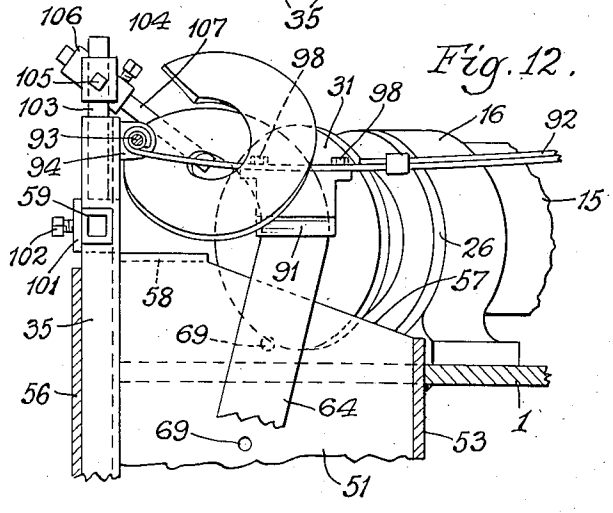


Fig. 12.



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Patented Dec. 14, 1943

2,336,602

UNITED STATES PATENT OFFICE

2,336,602

APPARATUS FOR ROLLING HELICOID CONVEYER FLIGHT

Hiram O. Fulson, Chicago, Ill., assignor to Link-Belt Company, a corporation of Illinois.

Application November 10, 1941, Serial No. 418,495

12 Claims. (Cl. 80—31.1)

My invention relates to apparatus for cold rolling helicoid flight such as is used in connection with spiral or screw conveyers.

Among the objects of my invention are to provide a new and improved type of feed box which will be easy, and convenient to assemble, maintain and adjust, durable and give a maximum amount of support to the stock and which will cooperate with the other elements of the machine to produce satisfactory cold rolled helicoid flight.

This application is a continuation application in part based on my co-pending application filed November 25, 1938, Serial Number 242,198, which is now Patent No. 2,262,227 dated November 11, 1941.

The present application concerns itself particularly with the means which guide and direct the flat strip or ribbon as it travels toward the forming rolls and with the particular contour and treatment of the flight as it emerges from the pass between the rolls, and therefore only so much of the device of the original patent application is illustrated in this application as is sufficient to show the characteristics of the guide and the relationship between the guide and mechanism and the relationship between the flight guide and controlling means and the rolls and reference is made to the original application for details not illustrated in the present application.

Other objects will appear from time to time throughout the specification and claims.

My invention is illustrated more or less diagrammatically in the accompanying drawings, wherein—

Figure 1 is a central vertical section through the device;

Figure 2 is a section along the curved line 2—2 of Figure 1;

Figure 3 is a section along the line 3—3 of Figure 1;

Figure 4 is a perspective of a type of stock guide plate and roller cages in disassembled arrangement;

Figure 5 is a section along the line 5—5 of Figure 1;

Figure 6 is a section along the line 6—6 of Figure 1;

Figure 7 is a section through a modified form of feed box on the same general section line as Figure 1;

Figure 8 is a section on the line 8—8 of Figure 7;

Figure 9 is a section along the line 9—9 of Figure 7;

Figure 10 is a plan view of the conical forming rolls showing a right hand conveyer take off with a wedge and forming pin;

Figure 11 is a front elevation with parts shown in Figure 10;

Figure 12 is a diagrammatic side elevation of the elements shown in Figure 11 with parts in section showing a right hand conveyer flight issuing from the machine;

Figure 13 is a detail showing the conveyer wherein the pitch and outside diameter are approximately equal;

Figure 14 is a detail showing a conveyer wherein the pitch is approximately one-half of the outside diameter.

Like parts are indicated by like characters throughout the specification and drawings.

1 is a table top. It is supported by legs 2. The top is generally triangular in cross section. The legs are tied together at the bottom by a horizontal frame-work 3, and at the top by a plurality of vertical parallel I-beams 4, joined by short perpendicular intermediate members 5, upon which the table top 1 rests, all uniting to make a rigid stiff, solid structure.

Welded or otherwise permanently attached to the table top 1, are four spaced rectangular sockets 8 and 9. These sockets all have inwardly extending set screws 10, which may be adjustable toward and from one another and the sockets 9 have associated with them brackets 11, which are rigidly attached to the I-beam structure below the table top, are welded to the table top as indicated and overhang the socket 9, each bracket having a plurality of set screws 12, which may be adjusted. The sockets 8 and 9 are arranged in two opposed pairs, one along each edge of the table top 1, along intersecting axes. Supported on the table top are two hollow shaft housings 15, each terminating in enlarged bearing pockets 16, 17, and each bearing sleeve having a foot 18 enclosed within the socket for adjustable movement and adapted to be locked in position by means of the set screws 10. 31 are conical rolls mounted on suitable roll shafts 29 contained within the shaft housings 15 and supported by bearings within the pockets 16 and 17, which bearings are not here shown.

Projecting upwardly above the table top and extending below it are two opposed angle members 35, rigidly attached by suitable means to the table top and other parts of the frame of the machine.

In line with the angles 35, the table top 1 is slotted and two opposed horizontal channel members 51, 52, extend vertically through this slot,

being welded to the table and to the front I-beams which are cut away to permit passage of the channel plates. 53 is a plate welded to the rear end of the two channels and extending vertically from a point above to a point below the table top 1, and having a right angle extension 54, which underlies and is welded to the channel flanges. This extension is perforated in line with a nut 55, the purpose of which will hereinafter appear.

56 is a plate joining the front edges of the channels 51 and 52, just as the plate 53, joins their rear edges. The upper portions of the channels 51 and 52, are cut away as at 57, adjacent the rolls 31 so that the upper edges of the channels terminate adjacent the apices of the rolls. 59 is a hollow square tube intersecting the forwardly extending flanges of the angles 35, which are cut away for that purpose. This tube is welded to the angles, projects across the machine and supports and contains welded therein a nut 60, the purpose of which will hereinafter appear.

61 is a bracket associated with one of the table support columns 2. It carries an inclined stub shaft 62, on which is mounted for rotation a reel 63, adapted to carry the stock or steel ribbon 64, which is to be used to form the helicoid flight. This steel ribbon is adapted to be fed upwardly from below into the pass between the rolls whereby it is formed into conveyer flight.

The means for guiding the stock include two opposed wear plates 65, 66, having a plurality of bosses 67, threaded to be engaged by studs 68, which enter through the channels 51, 52 by holes 69. These holes may be somewhat larger than the studs so as to permit some measure of adjustable movement of the studs, if desired, where they engage the bosses to assist in positioning the wear plates 65, 66. These wear plates are notched as indicated at 70, and terminate at their upper ends in guide members 71, 72, having tapered extremities 73, adapted to conform generally to the contour of the rolls so that these wear plates may guide the stock as closely up to the pass between the rolls as possible. 74, 75, are channel cages adapted to enclose the notched edges of the wear plates and terminating in heads 71, 72. Each of these cages carries preferably three rollers 76, which fit within the recesses or notches 70, and are adapted to engage the opposed edges of the stock. There is an additional roller 77, carried by the guide heads 71, 72, immediately adjacent the pass where the stock enters the rolls. These heads are thicker than the plates 65, 66 and constitute terminal reinforcements thereof. All this mechanism, including wear plates, cages, etc. is contained within the box perpendicular to the plane defined by the axes of the two rolls formed between the two channel plates 51, and 52, and the wear plate and cage assembly may be removable and interchangeable to provide for a range of stock of different width and different thickness.

To roll conveyer flight of different diameters, it is important to be able to adjust the position of the stock as it is fed to the rolls. This is accomplished by the two wedges 81, 82, which are slotted at 83, 84, as indicated to engage screw heads 85, 86, on screws 87, 88, threaded respectively in the nuts 55 and 60. These screws are provided with capstan bars 89. If desired, a filler plate 90, may be interposed between the wedge 82, and the cage 74, or the wedge 81, and the cage 75, as the case may be, depending upon the position on the rolls that it is desired to have the stock enter. The use of the two opposed wedges makes it possible to move the whole feed box assembly including the wear plates, the rollers, the cage and the bosses in a direction perpendicular to the plane defined by the axes of the two rollers so that the stock may enter the rolls close to or far from their apices. The wedges may also be used to supply a sufficient initial pressure upon the opposed edges of the stock to insure proper operation.

When it is desired to disassemble the feed box, the pressure on the wedges is released and the box may then be withdrawn from below because the flanges of the channels are outwardly disposed. When the box has been withdrawn, it is then possible to withdraw the two wedges by moving them laterally in a direction perpendicular to the plates 53, 56, to disengage them from the nuts 84, 85.

Under some circumstances, it is desirable to change the angle of approach of the stock. This may be done by substituting for the wedges 81, 82, wedges having faces whose inclination is different from those shown, or other suitable means may be used to change the angle, the reason for this being, of course, that variations in the thickness of the stock and variations in the contour of the helicoid need to be compensated for under some circumstances by changes in the angle of approach so that the metal strip or stock will flow smoothly into the pass between the rolls with a minimum of distortion, pressure and resistance.

As the stock is fed up through the pass between the rolls, it is distorted. The thickness remains constant or substantially constant at its inner periphery and is greatly decreased at its outer periphery. As a result, the inner periphery of the flight is short relatively to the outer periphery, this causes the stock to take generally the shape shown in Figure 10. Whichever way it goes, however, to the right or left as it comes out of the pass decides the question whether the flight is going to be a right hand or left hand flight. In order to control this, I use a wedge 91, which will be yieldingly held in the space between the rolls immediately adjacent the discharge side of the pass by a spring support 92, pivoted at 93, on a bracket 94, supported by the upper ends of the angles 35. At its rear end, this spring is supported by links 99. The wedge 91 is adjustably positioned on the spring lever 92, by means of a plurality of spaced holes 97, engaged by studs 98, so that the wedge may be longitudinally adjusted in consonance with longitudinal adjustment of the position of the feed box and stock for different positions of the pass along the face of the rolls.

If the flight is to be discharged to the right, the wedge is placed on the right hand side of the flight instead of as would at first thought be expected on the left hand side. In other words, the wedge is placed on the side of the flight toward which the flight is to go. The reason for this and effect of this will hereinafter appear.

101 is a bracket slidable along the shaft 59. It is adapted to be locked in position by means of a set screw 102. This bracket carries the upright 103, upon which is slidably mounted a sleeve 104, which may be angularly and vertically adjusted and held in position by the set screw 105, projecting laterally from this sleeve 104 is another sleeve 106, inclined to the sleeve 104. Under some circumstances, the sleeves 106

and 104 may be angularly adjustable with respect to one another or under other circumstances they may be adjusted once and for all and welded or otherwise rigidly fastened together. The sleeve 106 carries axially adjustable therein a flight guide 107, adapted to be adjusted in position to engage the flight as it passes out from between the pass in opposition to the wedge 91.

The sprocket 32, there being one on each roll shaft 29, is driven by a chain 113 from any suitable motor. There may be two motors one for each shaft or a single motor by two speed reducers not here shown may drive separately the two chains 113 but there is no direct mechanical connection between the two roll shafts.

Figures 10, 11 and 12 diagrammatically show the discharge of the stock from the pass between the rolls. Figure 11 shows the rolls as you would look at them standing in front of the machine. Figure 10 shows the rolls as you would look down on them from above. Figure 12 shows the roll if the near roll and associated elements were removed. In each case a right hand helicoid conveyer or flight is shown.

Considering first the aspect of the flight as in Figure 11, the rolls are so positioned that the thickest part of the flight is nearest to the apices of the rolls and nearest to the point at which the axes of the rolls prolonged, intersect, that is, at the point of minimum diameter of the roll the flight is the thickest and as the diameters of the rolls increase, the pass between them decreases and the flight decreases in thickness.

As the stock comes up through the pass, the tendency is for it to form a washer, the decreased thickness of the outer periphery resulting in an increased peripheral length and if nothing were done about it, the stock would tend to form a flat or nearly flat series of washers.

The guiding means applied to the flight after it has come through the pass determine whether or not the flight shall be right or left hand and determine the pitch. It will be noted that the stiffest part of the flight is at the inner periphery where the thickness has been little if any reduced. There is a tendency for the stock to come straight up, bisecting the angle between the opposed roll races. The flight guide member 107, engages the near face of the flight, and wedge 91, engages the forward side of the flight, as seen in Figure 11. The wedge tends to bend the thinner less resistant portion of the flight to the left, in Figures 10 and 11 in the direction opposite to the direction the flight is going to take in leaving the rolls. The guide 107, tends to cause the flight to discharge from the rolls toward the right, as shown in Figure 10. The operation of these two guide members fixes the direction of travel and the angle or pitch and the change in direction of the stiffer central portion of the flight is a minimum while the change in direction or change in angle of the lighter, thinner, more flexible portion of the flight is a maximum. These two cooperating guide elements are all that is required to determine the direction of travel and the pitch. The wedge 91, forcing the thinner portion of the flight over to the left causes the flight itself to form as it is discharged from the roll, the desired pitch of the stock to conform to the pitch imposed upon it by the guide 107.

Under some circumstances, a wide range of interchangeable wear plates may be used, and the holes in the channels 51, 52, under these circumstances will be of such size and shape that when the studs are inserted into the bosses for any pair of wear plates, the wear plates will be fixed in position without the possibility of adjustment. Under these circumstances, the adjustment will be made once and for all and when it is desired to roll any particular size or type of conveyer flight, the proper wear plates will be selected and will be bolted into position, the wedges being used both to assist in registering the wear plates with the stud holes in the channels and to help carry the load on the bolts. Such an arrangement insures a positive non-changing positioning of the wear plates for each size of flight.

One reason for the use of the filler plate 90, is that by using it a minimum wedge screw travel will be needed to fix the position of the cages and wear plates which form a part of the stock feed box.

If desired, the slots which permit the lateral disassembly of the wedges may have substituted for them a pocket which can be aligned with a hole in one or both of the channel plates so that access may be had to the end of the screw to pin or weld the head to the screw in the pocket in the wedge.

The stub shaft 62, which carries the reel 63, is mounted on a slide block 125, which travels between the channels 126, 127, on the frame. This block may be horizontally displaced by a screw 128, threaded in the nut 129 rigidly supported on the channels 126, 127, so as to adjust the position of the reel to insure that the stock as it is paid off the reel into the feed box will always be discharged tangentially from the reel and will travel a straight path from such tangential discharge to the feed box.

In order to assist in positioning the feed box in place, it may be supported by a diagonal screw 130 threaded in a nut 131, supported between the angles 35. This nut is sufficiently forward that the feed box when the pressure on the wedges has been released may be rotated enough to pass down between the wedge 81, and the nut 131, and the inner end of the screw 130, to permit withdrawal of the box. The slight inclination of the screw is not sufficient to interfere with this operation.

Although the wedge 91, might under some circumstances, be rigidly supported, experience teaches that it is better to have it spring supported, because a smoother action results and there is less danger of scarring the flight as it is discharged from between the rolls or of obstructing the movement of the flight between the rolls.

In the modified form shown in Figures 7 to 9, the feed box takes the form of two opposed grooved wear plates 141, 142, the groove being of such dimensions as to make a running fit with the stock to be fed. These two plates are socketed within a cage formed of the flanged plates 143, 144. These flanged plates are held together by studs 145, to lock and clamp the wear plates in position and the assembly is held in place between the two channel plates 51 and 52, by the studs 146, in the same way as the other feed box is held. The plates 143, 144 contain bearing sleeves 148, in which are supported roll shafts 149, carrying rolls 150, there being one roll at the upper end and one roll at the lower end of the feed box. The plates 143, 144, and 141, 142, are chamfered or tapered as indicated at 151, to fit deep into the throat between the rolls and to make it possible for the upper roller 152, which is

tapered as indicated also to fit deep into the throat between the rolls so as to guide the stock to the maximum as it enters the pass.

Another important function of the feed box adjusting wedge is in connection with the initial setting up of the apparatus for a new size of helicoid conveyer flight. When the calculations have been made for setting up the rolls to properly shape and position the pass and for positioning the feed box in proper alignment with the pass, the various roll adjusting means and the feed box adjusting wedges will be manipulated to set the machine up according to the desired adjustment, then flight may be rolled. If it happens that because of slight inaccuracies of adjustment or because of yielding of the parts or wear of the parts, the adjustment is not absolutely correct, this will appear by measuring the flight, then the various adjustments including the feed box wedges may be manipulated to compensate for such inaccuracies. A further run may be made, the flight again measured and this process can continue until proper correct conveyer flight is discharged from the machine, then the positions of the various parts may be scribed or otherwise indicated on the table top and on the feed box support and at that time the feed box bosses may be welded in place so that whenever it is necessary to set the machine up again for the particular conveyer flight, the parts may be reset without further calculations.

In connection with Figures 13 and 14, conveyer flight has been shown both as discharged from the rolls according to my invention and as to devices of the past for the purpose of pointing out and emphasizing the fact that by my arrangement with the conveyer flight so discharged and so guided that the central axis of the helix makes an acute angle with a plane tangent to the forming rolls extending from them in the general direction of discharge, the stiffer, thicker portion of the helix is given a minimum bend, thereby decreasing the burden upon the rolls and guiding elements and also decreasing the distortion of the metal.

Referring especially to Figures 13 and 14, which show two right hand helicoid flights of different pitch but the same outside diameter, and adapted to be mounted on the same size pipe, the stock in each case approaches the rolls along the line x—x'. As the helicoid is formed by the rolls, the wedge **91**, forces the outer thinner, less resistant portion of the helicoid to the left, and the thicker stiffer, more resistant inner portion of the helicoid is deflected slightly to the right. The thinner portion that was first deflected to the left as the helicoid is rolled out, travels in unison with the inner thicker portion winding about it so that the whole helicoid is discharged along the line x'—x'' which is the center of the helix. The line x'—x'' is the line of the inner stiffer helix. Thus there is a minimum of distortion of the thicker portion of the helicoid as it is discharged from the roll. This is in sharp contract with previous practice as indicated by the dotted line helicoid where instead of causing the two edges of the helicoid to discharge from the rolls, one on each side of the line of approach, the whole helicoid is forcibly bent to the right so that the thinner portion of the helicoid is discharged generally parallel with the line of approach and the deflection of the thicker, stiffer edge of the helicoid is greatly increased.

As a result, the distortion of the metal in my apparatus is reduced to a minimum in contrast with previously known devices where the distortion is a maximum. Because I allow the stiff portion of the helicoid so far as possible to travel the path it normally would travel doing the maximum amount of bending with respect to the thin, rather than the thick edge, I am able to use much lighter and cheaper guiding and positioning means. The wear on them and on the flight and the danger of scoring or distorting the flight is reduced to a minimum and even more important experience teaches that by my method the power requirements are substantially cut in half. The reverse of the above deflections would apply for left hand conveyer. The line x'—y indicates the center line of the helicoid discharged according to the old method.

It will be realized that while I have described and illustrated an operative machine, still many changes might be made in the size, shape, arrangement and disposition of parts without departing materially from the spirit of my invention and I wish, therefore, that my showing be taken as in a large sense diagrammatic.

While my invention is particularly well adapted to the production of helicoid conveyer flights and the like, it is of course obvious, that it may be used for the manufacture of springs or any other situation where it is desired to roll from a generally straight stock or strip, a generally spiral stock or strip or even where it is desired to form washers of rolled stock.

I have used the term "line of closest approach" to refer to the line of intersection of the plane in which the axes of the two rolls lie with a plane perpendicular to said plane defined by the said axes, such perpendicular plane passing between the two opposed roller surfaces.

I claim:

1. In an apparatus for rolling helicoid conveyer flight including a pair of opposed generally conical rolls, a feed box adapted to guide the stock into the pass between the rolls and positive means for adjusting the feed box longitudinally in parallelism with the line of closest approach of the roll surfaces, and in a plane containing said line of closest approach, said plane being at substantially right angles to a plane containing the axes of the rolls, whereby the position of the inner edge of the stock with respect to the point of intersection of the axes of the two rolls as it passes between the rolls may be positively controlled.

2. In a rolling machine for rolling helicoid conveyer flight, a pair of opposed generally conical rolls, a feed box presented to them including wear plates terminating immediately adjacent the face of the rolls, the wear plates terminating in reinforcing heads to prevent distortion thereof, a support for the wear plates and the heads and a guide member adapted to engage the edge of the stock fed between the wear plates immediately adjacent the throat between the forming rolls.

3. In a helicoid conveyer flight rolling machine, a pair of opposed generally conical rolls, an adjustable feed box adapted to guide the stock thereto, a fixed supporting box for the feed box and positive means for adjustably positioning the feed box in the supporting box, an parallelism with the line of closest approach of the roll surfaces, and in a plane containing said line of closest approach, said plane being substantially at right angles to a plane containing the axes of the rolls, whereby the position of the inner edge of the stock with respect to the point of inter-

section of the axes of the two rolls, as the stock passes between the two rolls, may be positively controlled.

4. In a helicoid conveyer flight rolling machine, a pair of opposed generally conical rolls, an adjustable feed box adapted to guide the stock thereto, a fixed supporting box for the feed box and positive means for adjustably positioning the feed box in the supporting box, said means being adapted to laterally displace the feed box toward and from the apices of the rolls in parallelism with the line of closest approach of the rolls, and in a plane containing said line of closest approach, said plane being substantially at right angles to a plane containing the axes of the rolls.

5. In a helicoid conveyer flight rolling machine, a pair of opposed generally conical rolls, means for guiding a strip of stock to the pass between the rolls, said means being adapted to maintain the stock in a plane perpendicular to the plane defined by the axes of the two rolls, and means for laterally displacing the stock in said plane laterally toward and from the apices of the rolls along the line of closest approach of the rolls.

6. In a helicoid conveyer flight rolling machine, a pair of opposed generally conical rolls, means for guiding a strip of stock to the pass between the rolls, said means being adapted to maintain the stock in a plane perpendicular to the plane defined by the axes of the two rolls, and means for laterally displacing the stock in said plane laterally toward and from the apices of the rolls along the line of closest approach of the rolls, and means for positively adjusting the angle of approach of the stock in said perpendicular plane.

7. In a helicoid conveyer flight rolling machine, a pair of opposed generally conical rolls, means for guiding a strip of stock to the pass between the rolls including a fixed rigid box member, a pair of lateral stock engaging wear plates enclosed between the wall of the box member, means for removably attaching each wear plate to one wall of the box, means adjacent each edge of the opposed wear plates adapted to engage the edge of the stock passing between them, and means for holding the wear plates and the edge engaging members in rigid fixed relationship within the box.

8. In a helicoid conveyer flight rolling machine, a pair of opposed generally conical rolls, means for guiding a strip of stock to the pass between the rolls including a fixed rigid box member, a pair of lateral stock engaging wear plates enclosed within the walls of the box member, means for removably attaching each wear plate to one wall of the box, means adjacent each edge of the opposed wear plates adapted to engage the edge of the stock passing between them, and means for holding the wear plates and the edge engaging members in rigid fixed relationship within the box, and means for positively adjusting the position of the wear plates and the wear engaging members in the box with respect to the rolls.

9. In an apparatus for rolling helicoid conveyer flight, including a pair of opposed generally conical rolls, a feed element adapted to guide the stock into the space between the rolls, said feed element lying in a plane perpendicular to the plane defined by the axes of the two rolls, said plane passing through the intersection of the axes of the rolls, and passing between said rolls, and means for adjusting the feed element in parallelism with the line of closest approach of the rolls.

10. In an apparatus for rolling helicoid conveyer flight, including a pair of opposed generally conical rolls, a feed element adapted to guide the stock into the space between the rolls, said feed element lying in a plane perpendicular to the plane defined by the axes of the two rolls, said plane passing through the intersection of the axes of the rolls, and passing between said rolls, and means for adjusting the feed element in parallelism with the line of closest approach of the rolls, said feed element including a fixed box and a pair of opposed and laterally spaced guides adjustable within said fixed box and lying, at all adjustments, in the plane of said feed box.

11. In a helicoid conveyer flight rolling machine, a pair of opposed generally conic rolls, a fixed supporting box lying in a plane which includes the line of closest approach of said rolls, an adjustable feed box adapted to guide the stock and located within and enclosed by said fixed supporting box and means for adjusting said adjustable feed box laterally in parallelism with the line of closest approach of the rolls.

12. In an apparatus for rolling helicoid conveyer flight, a pair of opposed generally conic rolls, the axes of which converge generally at the tips of said conic rolls, and means for guiding the stock into the spaces between the rolls including a feed element lying in a plane perpendicular to the plane defined by the axes of the two rolls, said feed element including means for feeding the stock along a plane passing through the intersection of the axes of the rolls and passing between said rolls, and means for adjusting said feed element in parallelism with the line of closest approach of the rolls.

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