

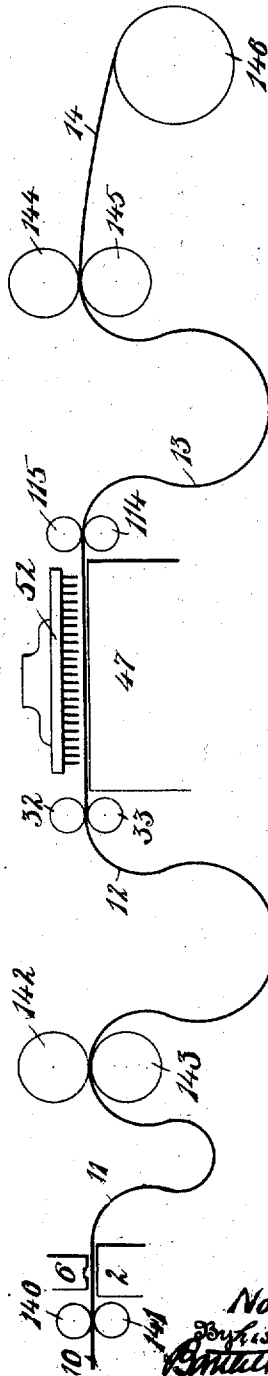
N. E. CLARK.
EXPANDED METAL MANUFACTURE.
APPLICATION FILED MAY 31, 1907.

1,062,768.

Patented May 27, 1913

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
Charles A. Reed
Louisa M. Reed

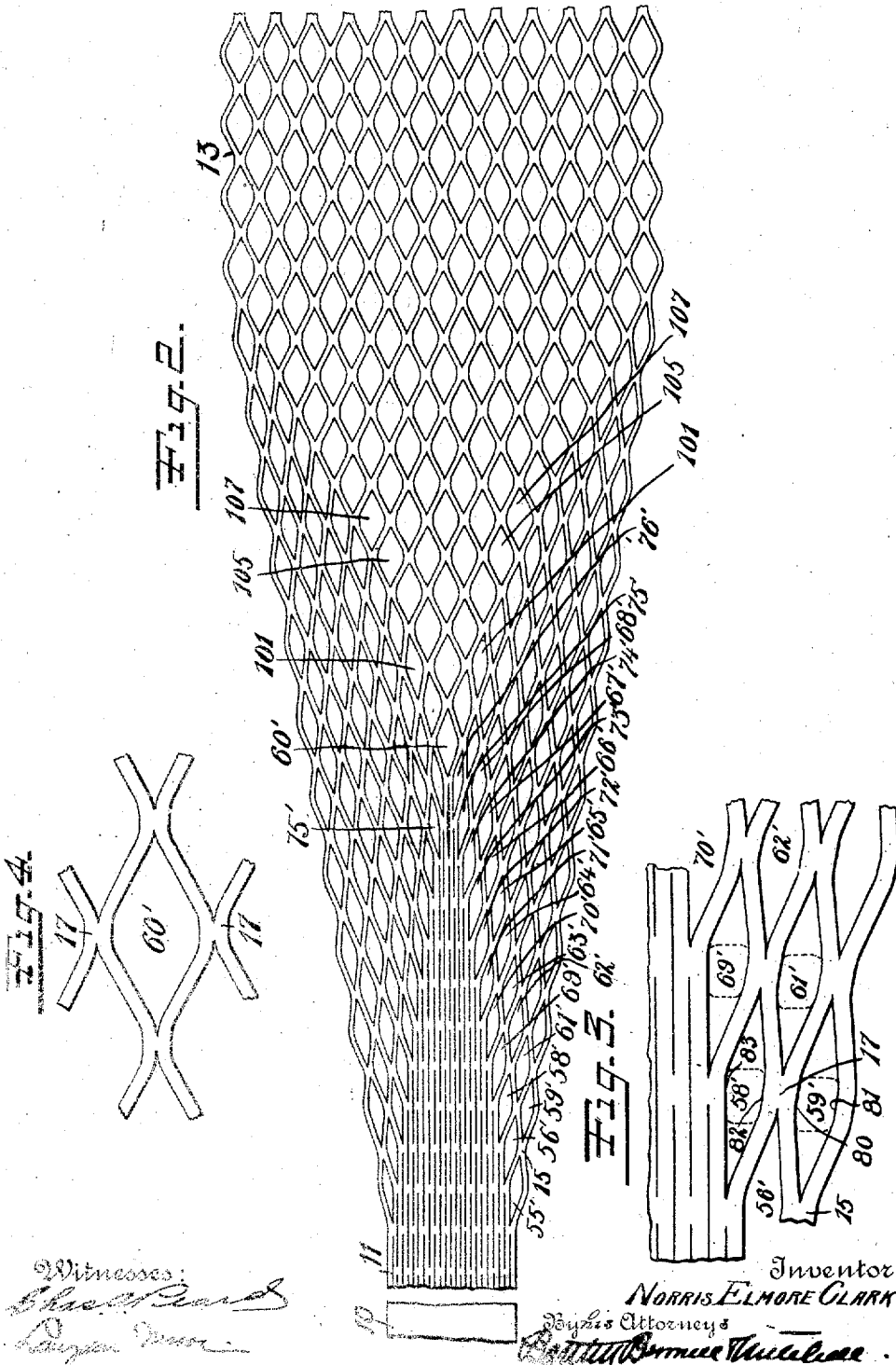
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3 SHEETS-SHEET 2.



Witnesses:
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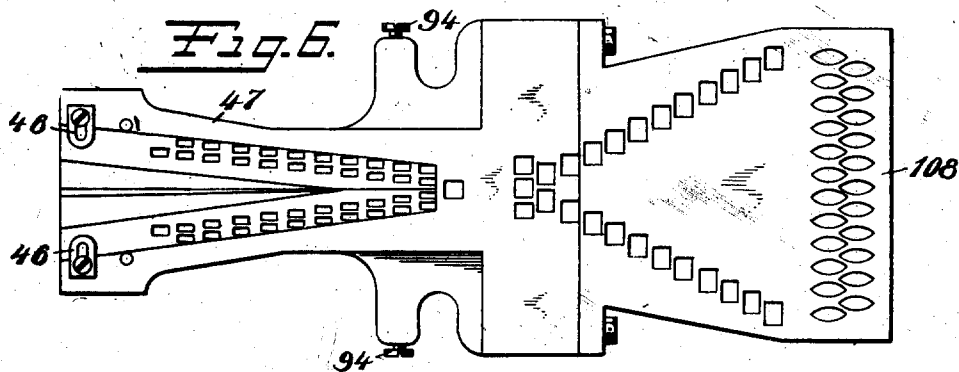
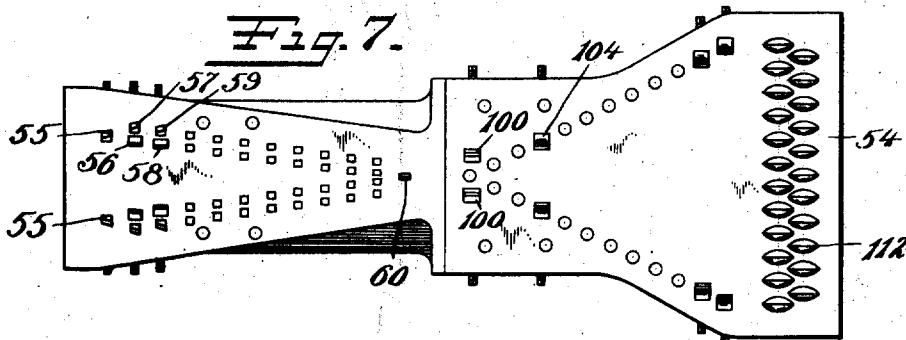
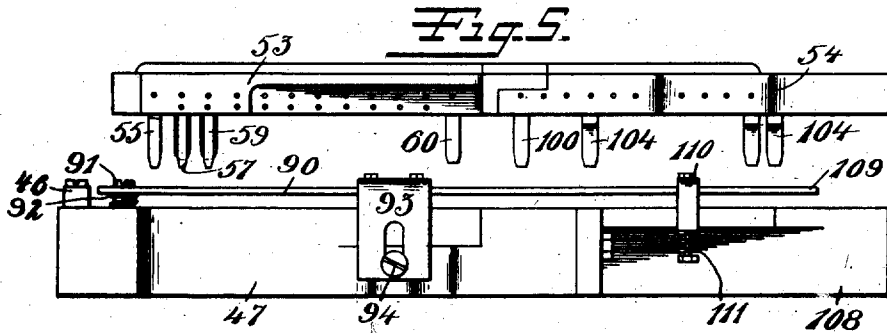
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3 SHEETS-SHEET 3.



Witnesses:
Wm. A. Reed
Charles W. Moore

Inventor
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By his Attorneys
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UNITED STATES PATENT OFFICE.

NORRIS ELMORE CLARK, OF PLAINVILLE, CONNECTICUT, ASSIGNOR TO THE NATIONAL METAL FABRIC COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

EXPANDED-METAL MANUFACTURE.

1,062,768.

Specification of Letters Patent.

Patented May 27, 1913.

Original application filed February 23, 1906, Serial No. 302,406. Divided and this application filed May 31, 1907. Serial No. 376,573.

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 Expanded-Metal Manufacture, of which the following is a full, clear, and exact description.

My invention relates to improvements in the art, process or method of forming so-called expanded metal.

This application is a divisional one from Serial No. 302,406, filed by me February 23, 1906.

The main object is to manufacture expanded metal particularly of the flat type of my former Patent No. 767,798.

The particular product of the method of manufacture herein set forth is claimed in my application Serial No. 323,451, filed June 26, 1906. This method is an improvement on my former method of Patent No. 767,798. The method is fully set forth in the following specification and claims. Viewed from different aspects the improvements will be found to contemplate a number of novel operations and sequences.

The stock is first slitted longitudinally, for instance, as set forth in my Patent No. 875,153, dated December 31, 1907, and then expanded laterally so that the product consists of continuous strips spaced apart at intervals in alternating rows. After slitting, the stock is rolled and flattened ready for expansion and the flattening slightly opens the slits and insures a more uniform expansion. The full expansion occurs in a plurality of stages, so as to be more uniform. It is intermittent and confined to limited portions of a sheet. Between the intermittent actions the material is subjected to an operation for flattening any distorted portion. The center of the sheet is guided as the material is expanded laterally. To prevent injury to the strands the expansion is directed to a definite extent and excessive expansion at or near the center is prevented. Each bond is held and directed during the expanding action so that the strands are uniformly bent in their orig-

inal plane and not strained. The bending is accomplished by long tapering punches in the slits, so that the action is gradual. The first expansion is along lines converging in the direction of feed of the stock, so that there is no tendency to cause the stock to buckle. This also causes the inside slits to be slightly opened and ready for the next punch action. After expansion the material is rolled to take out any tendency to buckle. It may also be treated for setting the bonds and strands into any special form. The flat product is conveniently coiled for handling, shipment, etc.

The accompanying three sheets of drawings illustrate one form of mechanism operable according to the process or method, and also the product in its various stages of manufacture. It will be obvious, however, that the operation of the method is not limited to the particular mechanism herein described, and that while an organized machine is the most expedient means of carrying the invention into effect, many steps might be carried out by hand tools. While the entire method accomplishes superior results, the different steps set forth in the claims have such advantages as make them useful in other and different types of expanding machines.

Figure 1 is a diagrammatic side view of mechanism for operating according to my new and improved method. Fig. 2 is a plan view of a piece of stock, showing the different stages of manufacture from plain strip to expanded product. Fig. 3 is an enlarged fragmentary view, showing details of the product during manufacture. Fig. 4 is a similar view showing one completed mesh. Fig. 5 is a side of the expanding mechanism proper. Fig. 6 is a plan view of the die bed or table of the expanding mechanism. Fig. 7 is a view of the under side of the punch member of the expanding mechanism.

The original stock 10 is fed by rolls 140 and 141 to the slitting mechanism, for instance die 2 and punch 6, by which the stock is prepared for expansion. It is immaterial to this invention whether material is removed by the slitting action or not. Of course no

stock is wasted where the action is pure shearing, but I wish it understood that by slitting I mean to cover any method of forming a sheet such as 11, so that it consists essentially of a plurality of narrow strips connected alternately on opposite sides in staggered arrangement, so that it is made up of strands and bonds and is in quality elastic. The slitting action roughens the material, so I prefer to flatten it, for instance by rolls 142 and 143. This flattening of the material also leaves the slits somewhat open, ready for the expanding punches. The different steps may be carried out in a single machine or separate machines. The flat slitted material 12 is then fed, for instance by rolls 32 and 33, over a die bed or table 47, and the principal expansion is effected by punches carried by a press gate or head 52. After expansion the product 13 is few away by suitable means, for instance rolls 115 and 114, which preferably flatten it. It may afterward be finished, if desired, by rolls 144 and 145, and the finished article 14 coiled, as at 146, for convenience in handling and shipment.

In the expanding machine, gages such as 46—46 are preferably used, and one or both may be adjustable for directing the strip as desired over the die bed or table 47. For convenience in manufacture and handling, the carrier for the punches is made in two parts 53 and 54. The slitted metal strip is fed underneath the punch carrier, and all the expansion takes place between the carrier and the die bed in substantially a horizontal plane but lateral of the direction of feed. The expansion is effected by two series of punches arranged in converging and diverging rows. The first series of punches is divided preferably into two rows. One of the punches 55 is arranged on each side of the center line of movement of the feed of the strip at a distance from the center such that it will enter the outside slit in the strip and open it up, as shown at 55' in Fig. 2. This punch 55 is shaped so that it will enter the slit and force the side strand out and slightly backward. 56 is a punch arranged to enter the next inside alternate slit when the strip is fed forward, and open it, as shown at 56' in Fig. 2. This slit, however, has been partially opened by the action of the punch 55 in the opening 55'. 57 is another punch similar to punch 55 arranged alongside of the punch 56, which is outside the bond 15 and which operates at the same time with the punch 56. The two punches between them draw the bond into its proper direction and prevent the strands from being unduly strained. 58 is another punch similar to punch 56 which enters and forms the opening 58'. At the same time the punch 59, which is similar to the punches 55 and 57, enters and forms

the opening 59', the bond between the openings 58' and 59' being directed by the two punches into such a position as to produce the least strain in the metal. A series of these punches like 55 and 56 is employed converging toward the longitudinal axis of the strip. They are arranged in two rows, as shown, and the punches of the inner row are somewhat shorter than the punches of the outer row. The operation of the punches on the inner and outer rows as soon as the strip has been fed in any length, is practically simultaneous. For this reason the punches of the inner row are made shorter, so that they do not enter until the opening in which they are to operate has been partially formed by the spreading of the strands on the outside by reason of the action of the outer row of punches. The punches may be secured in the carrier in any suitable manner.

60 is a punch arranged to operate in the center row of slits, as at 60'. This serves to expand the metal at this point and also to guide the strip and insure its being carried along in its proper line. The openings 55', 59', 61', 62', 63', 64', 65', 66', 67', and 68' are formed by the outer row of punches. The openings 56', 58', 69', 70', 71', 72', 73', 74', 75', and 76' are formed by the inner row of punches, all simultaneously. In Fig. 3 is shown on approximately a full-sized scale a fragment of the expanded metal after operation by this first series of punches. In this figure I have illustrated a fragment of the metal partially expanded, with the dotted outlines of punches in position, just having finished an operative stroke. The numbers applied to the openings are the same as the numbers applied to the punches for forming them, with the addition of indices. It will be understood, however, that all the punches of the outer row are essentially the same as the punch 55, and all the punches of the inner row are essentially the same as punch 56. The inner surface of the punch 59 presses against the outer edge 80 of the inner strands of the mesh 59'. The bearing face of the punch is wider than the length of the bond 17. Similarly the outer face of the punch operates against the inner edge 81 of the outer strand. The next inside punch 58 forms the opening 58', and for this purpose is located slightly in advance of the punch 59. Its outer surface presses against the inner edge 82 of the bond 17 opposite the inner face of the punch 59, and being wider than the length of the bond, it directs the bond to the proper inclination, so as to prevent undue strains in the strands particularly adjacent the outer end of the bond. The curves or bends in the strands adjacent the bond 17 are formed sufficiently remote from the end of the slit to prevent

rupture of the strands and to leave the strands in proper position relative to the other adjacent punches and the openings being formed thereby. The inner face of the punch 58 bears against the outer edge 83 of the strands which have not yet been opened, and tends to hold them in a definite position.

The stock is fed forward after each stroke of the punch, as before described, substantially the length from center to center of the slits. Each of the punches of the outer row enters the next succeeding opening diagonally in line with it, which has previously been formed by the next preceding punch of the inner row. Similarly, each punch of the inner row upon the next succeeding stroke of the punch carrier enters the slit immediately to the rear. The punches of the outer row being longer than the inner row open up the next succeeding inner row of slits preparatory to the entrance of the punches of the inner row. The only punch, therefore, which has to strike the slits accurately, is the first punch 55 of the outer row.

The centering punch 60 is symmetrically wedge-shaped on both sides, and serves to form the opening 60'. The slit immediately succeeding the opening 60' is allowed to be partially opened by the action of the punches in the openings 75' 75' on the opposite sides, so that the punch 60 may more readily enter. This opening out is permitted by cutting back the inner faces of the punches which are to form the openings 75'.

The die bed 47 has a series of openings corresponding substantially in position and size to the largest operative cross section of the punches, so that anvil-like surfaces are provided for supporting the strands and bonds of the expanded metal. When the punches are retracted they have a tendency to carry with them the expanded strip. To prevent this, I provide a stripper plate 90 having a series of passages approximately corresponding to the punches and beneath which the metal is fed. This plate 90 is mounted at its left end on headed posts 91 and pressed upward by springs 92, as seen in Fig. 5. The right hand end of the plate 90 is guided by brackets 93—93, which have slotted vertical arms through which pass the guide screws or bolts 94, as seen in Figs. 5 and 6. This end of the plate is further supported as will be hereafter described.

For certain purposes the mechanism thus far described may be said to be complete, as the product is expanded metal of considerably increased area and having openings depending upon the length of the slits and the size of the punches. When the punch carrier is brought down for the expanding action, the punches pass through

the stripper plate 90, expand the metal and then press the stripper down against the upper surface of the expanded metal and flatten it out to a certain extent. The stroke or position of the punch carrier might be made less so that the stock would not be flattened at all. For certain classes of work it is desirable that the expanded metal have more or less irregularity. The general expansion of the metal, however, is in its original horizontal plane. I prefer to carry out the expansion a step further. This is accomplished by a second series of punches carried by the holder 54. These punches are arranged in rows inclined toward the axis of the line of feed of the strip, but diverging in the opposite direction to the punches of the first series before described. In carrying out what may be termed this second step or expansion, I have found it desirable to employ holding punches such as the punch 100 shown in Figs. 5 and 7. These punches are located as shown, and are brought into operation in the openings numbered 101 in Fig. 2. The outer surface of each punch 100 serves to expand the metal partially on the outer side, while the inner face of each punch 100 serves to hold the adjacent metal on the inner side and prevent undue expansion. The two punches being arranged in the opposite openings 101, hold the metal in its proper position and prevent side pulls, which might result in improper action of the expanding punches beyond. The expanding punches are all substantially like punch 104 shown in Figs. 5 and 7. These operate in the openings 105, the outer face of each punch 104 acting against the inner edge of the opening and forcing the metal outward and expanding not only the adjacent metal, but all the metal lying between the two opposite punches. The result is that it is not necessary in some cases to employ punches for any openings in the second series before the openings 105, except the holding punches 100 just described. The width of each face of each punch is preferably greater than the length of the bonds and the corners are rounded, for the purpose before described of preventing rupture.

The number of punches employed, their size and arrangement, the presence or omission of any of the punches of either series, will depend largely upon the thickness of the metal, its ductility, and the size and shape of mesh desired. The same punches may, however, be used for different thicknesses of metal within quite wide limits, but for special classes of work it may be necessary to design special punches, as will be readily understood by one understanding the principles of sheet metal working.

After the metal comes from the machine thus far described, it may be passed through other machines of a similar character and

larger size, or the second series of punches may be increased in number. The punches of this second series may also be arranged in a plurality of rows, as the punches of the first series, getting a more gradual expansion. There is not, however, in the machine herein shown, the same necessity for a double row of punches in the second series as there is for a double row in the first series, because the metal has been given more nearly its final direction when it leaves the first series of punches, the further expansion being simply one of distance or degree. The expansion as herein described takes place laterally relative to the length of the stock and its direction of feed, the length being somewhat diminished in the process, depending upon the degree of expansion. The metal of the strands is, however, not materially elongated.

108 is the die bed beneath the second series of punches provided with openings corresponding to the punches. The metal when acted on by the second series of punches has a tendency to be retracted with them. I consequently provide a stripper plate 109, which, however, is arranged only along the outer edges of the punches. The plate might, however, be formed in one piece, as plate 90, with passages for the punches, but I prefer to form it as shown, so as to permit closer examination of the metal during the final expanding action. This stripper plate is connected at its left hand end, as shown in Fig. 5, to plate 90, and guided at this point. It is also supported on brackets such as 110, which are yieldingly held up by springs like 111. When the punches are withdrawn from the metal, the plates 90 and 109 hold down the expanded metal and strip it, as it is termed, from the punches.

In some cases it is desired to give a further form or shape to the expanded metal. This may be accomplished by means of an additional set of punches, as 112, as shown in Fig. 7. These do not act as true expanding punches, but simply bend the strands into shape corresponding to their outline. In this way different designs may be produced. Of course, when such punches are employed, the die bed will be provided with corresponding openings, so that the metal around the openings will act as an anvil to support the expanded metal. When such punches are employed, the stripper plate will, of course, be extended to correspond with them, or a separate stripper plate might be employed if desired.

When the sheet of expanded metal leaves the punches it is complete, but to give greater uniformity of thickness and finish in some cases, I prefer to employ rollers 114 and 115. These rollers not only serve to smooth out or finish the product, but they

also produce a pull upon it so as to assist in the feed of the strip. The dimensions and rates of movement of the rolls at each end of the machine must be properly proportioned to the percentage of expansion and contraction of the metal. Even when the discharge rolls 114 and 115 are employed, it is not always necessary to drive them positively, but they may be disconnected and act solely as a guide for the metal as it is forced through by the action of the feed rolls 32 and 33. When the punches are brought into action as before described, the metal at that instant, while being held stationary relative to its original strip, is foreshortened relative to the position of the rolls 114 and 115. This causes backward rotation of the rolls which is permitted by the gearing. The stock, however, might be released by releasing the pressure of the rollers during the duration of action of the punches.

The invention is adapted to the formation of expanded metal of various designs and for various purposes. I do not, therefore, limit myself to the production of metal as herein shown, nor do I limit myself to the particular mechanism herein shown for the purpose of slitting the metal. So also the two series of expanding punches may be arranged in separate machines. The blank strips of metal when purchased are ordinarily in rolls or hoops. These strips after slitting may be rolled up again and stored or transported preparatory to the expanding operation. For instance, they may be again rolled up for transportation or other purposes. The width of the expanded metal may be anything desired, depending only upon the original width of the stock and the size and arrangement of the machine. This method of manufacture, which makes it possible to produce expanded metal and coil it up for transportation and storage, I consider of great importance, and, so far as I am aware, is entirely novel. By its use it is possible to employ expanded metal in building constructions in continuous strips, where heretofore it has been impossible, it having been the custom to weld or secure the ends of short strips together.

It will be obvious that many advantages of the method could be attained by holding the stock stationary and giving the punch members a feeding movement as well as reciprocation. In other words, the "feed" of the stock is simply relative to the punch members.

What I claim is:

1. The method of forming expanded metal, which includes first slitting a sheet, then flattening it, and then expanding it laterally.

2. The method of forming expanded metal, which includes first slitting a sheet,

then flattening it, then expanding it laterally, and then flattening it.

3. The method of forming expanded metal, which includes slitting a strip, rolling it longitudinally, then expanding it laterally, and then flattening it.

4. The method of forming expanded metal, which includes slitting a strip, rolling it flat, and then expanding it laterally in the direction of its original plane.

5. The method of forming expanded sheet metal, which includes slitting a strip, flattening it, expanding it laterally, and setting the bonds and strands in the same plane.

6. The method of forming expanded metal, which includes slitting the stock, rolling it flat and expanding it laterally by successive rows.

7. The method of forming expanded metal, which includes slitting the stock, rolling it flat and expanding it intermittently by successive rows.

8. The method of forming expanded metal, which includes slitting the stock, rolling it flat and expanding it by successive converging rows.

9. The method of expanding sheet metal, which includes intermittently feeding a slitted strip and bending definite inclined rows of the material between the slits in a direction lateral to the line of feed and in substantially the original plane.

10. The method of expanding sheet metal, which includes intermittently feeding a slitted strip, and bending successively row after row of inclined rows of the material between the slits in a direction lateral to the line of feed and in substantially the original plane.

11. The method of expanding slitted sheet metal, which includes intermittently feeding the slitted sheet and engaging the edges of an inclined row of bonds so as to bend the connected strands gradually in the direction of the original plane of the stock.

12. The method of expanding slitted sheet metal, which includes intermittently feeding the slitted sheet and engaging the edges of an inclined row of bonds so as to bend the connected strands gradually in the direction of the original plane of the stock, and flattening the bonds after the bending of the strands.

13. The method of forming expanded metal, which includes slitting a sheet longitudinally, feeding it and bending individual strands outwardly along two rows converging forwardly in the direction of feed.

14. The method of expanding a slitted sheet, which includes the simultaneous bending of four inclined rows of strands.

15. The method of expanding a slitted sheet, which includes the simultaneous bending of converging and diverging rows of strands.

16. The method of forming expanded metal, which includes successively engaging the edges of substantially all of the bonds of a slitted sheet beginning at the outer edge of the sheet and proceeding toward the center successively.

17. The method of expanding slitted metal, which includes the first steps of bending outwardly the corner strands of a sheet and then setting the strands.

18. The method of expanding slitted sheet metal, which includes first bending the corner strands outwardly and thereafter bending the succeeding strands outwardly step by step.

19. The method of expanding slitted sheet metal, which includes the simultaneous bending of converging and diverging rows of strands step by step.

20. The method of expanding slitted sheet metal, which includes simultaneously engaging the inner edges of adjacent bonds in diverging rows and bending the strands outwardly.

21. The method of expanding slitted sheet metal, which includes engaging the bonds first along converging rows and then along diverging rows and bending the strands outwardly.

22. The method of expanding slitted sheet metal, which includes successively bending the strands first along two inclined rows and then along two other inclined rows.

23. The method of expanding slitted sheet metal, which includes successively bending the strands first along two inclined rows and then along two other inclined rows of different angles of inclination.

24. The method of expanding slitted sheet metal, which includes engaging portions of the stock along two converging rows and expanding it laterally in its original plane.

25. The method of expanding slitted sheet metal, which includes engaging portions of the stock along two converging rows and then along two other rows, and expanding it laterally.

26. The method of further expanding a partially expanded sheet, which includes intermittently feeding the sheet and bending outwardly diverging rows of strands.

27. The method of expanding slitted sheet metal, which includes bending converging rows of strands and subsequently giving a supplemental bending to diverging rows of strands.

28. The method of further expanding a partially expanded sheet, which includes holding strands near the center while diverging rows are being bent outwardly.

29. The method of expanding slitted sheet metal, which includes bending outwardly the strands of converging rows, holding the strands on both sides of the center, and bending outwardly the strands of diverging rows.

30. The method of expanding slitted sheet metal, which includes bending outwardly the strands of converging rows, holding the strands on both sides of the center, bending outwardly the strands of diverging rows, and intermittently flattening the bonds.
31. The method of forming expanded metal, which includes successive cycles of operation, each cycle consisting of expanding a portion, flattening it and then feeding it.
32. The method of expanding a slitted sheet, which includes feeding it longitudinally of the slits, expanding it partially in its original plane in a lateral direction, holding certain strands adjacent the center to prevent excessive bending, and continuing the lateral expansion beyond said strands.
33. The method of forming expanded metal, which includes forming a strip with partially opened slits, then bending the strands laterally and setting the bonds in the same plane.
34. The method of forming expanded metal, which includes forming a strip with partially opened slits, then intermittently bending the strands and setting the bonds in the same plane.
35. The method of forming expanded metal, which includes forming a strip with partially opened slits, then bending successively row after row of the strands setting the bonds in the same plane.
36. The method of expanding slitted sheet metal strips, which includes partially bending the strands and opening the slits, feeding the strip step by step, and further bending the strands between the partially opened slits.
37. The method of expanding slitted sheet metal strips, which includes partially bending the strands and opening the slits, feeding the strip step by step, and further bending the strands between the partially opened slits and setting the bonds and strands.
38. The method of forming expanded metal, which includes the successive and repeated bending of a limited number of strands of a slitted sheet, and setting the strands into the same plane with the bonds.
39. The method of forming expanded metal, which includes slitting a strip longitudinally, flattening it so as to partially open the slits, expanding the strip laterally, and flattening the expanded sheet to set the bonds and strands in the same plane.
40. The method of forming expanded metal, which includes slitting a strip, partially opening the slits, and intermittently bending the strands and flattening the product.
41. The method of forming expanded metal, which includes feeding a slitted strip longitudinally a distance substantially equal to the distance between centers of the slits in a row, and opening a plurality of slits, and repeating the operation of feeding and opening.
42. The method of forming expanded metal, which includes feeding a slitted strip a distance substantially equal to the distance between centers of the slits in a row, and opening a plurality of slits, repeating the operation of feeding and opening, and flattening the expanded portion after each opening action.
43. The method of forming expanded metal, which includes the successive lateral expansion of limited portions of a slitted sheet interspersed by flattening operations.
44. The method of expanding slitted sheet metal, which includes intermittently bending a plurality of strands laterally and flattening the bonds.
45. The method of expanding slitted sheet metal, which includes bending a plurality of strands laterally, flattening the bonds, and again bending and flattening the strands and bonds.
46. The method of expanding slitted sheet metal, which includes intermittently laterally bending and flattening the strands.
47. The method of forming expanded sheet metal, which includes slitting a sheet and subsequently bending a plurality of strands simultaneously in a definite row by reciprocating punches sliding against the edges of the bonds.
48. The method of forming expanded metal, which includes forming a flat slitted sheet and then feeding it and engaging the edges of the bonds within the slits to bend the adjacent strands.
49. The method of expanding slitted metal strips, which includes engaging and turning the individual connecting bonds between the reticulations in the direction of the original plane of the stock in line with the general direction of the edge of the expanded portion of the strip.
50. The method of expanding slitted metal strips, which includes engaging and turning the individual connecting bonds between the reticulations in line with the general direction of the edge of the expanded portion of the strip, and setting the bonds and strands in the same plane.
51. The method of expanding slitted metal strips, which includes engaging and turning the individual connecting bonds between the reticulations in line with the general direction of the edge of the expanded portion of the strip, and flattening the bonds.
52. The method of expanding slitted metal strips, which includes engaging and turning the individual connecting bonds between the reticulations in line with the general direction of the edge of the expanded portion of the strip, and flattening the strands.

53. The method of expanding slitted metal, which includes simultaneously engaging the inner and outer edges of rows of bonds to expand the sheet.
54. The method of expanding a slitted sheet, which includes the engagement of both edges of two rows of bonds to bend the adjacent strands.
55. The method of expanding a slitted sheet, which includes the engagement of both edges of a row of bonds to bend the strands, and flattening the bonds while thus engaged.
56. The method of expanding slitted sheet metal, which includes engaging the inner edges of a plurality of bonds so as to bend the strands outwardly while they are directed by means engaging the outer edges of the bonds.
57. The method of expanding slitted sheet metal, which includes engaging the inner edges of a plurality of bonds so as to bend the strands outwardly while they are directed by means engaging the outer edges of the bonds, and then flattening the bonds.
58. The method of forming expanded metal, which includes engaging the opposite edges of a plurality of adjacent bonds of a slitted sheet and expanding the sheet laterally.
59. The method of expanding slitted sheet metal, which includes the successive engaging and simultaneous directing of rows of bonds to expand the sheet.
60. The method of expanding slitted sheet metal, which includes simultaneously engaging both edges of converging rows of bonds and bending the strands outwardly.
61. The method of expanding slitted sheet metal, which includes simultaneously engaging both edges of converging rows of bonds, and subsequently engaging the inner edges of diverging rows of bonds.
62. The method of expanding slitted sheet metal, which includes engaging the bonds with punches wider than the length of the bonds and guiding the bonds while the strands are bent outwardly.
63. The method of expanding slitted sheet metal, which includes engaging both edges of the bonds with punches wider than the length of the bonds and guiding the bonds while the strands are bent outwardly.
64. The method of bending strands for expanding slitted metal strips, which includes the use of punches having operating surfaces of greater width than the length of the bonds and guiding the bonds while the strands are bent outwardly.
65. The method of expanding slitted metal strips, which includes holding certain bonds and bending the strands connected thereto to expand the sheet.
66. The method of expanding slitted stock, which includes engaging the edges of some of the bonds and the adjacent ends of the strands, and bending the strands in a predetermined manner.
67. The method of expanding slitted stock, which includes engaging the edges of some of the bonds and the adjacent ends of the strands, bending the strands in a predetermined manner, and then setting the bonds and strands.
68. The method of expanding slitted metal, which includes engaging a plurality of bonds first on one edge and then on the other for directing the bonds and bending the strands.
69. The method of expanding slitted metal, which includes engaging a plurality of rows of bonds first on one edge and then on the other for directing the bonds and bending the strands.
70. The method of expanding slitted metal, which includes engaging a plurality of bonds first on one edge and then on the other for directing the bonds and bending the strands, and then setting the bonds and strands in the same plane.
71. The method of expanding slitted metal, which includes engaging a plurality of rows of bonds first on one edge and then on the other for directing the bonds and bending the strands, and then setting the bonds and strands in the same plane.
72. The method of expanding a slitted sheet, which includes feeding the sheet, expanding it laterally and rolling it but allowing it to foreshorten while held by the feeding and expanding devices.
73. The method of expanding a slitted sheet, which includes the engagement of the inner edges of four rows of bonds for bending the adjacent strands simultaneously.
74. The method of working sheet metal, which consists in feeding a continuous slitted strip, expanding definite rows of the same at right angles to the direction of feed, and setting the bonds and strands in the same plane.
75. The method of working sheet metal, which comprises feeding a long strip of slitted metal step by step, and expanding definite rows of the same in the original plane laterally of the direction of feed.
76. The method of expanding slitted sheet metal, which includes feeding the strip step by step, and intermittently expanding the metal laterally and flattening it as it is fed step by step.
77. The method of forming expanded metal, which includes slitting a sheet by one instrumentality and then engaging in the slits by another instrumentality while the unexpanded part of the slitted sheet is held stationary.
78. The method of forming expanded metal, which includes successively engaging the edges of rows of bonds of a previously slitted flat sheet, and then expanding the sheet laterally.

79. The method of expanding slitted sheet metal, which includes simultaneously engaging the edges of a plurality of bonds in different longitudinal rows of slits to bend the adjacent strands.
80. The method of forming expanded sheet metal, which includes slitting a sheet, feeding it longitudinally, opening the slits in the direction of the original plane of the stock, and flattening it intermittently.
81. The method of forming expanded metal, which includes slitting a sheet, feeding it, and intermittently engaging the edges of multiple rows of bonds so as to bend the adjacent strands.
82. The method of forming expanded metal, which includes intermittently feeding a slitted sheet and bending a plurality of strands laterally in a single plane.
83. The method of forming expanded metal, which includes intermittently feeding a slitted sheet and bending a plurality of strands laterally in a single plane and along two converging lines.
84. The method of forming expanded metal, which includes intermittently feeding a slitted sheet and bending a plurality of strands laterally simultaneously in a single plane.
85. The method of expanding slitted sheet metal, which includes guiding a strip at the center row of slits, expanding the strip laterally, and setting the bonds and strands in the same plane.
86. The method of expanding slitted sheet metal, which includes guiding a strip at the center row of slits, expanding the strip laterally along converging lines, and setting the bonds and strands in the same plane.
87. The method of forming expanded metal, which includes slitting a sheet, feeding it in a direction longitudinal of the slits, flattening the strip, guiding the strip along the center row of slits, and expanding the strip laterally in its original plane.
88. The method of forming expanded metal, which includes slitting a sheet, feeding it in a direction longitudinal of the slits, flattening the strip, guiding the strip along the center row of slits, expanding the strip laterally in its original plane, and flattening the expanded strip.
89. The method of forming expanded metal, which includes slitting a sheet, feeding it in a direction longitudinal of the slits, guiding the strip along the center row of slits, and expanding the strip laterally in its original plane by engagement along converging lines.
90. The method of forming expanded metal, which includes slitting a sheet, feeding it in a direction longitudinal of the slits, guiding the strip along the center row of slits, and expanding the strip laterally by engagement along converging lines and diverging lines.
91. The method of expanding slitted sheets, which includes guiding a sheet along a definite row of slits, holding certain portions on each side to prevent undue bending, and expanding the sheet laterally in its original plane.
92. The method of expanding slitted sheets, which includes guiding a sheet along a definite row of slits, holding certain portions to prevent undue bending, expanding the sheet laterally, and flattening the bonds and strands.
93. The method of expanding slitted sheets, which includes guiding a sheet along a definite row of slits, holding certain portions to prevent undue bending, and expanding the sheet laterally along converging lines in its original plane.
94. The method of expanding a slitted sheet, which includes rolling it, expanding it laterally by engagement along converging lines in its original plane, and rolling it.
95. The method of expanding a slitted sheet, which includes guiding the sheet, and expanding it laterally by engagement along converging lines in its original plane.
96. The method of expanding a slitted sheet, which includes guiding the sheet, expanding it laterally along converging lines, and flattening the bonds and strands.
97. The method of expanding a slitted sheet, which includes a repetition of cycles consisting of feeding the sheet and engaging the edges of bonds in the slits of a plurality of rows simultaneously to bend the adjacent strands.
98. The method of expanding a slitted sheet, which includes a repetition of cycles consisting of feeding the sheet and engaging the edges of bonds in the slits of a plurality of rows simultaneously to bend the adjacent strands, and flattening the strands after each bending operation.
99. The method of forming expanded metal which includes first slitting the stock longitudinally so as to form strands and bonds in staggered arrangement then rolling it forwardly and setting the bonds and strands in to a common plane and finally expanding it laterally.
100. The process of forming expanded metal which includes successively forming rows of meshes and successively setting the strands of the rows which have just been formed while the succeeding meshes are being formed.
101. The process of forming expanded metal which includes rolling and flattening the slitted strip, punching open the successive slits and rolling and flattening the product.
102. The process of forming expanded metal which includes slitting a sheet longi-

tudinally, partially expanding it laterally, flattening the partially expanded sheet and then further expanding said sheet.

103. The process of forming expanded metal which includes forming a series of meshes by one series of punches and then extending the openings by another series of

punches adjacent thereto while a new series of meshes is being formed by the first series of punches.

NORRIS ELMORE CLARK.

Witnesses:

L. G. CLARK,
A. V. BROCK.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

Corrections in Letters Patent No. 1,062,768.

It is hereby certified that in Letters Patent No. 1,062,768, granted May 27, 1913, upon the application of Norris Elmore Clark, of Plainville, Connecticut, for an improvement in "Expanded-Metal Manufacture," errors appear in the printed specification requiring correction as follows: Page 2, line 21, for the word "few" read *fed*; page 6, line 32, after the word "strands" insert the word *and*; 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 1st day of July, A. D., 1913.

[SEAL.]

C. C. BILLINGS,

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