Feb. 6, 1951 A. E. HAMILTON 2,540,367

METHOD OF GRINDING AND FINISHING STRIP METAL

Filed July 5, 1947 3 Sheets-Sheet 1

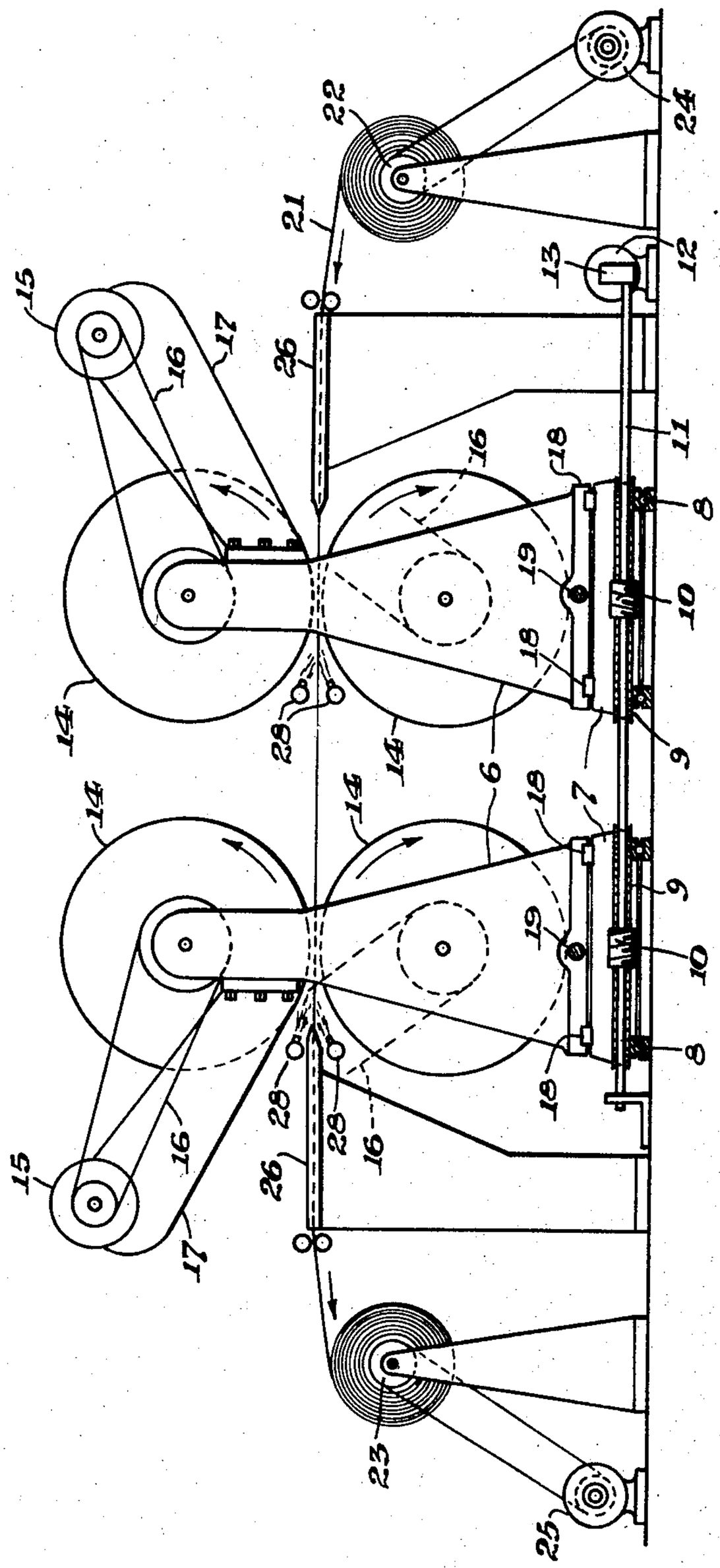

Fig. 1.

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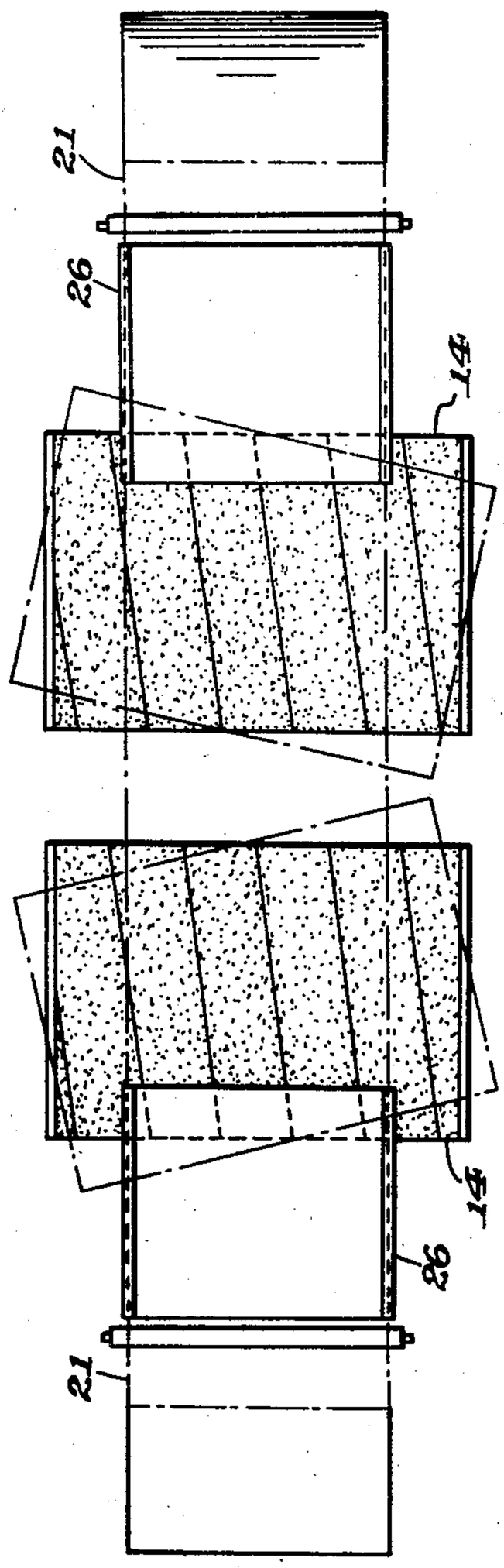

Fig. 2.

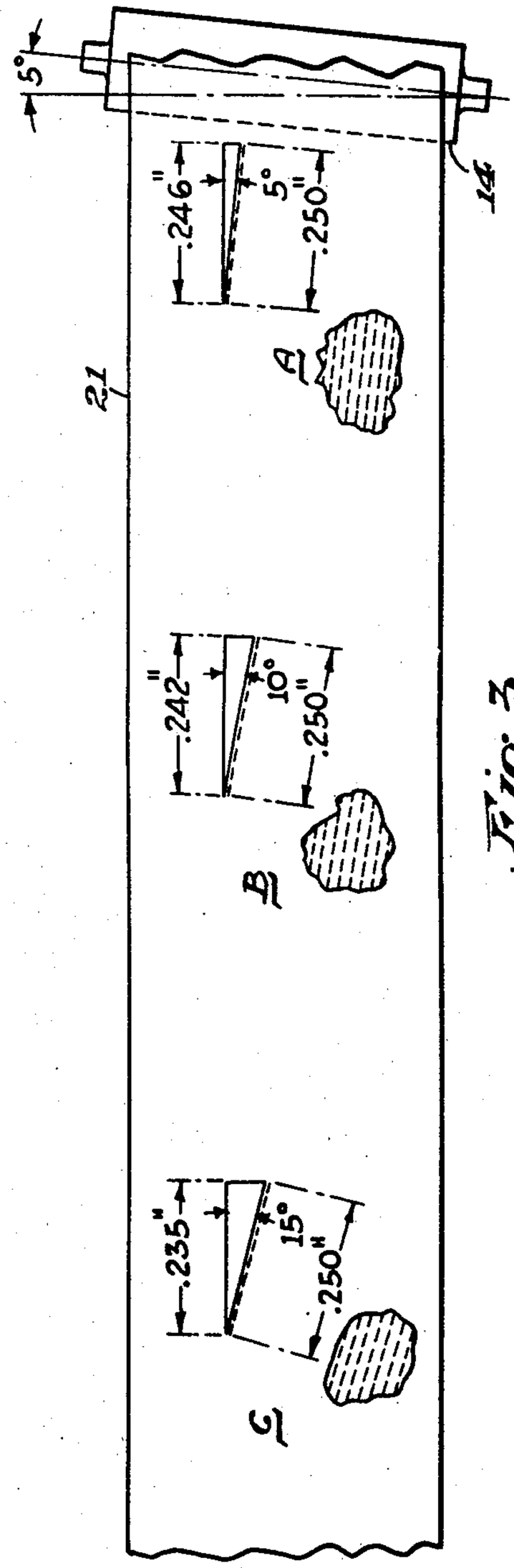

Fig. 3.

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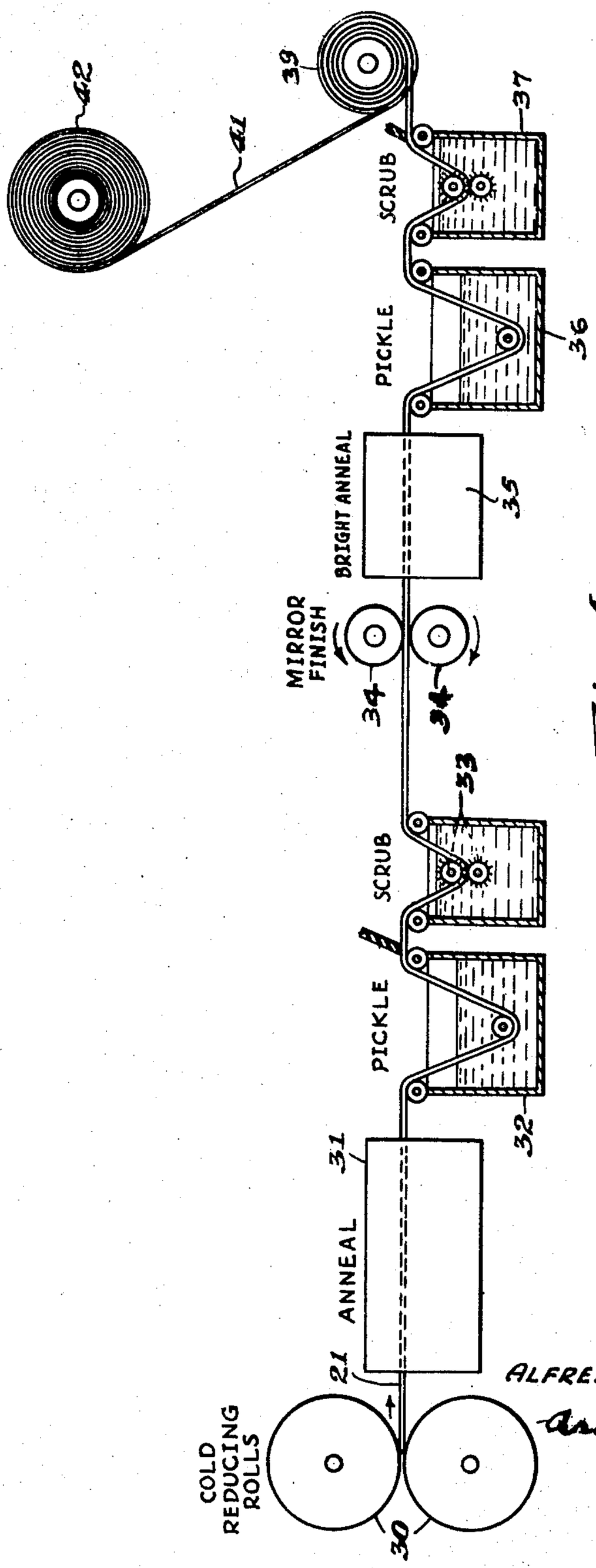

Fig. 4.

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UNITED STATES PATENT OFFICE

2,540,367

METHOD OF GRINDING AND FINISHING STRIP METAL

Alfred E. Hamilton, Pittsburgh, Pa.

Application July 5, 1947, Serial No. 759,012

4 Claims. (Cl. 29—18)

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My invention relates to a method of performing smoothing and finishing operations on strip or sheet metal, such as stainless steel for example. In my application Serial No. 646,833, filed February 11, 1946, now Patent No. 2,483,277, granted September 27, 1949, I disclosed and claimed apparatus for and a method of finishing strip steel, which involves grinding the strips on lines which extend diagonally of the strip instead of parallel to its longitudinal axis, to thereby avoid the forming of grain lines that extend longitudinally of the strip and tend to form lines of weakness which may cause cracking of the metal when it is thereafter stamped or bent along lines parallel to such grain lines.

In the present instance, I carry this concept further, to secure other advantageous results as hereinafter set forth.

The present invention is directed not only to the avoidance or elimination of grain lines or grinding marks that are produced by the granules of a grinding drum and the producing of a non-directional finish on the surface of the strip, but the various diagonal grit lines or small grooves formed on the strip during the grinding operation are individually of such short length that they are readily eliminated or smoothed out by a subsequent rolling operation, instead of being stretched to undue length longitudinally of the strip as is the case when the strip is ground by surfacing drums whose axes are at right angles to the path of travel of the strip. In the present instance, the reducing roll operates, in effect, somewhat crosswise of the grit lines, thus more effectively smoothing them out and doing so more quickly than where the grit lines extend parallel to the strip.

Another advantage of this invention is that the strip, when ground, may be more nearly at the gauge desired for the finished strip since there need not be as great reduction in gauge when rolling the strip subsequent to the grinding thereof.

In the accompanying drawings, Figure 1 is a side elevational view showing two pairs of grinding drums and the associated strip feeding and guiding mechanism in somewhat schematic form; Fig. 2 is a schematic plan view indicating the manner in which the surfacing drums are angularly positioned with respect to the strip; Fig. 3 is a diagrammatic view illustrating the manner in which grit lines of various lengths in directions longitudinally of the strip are formed through changes in angularity of the grinding

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drums, and Fig. 4 is a schematic view showing the manner in which the strip is finished subsequent to the grinding of the strip on the apparatus shown in Fig. 1 and the pickling thereof.

While in the present instance I have shown two pairs of grinding drums, it will be understood that a single pair of drums or more than two pairs of drums may be employed. Roll stands 6 are mounted on bases 7 which are, in turn, rotatively mounted on anti-friction bearings 8, so that the angularity of the roll stands and the rolls carried thereby can be adjusted. The bases 7 have teeth 9 of worm gear form that mesh with worms 10 that are secured to a shaft 11. The shaft 11 is driven by a motor 12 through reduction gearing at 13 whenever it is desired to change the angularity of the surfacing rolls relative to the strip.

The surfacing rolls or drums 14 may be of the form shown in my Patent 2,358,572 or of any other suitable form and are driven by motors 15 and driving belts 16, the motors being mounted on brackets 17 that are mounted on the roll stands.

Anti-frictional rollers 18 are interposed between the roll stand 6 and their bases 7 to permit shifting of the stands in directions transversely, by suitable means such as reversible screws or push-and-pull rods at 19, in the manner disclosed in my said patent or in the manner disclosed in my application Serial No. 778,554, filed October 8, 1947, now Patent No. 2,481,588, granted September 13, 1949. This transverse movement will usually be slow and for only three or four inches in each direction from the center line of the strip, although it may be much greater when relatively narrow strips are being ground. This reciprocable movement of the rolls not only reduces the tendency to form patterns on the strips in directions longitudinally thereof, but also distributes wear on the abrasive coverings substantially across the full surfaces of the rolls and consequently requires less frequent replacement of the abrasive coverings.

The strip 21 is shown as being drawn from a spool or reel 22 and wound upon a spool or reel 23. The reel 22 is driven by a motor 24, and the reel 23 by a motor 25. The motor 24 will be used when it is desired to run the strip in the direction opposite to that indicated by the arrows or can be utilized as a brake to prevent too free turning of the reel 22 when the strip is being withdrawn therefrom.

The rolls 14 turn counter to the strip so that

the strip is placed under considerable tension as it is being wound on the reel 23. This reduces tendency of the strip to be thrust out of line in an edgewise direction by the diagonal thrusts of the surfacing drums or rolls 14. Lateral deflections of the strip are further resisted by grooved guides 26 at the edges thereof such as the guides shown in my said application Serial No. 646,833, now Patent No. 2,483,277. No matter in which direction the rolls turn relative to the strip travel, it can be maintained under tension by braking resistance of one motor and coiling pull of the other motor. Wet grinding is usually desirable, and to this end, I provide water spray pipes 28 at the roll passes.

At A in Fig. 3 is shown the degree of angularity of the grit lines when the surfacing drums 14 are set at an angle of 5° from a line extending transversely of the strip. The lengths of these diagonal lines at A will vary in accordance with changes in peripheral drum speeds relative to the rate of travel of the strip and the grain sizes of abrasion. The surfacing drums may suitably be given a peripheral speed of 4000 feet to 6000 feet per minute and the strip travel be from 50 feet to 75 feet per minute, in a direction opposite to the direction which the drums move at the roll passes. The grit may suitably be of from 36 to 320 grain size. However, in many cases, it would be necessary for the abrasive grains to grind the strip to a depth of perhaps only .002 inch on each face of the strip.

By grinding the strips diagonally, I am enabled to use larger grain sizes than is desirable when the grinding along lines that extend longitudinally of the strip, because while the larger granules make deeper grid lines, such lines are readily rolled out instead of being stretched longitudinally of the strip. The use of larger grain sizes not only permits of more rapid surfacing of the strips, but large-grain abrasives are economical because they not only last longer, but do not "load up" so quickly with scale and metal particles as do smaller grit particles.

Assuming that the surfacing drums are rotated at 5000 feet per minute, the strip traveling at 50 to 75 feet per minute, with the drums set at an angle of 5° as indicated in Fig. 3, the average length of grit line would be approximately .250 inch, but the distance longitudinally of the strip will be .246 inch. It follows that when the strip is thereafter passed between reducing rolls, each grit line will be approximately entirely rolled out when there has been a .246 inch roll travel on the strip. As shown at B, the grit lines are still .250 inch in diagonal directions, but with the surfacing drums set at a 10° angle, the distance which the grit lines extend longitudinally of the strip is only .242 inch, so that the grit lines can be rolled out during a shorter roll travel. At C, with the surfacing drums at an angle of 15°, the grit lines will be rolled out when the reducing roll has moved a distance of but .235 inch on the strip.

In the grinding of strip steel where more than one pass of the material must be made between grinding drums, it is frequently desirable to have the drums set at different angles at successive grinding stations. For example, the first surfacing drums may be set at an angle of 15°. If the next pair of drums is set at an angle of 5° for example or even 10°, the lines of abrasion at the the second grinding station will not coincide with the lines of abrasion of the preceding grinding station or stations. This is, of course, desirable because at the second or succeeding stations metal will be removed from between the lines of abrasion made at a preceding station or stations.

The lengths of the grit lines, when a soft-faced surfacing drum is used, will depend also somewhat upon the degree to which the drum is pressed against the strip at the roll pass. In any event, the grit lines will be very short compared to what their lengths would be if the drums were not angularly positioned.

After the strip 21 has been ground by the surfacing drums and pickled, it will be passed between reducing rolls 30 (Fig. 4).

The percentage of gauge reduction necessary to roll out the grit lines varies directly in proportion to the angularity of the grit lines with respect to the strip. In other words, the greater the angle to which the grinding drums are set, the quicker the grit lines will be rolled out in the reducing roll pass, and furthermore, the rolling is in a direction somewhat crosswise of the diagonal grit lines so that they are more effectively and smoothly finished than when they extend parallel with the strip. This is of importance not only in grinding straight chrome stainless steel strip but in all intermediate grinding of all types of steel, because when grit lines are cut into the surface in a straight line paralleling the edges of the strip, the grit lines are tremendously lengthened during the longitudinal reduction of the strip in a subsequent rolling process.

By the use of the diagonal grinding process, coarser and consequently more efficient abrasive strips can be used for removing defects from the surface of the steel after it has been reduced to a thickness near to the final and finished gauge. This is true regardless of the lengths of the grit lines. By this diagonal grinding, or finishing process, if the operator determines the amount of rolling reduction required to bring the strip to final gauge, he can predetermine the size of abrasive grain in combination with the angle at which to set the grinding drums to enable him to grind out the defects and still be able to roll out the grit lines by the time the steel is reduced to final gauge.

Where exceedingly high grade finishes are desired, the strip, after it has been passed through the reducting rolls 30, will be passed through an annealing chamber 31, and a pickling tank 32. Thereafter, it is passed through a scrubbing tank 33 where it is washed by hot water and thence through mirror-finish rolls 34 and a bright annealing chamber 35. From the annealing chamber, it will be passed through a pickling tank 36 and a scrubbing tank 37. The strip is then dried and wound on a coil 39, the convolutions of the strip in the coil being separated by a paper strip 41 that is drawn from its roll 42.

Strips or sheets that have been ground along diagonal lines as heretofore explained are particularly suitable for use in the forming of bent or stamped articles such as channels and sheet metal vessels, particularly when used in forming articles that are bent along lines or about axes that extend either longitudinally of the sheet or transversely thereof. The axes of bend will usually extend somewhat crosswise of the lines of abrasion, and therefore there will be less danger of the metal cracking or splitting than if the axes of bend were parallel to the lines of abrasion.

I claim as my invention:

1. The method which comprises moving abrading elements on the surface of sheet metal, in a given direction, and thereafter reducing the

gauge of the metal by moving a roll on the surthereof, in a direction to cross the lines of abrasion at an angle not less than 5°.

2. The method which comprises grinding strip metal by moving abrading element across its surface, in a direction that is diagonal relative to the longitudinal edges of the strip, and thereafter reducing the strip to a thinner gauge, by a rolling operation in a direction to cross the diagonal lines of abrasion at an angle not less than 5°.

3. The method which comprises the steps of abrading the surface of sheet metal in a given direction, pickling the metal to clean the same, and thereafter moving a roll on the surface thereof in a direction to cross the lines of abrasion at an angle not less than 5°.

4. The method which comprises pulling strip metal between abrading rolls which are rotated in a direction to oppose movement of the strip, and thereafter passing the strip between reducing rolls whose axes are positioned at different

angles relative to the path of strip travel than are the abrading rolls the relative angularity of the abrading rolls and the reducing rolls being not less than 5°.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
743,911	Muller	Nov. 10, 1903
1,145,114	Bryen	July 6, 1915
1,921,039	Remington	Aug. 8, 1933
2,023,904	Schulte	Dec. 10, 1935
2,056,424	Fenton	Oct. 6, 1936
2,171,300	Castle	Aug. 29, 1939
2,250,398	Schon	July 22, 1941
2,282,723	Hamilton	May 12, 1942
2,302,120	Hamilton	Nov. 17, 1942