

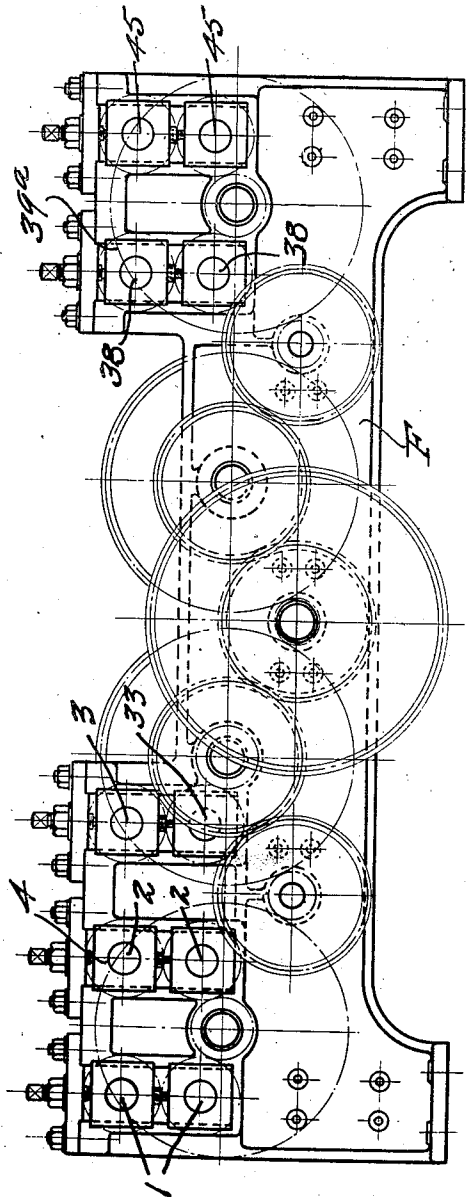
H. E. WHITE.
MACHINE FOR MAKING RIBBED SHEET METAL.
APPLICATION FILED FEB. 13, 1912.

1,056,962.

Patented Mar. 25, 1913.

9 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

A. C. Stewart
Agnes A. Johnston

H. E. WHITE, INVENTOR.

BY *W. C. Carman*

ATTORNEY.

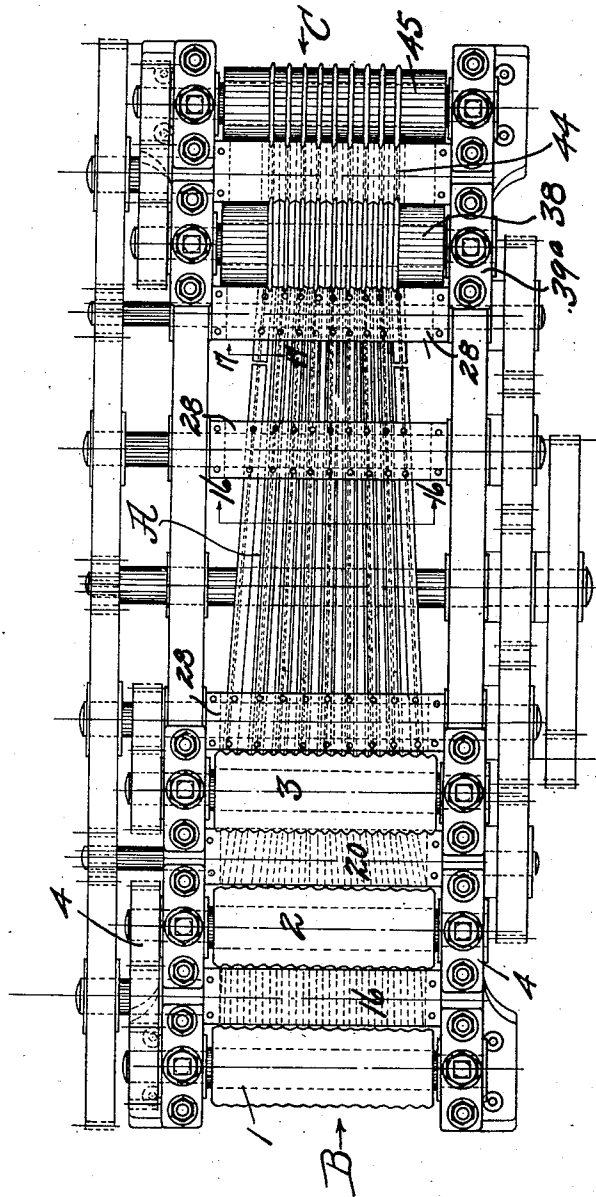
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9 SHEETS—SHEET 2.

Fig. 2



WITNESSES:

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Agnes A. Johnston.

H. E. WHITE, INVENTOR.

BY W. C. Carman,

ATTORNEY.

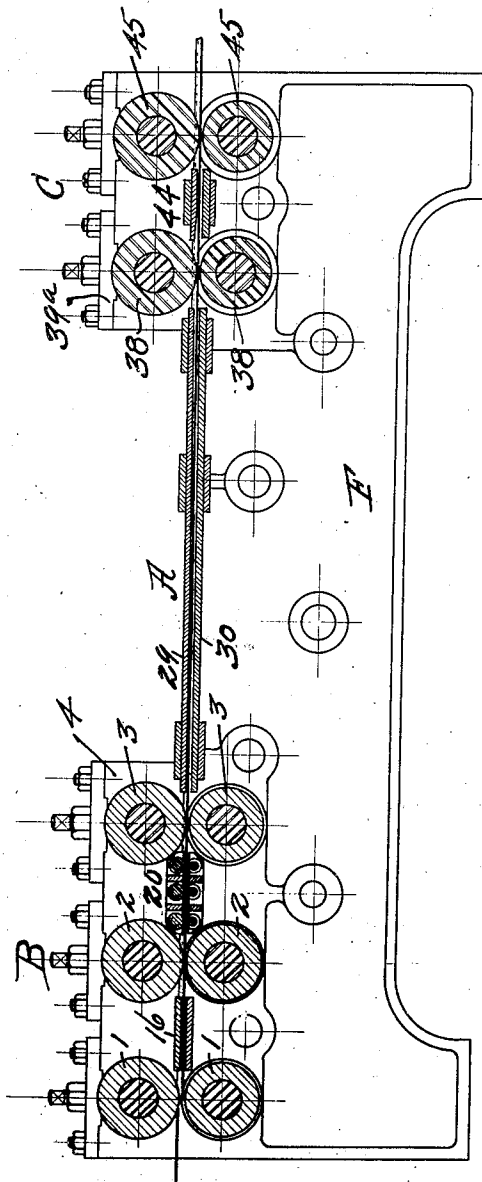
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9 SHEETS—SHEET 3.

Fig. 3.



WITNESSES:

A. C. Stewart
Agnes A. Johnston

H. E. WHITE, INVENTOR.

BY *W. C. Carman*

ATTORNEY.

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9 SHEETS—SHEET 4.

Fig. 4.

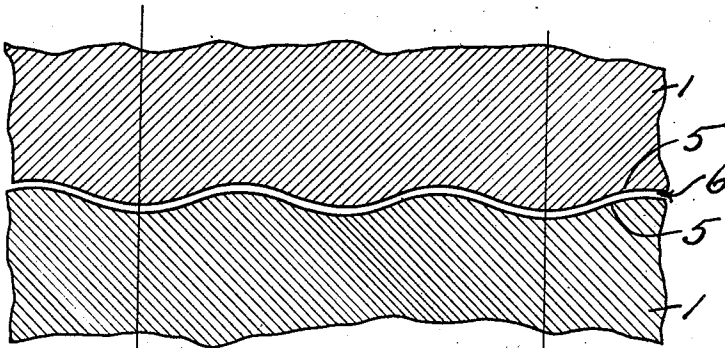


Fig. 5.

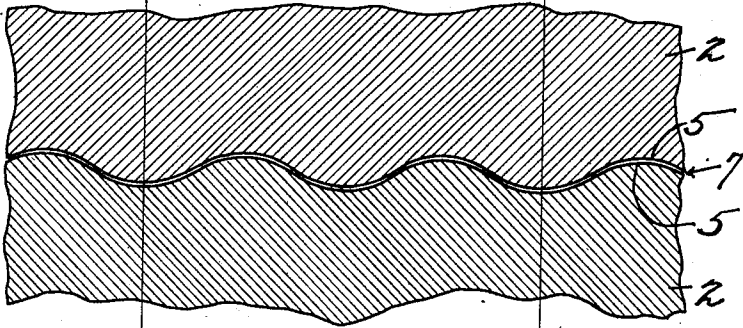
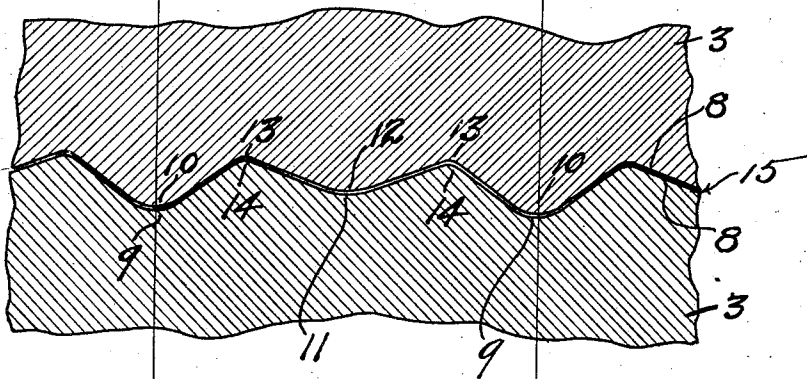


Fig. 6.



WITNESSES:

A. C. Stewart
Agnes A. Johnston.

H. E. WHITE, INVENTOR.

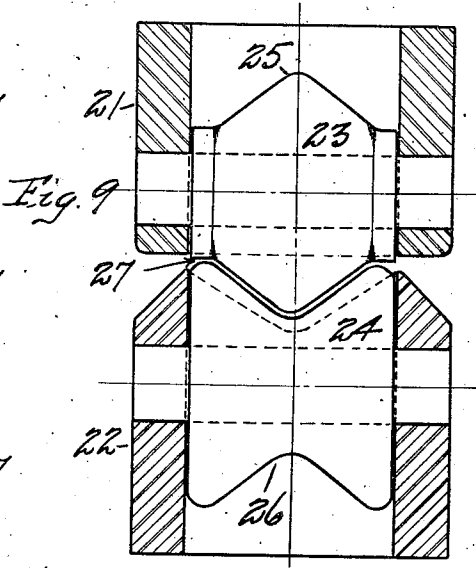
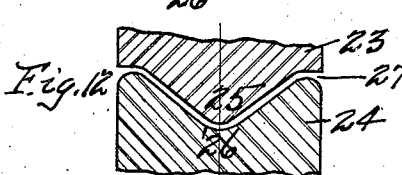
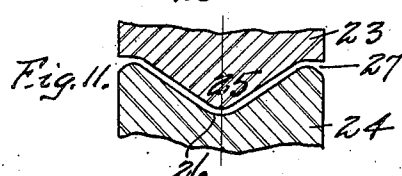
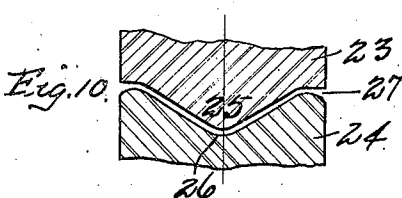
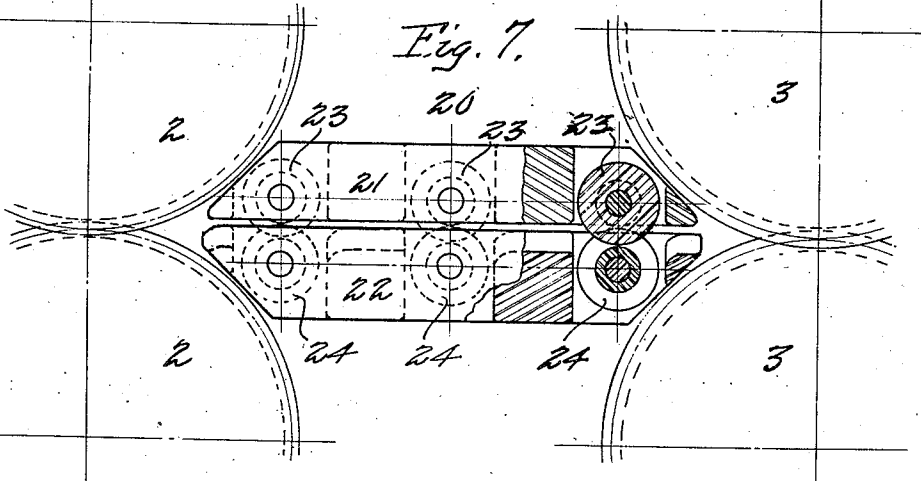
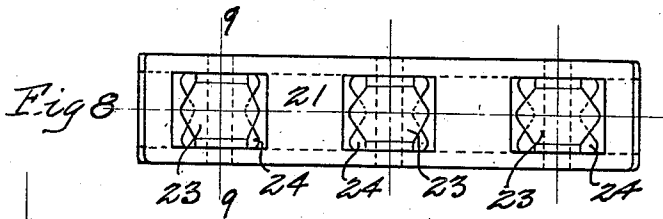
BY W. C. Carman
ATTORNEY.

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9 SHEETS—SHEET 5.



WITNESSES:

A. C. Stewart
Mary A. Johnston

H. E. WHITE, INVENTOR.

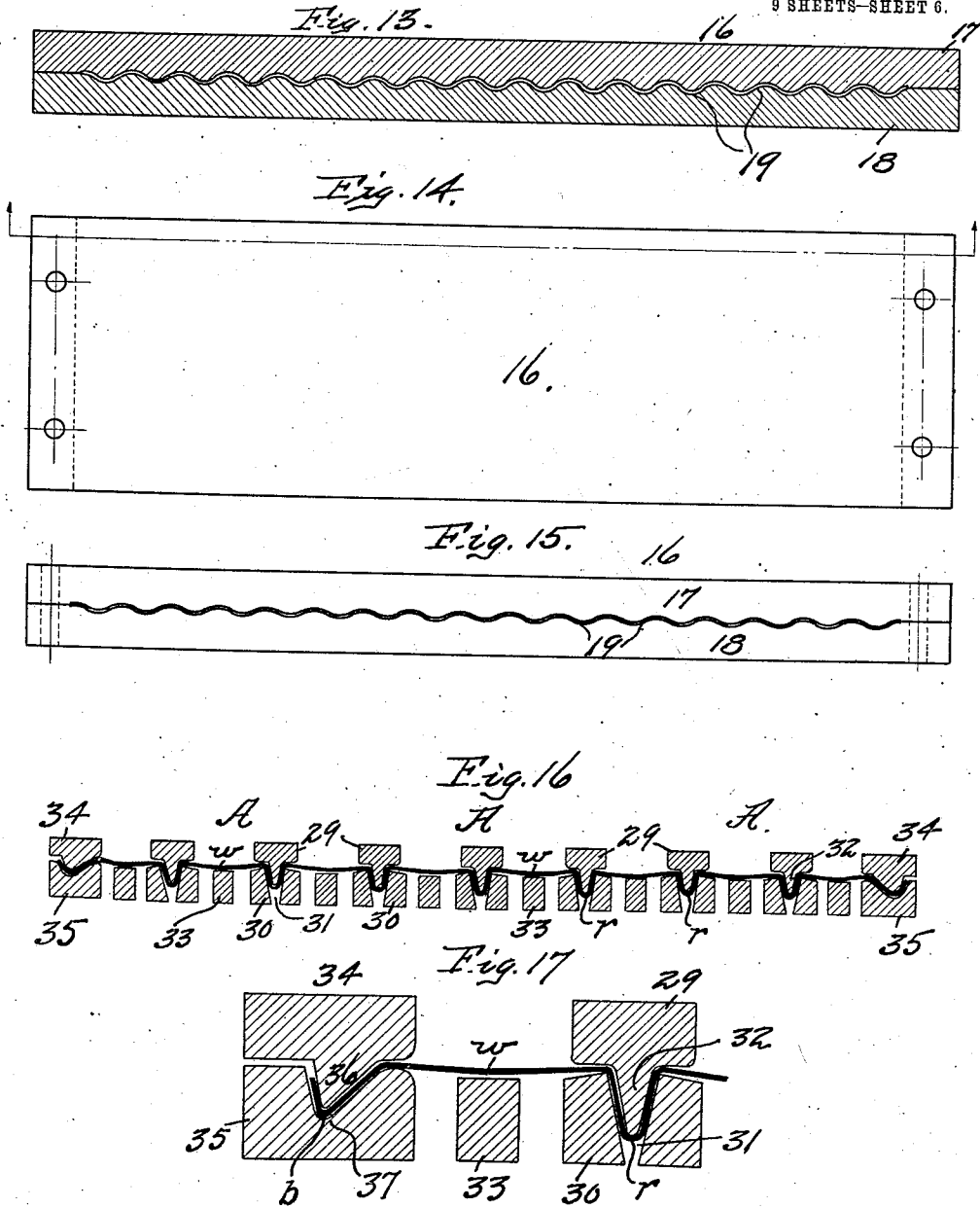
BY *W. C. Carman*
ATTORNEY.

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9 SHEETS—SHEET 6.



WITNESSES:

A. C. Stewart
Agnes A. Johnston.

H. E. WHITE, INVENTOR.

BY *W. C. Carman*

ATTORNEY.

H. E. WHITE.
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9 SHEETS—SHEET 7.

Fig. 18.

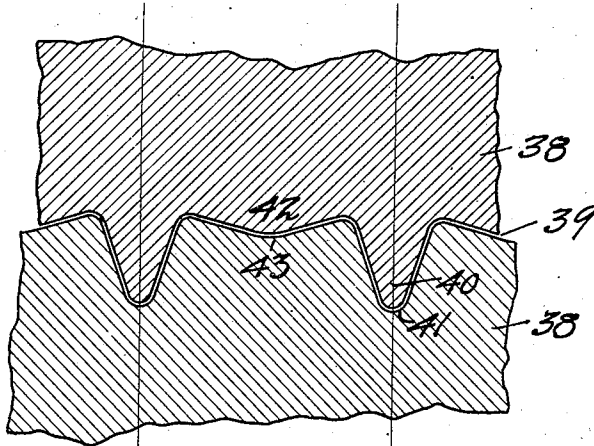
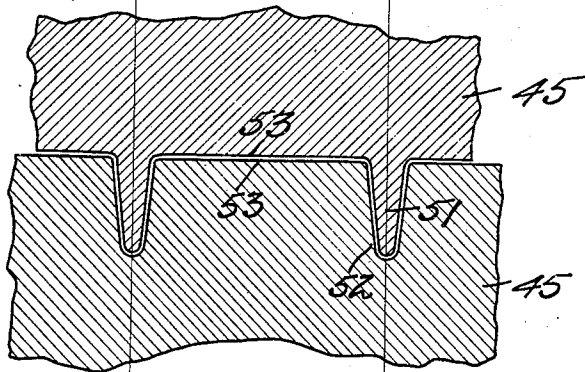


Fig. 19.



WITNESSES:

A. C. Stewart
Agnes A. Johnston.

H. E. WHITE, INVENTOR.

BY *W. C. Carmichael*

ATTORNEY.

H. E. WHITE.
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9 SHEETS—SHEET 8.

Fig. 20

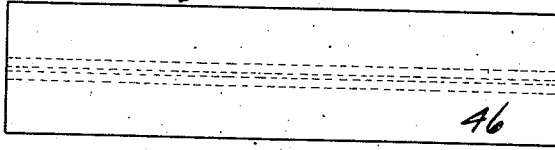


Fig. 21.

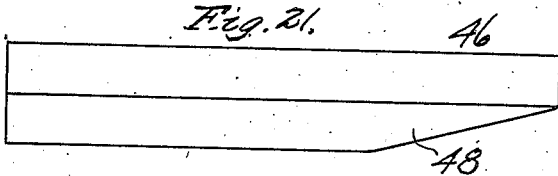


Fig. 23

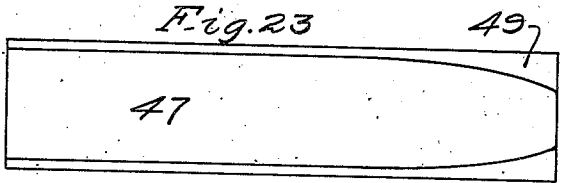


Fig. 24

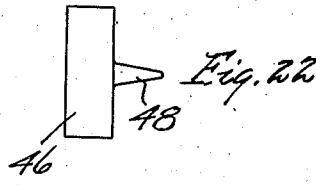
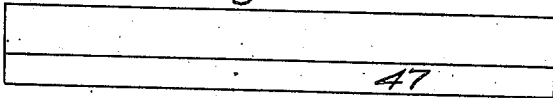


Fig. 22

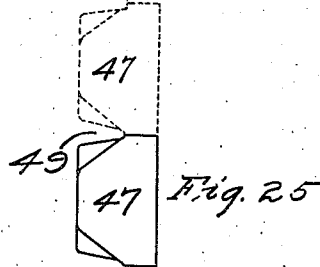


Fig. 25

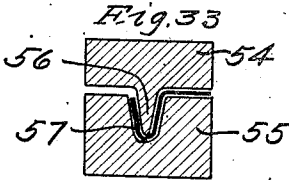


Fig. 33

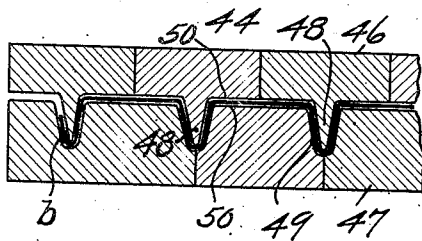


Fig. 26

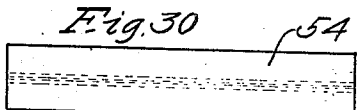


Fig. 30

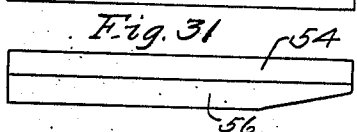


Fig. 31

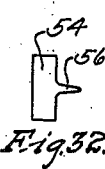


Fig. 32

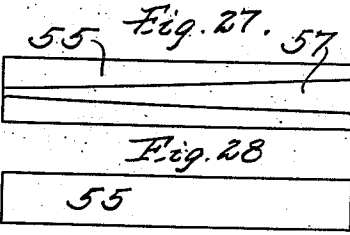


Fig. 27

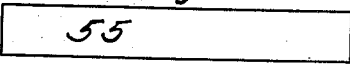


Fig. 28

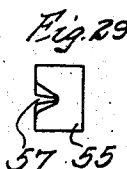


Fig. 29

WITNESSES:

A. C. Stewart
Agnes W. Johnston

H. E. WHITE, INVENTOR.

BY W. C. Carman

ATTORNEY.

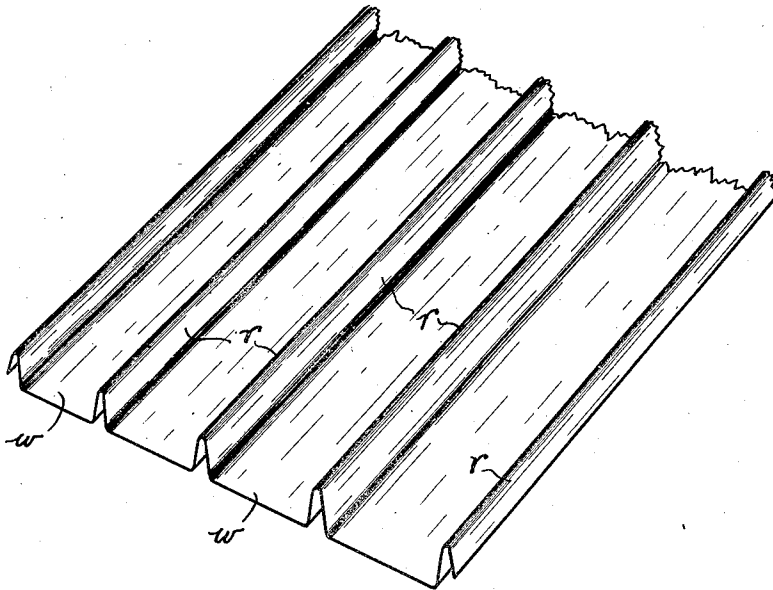
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9 SHEETS—SHEET 9.

Fig. 34



WITNESSES:

A.C. Stewart
Agnes A. Johnston.

H. E. WHITE, INVENTOR

W. Carman ^{BY}
ATTORNEY

UNITED STATES PATENT OFFICE

HERBERT E. WHITE, OF YOUNGSTOWN, OHIO, ASSIGNOR TO THE GENERAL FIRE-
PROOFING COMPANY, OF YOUNGSTOWN, OHIO, A CORPORATION OF OHIO.

MACHINE FOR MAKING RIBBED SHEET METAL.

1,056,962.

Specification of Letters Patent.

Patented Mar. 25, 1913.

Application filed February 13, 1912. Serial No. 677,373.

To all whom it may concern:

Be it known that I, HERBERT E. WHITE, a citizen of the United States, residing at Youngstown, in the county of Mahoning and State of Ohio, have invented certain new and useful Improvements in Machines for Making Ribbed Sheet Metal, of which the following is a specification.

This invention relates to the general subject of machines for preparing and forming sheet metal products, and has particular reference to a machine designed for the production of ribbed sheet metal. This material is made by forming deep grooves in a flat sheet, and these grooves form ribs which stiffen and otherwise change the general character of the sheet, adapting it for a variety of uses, and I propose to employ such sheets in a special way which calls for their production rapidly and economically on a large scale. This special use of the ribbed blanks or sheets is for the fabrication of expanded metal structures, in which structures the deep rib-forming grooves have several important functions as will appear. They are not only designed to stiffen the sheet in the well known and usual meaning of the term, but in addition, I make the ribs an instrumentality for the rapid and economical expansion of the metal between them. For example, after forming the ribs I slit the web part of the sheet between the ribs, such for instance as by means of the kind disclosed in my application for patent, filed February 13, 1912, Serial No. 677,361. After this slitting operation, the slitted blank is then rapidly carried through an expanding machine, (for example, the kind disclosed in my pending application for patent, filed September 8, 1911, Serial No. 648,384), and thus converted into an expanded fabric, and in which fabric the ribs serve, in addition to the functions already noted, the further function of acting as reinforcing elements in concrete structures.

Inasmuch as a very important use is made of the ribbed metal to facilitate the quick and economical production of expanded sheet metal, and also since a product of this kind has gone into extensive use, by reason of its important advantages in concrete

structures, the simplification and cheapening of the cost of producing this fabric has been made a consideration of great importance, and it will be seen from the present invention that the same comprises a machine which provides not only a novel, but also a very quick and cheap means for forming the ribbed metal blanks.

In further explanation of the distinguishing features of the present invention, it should be observed that the usual method of simultaneously making a plurality of rib-forming grooves in sheet metal requires that the sheet or plate be similarly acted upon at one time over the whole area which is to be formed into the ribs or grooves, for if the grooves be started from one end of the sheet, the metal must either be stretched sufficiently to permit of the ribs being formed, or the sheet must be contracted in width as the formation of the grooves starts, or a combination of the two effects may take place. Light sheet steel such as contemplated for use in the present invention will not stand stretching to form relatively deep ribs, and no sheets or plates can be contracted in width beginning at one end, under the ordinary methods without serious buckling. Accordingly, it is to be understood that a distinctive feature of the present invention resides in a machine which embodies novel and practical means for starting the grooves in the blank at one end of the sheet and carrying the same progressively through the body to the other end of the sheet; therefore, necessarily comprising means which first disposes of the natural impediment to this operation by breaking up and distributing the buckles between non-adjacent rib-forming grooves to get the same out of the way, and then later utilizes the buckles (which assume the form of bowed webs) so disposed as a means of permitting a folding action for the side walls of non-adjacent grooves to give the stout non-adjacent reinforcing ribs their final shape, as distinguished from subjecting the metal involved in the formation of the grooves to the harsh die drawing and stamping action usually characteristic of the operation of metal forming mechanism.

The essential features of this invention are necessarily susceptible to structural modification without departing from the spirit and scope thereof, but one of the preferred and practical forms of the invention is shown in the accompanying drawings, in which:

Figure 1 is a side elevation of a machine for making ribbed sheet metal, the same being constructed in accordance with the present invention. Fig. 2 is a top plan view thereof. Fig. 3 is a vertical longitudinal sectional view of the machine. Figs. 4, 5 and 6 are detail sectional views showing the roll-pass formation of the several pairs of preliminary rolls that initially produce and develop corrugations, of progressing depth, in the sheet metal blank as it is pushed toward the main set of grooving and contracting dies. Fig. 7 is a diagrammatic elevation, partly in section, illustrating the guiding roller dies that are employed as the guides between the second and third pairs of rolls of the feeding mechanism to ease the friction on the sheet, and at the same time present die-passes that further develop the corrugations to a depth that more nearly approaches the construction herein termed "grooved". Fig. 8 is a detail plan view showing one set of guiding roller dies. Fig. 9 is an enlarged cross-sectional view of a pair of the complementary rollers, on the section line 9—9 of Fig. 8. Figs. 10, 11, and 12 are detail sectional views showing the pass formation of the several pairs of roller dies. Figs. 13, 14 and 15 are sectional, plan, and edge views respectively of the corrugated sheet guide as arranged between the first and second pairs of corrugating rolls of the feeding mechanism. Fig. 16 is a cross-sectional view of the main die-set on the line 16—16 of Fig. 2. Fig. 17 is a view similar to Fig. 16, but on the line 17—17 of Fig. 2 at or near the delivery end of the machine, showing the distribution of the metal incident to its lateral contraction. Figs. 18 and 19 are detail sectional views showing the roll-pass formation of the two pairs of rolls of the delivery mechanism. Figs. 20, 21 and 22 are plan, side and end views, respectively, of one of the upper die members of the finishing die arranged between the two pairs of rolls of the delivery mechanism. Figs. 23, 24 and 25 are similar views of one of the lower members of the finishing die, illustrating the formation thereof to provide for the folding-in action that draws the walls of the grooves toward each other to give the finishing form and set to the ribs of the sheet. Fig. 26 is an enlarged cross-sectional view of a portion of the finishing die. Figs. 27, 28 and 29 are plan, side and end views, respectively, of the lower marginal die member of the finishing die. Figs. 30, 31 and 32 are similar views

of the upper marginal die member of the finishing die. Fig. 33 is a cross-sectional view of the upper and lower marginal die members of the finishing die in operative relation. Fig. 34 is a detail perspective view of the ribbed sheet metal product formed in the present machine.

Like references designate corresponding parts in the several figures of the drawings.

The novel machine claimed herein resolves itself into three principal parts, viz. a main die-set that grooves and contracts the corrugated sheet, a feeding mechanism comprising what may be termed a primary set of push-feed dies that progressively corrugates and stiffens the sheet and push the same into and through the main die-set, and a delivery mechanism which receives the sheet as it leaves the main die-set and which comprises what may be termed a finishing set of dies that give final set to the grooved and contracted sheet and discharge it from the machine. These several divisions of the machine may be conveniently designated in their entirety respectively, the main die-set A, the push-feed and stiffening mechanism B, and the delivery mechanism C, all of which, including the various accessories thereof are mounted in a suitable machine stand or frame designated by the letter F. The first and initial steps of the process are carried out on the feeding end of the machine, that is the end of the machine equipped with the feeding mechanism B.

Referring particularly to the feeding mechanism shown in the drawings, the same includes a plurality of pairs of roll dies that may be termed the preliminary corrugating and stiffening rolls 1—1, 2—2 and 3—3 of substantially similar formation and journaled at their ends in the roll housings 4 arranged at opposite sides of the machine frame F at the feeding end thereof. The several pairs of rolls 1, 2 and 3 are arranged in suitable spaced relation to accommodate the movement and guiding of the sheet from one pair of such rolls to the other, and the rolls in each pair are arranged in superposed relation, one above the other, and are complements of each other so as to provide roll passes between them which produce corrugations in the blank sheet of metal. In the first pair of corrugating and stiffening rolls 1—1, the opposing surfaces or walls thereof are formed with regularly curved shallow and corrugated surfaces 5 forming the initial corrugating pass 6 that starts and impresses the corrugations in the blank sheet as it is fed to and between the said first two rolls 1—1, and this configuration is preserved for the rolls 2 of the second pair of corrugating rolls, with the exception that in the corrugating pass 7 of the said second set of rolls, the ridges and valleys of the corrugations are more pronounced. A still

more pronounced development and deepening of the corrugations in the sheet is effected by the rolls 3—3 of the third pair of corrugating and shaping rolls, by reason of forming the said rolls 3—3 with what may be termed angular corrugating die-surfaces 8. These die-surfaces 8 include relatively deep valleys 9 and complementary die ribs 10 of approximately an open V formation, relatively shallow and wide valleys 11 and complementary die-ribs 12, and relatively shallow and approximately angular valleys 13 and complementary die ribs 14, all of which combine to produce the peculiarly shaped roll pass 15 as plainly shown in Fig. 6 of the drawings, and which will be more particularly referred to.

All of the various rolls 1—1, 2—2, and 3—3 are positively driven by means of suitable gearing so as to exert a pushing forward action upon the sheet metal toward the main die-set A, and between the first and second pairs of the said corrugating and stiffening rolls 1—1 and 2—2, the sheet metal passes through what may be termed a corrugated guiding die 16. This die is plainly shown in Figs. 13, 14 and 15 of the drawings, and essentially consists of upper and lower die plates 17 and 18 respectively, and the opposing faces of which are provided with regularly curved shallow corrugations 19 that conform to the configuration of the slightly corrugated sheet as it issues from the pass 6 of the first pair of rolls 1—1, and by reference to Fig. 2 of the drawings, it will be observed that in the said guiding die 16 there is a slight or gentle forward convergence of the corrugations 19 to provide a slight contraction of the sheet, and also serving to advance the form of the sheet as it comes from the first corrugating rolls so that it may be properly engaged by the rolls 2—2 of the second pass, which second pair of rolls serves to deepen the corrugations. The corrugated sheet, in the shape given to it by the second pair of corrugating rolls, passes from such rolls to what has been termed a guiding roller die and designated in its entirety by the reference number 20. This guiding die comprises a transverse and convergent series of suitably supported upper and lower guide frames 21 and 22 arranged in pairs, with the frames of each pair lying one above the other, and each having loosely journaled therein a plurality of spaced and freely revoluble die rollers. The die rollers of the upper guide frame 21 are designated by the reference number 23 and constitute the male die elements, while the die rollers of the lower guide frame 22 are designated by the reference number 24 and constitute the female die elements that are paired with the die elements or rollers 23. Accordingly, in the preferable construction shown, each of the

upper die rollers 23 presents a substantially angular convexed surface 25 that is a complement of the correspondingly shaped concaved surface 26 of the lower die roller which is paired therewith, so that between the two rollers is provided a substantially V-shaped roll pass 27. The roll passes 27 of the several pairs of rollers 23 and 24 are progressively graduated as plainly shown in Figs. 10, 11 and 12 of the drawings, to gradually, though slightly, increase the depth of the corrugations in the sheet as it passes from the second pair of corrugating and stiffening rolls 2—2 to the third pair of such rolls 3—3. The third pair of rolls 3—3, by reason of the complementary valleys and die ribs 9 and 10, 11 and 12, 13 and 14, serve to initiate or start the final form of the metal sheet. The elements 9 and 10 are spaced at regular intervals apart on the surface of the rolls 3—3 and deepen certain of the corrugations to start the deep grooves in the sheet which produce the stiffening ribs thereof as hereinafter more particularly referred to, while the elements 11 and 12 in effect flatten or widen certain of the corrugations to leave the intermediate bowed web *w* between the ribs *r* of the metal sheet, and the elements 13 and 14 serve to start the shape of the corners or bends in the metal sheet between the ribs *r* and the web portions *w*, which parts may be readily located by reference to Figs. 16, 17 and 26 of the drawings. The sheet as formed by the third pair of shaping rolls 3—3 is pushed forward through the stationary converging multipass main die set A. The main die set is suitably supported rigidly within the machine frame, by means of suitable supporting elements 28, between the push-feed mechanism B and the delivery mechanism C, and the effect of this main die set is to produce and define the longitudinal grooves in the sheet, and simultaneously contract the sheet so that the same as acted upon by the said main die set possesses stiffness and rigidity.

A preferable construction of the main die set is plainly shown in Figs. 16 and 17 of the drawings which respectively illustrate the main die set at different points, and the respective shapes of the sheet at such points. It includes in its organization a series of die units made up of upper guiding dies 29 and a series of complementary lower guiding dies 30, the lower guiding dies 30 being provided with longitudinally extending and transversely flaring die grooves 31, while the upper guiding dies 29 are provided with approximately V-shaped die ribs 32 that extend into the grooves 31 of the complementary dies and provide a V-shaped guideway through which the grooved and ribbed portions *r* of the sheet are forced by the action of the feeding mechanism. Between

the paired upper and lower guiding dies 29 and 30, the said main die-set A is provided with longitudinally arranged holding bars 33 which underlie the bowed web portions *w* of the grooved sheet, and assist in the general operation of the main die-set to produce and define the rib forming grooves, while at the same time preventing undue downward displacement or malformation of the webs *w* as the sheet sharply contracts laterally. The uniform lateral contracting of the sheet to compensate for the deepening and narrowing of the rib forming grooves therein, is provided for by the feature of having the series of upper and lower guiding dies of the main die-set convergently arranged in a forward direction, as plainly shown in Fig. 2 of the drawings, so that when the metal sheet leaves the discharging end of the main die-set, it has more closely approached its finished form, which includes a rather sharp angular edge bend *b*. This edge bend is formed between the upper and lower die members 34 and 35 of the marginal die-units of the main die-set, said upper member 34 being constructed with a depending die rib 36 lying within a corresponding complementary die groove 37, the apices of the said ribs and grooves lying in a plane oblique to the perpendicular. This formation is plainly shown in Fig. 17 of the drawings, while the more open shape of the die members 34 and 35 of the marginal die-units for starting the edge bends *b* is shown in Fig. 16 of the drawings.

The ribbed sheet, as discharged from the main die-set, is delivered between the rolls 38 constituting the first pair of delivery rolls, said rolls being journaled in the roll housing 39^a provided at the delivery end of the machine frame F. The said rolls 38 are arranged in superposed relation, one above the other, and have die surfaces corresponding in general configuration to the delivery end of the main die-set, the difference between the same being that the roll pass 39 of the rolls 38 has complementary die-ribs and valleys 40 and 41 corresponding approximately to the dimensions of the ribs *r* in the sheet as it leaves the main die-set, and other wider complementary die-ribs and valleys 42 and 43 corresponding to the shape and dimensions of the rather deeply bowed web portion *w* as it leaves the main die-set. These various elements of the roll-pass 39 are so disposed in substantially or approximately parallel relation as to provide for setting the sheet ribs *r* into their straightened parallel relation, while the rolls 38 also serve as primary rolls for picking up the sheet as it issues from the main die set and then feeding it to the finishing die 44 that is suitably supported in line with the passes between the first pair of delivery rolls 38, and a final pair of rolls 45—45.

The finishing guiding die 44 consists of a plurality of die-units with die-passes between them that are formed by upper and lower guiding die members 46 and 47 respectively. See Figs. 20 to 25 inclusive. The upper guiding die members are provided with narrow depending V-shaped die ribs 48, and the lower guiding die members 47 have recessed or grooved edges that register to form between them the die-grooves 49. The die-grooves 49 receive the die-ribs 48 and are straight for the greater portion of their length, while at their receiving ends they are flared or tapered as shown in Figs. 23 and 25 to give final dimension, set and shape to the ribs *r* of the metal sheet. The action of these die-grooves 49, tapered at one end, is to fold the walls of the rib-forming grooves toward each other and thus narrow the same to final form. The operation of folding-in the groove walls by a so-called hinge action is in sharp contradistinction to the crowding down of metal into a die, and is rendered possible by the bowed or bulged webs *w*. Furthermore, intermediate the complementary die ribs and grooves 48 and 49, the opposing walls of the die members 46 and 47 are provided with straight die surfaces 50 between which is formed a guiding pass that serves to flatten and straighten out the bow in the web portions *w* and give the final set to such portions of the sheet. The die 44 also includes marginal die-units (Figs. 27 to 33) consisting of upper and lower die members 54 and 55, respectively, having the complementary die ribs and grooves 56 and 57. These grooves 57, tapered longitudinally of the die-unit and serve to fold-in the edge bends or heads *b* to their final form and set in the same manner as the action of the main units of the die 44 on the ribs *r* of the sheet. (See Fig. 27.)

The prepared and set sheet is drawn from the die 44 and discharged from the machine by the final pair of delivery rolls 45 which are constructed with complementary die ribs and grooves 51 and 52 corresponding to the ribs and grooves 48 and 49, and with complementary flat and straight die surfaces 53 corresponding to the die surfaces 50 of the guiding die 44.

From the foregoing description it is to be observed that the improved machine is so constructed as to make provision for shaping alternate corrugations at the same side of a corrugated sheet into rib-forming grooves and flattening the intervening corrugations between the ribs, thus producing the product illustrated in Fig. 34 of the drawings.

The finished product, as thus produced, possesses that strength and rigidity which best prepares the sheet for the subsequent operation of slitting and punching which

is taken care of by a separate process and a separate machine forming no part of the present invention.

I claim:

1. In a machine of the class described, a die having means for corrugating a metal sheet, another die having means for shaping alternate corrugations at the same side of the sheet into rib-forming grooves, and a die having means for narrowing the said alternate grooves to produce ribs and for flattening the intervening corrugations between the ribs.

2. In a machine of the class described, the combination of a die having means for grooving and contracting the sheet, and a feeding mechanism including a plurality of roll dies having progressively deepening corrugating passes, the pass of the final pair of said roll dies being provided with means for initiating ribs from alternate corrugations at the same side of the sheet and for flattening the intervening corrugations between the ribs.

3. In a machine of the class described, the combination of a main die set having means for grooving and contracting the sheet, and a feeding mechanism including a plurality of roll dies having corrugating passes, and a guiding roller die between certain pairs of the roll dies, said guiding roller die comprising a transverse series of longitudinally arranged revoluble die rollers which are paired in complements and provided with means for progressively deepening and hardening non-adjacent corrugations in the sheet.

4. In a machine of the class described, feeding mechanism having means for corrugating a metal sheet, and a multi-pass main die set comprising a series of stationary dies convergently arranged in the direction of feed and engaging alternate corrugations at the same side of the sheet, whereby ribs are developed therefrom.

5. In a machine of the class described, a feeding mechanism having means for corrugating a metal sheet, a main die set comprising a series of upper and lower longitudinally arranged guiding dies having complementary ribs and grooves and holding bars alternating with the ribbed and grooved parts of the die, said upper and lower dies and holding bars converging toward the delivery end of the machine, and comprising means for developing ribs from non-adjacent corrugations and intervening web portions between the ribs.

6. In a machine of the class described, a feeding mechanism having means for corrugating a metal sheet, a main die set comprising a series of upper and lower longitudinally arranged guiding dies having complementary mating ribs and grooves and upper and lower marginal die members

having mating ribs and grooves lying in a plane oblique to the perpendicular, the said die elements of the main die set converging toward the delivery end of the machine, and comprising means for developing ribs from non-adjacent corrugations and intervening web portions between the ribs.

7. In a machine of the class described feeding mechanism having means for corrugating a metal sheet, a multi-pass main die set having stationary forwardly converging dies engaging alternate corrugations at the same side of the sheet to develop ribs therefrom, and a delivery mechanism including means for narrowing the ribs and flattening the intervening corrugations between the ribs.

8. In a machine of the class described, a feeding mechanism having means for corrugating the metal sheet, a stationary multi-pass main die set having means for contracting the sheet and simultaneously developing ribs from alternate corrugations at the same side of the sheet, and bowed web portions between the said alternate corrugations, and a delivery mechanism including rolls and a finishing die between such rolls, said finishing die consisting of upper and lower die members provided with complementary V-shaped die-ribs and die grooves and with straight die surfaces between said ribs and grooves to flatten the intervening corrugations between the ribs.

9. In a machine of the class described, a feeding mechanism having means for corrugating the metal sheet, a stationary multi-pass main die set having means for contracting the sheet and simultaneously developing ribs from alternate corrugations at the same side of the sheet, bowed web portions between the said alternate corrugations, and a delivery mechanism including a finishing guiding die having complementary die ribs and die grooves and straight die surfaces between said ribs and grooves, a pair of rolls between the main die set and said guiding die having a roll pass with the configuration of the sheet as it leaves the main die set, and another set of rolls arranged at the delivery side of said guiding die and having a roll pass of the configuration of the sheet as it leaves the guiding die.

10. In a machine of the class described, a die having means for corrugating a metal sheet, another die having means for shaping alternate corrugations at the same side of the sheet into rib-forming grooves, and a die having means for folding the walls of said non-adjacent grooves toward each other to produce stiffening ribs.

11. In a machine of the class described, a die having means for progressively developing corrugations in a metal sheet from an end edge thereof, another a stationary

multi-pass die having means for shaping alternate corrugations into rib-forming grooves, and a die having means for folding the walls of each of said alternate
5 grooves toward each other to produce stiffening ribs.

12. In a machine of the class described, a plurality of dies having means for progressively developing corrugations in a
10 metal sheet, and shaping alternate corrugations at the same side of the sheet into rib-forming grooves and producing intervening buckles between the latter, said dies also in-

cluding means for simultaneously gradually contracting the sheet, and a die having
15 means for folding the walls of each of said alternate grooves toward each other to produce stiffening ribs, and for flattening said intervening buckles between the ribs.

In testimony whereof I hereunto affix my
signature in the presence of two witnesses.

HERBERT E. WHITE.

Witnesses:

A. M. PARKINS,
EMORY L. GROFF.