Nov. 21, 1933. H. H. CRAFTON 1,936,228

APPARATUS FOR CORRUGATING SHEETS

Filed Jan. 22, 1931 2 Sheets-Sheet 1

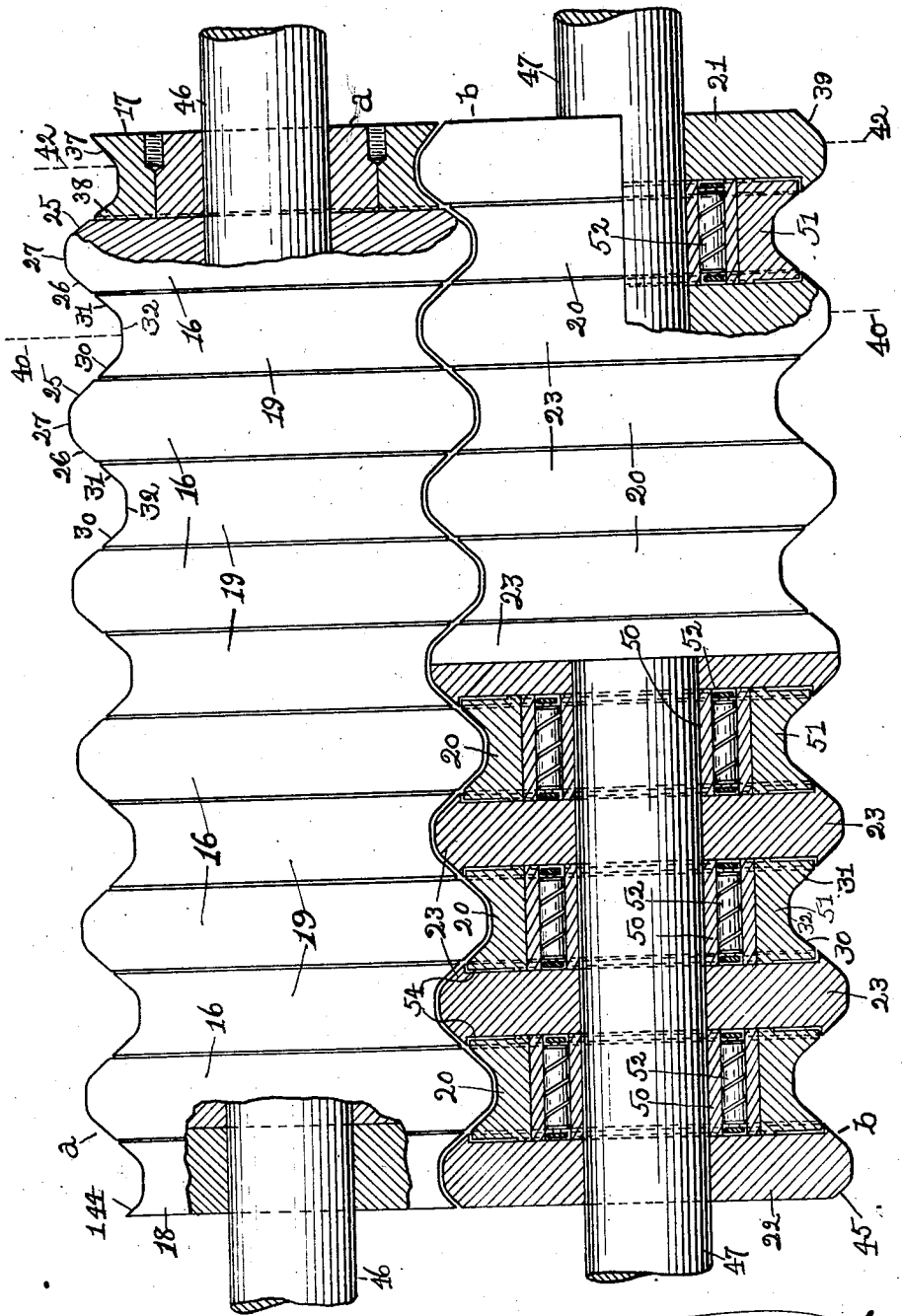


Fig. 1.

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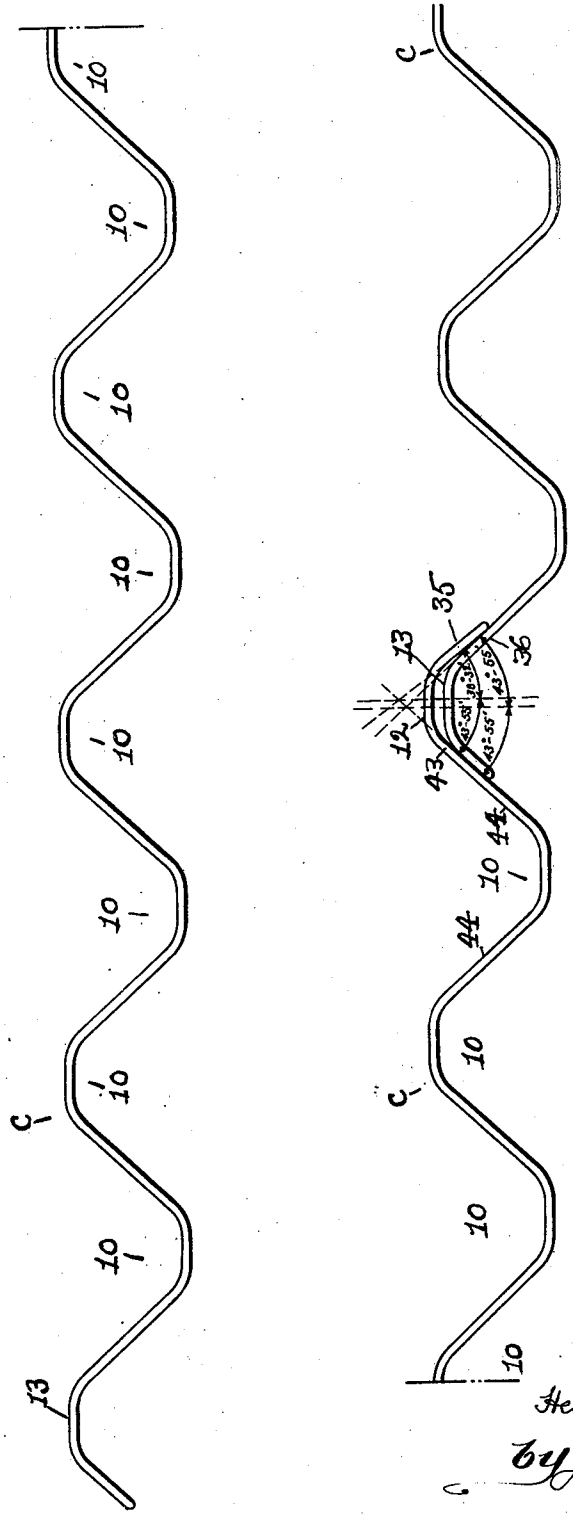


Fig. 2.

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APPARATUS FOR CORRUGATING SHEETS

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4 Claims. (Cl. 153—77)

This invention relates to apparatus for corrugating sheets and particularly metal sheets protected against corrosion and acid and alkali fumes and now commonly used in the construction of buildings and like structures as the roof and side walls thereof.

A building material of this character is shown and described in United States Patent No. 1,277,755, dated September 3, 1918, and has a metal sheet, preferably of steel, covered on all sides with a layer of asphalt or like bituminous material, which in turn is enveloped in a covering of asbestos or like felt which is saturated with asphalt or like bituminous material.

The present invention has for one of its objects to provide an apparatus for providing a metal sheet with substantially deep V-beam corrugations in its body portion and with shallower V-beam corrugations at the opposite sides of said sheet, and to form the inclined outer side wall of one of the shallower V-beam corrugations of a different angularity from the angularity of the inclined side walls of the deeper V-beam corrugations, for a purpose as will be described.

The invention also has for its object to provide a corrugating apparatus with which metal sheets may be corrugated in a superior manner and with which protected metal sheets having a layer or covering of asbestos or like felt may be provided with V-beam corrugations and curved without tearing or otherwise diminishing the protective value of the felt or like fibrous layer or covering.

To these ends, the corrugating apparatus comprises essentially co-operating corrugating rolls provided with male and female bending members of a construction as will be described.

These and other features of this invention will be hereinafter described and pointed out in the claims at the end of this specification.

Fig. 1 represents a pair of co-operating rolls of a corrugating apparatus embodying this invention, and

Fig. 2 shows an end elevation of corrugated sheets produced with the apparatus shown in Fig. 1.

Referring to the drawings *a*, *b*, shown in Fig. 1, represent a pair of corrugating rolls of a corrugating apparatus for producing a corrugated metal sheet *c* substantially of the character shown in Fig. 2, which corrugated sheet is provided in its body portion with a plurality of relatively deep substantially V-beam corrugations 10 and with shallower V-beam corrugations 12, 13, at the opposite sides of said corrugated sheet, with the outside wall of one of said side corrugations having an angularity which is sharper than the angularity of the side walls of the deeper corrugations 10, whereby the corrugated sheet produced by the rolls *a*, *b*, may be of maximum load-sustaining capacity and provided with an inclined side wall with which a superior feather joint may be obtained between overlapping sheets.

As shown in Fig. 2, the outer inclined wall of the side corrugation 13 is shown of the same angularity as the inclined walls of the deeper V-beam corrugations, as in practice it is covered by the overlying sheet.

To produce a V-beam corrugated sheet of the character shown in Fig. 2, the rolls *a*, *b* are provided with male and female bending members as will now be described.

As shown in Fig. 1, the roll *a* is provided with six annular male members and seven female members, with the male members 16 located between end female members 17, 18 and intermediate female members 19, which latter are located between adjacent male members 16.

The roll *b* herein shown is provided with seven male members and with six female members, with the female members 20 located beween end male members 21, 22 and intermediate male members 23, which latter are located between adjacent female members 20.

The male members 16 of the roll *a* co-operate with the female members 20 of the roll *b*, and the female members 17, 18, 19 of the roll *a* co-operate with the male members 21, 22, 23 of the roll *b*.

The intermediate male and female members of the rolls *a*, *b* are designed to form the substantially deep V-beam corrugations 10 in the body portion of the metal sheet, and for this purpose each annular male member intermediate the end members of the rolls *a*, *b* is provided with inclined walls 25, 26 extended from a central substantially flat annular wall 27, the inclined walls 25, 26 being of the proper angularity to impart to the body corrugation 10 the desired angularity, which in the present instance, as shown in Fig. 2, is substantially 44°.

The intermediate female members of the rolls *a*, *b* are of smaller diameter than the male members and are provided with circumferential grooves or recesses having inclined side walls 30, 31, which are of the same angularity as the inclined walls 25, 26 of the male members, and which converge toward the substantially flat bottom wall 32 of the circumferential groove or re-

cess, which bottom wall 32 is of the same width and shape as the substantially flat central wall 27 of the male members to co-operate therewith.

The end female members 17, 18 of the roll *a* and the end male members 21, 22 of the roll *b* are designed and constructed to form the shallower substantially V-beam corrugations 12, 13 at the opposite sides of the metal sheet, and to provide the outside wall of one of the shallower corrugations with an angularity which is different from the angularity of the side walls of the male and female members which form the deeper V-beam body corrugations.

In the corrugated sheet shown in Fig. 2, the shallow side corrugation 12 is designed to overlie the shallow side corrugation 13 of an adjacent corrugated sheet, and to provide the outer side wall 35 of the corrugation 12 with a sharper angularity than the angularity of the side wall 36 of the corrugation 13 which it overlies. The female end member 17 of the roll *a* has the outer inclined side wall 37 of its annular groove of a different angularity from that of the inner side wall 38 of said groove, and the outside inclined wall 39 of the male end members 21 of the roll *b* is provided with the same or substantially the same angularity as the outer side wall of the annular groove in the female end member 17 of the roll *a* with which it co-operates to form the outside wall 35 of the shallower V-beam side corrugation 12 in the V-beam corrugated sheet *c*. To this end, the outside side wall 37 of the groove in the end female member is inclined with relation to a plane through the female member and located at one side of the axial center through the annular groove of the female end member 17, and the inclined outside wall 39 of the co-operating male end member 21 of the roll *b* has the same inclination to the same plane extended through the male end member of the roll *b*.

By reference to Fig. 1, it will be seen that the side walls of the intermediate male and female members of the rolls *a, b* are inclined with relation to a plane passing through the axial center of the male and female members and between the ends of the substantially flat portions, 27, 32 of said bending members, which plane is indicated by the line 40 in Fig. 1, whereas the outside inclined walls 37, 39 of the end bending members 17, 21 are inclined to a plane passing through the bending members substantially at one end of the flat portions 27, 32 thereof, which latter plane is indicated by the line 42 in Fig. 1.

As a result of this construction of the end bending members at the right-hand end of the rolls *a, b*, the metal sheet when passed through the rolls *a, b* in the direction of the length of said sheet, will be provided with the outside wall 35 which has a different angularity from the inner wall 43 of the shallower side corrugation 12 and also of a different angularity from the inclined side walls 44 of the intermediate deeper V-beam corrugations 10, whose angularity is the same as that of the inner wall 43 of the side corrugation 12.

As represented in Fig. 2, the angularity of the side walls 44 of the deeper V-beam corrugations 10 is substantially 44°, whereas the angularity of the outer side wall 35 of the shallower side corrugation 12 produced by the rolls *a, b* shown in Fig. 1, is substantially 39°, and therefore sharper than the angularity of the side walls 44 of the deeper V-beam corrugations.

As a result of this construction, the outer wall 35 of sharper angularity, when it overlies an adjacent V-beam corrugated sheet, as represented in Fig. 2, and is secured thereto by bolts or other usual fastening devices employed to fasten said sheets to the framework of a building and not herein shown, has its side edge firmly pressed against the side wall of the corrugation 13 of the underlying sheet and makes a superior weather-tight joint therewith.

The female and male members 18 and 22 at the opposite ends of the rolls *a, b*, which are designed to form the shallower V-beam corrugation 13 at the opposite side of the V-beam corrugated sheet, may be provided with an outer inclined wall of a different angularity, if desired, but inasmuch as the shallower side V-beam corrugation formed by these end bending members, is in practice covered by the weather corrugation of an overlying corrugated sheet, as represented in Fig. 2, the bending end members 18, 22 of the rolls *a, b*, which form the covered shallower side corrugation 13 are and may be provided with outside inclined walls 144, 45 of the same angularity as the side walls of the deeper corrugations 10, and as herein shown will provide the covered side shallower corrugation 13 with an outer wall of an angularity of substantially 44° as indicated in Fig. 2.

The corrugating rolls *a, b* may have their male and female bending members each composed of one-piece members which are suitably secured to the shafts 46, 47 of said rolls to rotate therewith, and while such rolls *a, b* may be used to produce the corrugated sheets illustrated in Fig. 2, it is preferred to provide the rolls *a, b* with intermediate female members which are loose on their shafts and are not positively driven by said shafts but are free to be turned on their shafts by contact with the sheet, which is positively fed through the rolls *a, b* by the male and female end members thereof, which latter members are keyed or otherwise positively secured to their shafts and are assisted by the intermediate male members which are fast to their shafts and rotate therewith.

Preferably the intermediate female members are composed of an inner member or hub 50, an outer member 51 and an interposed antifriction bearing 52, which may be the well-known Hyatt roller bearing, the outer member 51 being provided with a circumferential groove having the inclined side walls 30, 31 and the bottom wall 32.

The intermediate female members of the rolls may and preferably will be extended into circular recesses 54 in the sides of adjacent male members with the inclined side walls 30, 31 of the female member co-operating with the inclined walls 25, 26 of the adjacent male members to practically form continuations thereof, after the manner illustrated in Fig. 1.

It will thus be seen that the intermediate female members of the corrugating rolls are mounted to turn freely on their shafts and are useful in reducing friction between them and the sheet fed between the said rolls, and such corrugating rolls can be used to advantage with plain metal sheets and especially with metal sheets provided with protective layers of fibrous material, as the danger of tearing or otherwise injuring the fibrous protective layers is avoided or at least reduced to a minimum.

In the present instance, the corrugating rolls *a, b* are shown separately from the framework of the apparatus in which they are mounted, as the said framework and gearing for driving the rolls may be of any desired construction and it

is not deemed necessary to show them as they are not considered essential for a complete understanding of the present invention.

In Fig. 2, one angularity for the side walls of the intermediate corrugations, to wit: substantially 44°, and a sharper angularity for the outer wall of the weather-side corrugation 12, to wit: substantially 39°, is shown and described, but it is not desired to limit the invention to these particular angularities.

By the term "substantially V-beam corrugation" herein used, a corrugation is described which has a substantially flat and relatively short horizontal wall at the top and bottom of the corrugations or valleys of the corrugated sheet, and inclined substantially straight side walls for said valleys. The substantially flat bottom walls of the corrugations afford a bearing surface of substantial area for the corrugated sheet to rest upon a supporting member, and the flat bottom and top walls cooperate with the straight side walls to impart to the corrugation the function of a beam. The deeper the substantially V-beam corrugations are, the greater the load-sustaining capacity of the corrugated metal sheet. The shallower outside substantially V-beam corrugations enable a maximum number of deep V-beam corrugations to be made in a flat metal sheet of standard width, either 30" or 36", and provide outside inclined walls for the shallower V-beam corrugations of less width than the side walls of the deeper corrugations yet of sufficient width to enable the outside walls of the shallower corrugations and especially the outside wall which is exposed to the weather, to be bent at a sharper angle to the flat top wall of the substantially V-beam corrugations than the angle of the side wall of the deeper V-beam corrugation is to said flat top wall. By making the outside walls of the shallower outside corrugations of less width than the side walls of the deeper intermediate corrugations, not only can a flat sheet of standard width be provided with a maximum number of relatively deep substantially V-beam corrugations, but also practical difficulties are avoided if it were attempted to make the outside walls of the outside substantially V-beam corrugations of a width equal to or greater than the side walls of the relatively deep body V-beam corrugations. These practical difficulties include not only the use of a materially wider sheet than that of the standard width now commonly made with its added cost, but also includes the difficulty of getting a tight joint between the overlapping walls of the corrugated sheets.

By reference to Fig. 1, it will be seen that the substantially flat top walls 27 of the male members 16 are in one plane and the substantially flat bottom walls 32 in another plane parallel to the first-mentioned plane, and that the outside walls 39, 45 of the male end members 21, 22 and the walls 37, 144 of the end female members terminate in planes between the planes in which the top and bottom walls 27—32 are located, and act on the metal sheet to produce the shallower outside corrugations 12—13 in the corrugated sheet.

What is claimed is:

1. A roll for corrugating apparatus comprising a shaft, a plurality of annular male bending members fast on said shaft and spaced apart thereon, said male bending members having inclined outer surfaces, and a plurality of annular female bending members of smaller diameter than said male members and loose on said shaft to turn thereon, said female members being located between said male members and provided with circumferential grooves having inclined side walls of substantially the same angularity as the inclined outer surfaces of adjacent male members and co-operating with said outer surfaces to extend the same and form substantially deep V-beam corrugations.

2. Corrugating apparatus comprising co-operating rolls having annular male bending members spaced apart and provided with inclined outer surfaces and intermediate annular female members of smaller diameter than said male members and provided with inclined side walls of substantially the same angularity as the inclined outer surfaces of said male members and co-operating therewith to form substantially deep corrugations, shafts upon which said male members are rigidly mounted and upon which said female members are loosely mounted, the male members of one roll co-operating with the female members of the other roll, and the end male member of one roll and the co-operating female member of the other roll having their outer inclined surfaces of a sharper angularity than the angularity of the inclined surfaces of the intermediate co-operating male and female members.

3. A roll for corrugating apparatus, comprising a shaft, a plurality of annular male bending members fast on said shaft and spaced apart thereon, said male bending members having inclined outer surfaces, and a plurality of annular female members of smaller diameter than said male members and comprising an inner member, an outer member and an antifriction bearing interposed between said inner and outer members, said female members being located between said male members and having the outer members thereof provided with circumferential grooves having inclined side walls of substantially the same angularity as the inclined outer surfaces of adjacent male members and co-operating with said outer surfaces to extend the same and form substantially deep V-beam corrugations.

4. A roll for corrugating apparatus provided with a shaft and a plurality of male bending members fast on said shaft and spaced apart thereon, a female bending member loosely mounted on said shaft between adjacent male bending members, and an anti-friction bearing for said female member interposed between the latter and said shaft.

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