

June 11, 1957

P. L. T. JENSEN
APPARATUS FOR ROLLING A STRIP OF SHEET
MATERIAL INTO A REGULAR ROLL

2,795,384

Filed Aug. 28, 1952

4 Sheets-Sheet 1

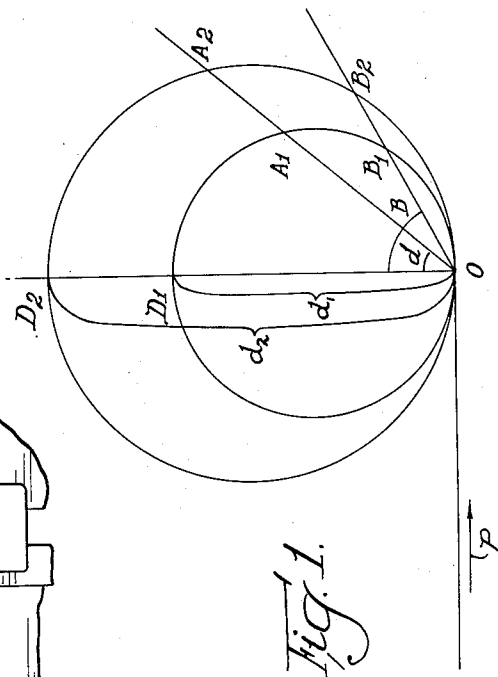
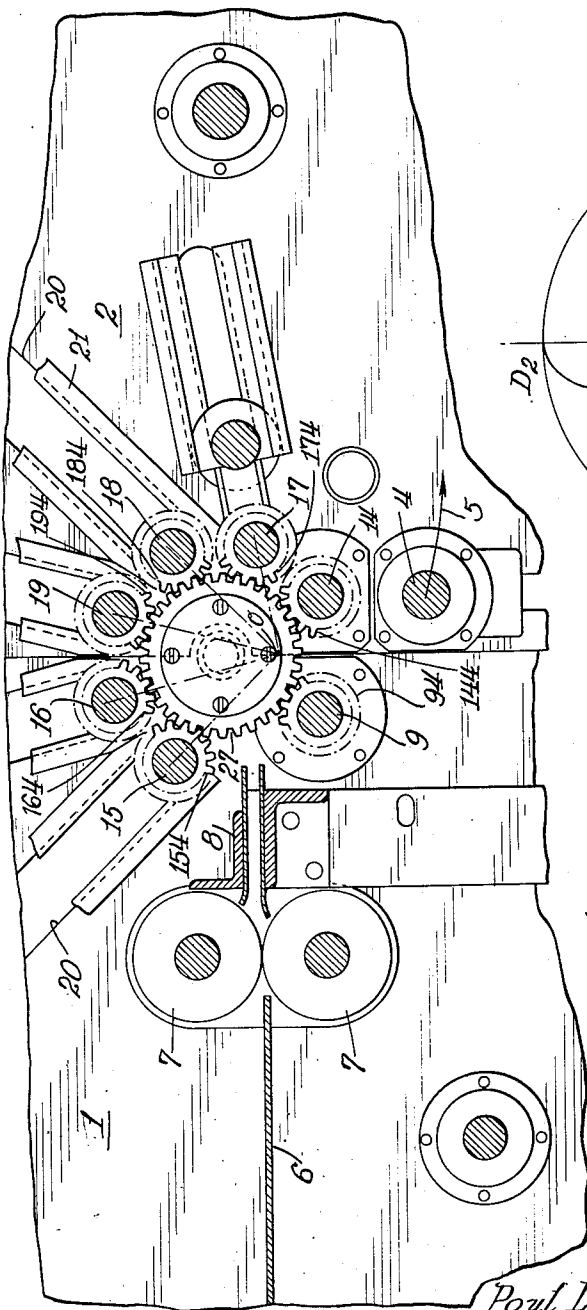


Fig. 3.

Fig. 1.

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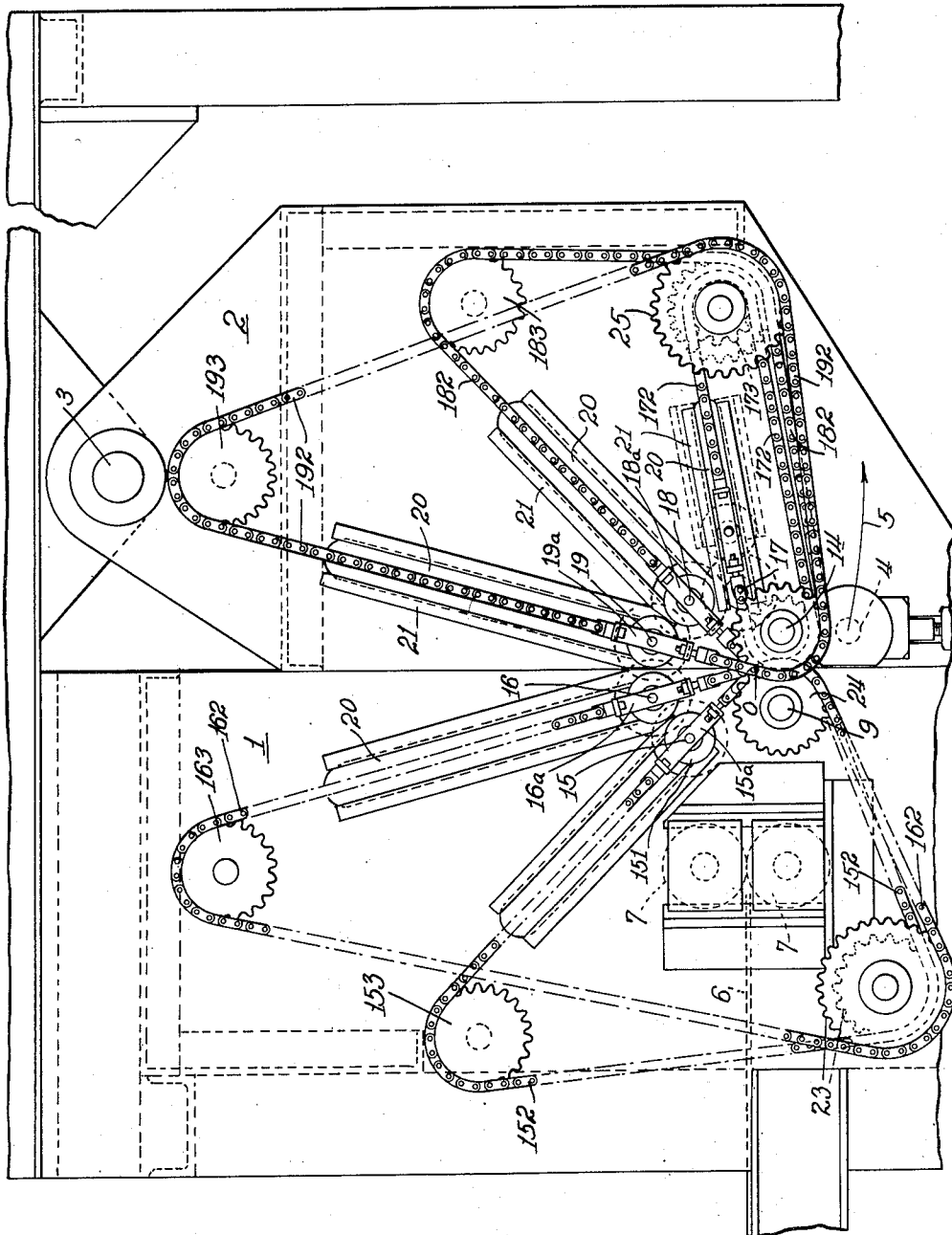


Fig. 2.

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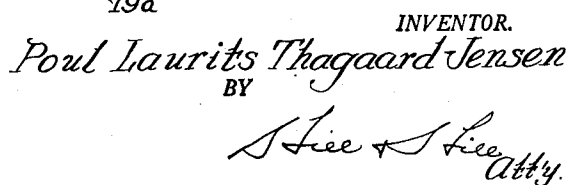
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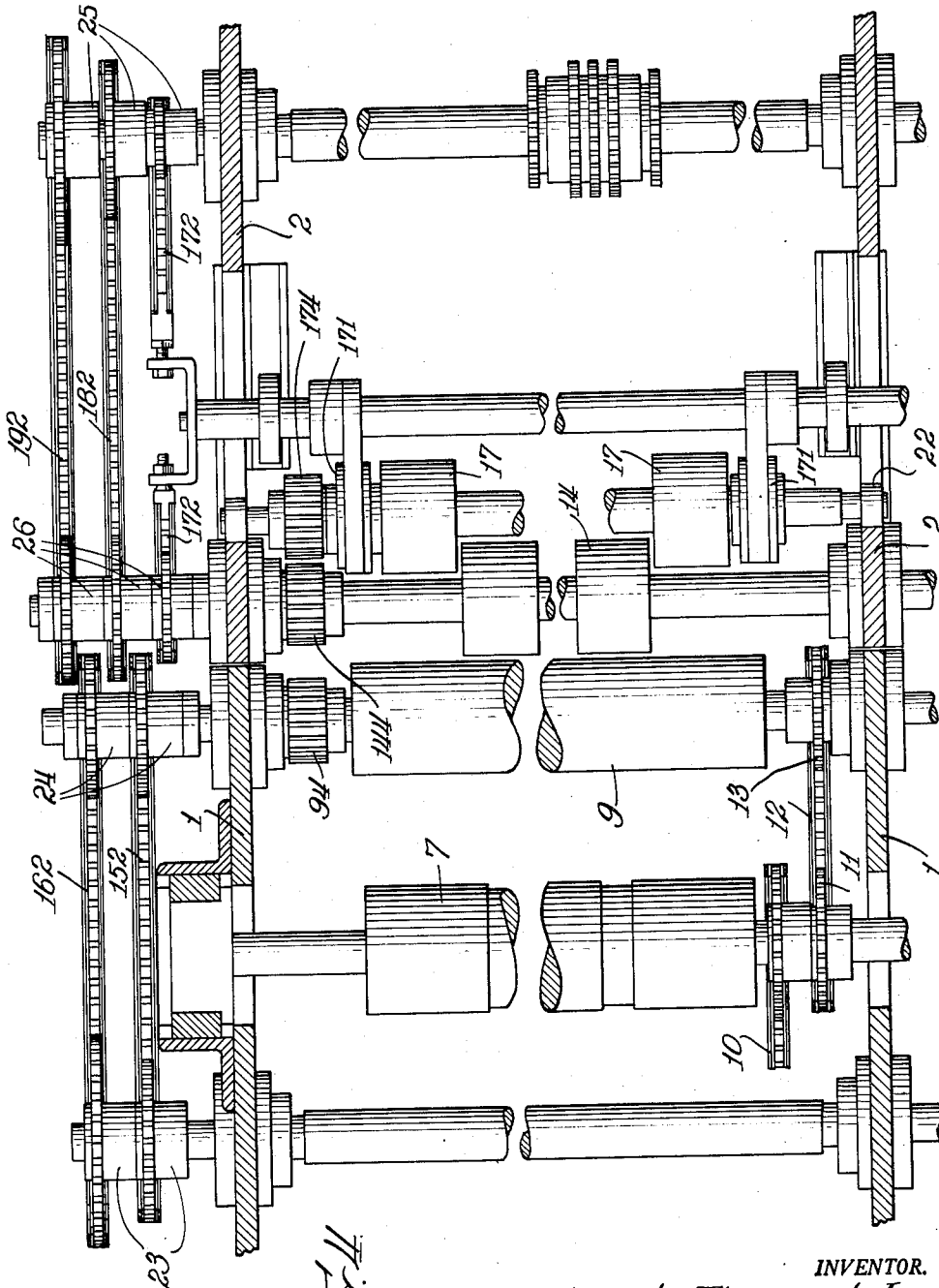


Fig. 11

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APPARATUS FOR ROLLING A STRIP OF SHEET MATERIAL INTO A REGULAR ROLL

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16 Claims. (Cl. 242—66)

The invention relates to a device for rolling strips of sheet material, for instance, roofing felt, into regular rolls.

It is the principal object of the invention to provide an apparatus constructed on the basis thereof for the rolling of stiff strips of sheet material offering considerable resistance against rolling into regular rolls without the use of a mandrel or core. The use of such mandrel or core, which as stated, is obviated by the invention involves various drawbacks, inasmuch as the mandrel, which may, for instance, consist of a tube of cardboard manufactured beforehand, must either be left in the roll, which materially increases the costs of production, or must be removed from the completed roll, an operation which renders the production more difficult.

The difficulty of making a stiff strip of sheet material roll straight into a regular roll without the use of a mandrel or core is overcome according to the invention by carrying the strip over supporting rollers placed at right angles to direction of motion of the strip and under a number of shaping rollers parallel to the supporting rollers and so coupled that they may be forced apart and compelled to follow one another so that they will always be situated on a circle passing through the point of contact of the strip with the supporting rollers, with the result that during the entire rolling process the stiff strip will be supported by many rollers distributed along its circumference and compelled always to stay on a circle wherefore they will by positive action prevent the roll from becoming distorted.

For the purpose of a detailed explanation of the invention reference is made to the drawing in which

Fig. 1 shows a diagram explaining the geometrical factors on which the method is based,

Fig. 2 a part of an apparatus according to the invention in side elevation.

Fig. 3 a vertical section through part of the same apparatus also in side elevation,

Fig. 4 a horizontal section through the same part, and

Fig. 5 some shaping rollers seen from above.

If we regard a circle as shown in Fig. 1, which during a certain period increases in size, so that its diameter from $OD_1=d_1$ grows to $OD_2=d_2$, a chord OA_1 issuing from point O at an angle α with the diameter OD_1 will grow from OA_1 to OA_2 . As $OA_1=d_1 \cos \alpha$ and $OA_2=d_2 \cos \alpha$, A_1A_2 will be equal to $D_1D_2 \cos \alpha$. Another chord at angle β will correspondingly increase $B_1B_2=D_1D_2 \cos \beta$. It will therefore be found that all chords issuing from point O at different angles will have increases bearing the same relation to one another as the ratio between the cosines of their angles irrespective of the increase in diameter. It will therefore be evident that if points A_1, B_1 , etc. situated on the small circle are moved outwards along the chord so that the ratios between their simultaneous shiftings and the cosines of their angles remain constant and uniform as regards all the points, the latter will remain situated on a common, increasing circle through point O.

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The present method for the rolling of a strip of sheet material into a roll is based on the facts that the strip is entered at right angles to the diameter OD, as indicated by the arrow P in Fig. 1, and supported by shaping rollers placed in points of a circle and guided by rectilinear guides along the chord issuing from point O and so coupled together that they will at all times remain on a common circle, whereby the strip will be rolled into a regular roll as will be explained in more detail in the following, in which under reference to the drawing a description will be given of a specimen embodiment of such an apparatus. It is pointed out that the method may be carried out in many ways other than the specimen embodiment produced and explained and that the invention is therefore not confined to such specimen embodiment.

The apparatus shown has two fixed side plates or frames 1 parallel to one another and two likewise parallel, turnable sideplates 2 situated in the same plane as the fixed sideplates and suspended from bolts 3 serving as co-axial pivots. The turnable side plates 2 are at bottom provided with journals 4, which may be swung outward on tappets 3 in the direction indicated by arrow 5.

Between the fixed plates 1, a fixed table 6 is placed contiguous to the entrance between two feed rollers 7 which are mounted on the plates 1 and serve to feed a strip of sheet material, for instance roofing felt, placed on the table 6 in between guides 8 and on to a supporting roller 9 mounted on plates 1. The feed rollers are operated by a motordriven chain 10 and carry a sprocket wheel 11 which by a chain 12 is connected with a sprocket wheel 13 on the supporting roller 9. In plates 2 is mounted a supporting roller 14 corresponding to the driven roller 9. Rollers 9 and 14 are mounted symmetrically on the plane of contact between side plates 1 and 2. The roller 14 is not a single, cylindrical roller but a collection of short, cylindrical lengths of roller evenly distributed along the length of the roller and interspaced so that the roller will be in a stepped or overlapped relationship with the rollers of a shaping roller 17, Fig. 4, for rolling the strip of sheet material being rolled into a regular roll.

In the apparatus shown in the drawing the fixed sideplates 1 further have bearings for two shaping rollers 15 and 16 and the turnable side plates 2 bearings for three shaping rollers 17, 18 and 19. These shaping rollers rest in rectilinear guides formed by recesses or slots 20 in the side plates, the said recesses or slots being edged with guide strips 21 between which bearings 22 for the roller gudgeons are placed, so that the shaping rollers may shift forwards and backwards in the guides. The recesses or slots 20 which have the guide strips 21 on the opposite longitudinal edges of the slots provide shaping roller guide grooves to complementally receive the bearings 22. The lines of direction of all the guides issue from one point O, Fig. 2, situated intermediate the rollers 9 and 14. The guides are placed at different angles to a perpendicular through point O on table 6.

The axles of rollers 15—19 are at both ends provided with bushings 151—191 connected by links 15a and 19a, Figs. 2 and 5, with endless chains 152—192 carried over sprocket wheels mounted on the sideplates as will be described in the following. Rollers 16 and 18 have similarly mounted links 16a and 18a, Fig. 2 and Fig. 5.

Chain 152 for the shaping roller 15 is as shown in Fig. 2 operatively connected to the bushing 151 and trained over sprocket wheel 153 in such a way that the part of chain between the bushing 151 and the sprocket wheel 153 runs in the direction of the guide 20, 21 of shaping roller 15. Thence chain 152 is carried on over a dual sprocket wheel 23 common to chains 152 and 162, the diameters of the pitch circles of the said dual

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sprocket wheel 23 bearing the same ratio to one another as the cosine of the angles of the rectilinear guides taken along the centerline thereof, for shaping rollers 15 and 16, said angles referred to the diameter of the roll as it is being rolled, Fig. 1, said diameter being perpendicular to the direction of the strip of material being fed. From the sprocket wheel 23 the chain 152 is taken over a guide-wheel 24 loosely mounted on the axle of supporting roller 9, so that the chain will be guided from sprocket wheel 23 at right angles with respect to the axis of bushing 151. In a similar manner chains 162—192 are carried over guide-wheels 163—193, so that the parts of chain leading from bushings 161—191 will run in the direction of the guides of the shaping rollers to which they belong and thence over the sprocket wheel 23 for chains 152 and 162 for the shaping rollers mounted 15 and 16 on plates 1 and a triple sprocket wheel 25 for the shaping rollers 17, 18 and 19 mounted on plates 2, and finally over a guide-wheel 26 corresponding to guide-wheel 24, the former carrying the chains 172—192 back to bushings 171—191 in the direction of the rectilinear guides for shaping rollers 17—19. The pitch circles of the three sprocket wheels forming the triple wheel 25 have diameters bearing the same relation to one another as the cosines of the angles of the three rectilinear guides for shaping rollers 17, 18 and 19.

The shaping rollers are stepped in the same manner as supporting roller 14 and are so shaped and mounted that the steps will engage each other and the supporting roller 14.

When the shaping rollers are left to themselves they will by gravity be forced to the bottoms of guides 20, 21 into the position shown in the drawing. In this position of rest the shaping rollers will lie on a small circle passing through point O.

The supporting roller 9 is provided with a pinion 94 meshing with a pinion or spur gear 27 mounted on sideplate 2 which pinion in turn meshes with a pinion 144 on the supporting roller 14 and with pinions 154—194 on each of the shaping rollers 15—19, so that all these rollers will be made to rotate by sprocket-wheel 11 when the parts of the machine are in the positions shown in the drawing.

The bearings of the shaping rollers in guides 20, 21 being coupled together through the coupling wheels 23 and 25 which are produced in the manner stated, the shaping rollers will be so coupled together that they will always move together forwards and backwards in the guides and so that they will always lie on circles through point O and with diameters at right angles to the plane of table 6. It may further be observed that if only one of the shaping rollers is pushed outwards in its guide all the rest of them will follow suit, so that they will always be on a circle.

This apparatus works in the manner that the strip of sheet material which is to be rolled is placed on the table 6 where it is gripped by the feed rollers 7 which will push it in between guides 8 and thence in over the supporting rollers 9 and 14. The forward edge of the strip will then impinge against the shaping rollers engaging supporting roller 14, first against roller 17 and then against rollers 18, 19 and 16 and 15, all of which are being rotated by their pinions, 184, 194, 164, and 154, respectively. As it will require some force to push the shaping rollers outwards, the strip will thereby be bent in a circle and again be carried in over the supporting rollers 9 and 14 and will in this manner be rolled up into a roll. Gradually as the diameter of the roll increases, the roll will overcome the weight of the rollers and force them outwards in the guides 20, 21 so that the rolling will at all times be fully supported by the shaping rollers which exert a formative pressure on the roll. If the roll should commence to become distorted one of the shaping rollers will be subjected to a greater pressure than the rest. This shaping roller will then be forced

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outwards and pull all the others with it so that the roll will be subjected to pressure only at the place where the distortion commences and it will therefore come into alignment again and become even. When the roll has attained a certain size, pinions 154—194 will be disengaged from pinion 27 and the rollers will then be rotated solely by the roll. When the whole strip has been rolled, journal 4 may be pulled outwards in the direction indicated by arrow 5, whereby plates 2 with the shaping rollers 17—19 and the supporting roller, 14, thereon mounted will swing outwards, so that the finished roll will drop out through the opening thus formed between supporting rollers 9 and 14. When the roll drops out all the shaping rollers will drop to the bottoms of their guides and again assume the positions shown in the drawing while at the same time plates 2 will be swung back into place. The apparatus is now ready for another rolling.

The invention is not confined to a guiding and coupling of the shaping rollers in the manner shown. For this purpose many means other than chains and sprocket wheels, as shown, may be used, nor is it necessary to have the rollers mounted in rectilinear guides as indicated. The rollers may, for instance, be mounted on pivoted arms coupled by link rods or pinions and having their movements guided by curved discs or curved guides, so that the shaping rollers as mentioned will always stay on circles, but the embodiment shown and described is rather simple and has proved to work satisfactorily in practice.

I claim:

1. Apparatus for rolling a strip of sheet material into a roll, comprising oppositely arranged similar sideplates, each of said sideplates provided with rectilinear slots formed as shaping roller guide grooves, arranged to provide opposite pairs of slots and radiating from a common point at different angles, said common point being the intersection of a diameter of the roll as it is being rolled and a tangent thereto formed by the direction of feeding of the strip of material, said angles formed by the chords of the roll corresponding to the angles of the rectilinear slots taken along the centerline thereof and passing through the common point, and the base of the angles being the diameter perpendicular to the aforesaid tangent to the roll as it is being rolled, two supporting rollers operatively mounted on the plates with a plane tangent to the surfaces of the supporting rollers including said point, a shaping roller shiftably mounted in each pair of grooved slots, means for coupling the shaping rollers so that they will be forced to follow each other in their outward and inward movements in the slots to roll the material into a roll, the periphery and diameter of the roll as it is being rolled passing through said point, and means to feed a strip of sheet material over the said supporting rollers and under the said shaping rollers.

2. Apparatus as in claim 1, in which the shaping rollers are stepped rollers in which the side edges thereof operatively engage one another.

3. Apparatus as in claim 1, comprising sprocket wheels mounted on the sideplates, chains operatively mounted on said sprocket wheels and having lengths running in the directions of the guide grooves, bushings on the axles of the shaping rollers connected with the said chain lengths, some of the said sprocket wheels being joined together so as to impart movement from one shaping roller to all shaping rollers.

4. Apparatus as in claim 3, in which certain of said sprocket wheels are double and triple sprocket wheels, and the diameters of the pitch circles of the double or triple sprocket wheels bear the same ratio to each other as the cosine of the angles of the guide grooves of the shaping rollers connected with the chains carried over the respective double and triple sprocket wheels.

5. Apparatus as in claim 1, in which each side plate

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is divided into two parts, comprising a hinge hinging the parts of the sideplates together so that they may turn in relation to one another, whereby the roll of strip material is adapted to be discharged between the supporting rollers as one supporting roller is pivoted with respect to the other supporting roller.

6. Apparatus for rolling a strip of sheet-like material into a roll, comprising side frames, a plurality of oppositely arranged pairs of guide slots provided in the side frames and radiating at different angles from a locus of the intersection of the planes in which the center-lines of the slots are arranged, said locus being the intersection of the plane through a diameter of the roll as it is being rolled and a plane including a tangent thereto formed by the plane of the direction of feeding of the strip of sheet-like material, said angles formed by the plane of the chords of the roll corresponding to the angles of the guide slots taken along the plane including the centerline thereof and passing through the locus, and the base of the angles being a plane including the aforesaid diameter perpendicular to the aforesaid tangent to the roll as it is being rolled, supporting rollers operatively mounted on the side frames whereby a plane tangent to the surfaces of the supporting rollers includes said locus, a stepped shaping roller shiftably mounted in each pair of slots, coupling means for operatively permitting the rollers to move together in their outward and inward movements in the slots to roll the sheet-like material into a roll, whereby the locus of the contacting surfaces of the stepped shaping rollers will be the surface of a cylinder through the aforesaid first-mentioned locus.

7. Apparatus for rolling a strip of sheet-like material into a roll, comprising side frames, a plurality of oppositely arranged pairs of guide slots provided in the side frames and radiating at different angles from a locus of the intersection of the planes in which the center-lines of the slots are arranged, said locus being the intersection of the plane through a diameter of the roll as it is being rolled and a plane including a tangent thereto formed by the plane of the direction of feeding of the strip of sheet-like material, said angles formed by the plane of the chords of the roll corresponding to the angles of the guide slots taken along the plane including the centerline thereof and passing through the locus, and the base of the angles being a plane including the aforesaid diameter perpendicular to the aforesaid tangent to the roll as it is being rolled, supporting rollers operatively mounted on the side frames whereby a plane tangent to the surfaces of the supporting rollers includes said locus, gravity actuated shaping rollers operatively mounted parallel to the supporting rollers and shiftably mounted in the aforesaid guide slots, coupling means for operatively permitting said gravity actuated shaping rollers to move together in their outward and inward movements in the slots under the pressure of the strip inserted under them in such a manner that the ratio between all movements of each individual shaping roller in its guide slots and the cosine of the angle of the guide slots concerned is constant and uniform for said gravity actuated shaping rollers.

8. Apparatus for rolling a strip of sheet-like material into a roll, comprising side frames, a plurality of oppositely arranged pairs of guide slots provided in the side frames and radiating at different angles from a locus of the intersection of the planes in which the center-lines of the slots are arranged, said locus being the intersection of the plane through a diameter of the roll as it is being rolled and a plane including a tangent thereto formed by the plane of the direction of feeding of the strip of sheet-like material, said angles formed by the plane of the chords of the roll corresponding to the angles of the guide slots taken along the plane including the centerline thereof and passing through the locus, and the base of the angles being a plane including the aforesaid diameter perpendicular to the aforesaid tangent to the roll as it is being rolled, supporting rollers operatively mounted on the side frames

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whereby a plane tangent to the surfaces of the supporting rollers includes said locus, gravity actuated shaping rollers operatively mounted parallel to the supporting rollers and shiftably mounted in the aforesaid guide slots, pinions operatively mounted on the aforesaid gravity actuated shaping rollers and the aforesaid supporting rollers, a spur gear operatively mounted for directly driving the aforesaid gravity actuated shaping rollers and the supporting rollers in a common direction for rolling the strip of sheet-like material into a roll, and said guide slots for said gravity actuated shaping rollers providing a lost-motion connection between the pinions operatively mounted on the gravity actuated shaping rollers and the aforesaid spur gear, whereby as the roll of sheet-like material is enlarged beyond a predetermined diameter the aforesaid pinions become disconnected from the spur gear and upon removal of the roll, the aforesaid pinions operatively connected to the shaping rollers re-engage the spur gear.

9. Apparatus for rolling a strip of sheet-like material into a roll, comprising side frames, a plurality of oppositely arranged pairs of guide slots provided in the side frames and radiating at different angles from a locus of the intersection of the planes in which the center-lines of the slots are arranged, said locus being the intersection of the plane through a diameter of the roll as it is being rolled and a plane including a tangent thereto formed by the plane of the direction of feeding of the strip of sheet-like material, said angles formed by the plane of the chords of the roll corresponding to the angles of the guide slots taken along the plane including the centerline thereof and passing through the locus, and the base of the angles being a plane including the aforesaid diameter perpendicular to the aforesaid tangent to the roll as it is being rolled, supporting rollers operatively mounted on the side frames whereby a plane tangent to the surfaces of the supporting rollers includes said locus, gravity actuated shaping rollers operatively mounted parallel to the supporting rollers and shiftably mounted in the aforesaid guide slots, pinions operatively mounted on the aforesaid gravity actuated shaping rollers and the aforesaid supporting rollers, a spur gear operatively mounted for directly driving the aforesaid gravity actuated shaping rollers and the supporting rollers in a common direction for rolling the strip of sheet-like material into a roll, said guide slots for said gravity actuated shaping rollers providing a lost-motion connection between the pinions operatively mounted on the gravity actuated shaping rollers and the aforesaid spur gear, whereby as the roll of sheet-like material is enlarged beyond a predetermined diameter the aforesaid pinions become disconnected from the spur gear and upon removal of the roll, the aforesaid pinions operatively connected to the shaping rollers re-engage the spur gear, and coupling means for operatively connecting said gravity actuated shaping rollers to move together in their outward and inward movements in the slots under the pressure of the strip inserted under them in such a manner that the ratio between all movements of each individual shaping roller in its guide and the cosine of the angle of the guide concerned is constant and uniform for said gravity actuated shaping rollers.

10. In apparatus for rolling a strip of sheet-like material into a roll as set forth in claim 9, wherein said coupling means comprises sprocket wheels operatively mounted on the side frames, chains operatively mounted on said sprocket wheels and having lengths running in the direction of the guide slots, said shaping rollers operatively connected with their respective chain lengths, certain of said sprocket wheels being joined together whereby movement from one shaping roller is imparted to all shaping rollers, and others of said sprocket wheels being double and triple sprocket wheels, and the pitch circles of the double and triple sprocket wheels bearing the same ratio to each other as the cosine of the angles of the guide slots of the shaping rollers connected with the

chains carried over the respective double and triple sprocket wheels.

11. In apparatus for rolling a strip of sheet-like material into a roll as set forth in claim 10, wherein the aforesaid side frames are divided in two parts, certain of said parts being stationary and the other of said parts being movable, certain of said shaping rollers and their respective guide slots and one of said supporting rollers and the sprocket wheels for the respective shaping rollers and supporting roller operatively mounted on the stationary side frame, the remainder of the shaping rollers and the supporting roller together with their respective guide slots and sprockets operatively mounted on the movable side frame, and means permitting the movable side frame to be affixed to the stationary side frames as the strip of sheet-like material is rolled into a roll, and upon completion of the roll the movable side frames are movable with respect to the stationary side frames allowing the roll to be removed between the separated supporting rollers.

12. Apparatus for rolling a strip of sheet material into a regular roll, comprising means for continuously feeding the strip lengthwise, means for supporting the strip at right angles to the direction of advance of the strip, oppositely arranged similar side plates provided with rectilinear slots formed as guide means, and roller means operatively mounted in said guide means and for simultaneously continuously shaping and compacting the strip as it is being rolled with a force of compaction acting upon the roll as it is continuously shaped into a regular roll in at least one plane passing through the locus formed by the intersection of the plane of the strip of sheet material and the plane of the diameter of the roll tangent to the plane of the strip.

13. Apparatus for rolling a strip of sheet material into a regular roll, comprising means for continuously feeding the strip lengthwise, means for supporting the strip at right angles to the direction of advance of the strip, oppositely arranged similar side plates provided with a plurality of oppositely and angularly arranged rectilinear slots formed as guide means, a plurality of roller means operatively mounted contiguous to and after the means for continuously feeding the strip, and said plurality of roller means operatively and shiftably mounted within said guide means for simultaneously shaping and compacting the strip as it is rolled with a plurality of forces of compaction acting upon the outer periphery of the roll as it is shaped into a regular roll with each of the forces acting in a line of contact with the roll and parallel to the axis of the roll and in a plane passing through the locus formed by the intersection of the plane of the strip of sheet material and the plane of the diameter of the roll tangent to the plane of the strip.

14. Apparatus for rolling a strip of sheet material, comprising means for feeding the strip lengthwise, means for supporting the strip at right angles to the direction of advance of the strip, oppositely arranged similar side

plates provided with rectilinear slots formed as guide grooves, roller means operatively and shiftably mounted in said guide grooves and for shaping and compacting the strip as it is rolled with the force of compaction acting upon the outer periphery of the roll as it is shaped in a line of contact with the roll and parallel to the axis of the roll so that the line of contact of the force of compaction shall lie on the surface of a cylinder generated by the rolling of the strip into a roll and in which the surface of the roll passes through the line of contact of the strip and the intersection of the plane of the strip of sheet material as it is advanced and the plane of the diameter of the roll as it is rolled tangent to the plane of the strip.

15. Apparatus for rolling a strip of sheet material into a regular roll, comprising means for feeding the strip lengthwise, means for supporting the strip at right angles to the direction of advance of the strip, oppositely arranged similar side plates provided with rectilinear slots formed as guide grooves, a plurality of roller means operatively mounted in said guide grooves and for shaping the strip as it is rolled with forces of said plurality of roller means applied in planes at different angles to a plane perpendicular to the strip at the intersection thereof with the plane of the strip of sheet material, said plane perpendicular to the strip including the diameter of the roll tangent to the plane of the strip as it is rolled.

16. Apparatus for rolling a strip of sheet material into a regular roll, comprising means for feeding the strip lengthwise, means for supporting the strip at right angles to the direction of advance of the strip, oppositely arranged similar side plates provided with rectilinear slots formed as guide grooves, roller means operatively mounted in said guide grooves and for shaping the strip as it is rolled with forces applied in planes at different angles to a plane perpendicular to the strip at the intersection thereof with the plane of the strip of sheet material, said plane perpendicular to the strip including the diameter of the roll tangent to the plane of the strip as it is rolled, and means for coupling said roller means for shaping the roll so that the applied forces of the roller means move together outwardly and inwardly under the pressure of the strip being rolled, whereby the ratio between the movements of the applied forces and the cosine of the angle of each applied force will be constant and uniform.

References Cited in the file of this patent

UNITED STATES PATENTS

1,678,326	Cameron	July 24, 1938
2,207,832	Spellacy	July 16, 1940
2,268,125	Nash et al.	Dec. 30, 1941

FOREIGN PATENTS

45,029	Sweden	Feb. 5, 1919
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