March 17, 1953 A. W. COFFMAN 2,631,641

METHOD OF AND APPARATUS FOR PRODUCING PROTECTED METAL ARTICLES

Filed June 4, 1949

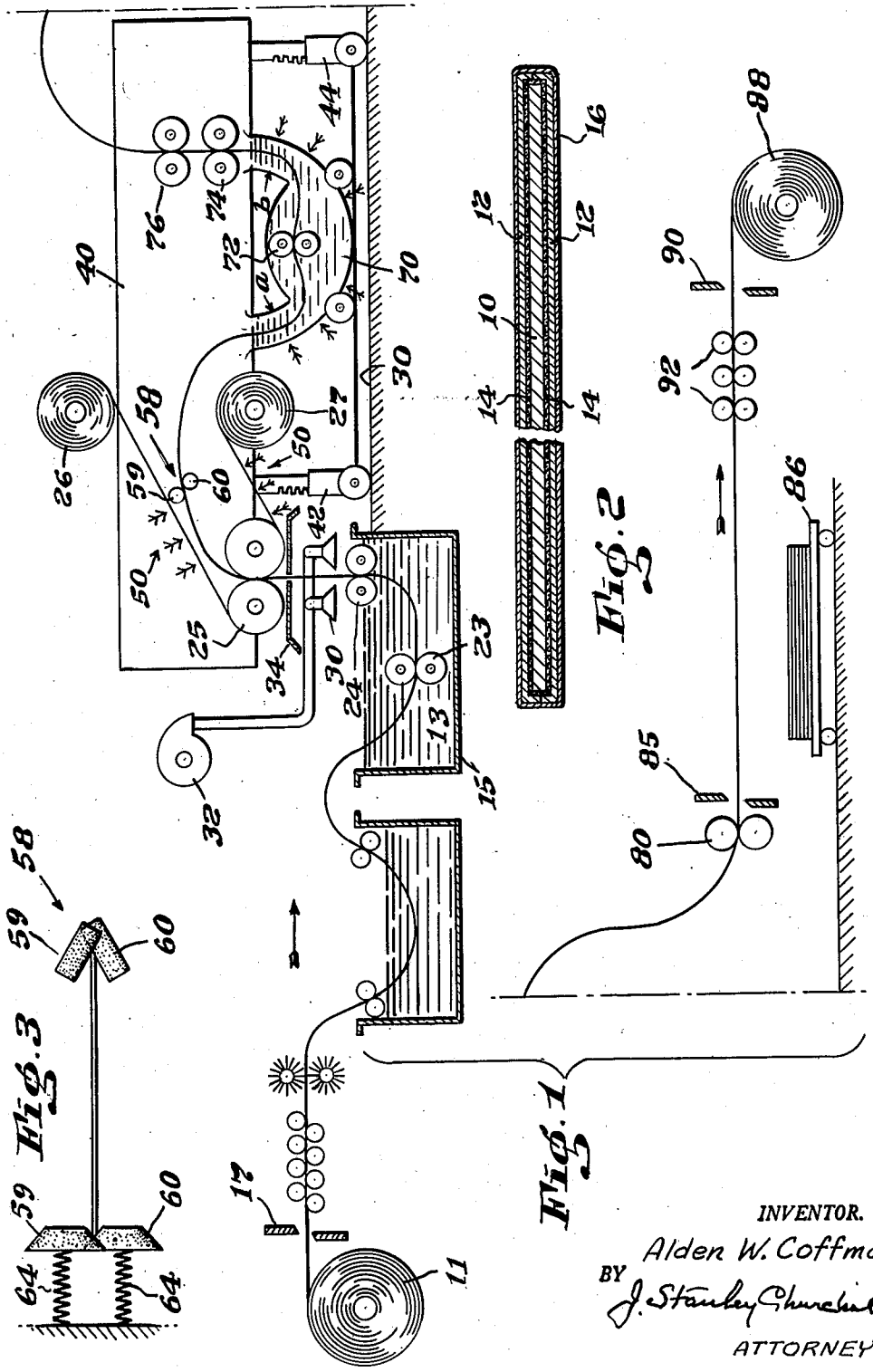


Fig. 1

Fig. 3

Fig. 2

INVENTOR.
Alden W. Coffman
BY J. Stanley Churchill
ATTORNEY

Patented Mar. 17, 1953 2,631,641

UNITED STATES PATENT OFFICE

2,631,641

METHOD OF AND APPARATUS FOR PRODUCING PROTECTED METAL ARTICLES

Alden W. Coffman, Pittsburgh, Pa., assignor to H. H. Robertson Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application June 4, 1949, Serial No. 97,246

4 Claims. (Cl. 154—1)

1

This invention relates to a method of and to apparatus for producing a protected metal article.

The object of the invention is to provide novel and improved methods of and apparatus for producing protected metal articles forming the subject matter of my United States Patent No. 2,073,334, dated March 9, 1937, and with which superior protected metal articles may be produced in an economical, rapid and efficient manner.

With this general object in view and such others as may hereinafter appear, the invention consists in the method of making the protected metal article, in the apparatus for making the protected metal article, and in the various structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of this specification.

In the drawings, Fig. 1 is a diagrammatic view in side elevation of the present apparatus for producing protected metal sheets; Fig. 2 is a sectional detail of the protected metal sheet produced by the apparatus of Fig. 1, and Fig. 3 is a detail in front elevation illustrating the mechanism for trimming the edge portions of the protected metal sheets.

In general, the present protected metal article comprises a metal article 10, preferably an iron or steel sheet having layers 12 of fibrous material, preferably asbestos paper or felt, secured to at least one and preferably to both of the opposite surfaces thereof by an interposed layer of metal adhesive 14. The metal adhesive 14 preferably completely envelops the metal sheet 10 and may comprise a non-corrodible metal such as zinc, tin, cadmium, lead or other non-corrodible metal or alloy, and the metal adhesive is alloyed to the metal sheet 10 and keyed or anchored to the fibers comprising the fibrous layer 12. In practice the fibrous layers may be saturated with a suitable impregnant comprising preferably a bituminous composition such as asphalt or resinous material or the like, or with any of the other commercial impregnants which have been or may be found suitable for use for impregnating such fibrous layers, and if desired, the protected metal article thus far described may be further protected by an outer weather-proofing coating 16 which may comprise any desired composition of bituminous material, weather resisting resins, or resinous compositions, and in practice a bituminous composition including cottonseed pitch and asphalt has been found to possess the desired weather resistance and durability.

2

The apparatus and method for producing protected metal sheets illustrated in my Patent No. 2,073,334, above referred to, and the commercial process heretofore employed in the production of such protected metal sheets have contemplated the passage of successive steel sheets through a galvanizing bath, and as the sheets leave the bath they are conducted upwardly between a pair of exit rolls and are then immediately conducted in a direction substantially at right angles to the direction at which the sheet leaves the bath. In other words, as the metal sheets leave the galvanizing bath they are passing in a general vertical direction and the course of travel of the sheets is then deflected to a horizontal direction as the sheets pass between the bonding rolls by which the fibrous layers are rolled onto the galvanizing coating before the latter has become solidified as illustrated in said patent. Experience has demonstrated that this method of manufacturing the protected metal sheets introduces several difficulties and the present invention seeks among other things to provide a method and apparatus wherein these difficulties may be avoided. The following indicates some of these difficulties.

Because of the size and bulk of the bonding rolls and other associated equipment and supporting structure, it had been found necessary in practice to locate the bonding rolls several feet away from the exit rolls of the galvanizing bath, with the result that mechanical guiding mechanism had to be provided for conducting the sheet from the galvanizing bath to the bonding rolls, particularly as the direction of travel of the metal sheets in passing from the galvanizing bath to the bonding rolls had to be altered substantially 90°. It was found that the guiding mechanism scored the underside of the freshly applied galvanized surface of the sheet so that the mobile zinc coating was abraided and marked by contact with the guiding mechanism and as a result the uniformity of the zinc coating on the under surface of the steel sheet being processed was destroyed. This lack of uniformity tended to produce lack of adhesion between the fibrous sheet and the under surface of the steel sheet at the points where the marking had occurred.

Another difficulty experienced in the practical operation of the apparatus shown in my patent above referred to, arose from the fact that the slight excess of zinc was rolled off the end of

the galvanized sheet by the bonding rolls when the end of the sheet reached the nip of the rolls. This zinc was deposited in small masses upon the adjacent surface of the felt being fed over the lower bonding roll and permeated the felt layer during the bonding operation and formed in drops upon the outer surface of the felt layer thus bonded to the underside of the steel sheet, in many instances dropping down onto the fibrous covering which was usually used to cover the lower bonding roll. This takes places while the zinc is in a molten or fluid condition, and after this excess zinc which finds its way onto the lower bonding roll and solidifies, it is then forced by the bonding rolls into the surface of the succeeding portions of the fibrous felt during the continued operation of the apparatus, rupturing the felt and at the same time pox-marking the surface of the lower bonding roll. Continued operation over a period of time produced such indentations in the bonding rolls that pressure of the bonding rolls across the width of the protected metal sheet being produced as it passed through the bonding rolls became no longer uniform, but was localized at the high points of the irregular surface of the rolls, producing areas over the surface of the protected metal sheet where blistering occurred due to the defective bonding because of the uneven pressures produced. In addition, the depressed portions resulting in the bonding roll because of the pox-marks, produced areas of low pressure resulting in blistering between the felt and the galvanizing coating due to lack of proper bonding pressure at such points.

Another difficulty experienced with the foregoing apparatus is the production of an inequality in the density or amount of metal coating, such as galvanizing coating, upon the bottom and top sides of the steel sheet. This results primarily from the fact that as the metal sheet leaves the coating bath its direction of travel is changed about 90° so that during the bonding of the fibrous sheets thereto the metal sheet assumes an arc or a curve creating the inequality of metal coating, and in practice it has been found that the fibrous sheet upon the upper surface of the completed sheet is always more uniformly bonded to the steel sheet than is the fibrous sheet secured to the lower surface thereof. While the various operational difficulties above set forth detract to some extent from the most efficient operation of the apparatus referred to, nevertheless the apparatus has proven to be commercially operative and large quantities of the product produced thereby have been sold.

In accordance with the present invention a more uniformly and more perfectly bonded protected metal sheet of the character described may be produced by disposing the bonding rolls above the galvanizing bath in substantial alignment with the path of travel of the metal sheet as the latter leaves the bath so that the sheet continues to travel in substantially a straight path until and during its passage through the bonding rolls. Preferably the bonding rolls are disposed above the galvanizing bath so that the metal sheet as it emerges from the bath, travels in a vertical direction. This enables any excess zinc on both surfaces of the sheet, as it is emerging from the bath, to run uniformly down the sheet by gravity so that the coating weight may be controlled by the surface tension of the zinc itself and also permits this excess zinc to drop back into the galvanizing bath thus preventing it from finding its way onto the bonding rolls. In addition, regulation of the temperature of the galvanized coating upon the sheet between the time that the sheet leaves the coating bath and the time that the bonding operation is performed as the sheet travels between the bonding rolls, contributes to most efficient bonding.

The temperature of the coating of zinc upon the galvanized metal sheet during the period of time the sheet is travelling from the point where it emerges from the galvanizing bath to the point where it passes between the bonding rolls may be regulated in various ways. In the preferred method and apparatus provision is made for adjusting the bonding rolls vertically to shorten or lengthen the distance of the same from the bath and in that way to maintain the temperature of the coating of zinc upon the sheet at the point of bonding within a predetermined range. The temperature range at which bonding takes place may be elevated or lowered by shortening or lengthening such distance as the case may be. This adjustment of the bonding rolls toward and from the bath may be effected manaully by mounting the rolls on vertical slides and adjustably clamping the slides in different positions corresponding to the desired position of the rolls. In some instances I may prefer to provide automatic mechanism controlled by the temperature of the coating bath for automatically adjusting the vertical position of the bonding rolls. In some instances I may prefer to maintain the bonding rolls in a fixed position and to utilize auxiliary heating means for providing a controlled and heated atmosphere through which the coated metal sheet passes as it emerges from the bath in its travel to the bonding rolls. The control of the temperature of the coating upon the metal sheet at the time that it is ready to pass through the bonding rolls plays an important part in obtaining the most satisfactory bond between the fibrous material and the metal sheet, and in addition enables the thickness or weight of zinc coating on each side of the sheet to be carefully controlled to the end that the steel core sheet may be satisfactorily and most economically weather-proofed.

I prefer to employ one or more of the foregoing methods of controlling the temperature of the metal adhesive coating on the sheet as described in order that the continuous operation of the machine may not be interrupted, stopped, or slowed down, in order to compensate for any variations occurring in the process. For example, when the apparatus embodies a galvanizing bath, if fresh zinc is added to the bath, quite naturally the zinc bath will drop somewhat in temperature. This drop in temperature of the bath may be rapidly offset by a movement of the rolls closer to the surface of the zinc coating bath. Likewise, if during the process a different gauge or strip steel or sheet steel were to be processed, the bonding rolls would be moved somewhat nearer or farther away from the bath, depending upon the heat balance which resulted in the steel strip.

It is a fact that during solidification of the molten zinc coating upon the metal sheet, after passage of the sheet through the bath, the coating passes through a so-called "mushy" stage due to the presence of small impurities. For most effective results, the bonding operation

should take place at a temperature reasonably near, but above, this mushy stage. It has been found that sheet steel of various gauges when heated in the galvanizing bath at 850° F. and removed therefrom, have on their surface a liquid zinc coating which solidifies when exposed to the air after varying lengths of time, depending upon the gauge of the steel. For example, 26 gauge steel so treated results on exposure to room temperature in a solidification of the zinc in ten seconds; whereas 18 gauge steel upon cooling under similar conditions for thirty seconds has a zinc surface which is solid. It can therefore be seen that a change of gauge, a change of air temperature surrounding the steel strip coming from the galvanizing bath, fluctuations in the speed of travel of the steel strip, and fluctuations in the temperature of the galvanizing bath all have a distinct bearing on the relative location of the bonding rolls to the bath to assure the most efficient position of the rolls at which the bonding operation should be carried out. With properly designed bonding rolls which can be rapidly adjusted in height above the galvanizing bath, the problem of balancing all of these factors may be readily solved.

Referring to the drawing which illustrates a protected metal sheet and the preferred apparatus for practicing the present invention, a coil 11 of either hot or cold rolled steel strip may be operatively supported in a suitable standard, not shown, and from which an elongated strip of steel may be conducted into the galvanizing bath 13 contained within the galvanizing tank or pot 15 or individual lengths or sheets of steel may be fed by suitable feed rolls, not shown, into the galvanizing bath. In some instances it may be desirable to feed individual sheets cut by shears 17 from the continuous coil of steel and in any event the individual sheets or the continuous strip are passed under bottom rolls 23 located below the level of the molten zinc, lead or other metal in the bath and from which the sheets or strip are caused to emerge by driven exit rolls 24 located above the bottom rolls 23 and preferably arranged side by side so as to permit the coated steel sheet or strip to emerge in a vertical direction from the bath. The design, combination and location of the various rolls for handling the steel sheets or strip in and from the bath may depend upon the type of galvanizing process used and particularly upon the presence or absence of a flux.

In the event that the galvanizing coating bath is operated with a flux, it is preferred to provide an exhaust system including hoods 30 connected to an exhaust fan 32 for drawing off any fumes from the flux or if desired, suitable shielding members 34 may be interposed between the galvanizing bath 13 and the bonding rolls indicated generally at 25, in order to prevent the volatilizing flux from depositing excessively on the galvanized sheet or upon the fibrous layers to be bonded thereto as in either case the deposited flux when contacting the hot coated steel prevents the most perfect adhesion of the fibrous felt to the steel resulting in a blistered product.

In accordance with the present invention the bonding rolls 25 around which the asbestos felt or other fibrous layers are caused to pass from supply rolls 26, 27 thereof comprise steel rolls which are driven to advance the sheet of steel passing therebetween and in accordance with the present invention are arranged side by side in a substantially horizontal position such as to permit the steel sheet after it has left the exit rolls 24 from the galvanizing bath 13 to pass in a straight path and to avoid any substantial deflection of the steel strip until after it has passed through the bonding rolls. In practice and as illustrated herein it is preferred to mount the bonding rolls together with the supply rolls 26, 27 upon a movable carriage 40 by which the entire assembly may be bodily moved into a position to one side of the exit rolls 24 leading from the galvanizing bath 13 to thus expose the entire galvanizing bath and to afford access thereto. Preferably the entire assembly is also mounted to permit it to be moved vertically toward and from the galvanizing bath and these results may be accomplished as herein shown by mounting the framework upon which the bonding rolls and associated parts are assembled, upon two uprights 42, 44 to be elevated by hydraulic or other means and also to permit the entire assembly to be dropped down when such pressure is withdrawn or lowered. As herein shown, the entire assembly is movably mounted upon rails 30 to permit the entire assembly to be moved laterally as described.

During the withdrawal and travel of the asbestos felt layers from the supply rolls 26, 27, it is necessary for best operation to preheat such felts in order to remove all moisture and also preferably most of the binding and organic material in the felt. Such procedure is necessary first to produce a moisture free felt which will not blister when it comes in contact with the coated steel and secondly to give a more or less porous felt which will be best suitable for saturation in the successive steps of operation, as will be described. For this purpose various types of heating devices may be employed, herein shown as a series of gas burners 50, so located that the gas flame impinges on the surfaces of the asbestos felt which are to come in immediate contact with the zinc or similar coating upon the steel strip during the passage of the coated steel and felt between the bonding rolls 25. It is important that the gas burners be located to direct the flame in this manner because if the heating were to be directed against the opposite side of the felt, small quantities of volatile material would remain on the surface of the abestos felt which is to come in contact with the zinc or other coating and such a procedure would result in blistering due to the rapid volatilization of such constituents under the heat contained in the coated steel.

In passing through the bonding rolls 25, the zinc coating on the steel is forced into the interstices of the asbestos felt and simultaneously, at least in part, solidifies due to removal of the heat from the assembly of felt and steel and, as the steel strip issues from the exit side of the bonding rolls, the asbestos felt is firmly attached to the strip of steel. In the bonding operation, it is desirable to employ asbestos felt somewhat wider than the strip steel used, so as to compensate for any slight lateral travel of the strip or of the asbestos felt. Therefore, the assembly issuing from the bonding rolls has an excess of felt extending beyond the lateral edges of the steel strip. This excess material must be removed from the strip, preferably before the strip is impregnated with asphalt or other impregnant. In order to accomplish this removal, the sheet is carried up through the conveyor where the trimmer device 58 is installed. As herein shown, this device consists of two grinding wheels 59, 60. The upper

wheel 59 grinds off the excess of the upper felt and the bottom wheel grinds off the excess of the bottom felt. The springs 64 are adjusted in such a way that the grinding wheels always follow the strip edges even when the strip tends to move in lateral directions. By creating V shapes on both edges of the passing strip assembly the wheels hold the strip closed by the two bottoms of the V's and do not allow it to move in vertical direction. The wheels may be made from regular Carborundum or from special steel and may be of cylindrical form as indicated. As the grinding operation creates asbestos dust, an exhaust system is preferably provided to remove the dust to an accumulator.

The trimming operation has to remove not only the excess felt but also the excess zinc which is squeezed from the surfaces of the steel and accumulates at the edges of the strip during the bonding process. Therefore the trimming device should be installed near the bonding rolls in order to grind off the zinc excess when the zinc is not too hard but still in the more or less plastic state. After the trimming of the excess felt and zinc, the product is saturated in asphalt or other waterproofing impregnant.

As described in U. S. Patent No. 2,073,334, the saturating operation is preferably carried out in a single pass through a saturating tank 70. While such a procedure results in a partial saturation of the asbestos covered strip, the saturation is far from complete and, in order to achieve complete saturation, it has been found that the asbestos covered strip must be passed through a saturating tank having more than one set of squeeze rolls 72. As indicated, the strip passes beneath the surface of the liquid asphalt at (*a*) and then passes through the first set of squeeze rolls 72 which remove the excess of asphalt on the surface of the asbestos covered sheet, and then the sheet passes through a second dip at (*b*), followed by a second set of squeeze rolls 74 which again remove a large part of the excess asphalt on the surface of the asbestos felt. A final pass through a set of hot rolls at 76 smooths out and makes more uniform the entire appearance and surface of the saturated asbestos on the steel. By such a procedure, it has been possible to build up the saturation of the asbestos felt from about 25% to a maximum of about 40%. That is to say, the asbestos felt, by successive dippings, is more or less completely saturated rather than left in a partially saturated condition. The problem of saturation is more difficult than the saturation of ordinary felt since, in the saturation of felt, the saturation takes place from both sides of the felt surface, whereas in this procedure all saturation must be from one side of the felt only, since a metal sheet separates the two layers of felt bonded to the surfaces of the steel. A further improvement in the saturation process is that the saturating tank is mounted to be movable. Its location depends on the speed and gauge of the strip. Furthermore, due to its special shape, the level of the asphalt contained in the tank can be regulated thus permitting the operator to regulate the saturation time and obtaining a dry product. By these improvements, in the design of the saturating tank, the easy and quick adjustments of the saturating process is achieved and when the factors such as temperature of asphalt, distance from bonding rolls and level of asphalt are synchronized with the gauge of the passing strip, the saturation process reaches practically the maximum of efficiency.

Subsequent to the saturating operation, the strip is permitted to continue its travel due to the action of the pinching rolls 80 to the shear 85 where it can be cut to the desirable lengths and loaded on the buggy 86 or the strip may be conveyed to the recoiler machine 88 which is equipped with a cut-off device 90 as used in standard practice and which is preceded by several idling rolls 92 to permit handling of the continuous passage of the strip through the complete line of manufacture. The above described operation results in the manufacture of asbestos protected strip in coil form in which the asbestos is saturated with asphalt or other suitable impregnating material. This product may then be uncoiled, passed through a roller leveler, cut to length and provided with a weather proof coating as previously disclosed in U. S. Patent No. 2,073,334.

While the preferred embodiment of the invention has been herein illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. In apparatus for producing a building sheet of the character having a metal core sheet, and fibrous layers covering the surfaces of the core sheet and secured thereto by thin layers of non-corrodible metal adhesive alloyed to the surfaces of the metal core sheet and keyed to the fibrous layers, in combination, a receptacle for a bath of molten metal adhesive, means for conducting a metal core sheet through the bath to coat the metal core sheet with a layer of the molten metal adhesive, and means for conducting the metal core sheet from the bath in a substantially vertical direction, a pair of bonding rolls arranged side by side with their axes in substantially the same horizontal plane disposed directly above the point at which the sheet emerges from the bath in a position to permit the core sheet to travel in a substantially straight path from the bath through the bonding rolls, and means for supplying fibrous sheets to the bonding rolls to be pressed thereby into the freshly applied and molten metal adhesive coating on each side of the metal core sheet, and means mounting said bonding rolls for movement generally along said straight path toward and away from said receptacle for controlling the temperature at which said metal adhesive enters between said bonding rolls.

2. In apparatus for producing a building sheet of the character having a metal core sheet, and fibrous layers covering the surfaces of the core sheet and secured thereto by thin layers of non-corrodible metal adhesive alloyed to the surfaces of the metal core sheet and keyed to the fibrous layers, in combination, a receptacle containing a bath of molten metal adhesive, means for conducting a metal core sheet through the bath and then conducting the metal core sheet from the bath, a pair of bonding rolls disposed above the bath of metal adhesive and with the bight of the bonding rolls lying in the plane of travel of the sheet as it emerges from the bath to permit the passage of the metal core sheet through the bonding rolls without substantial deflection from the direction in which it is travelling as it emerges from the bath, and means for supplying fibrous sheets to the bonding rolls to be pressed thereby into the freshly applied and molten metal adhesive coating on each side of the metal core

sheet, and means responsive to the temperature of the bath of metal adhesive for automatically moving the bonding rolls toward the bath when the latter drops below a predetermined temperature and for raising the bonding rolls from the bath when the temperature exceeds said predetermined temperature.

3. In apparatus for producing a building sheet of the character having a metal core sheet, and fibrous layers covering the surfaces of the core sheet and secured thereto by thin layers of noncorrodible metal adhesive alloyed to the surfaces of the metal core sheet and keyed to the fibrous layers, in combination, a receptacle containing a bath of molten metal adhesive, means for conducting a metal core sheet through the bath and then for conducting the metal core sheet from the bath, a pair of bonding rolls disposed above the bath of metal adhesive and with the bight of the bonding rolls lying in the plane of travel of the sheet as it emerges from the bath to permit the passage of the metal core sheet through the bonding rolls without substantial deflection from the direction in which it is traveling as it emerges from the bath, and means for supplying fibrous sheets to the bonding rolls to be pressed thereby into the freshly applied and molten metal adhesive coating on each side of the metal core sheet, heating means for creating a heating zone

through which the sheet is caused to pass in passing from the metal adhesive bath to the bonding rolls, and automatic means for controlling the temperature of the heating zone in response to variations in the temperature of the bath.

4. Apparatus as defined in claim 1 wherein said last named means comprises means mounting said bonding rolls for movement as a unit generally along said straight path toward and from said receptacle whereby to control the time said molten metal adhesive is exposed to the surrounding atmosphere.

ALDEN W. COFFMAN.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,060,759	Heldmann	May 6, 1913
1,593,652	Donauer	July 27, 1926
2,031,035	Dreymann	Feb. 18, 1936
2,073,334	Coffman	Mar. 9, 1937
2,194,757	Klaas et al.	Mar. 26, 1940
2,330,530	Tuttle	Sept. 28, 1943
2,423,870	Blessing	July 15, 1947