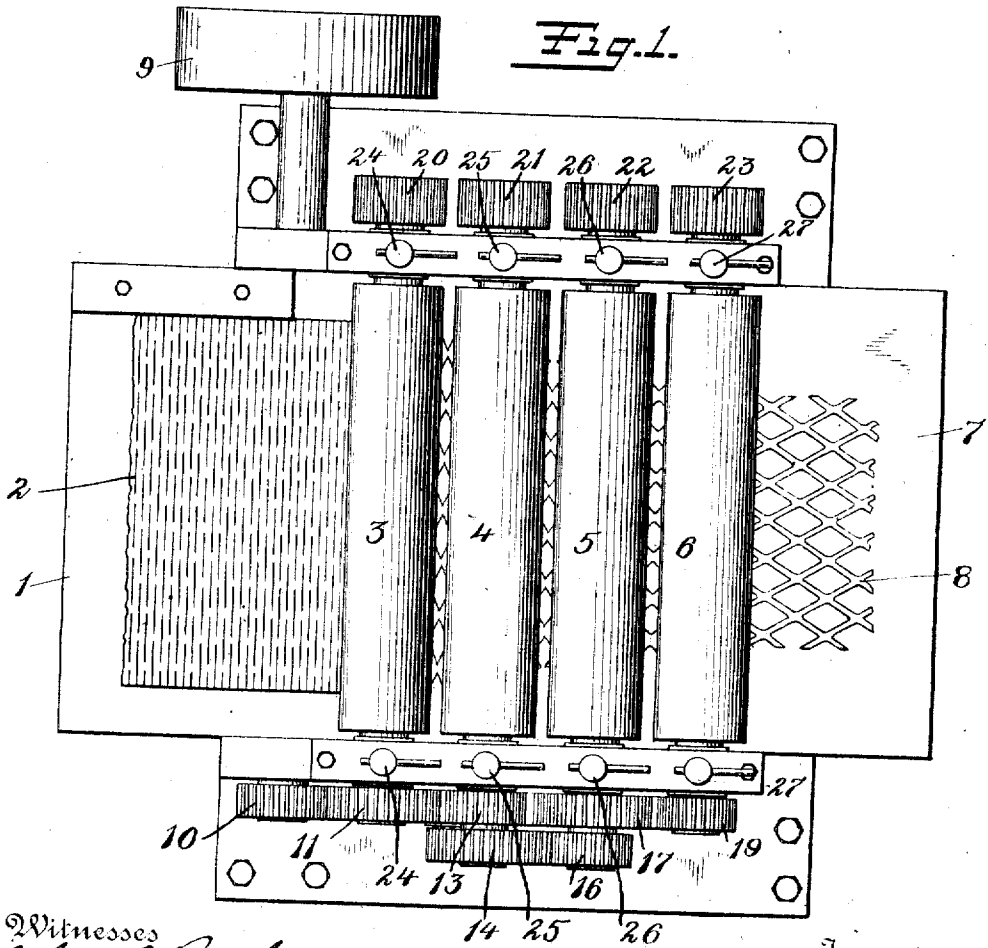
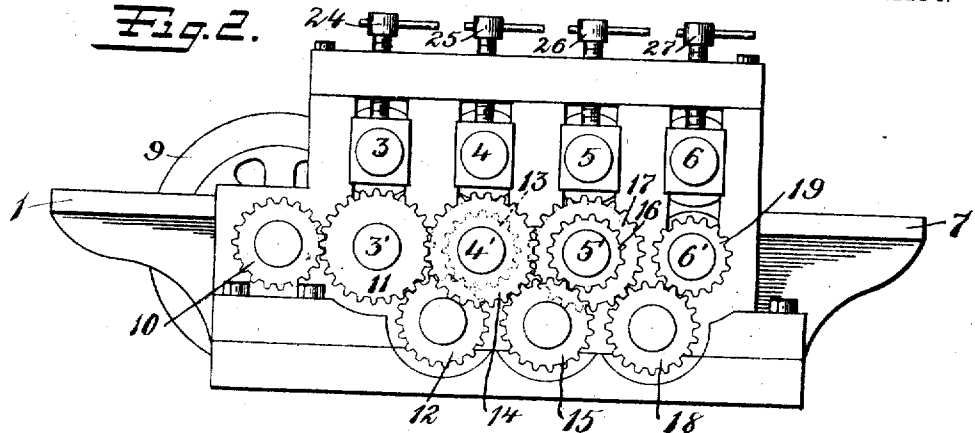


N. E. CLARK.
 APPARATUS FOR MANUFACTURING EXPANDED METAL.
 APPLICATION FILED JAN. 12, 1906.

1,103,033.

Patented July 14, 1914

4 SHEETS-SHEET 1.



Witnesses
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Paul H. Brown & H. C. H. H. H.

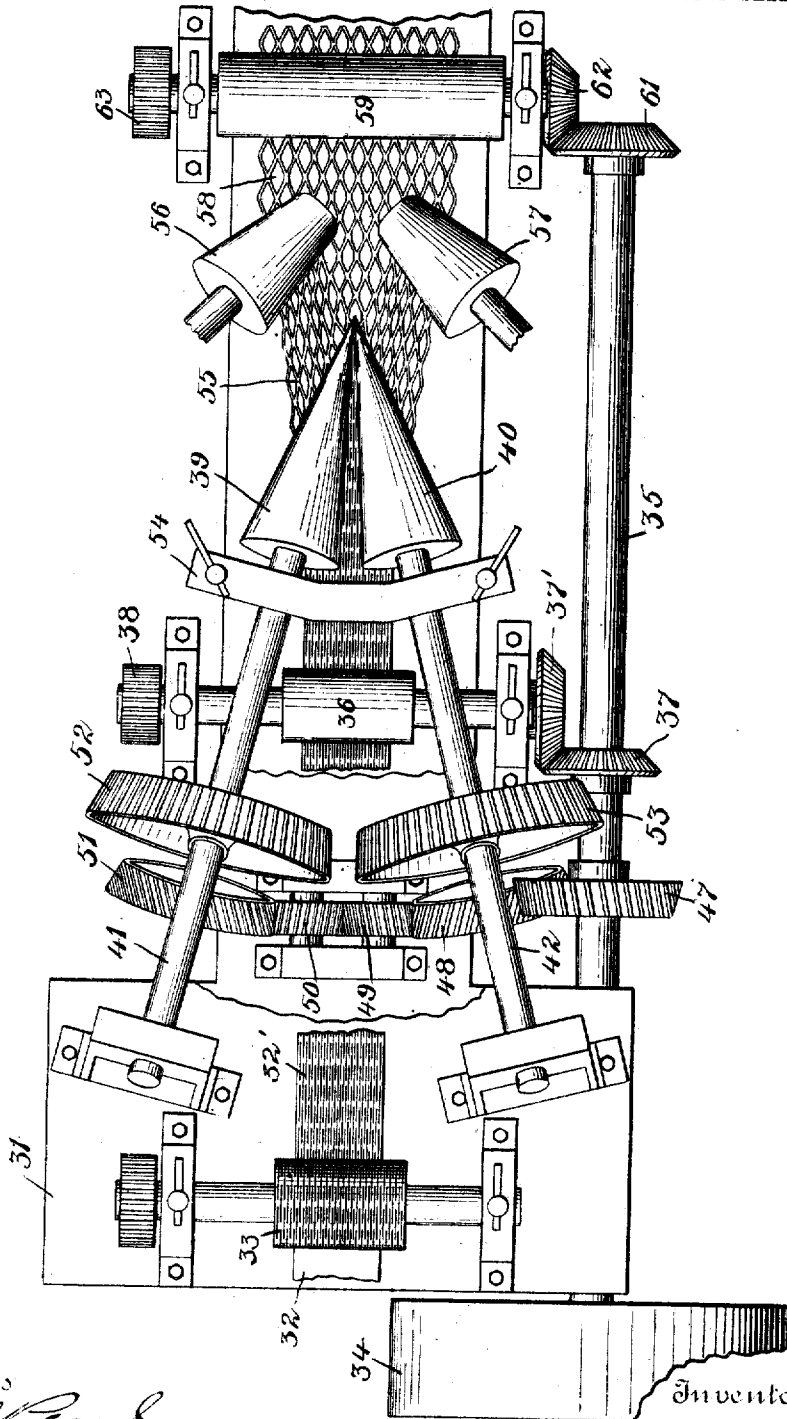
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4 SHEETS-SHEET 2.

Fig. 3.



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4 SHEETS—SHEET 3.

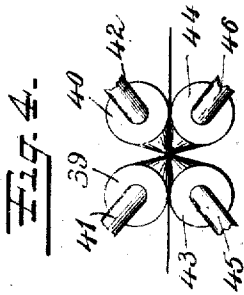


Fig. 8.

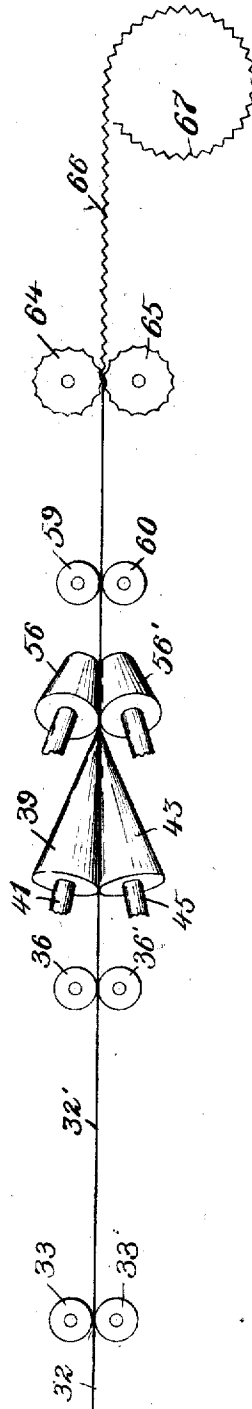
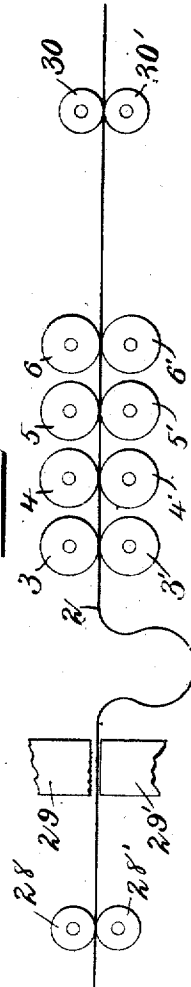


Fig. 9.



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Fig. 5.

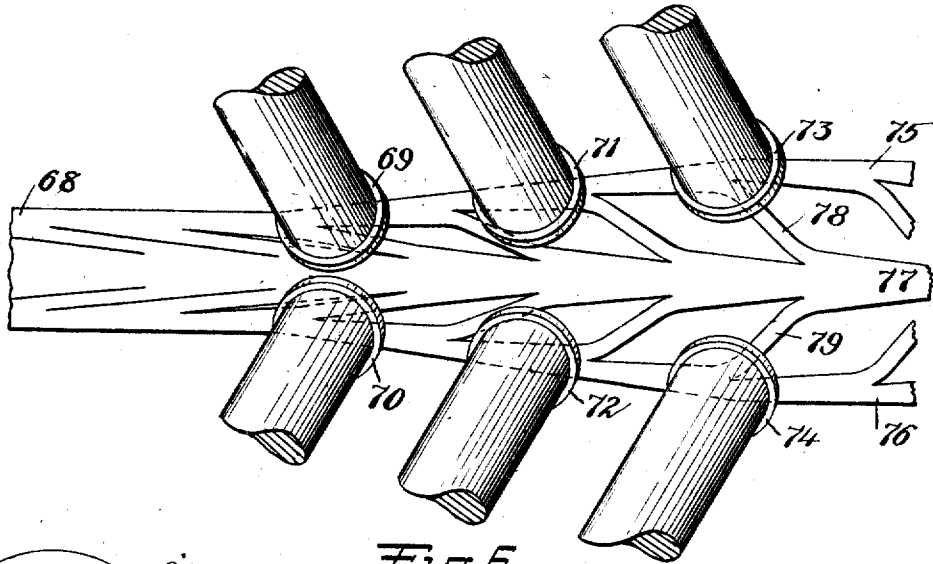


Fig. 6.

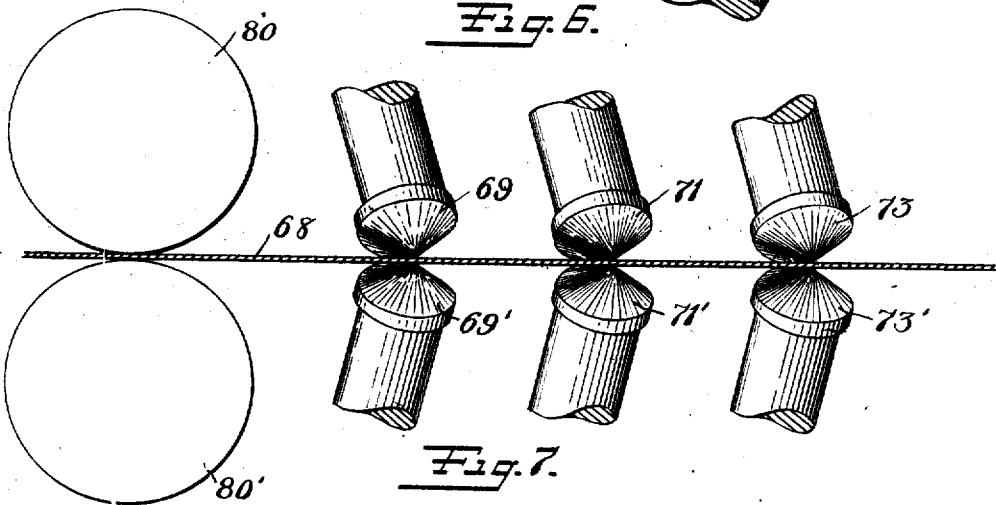
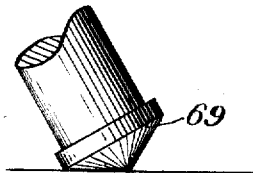


Fig. 7.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR MANUFACTURING EXPANDED METAL.

1,103,033.

Specification of Letters Patent.

Patented July 14, 1914.

Application filed January 12, 1906. Serial No. 295,810.

To all whom it may concern:

Be it known that I, NORRIS ELMORE CLARK, a citizen of the United States, residing at Plainville, Hartford county, Connecticut, have invented certain new and useful Improvements in Apparatus for Manufacturing Expanded Metal, of which the following is a full, clear, and exact description.

My invention relates to apparatus for manufacturing expanded metal and more particularly flat metal of the type set forth in my Patents No. 767,798 and No. 788,093.

The object of the invention is to produce plates, strips or sheets of reticulated metal economically and rapidly.

A further object is to provide mechanism of simple construction for producing the expanded material in long strips which may be readily coiled up for purposes of transportation and distribution.

Expanded metal of the character which I desire to produce has previously been made by me by the use of reciprocating punches operating upon slitted or lanced strips or sheets as set forth in my application #302,406, filed Feb. 23, 1906. Such processes and apparatus operate satisfactorily and produce satisfactory results. In my present invention I have sought to provide mechanism by which the manufacture of the expanded sheets or strips may be effected, even by unskilled operators, at a high rate of speed and with a low cost of maintenance of the machine.

The method consists in slitting the sheets or strips of metal by suitable mechanism, and then drawing out the strips or sheets by means of friction rolls so as to open the slits and form reticulations, and accomplishing simultaneously with the drawing action a smoothing or finishing of the product. By "slitting" I mean any treatment which outlines a series of strands connected at intervals whether any metal is punched out or not. This drawing action of the rolls is preferably accomplished gradually from the slitted material to the full open mesh, so that the expansion may take place with greater uniformity and without undue strain upon the strands of the material. I have illustrated the invention adapted to

expansion of three classes of slitted material, first, material slitted transversely of the direction of feed or line of travel in a machine, second, material slitted longitudinally of the direction of feed in the machine, and third, material slitted obliquely to the line of travel in the machine. Each of these classes of slitted material require, preferably, special mechanism for producing the expansion. The expansion of transversely slitted stock is preferably accomplished by cylindrical rolls. The expansion of the longitudinally slitted stock is preferably accomplished by the use of conical rolls for simultaneously acting upon the strands adjacent a diagonal row of slits, the angle of the cones being acute. The obliquely slitted strip is illustrated narrow in width and particularly adapted for fencing. This is preferably produced by the use of a number of conical rolls, one for each bond between the strands, the angle of the cones being obtuse.

The drawings are largely diagrammatic, but sufficiently illustrative of the invention to enable one acquainted with expanded metal working to comprehend perfectly.

Figure 1 is a plan view of a machine for expanding metal slitted transversely of the line of feed. Fig. 2 is a side view of the same. Fig. 3 is a plan view of a machine for expanding metal slitted longitudinally of the line of feed, the parts being broken away to show the gearing underneath the table. Fig. 4 is a view from the feed end of the same type of machine, showing the conical rolls, the driving mechanism and supports being omitted. Fig. 5 is a plan view illustrating a series of conical rolls operating upon a strip of obliquely slitted metal. Fig. 6 is a longitudinal view showing the strip of metal in section. Fig. 7 is a detail view of one of the obtuse conical rolls. Fig. 8 is a diagrammatic view showing the continuous operation of slitting longitudinally, expanding by conical rolls, corrugating, and the formation of a roll of corrugated expanded metal. Fig. 9 is a diagrammatic view showing the continuous operation of slitting transversely, expanding and rolling. The mechanism illustrated in Figs. 1 and

2, and the diagram of Fig. 9, are for the construction of expanded metal from transversely slitted stock. It is not necessary for the slits to be exactly at right angles to the length of the stock but simply that they extend generally in a transverse direction so that the sheet can be stretched forwardly. 1 is the table of the machine on which the transversely slitted stock 2 is fed. 3, 4, 5 and 6 are cylindrical friction rolls driven at different speeds, each successive roll revolving at a slightly greater peripheral speed than the next preceding roll. These rolls are arranged in pairs above and below the line of travel of the stock. 7 is the delivery table where the expanded stock 8 is delivered. The total area of the stock is increased, whereas its width is decreased in the process of manufacture. 9 is a suitable driving pulley. 10 is a gear wheel on the shaft of the driving pulley, which drives the lower set of rolls 3, 4, 5 and 6 by means of the train of gears 11, 12, 13, 14, 15, 16, 17, 18 and 19. The upper rolls 3, 4, 5 and 6 have gears 20, 21, 22 and 23, which are driven by corresponding gears which rotate with the lower rolls 3', 4', 5' and 6'. Suitable means, such as the press screws 24, 25, 26 and 27 may be employed for adjusting the pressure exerted between the rolls or adjusting the height of the top rolls. The stock is fed between the rolls 3-3', where it is gripped tightly. As it passes along, the front edge is caught by the rolls 4-4' which are traveling at a slightly greater peripheral speed. This frictional engagement draws out the stock and opens up the slits to form openings. The rolls 5-5' operate in the same way, but rotating at a greater speed than the rolls 4-4' to draw out the stock still farther. The drawing and expansion is continued by rolls 6-6' and may be continued indefinitely up to the limits of the size of mesh of the product desired. At the same time that the expansion is taking place the stock is being constantly rolled so as to present a comparatively finished surface which is flat and lies in the original plane of the stock. In the diagram in Fig. 9, 28-28' indicate suitable feed rolls. 29-29' are suitable slitting punches, and 30-30' are suitable delivery and finishing rolls. This illustrates that the invention may be carried out by a continuous process. It is preferred, however, that there shall be a loop of considerable size formed in the slitted stock between the punch 29 and the rolls 3-3', so that the rolling process may be continuous while the punch operation is intermittent, the punch being of the reciprocating type.

In Fig. 3 and the diagram of Fig. 8, the mechanism is illustrated for expanding longitudinally slitted stock. 31 is the table of the machine. 32 indicates the blank stock

which is fed onto the table. 33 is a slitting roll driven by a suitable gearing (not shown) from the pulley 34. 32' indicates the slitted stock. 36 indicates one of a pair of feed rolls driven from the pulley shaft 35 by means of bevel gears 37-37'. The lower roll 36', corresponding to 36, (see Fig. 8) is provided with a gear similar to gear 38 with which it meshes for driving purposes. 39 and 40 are two conical rolls carried by the shafts 41 and 42 above the level of the table 31. 43 and 44 are two more similar rolls mounted below the level of the table on the shafts 45 and 46. The shafts 45 and 46 are immediately below the shafts 41 and 42 and are driven by a system of gears 47, 48, 49, 50 and 51, the gears 48 and 51 being respectively on the shafts 46 and 45. 52 and 53 are gears mounted on the shafts 41 and 42 which are driven from corresponding gears carried by the shafts 45 and 46. The shafts 41 and 42 are provided with a suitable bearing preferably adjustable, as 54, for holding the cones 39 and 40 into frictional engagement with the stock as it is fed along. The shafts are inclined toward the direction in which the stock is moving. As the cones are rotated the strands of the stock are gripped between the surfaces of the upper and lower cones and drawn outwardly so as to form the expanded stock 55. 56 and 57 indicate a pair of rolls shaped like the frustums of cones, which may be employed for giving a further expansion to the stock, as shown at 58. A similar pair of rolls is mounted beneath 56 and 57. These cones bear only on the outer edges of the stock and their conjoint action is sufficient to expand the central portion of the stock. 59 and 60 are the delivery rolls which continually smooth the metal as it comes from the draw rolls and keep it under sufficient tension, so that the operation of the draw rolls is uniform. The lower delivery roll is driven by gears 61 and 62, while the upper roll is driven from a gear on the lower roll shaft meshing with gear 63 on the upper roll shaft. It is not necessary to show the details of gearing, as they will be readily understood.

In the diagram of Fig. 8, the stock is slitted by the rolls 33-33' is passed between the rolls 36-36', expanded by the rolls 39-40, 56-56', and smoothed by the rolls 59 and 60. 64 and 65 are two rollers adapted to corrugate the expanded strip transversely to form the stock illustrated diagrammatically at 66. This may be rolled up in a coil, as 67, for convenience in handling. Of course the corrugating rolls 64 and 65 may be omitted if desired, but by their use it is possible to construct expanded metal having any shape or character desired by simply properly designing the rolls 64 and 65. The stock as delivered from the rolls 30-

30' in Fig. 9, may also be coiled continuously if desired. It is a convenient form of handling the stock when it is manufactured in long strips. It is possible to coil the completely expanded metal formed in this way with rapidity. The peripheral speed of the conical rolls 39 and 40 and their corresponding lower rolls 43 and 44, of course changes gradually from the apices of the cones toward their bases. The result is that the outer portion of the slitted strip is acted upon at a greater rate of speed, and the expansion along the outer edge is more rapid. This action is transmitted through the material being acted upon toward the center, however, so that the central portion is acted upon not only by the tips of the cones directly but indirectly through the tension in the stock. The same general operation is true of the cones 56 and 57. The taper of the cones and the angles which their axes make relative to the line of feed of the stock, will depend upon the proportion of expansion which it is desired to effect in the material, upon the speed of travel of the strip, and upon the length of the slits in the strip.

Figs. 5 and 6 illustrate the mechanism for expanding an obliquely slitted strip and the method of expansion. 68 indicates the strip which has previously been slitted in lines oblique to the length of the strip, the slits overlapping or alternating relative to one another. 69, 70, 71, 72, 73 and 74 indicate a series of cones, the angle of the taper of which is obtuse, as shown particularly in Fig. 7. Below the line of travel of the strip is located a series of corresponding cones. Three of these are shown in Fig. 6 and are indicated at 69', 71' and 73'. A strip of material may be said to be made up of two outer continuous strands 75 and 76, and the central strand 77, connected to the outer strands by the strands 78 and 79. It is preferred to accomplish the expanding action gradually. A series of cones are therefore provided, and their frictional or gripping surfaces are located so as to cooperate with the strip as it moves along. The peripheral speed of the cones is graduated so as to correspond with the relative movement of the outer edges of the material. The rolls 80 and 80' may be provided to cooperate with the action of the conical rolls so as to produce a uniform expanding action. This product I claim in another application #441,959 filed July 6, 1908.

The gripping surfaces of the rolls in all three types of my invention may be perfectly smooth if desired, so as to produce a smooth product. This will, of course, require the application of considerable pressure in order to produce the friction necessary for the expanding action. The surfaces of the rolls may, however, be roughened or provided with teeth, grooves, corrugations, or pro-

jections for assisting in the drawing action. The particular character of surface employed will depend upon the finish required in the product. The method or art of manufacture and the mechanism employed are of such character as to permit of a wide range of variations in the product. The product is flat and has all bonds and strands lying in the same plane. By preserving each bond and the portions of strands adjacent thereto in the same plane, much greater strength of the product is provided. The flat product may be converted into a roughened or irregular product more suitable for certain characters of work by subjecting it to a corrugating action. By deferring the corrugating action until after the complete expansion, many of the advantages of the flat bond and strand construction are preserved. The product, as a consequence of the process of manufacture, is particularly adapted for transportation and handling, since it may be readily coiled up. I do not wish it understood, however, that I consider the invention as limited to the operation on long strips, since for certain classes of work the invention is peculiarly applicable to the production of large plates.

The frictional engagement herein referred to is such engagement as results from the use of smooth or substantially smooth surfaces whereby slippage of the material between the surfaces is possible.

What I claim is:

1. A machine for forming expanded metal, consisting of means for continuously feeding a slitted strip, and means for frictionally engaging and continuously operating upon the strip to open the slits in a single plane.

2. A machine for forming expanded metal, consisting of rolls for feeding a slitted strip, and means for simultaneously opening all the slits of a single row and retaining the bonds and strands in a single plane.

3. A machine for forming expanded metal, including a plurality of pairs of rolls for frictionally engaging the surfaces of a slitted strip and opening the slits laterally in a single plane.

4. A machine for forming expanded metal, including a plurality of pairs of rolls for frictionally engaging the surfaces of a slitted strip and opening the slits laterally, one of said pairs of rolls having a different surface speed.

5. In a machine for expanding sheet metal, means for slitting the metal, rolls for rolling and flattening the slitted stock, means for continuously operating upon the slitted stock to open the slits and at the same time retain the bonds and strands in a single plane.

6. In a machine for expanding sheet

metal, a pair of rolls for continuously feeding and holding the slitted stock, and a second pair of rolls for continuously and frictionally operating upon the stock to open the slits.

7. In a machine for forming expanded sheet metal, means for feeding a slitted strip, means for continuously operating on the slitted strip to open the slits in the plane of the original stock, and rolls for corrugating the expanded strip.

8. In a machine for expanding a previously slitted sheet of metal, a plurality of pairs of friction rolls having differential peripheral speeds for engaging the surfaces of the metal and opening the slits.

9. In a machine for expanding metal sheets previously slitted transversely, a plurality of pairs of cylindrical friction rolls for engaging the opposite surfaces of the metal, and means for giving the rolls differential peripheral speeds.

10. In a machine for expanding metal, means for slitting the stock to form strands, means for opening the slits and separating the strands, and rolls for rolling and smoothing the expanded product to set the strands and bonds in a single flat plane.

11. In a machine for expanding slitted metal, rolls for separating the strands of a flat slitted sheet and preserving them with the bonds in the plane of the original stock.

12. In a machine for expanding slitted metal, means for continuously but gradually separating the strands, and rolls for continuously smoothing the product and setting the bonds and strands in the same plane.

13. In a machine for expanding slitted metal strips, means for separating the strands in one plane, and rolls for corrugating the product transversely of the line of feed.

14. A machine for expanding a slitted sheet which comprises rolls for flattening the slitted stock, and rolls for performing the double function of stretching and flattening the product.

15. A machine for expanding a slitted sheet comprising means for subjecting a limited portion to a gradual stretching action and means for again gradually stretching the same portion to substantially the same proportional extent while a previously untreated portion is being subjected to the first action.

16. A machine for expanding slitted sheets comprising rolls for stretching and flattening the stock and other rolls for again stretching and flattening the partially expanded product while previously untreated stock is being subjected to the first action.

17. A machine for expanding slitted sheets comprising means for stretching the slitted stock and rolls for rolling the product to set the bonds and strands in a single plane.

18. A machine for expanding slitted sheets comprising means for feeding the stock at a certain speed, means for applying a stretching force at a speed to produce the desired total expansion and means for applying an intermediate stretching force whereby the total effective stretching action is divided into definite gradual steps.

19. A machine for expanding slitted sheets including rolls for drawing out the strands of a transversely slitted sheet in the direction of the line of feed and flattening the product.

20. A machine for expanding slitted sheets which includes a pair of smooth rolls for engaging the surfaces of the stock and opening the slits without turning the strands on edge.

21. A machine for forming expanded metal which includes three or more pairs of rolls having differential peripheral speeds, the excess of speed of the succeeding rolls being proportioned to the distance of their gripping surfaces from the gripping surfaces of the first pair.

22. In a machine for forming expanded metal from stock slitted in staggered arrangement, means for flattening the slitted stock, means for expanding the same, means for flattening partially expanded stock, means for continuing the expansion and means for finally flattening the same.

23. In a machine for forming expanded metal from stock slitted in staggered arrangement, means for flattening the slitted stock, means for expanding the same, means for flattening partially expanded stock and means for continuing the expansion.

24. In a machine for expanding slitted stock, means for flattening the stock, means for opening the slits to expand the stock and means for flattening the expanded stock and setting the bonds and strands in a single plane.

25. In a machine for forming expanded metal from stock slitted in staggered arrangement, means for expanding the slitted stock, means for flattening the partially expanded stock, means for continuing the expansion and means for finally flattening the product and setting the bonds and strands in a single plane.

26. In a machine for forming expanded metal from stock slitted in staggered arrangement, means for expanding the slitted stock, means for flattening the partially expanded stock and setting the bonds and strands in a common plane and means for continuing the expansion of said stock.

27. In a machine for expanding slitted sheet metal, a table for supporting the slitted metal stock and a plurality of pairs of smooth rolls for successively acting upon the slitted stock and serving to draw the stock through and feed the stock out of the

machine and to set it and overcoming the tendency of the expanded stock to buckle.

28. In a machine for expanding a previously slitted sheet of metal, a plurality of pairs of friction rolls having differential peripheral speeds for engaging the opposite surfaces of the sheet to stretch the sheet

and open the slits and means for drawing the expanded sheet from said friction roll

NORRIS ELMORE CLARK

Witnesses:

A. V. BROCK,
D. G. CLARK.

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Witnesses:

A. V. BROCK,
D. G. CLARK.

Corrections in Letters Patent No. 1,103,033.

It is hereby certified that in Letters Patent No. 1,103,033, granted July 14, 1914, upon the application of Norris Elmore Clark, of Plainville, Connecticut, for an improvement in "Apparatus for Manufacturing Expanded Metal," errors appear in the printed specification requiring correction as follows: Page 1, line 13, for the article "The," first occurrence, read *One*; page 2, line 41, for the word "farther" read *further*; page 3, line 36, after the article "the," second occurrence, insert the word *strip*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of August, A. D., 1914.

[SEAL.]

J. T. NEWTON,

Acting Commissioner of Patents.

It is hereby certified that in Letters Patent No. 1,103,033, granted July 14, 1914, upon the application of Norris Elmore Clark, of Plainville, Connecticut, for an improvement in "Apparatus for Manufacturing Expanded Metal," errors appear in the printed specification requiring correction as follows: Page 1, line 13, for the article "The," first occurrence, read *One*; page 2, line 41, for the word "farther" read *further*; page 3, line 36, after the article "the," second occurrence, insert the word *strip*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

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J. T. NEWTON,

Acting Commissioner of Patents.