APPARATUS FOR ONSITE ROLL FORMING AND APPLICATION OF ROOFING SHEETS

13 Claims, 15 Drawing Figs.

ABSTRACT: A method and apparatus for mechanically roll forming and applying full length roofing sheets in a continuous operation at a job site.
APPARATUS FOR ONSITE ROLL FORMING AND APPLICATION OF ROOFING SHEETS

BACKGROUND OF THE INVENTION

Roofing construction heretofore included transporting roofing materials in rolled sheet form to a job site and thereafter applying the individual sheet to a support structure. Such methods required prefabrication of the sheets and subsequent transportation to a job site for application. Expenses of additional labor and transportation were involved in such methods as also the multiple handling of the sheet material prior to, during and subsequent to roll forming of the individual sheets and storage facilities were required.

An optimum desire in the industry was to eliminate such additional handling, storage and transportation and permit an overall method of forming an application of such sheets at the job site, thereby enabling flatter roof decks and continuous runs of the sheet without having any end joints or ridge-rolls. A roofing construction of this type is shown in my preceding U.S. Pat. No. 3,335,530 entitled "Roofing System With Supporting Straps Assemblies," dated Aug. 15, 1967.

SUMMARY OF THE INVENTION

The present invention has as its principal object method and apparatus for mechanically conveying and applying the roofing design covered by above patent or any other designs forming the site. The apparatus includes a machine with a central drive shaft which operates the roll formers and both the steel bands and the winch line that tow the conveyer machine to and fro for deposition and attachment of the sheet in place for a roof structure, and to guide and drive the mechanism for properly conveying, spacing and dropping the sheet. The various mechanisms are so interconnected and synchronized that they function as a unit and after formation, placement and anchorage of the sheet, components of the unit are movable to a subsequent cycle of operation.

Additional objects and advantages of the present invention will become more readily apparent from the following detailed description of embodiments thereof when taken together with the accompanying drawings in which:

FIG. 1 is an elevational schematic view of components forming a unit of roll forming and placement of roofing sheets as contemplated by the invention;

FIG. 2 is a top plan view of the unit of FIG. 1;

FIG. 2A is a schematic sectional view of a partially formed roofing sheet in one stage of transportation and application;

FIG. 3 is a view similar to FIG. 2 with the sheet conveyer and fastening apparatus in a reverse sequential operational sequence from that of FIG. 2;

FIG. 5A is a view similar to FIG. 2A showing the sheet and application phase corresponding to the step performed in FIG. 3;

FIG. 4 is an end elevational view, parts being in section, of the roll forming section of the apparatus;

FIG. 5 is a plan view of the apparatus of FIG. 4, parts being removed for clarity;

FIG. 6 is a plan view of sheet transfer mechanism corresponding to the showing of FIGS. 2 and 2A;

FIG. 7 is a view taken on line 7-7 of FIG. 6;

FIG. 8 is a view similar to FIG. 6 and corresponding to the sequential phase of FIGS. 3 and 3A;

FIG. 9 is a sectional view taken on line 9-9 of FIG. 6;

FIG. 10 is an elevational view of a portion of the conveying and forming apparatus showing a formed sheet weighing and positional holding mechanism in operative and inoperative position;

FIG. 11 is a fragmentary sectional view of an application phase of a sheet to a roof support structure;

FIG. 12 is a fragmentary sectional view disclosing a second sheet application phase of a first support application and over-lay step; and

FIG. 13 is a view similar to FIG. 12 of a subsequent application phase of an additional sheet placement and affixing.

Referring now more specifically to the drawings, vertical supports 20 for a building or the like, such as walls, have placed thereon in a usual manner a plurality of laterally spaced rails 22 adapted to support a plurality of roofing sheets 24 therebetween which can be of a type referred to in my aforesaid patent number 3,335,530 although the present invention in principle and apparatus is capable of use in different styles and types of roof application as will be apparent hereinafter. Preferably combined pan supports and rail braces 36 (FIG. 11) interconnect and space the rails, by means of juxtaposed vertical flanges 28 bent into continuous profile and hook shaped tabs 30 inserted in openings 32 in the rails. This arrangement provides for proper spacing, support and rigification of the supporting structure or substructure to receive and mount the individual roofing sections.

FIGS. 1—3 schematically illustrate the overall system and apparatus of the invention which generally consists of a roll forming unit 34 which also contains a power and drive mechanism for the apparatus consisting of, in this embodiment, an electric motor 36, a toothed sprocket wheel 38 and an interconnecting drive chain 40 or the like. A sheet conveyer unit 42 includes sheet clamping means 44 for attachment of the unit to a leading edge of a sheet after passage through the roll forming unit for moving or conveying the same along the rails to a proper position for placement and securement thereon. The sheet conveyer unit 42 also includes sets of opposed rolls 46 operable during one phased sequence of operation as a punch former and attachment means of the sheets on and to the rails. FIG. 2 shows the rolls in open nonoperative position and FIG. 3 shows the rolls in closed punching and securing relationship. Movement of the rolls from open to closed positions is effected by handles 48 through appropriate gearings arrangements in the nature of a worm gear and shaft assembly generally designated 50 (FIG. 8).

The apparatus additionally includes a guide and placement unit 52 which includes spaced arms 54 mounted on pivot 56. Spaced toothed or sprocket wheels 58 are rotatably mounted by means of shaft 60 and clamps 62 are provided on the arms 54 to permit securement thereof on adjacent ones of rails 22 between and upon which roofing sheets are to be attached. This arrangement and construction is such that after a sheet has been attached to a set of adjacent rails, the unit can be removed therefrom and mounted on a next succeeding rail set for cooperation in mounting a subsequent roofing sheet thereon.

The upper edges of the rails 22 are preflushed as at 64 which make them adaptable for a system of mechanical anchoring of the sheets and for holding the units 42 and 52 secure from wind uplift during sheet installation as will appear hereinafter. The rail braces, the bands containing the arc of the pan and the rail spacers being combined into a single precision stamped panel including flanges and interlocking hooks assure precise spacing of all components in the substructure and the punched rails provide for proper sheet disposition and placement therealong. As shown in FIGS. 1—3 a normal roof overhang is provided as indicated at 66 beyond support walls 20 with ends of the rails 22 determining and defining the amount of overhang.

Precut and predimensioned roofing sheets are carried to a job site on movable drums as generally indicated at 68 for mounting of their shafts 70 in cradles 72. The overall components of the roll forming unit 34 and sheet roll support etc. are mounted on a base or substructure 74 which in turn is adapted for support at the roof edge line from the platform of a mobile elbow-crane having dual controls or the like. As shown in FIG. 4 a gravity decoder bar 76 is operatively pivotably mounted at 78 for contain in unreeling a sheet 80 of the roofing as indicated at 82 in the drawing being fed into the sets of sheet edge rollers 84 of a standard type for producing desired edge designs. A guide baffle 86 is
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preferably incorporated for guiding a sheet edge into the forming rolls. The forming rolls can be driven in any suitable known manner. In FIG. 1 an electric motor drive is utilized whereas in FIG. 4 a winch 88 is operatively associated through chain 94, drive clutch 92 and thence through chain 95, drive clutch 96 and which latter mechanism is operatively connected to the rollers 84. In this embodiment the drive motor 98 is connected to a drive control mechanism 100 with appropriate control mechanisms such as a gear shift or the like, through clutch 102 and thence to a central shaft 104 having mounted thereon perforated steel belt 106 driven in the drive to stop operation as a sheet leaves the drive shaft and in a transversely spaced arrangement for coaction with and driving of the perforated belts the opposite ends of which are entrained around toothed wheels 58 on shaft 60 in the guide and placement unit 52. This structure can include if desired a free wheeling roller drum schematically indicated at 110 for cable coaction with winch 88. The various gears 110 of the drive gear train are appropriately mounted in bearings and which serve to operate the roll formers. The perforated belt drive wheels are also keyed to the same drive shaft that operates the rolls. The sprocket wheels 112 are keyed to their individual shafts in the drive train. The drive control mechanism 100 is preferably a Morse adjustable speed drive control in conjunction with a reduction box mechanism. An automatic cutoff switch 114 is incorporated in a control mechanism for the drive to stop operation as a sheet leaves this roll former unit. Arms 116 are provided for hoisting the unit 42 in moving positions as will be set forth hereinafter.

The sheet conveyor unit 42 referring in detail to FIGS. 6—10 inclusive includes a substructure designated 118 extending transversely over the spaced rails 22 and movably supported thereon by rail track wheels 120. The latter being keyless clamped 122. The clamps generally indicated at 122 are operable to engage ends 124 in perforations 126 of perforated belts 106 through the adjustment means 128 as shown in FIG. 9 whereby this unit is fixed for travel with the belt in a forward or reverse movement thereof according to operation of the drive means incorporated in the roll former unit 34. The conveyor unit includes clamping means 130 manually operable by handle 132 to engage clamp 134 with sheet edges 80A. In the direction of travel indicated by the arrows in FIGS. 2 and 6 these clamps are engaged with the sheet edge for movement with the conveyor unit. Upon return movement of this unit after a sheet having the formed edges is drawn along the rails to a proper placement position the clamps 134 are released and upon movement in the direction of the arrows of FIGS. 3 and 8 the belt will remain in placed position on the rails. As will be seen from FIG. 8 the clamps 130 can be swiveled to an inoperable position as at 130A as indicated by the arrows 136.

Sets of punching and attaching wheels 138 are rotatably vertically mounted on substructure 118 in coacting relationship to each of the rails 22. The wheels 140 are provided with preferably, male and female punches as at 142 which are mated with the perforations in the upper edges of the rails. The wheels 140 are mounted on sliding blocks 144 for controlled movement through mechanism including a hand wheel and shaft assembly 146 into punch mating and coacting relationship as indicated by arrows in FIG. 8 or to inoperative position as indicated by arrows in FIG. 6. When a sheet is being conveyed for placement position along the rails these after placement of the sheet the wheels are placed in the closed position indicated in FIG. 8 and on return movement of the unit with return perforated belt movement, the punches 142 coact to complete roof edge formation of the sheets around the upper rail edges in a manner shown in FIGS. 11—13. A single overlay of a single sheet 80B is shown in FIG. 12 with a punch portion 80C extending into one of the rail perforations for securement thereto. In FIG. 13 a subsequently adjacent sheet has been laid and punches then punch portions 80D of sheet 80E into the punched portion 80C of the first or underlaying roofing sheet, all as shown in FIG. 13.

In the form of sheet as shown in the drawings, the central portion thereof is preferably formed concave as shown in FIG. 2A which corresponds with the step of FIG. 6. FIG. 3A corresponding with the step of FIG. 8 denting with a sprocket wheel. FIG. 4A showing a sheet edge into the punched portion 80C of the first or underlaying roofing sheet, all as shown in FIG. 13. The punching wheel 140 is operatively driven with the puncher 116 and thence through chain 118 of sheet 80E into the punched portion 80C of the first or underlaying roofing sheet, all as shown in FIG. 13.

The guide and placement unit 52 provides belt guide pulleys and serves as a stop block for conveyor unit 42 to space and drop a sheet. The automatic cutoff switch in unit 36 thus space the unit 42 a few inches away from unit 52 where it is manually jacked tightly against the unit for proper sheet spacing. After completion of the forward and reverse cycles of the conveyor unit 42 the apparatus is then shifted to a subsequent set of rails. As the unit 34 is being shifted to the next rails the perforated belts are slacked, the clamps of unit 52 engaged in the rail apertures or perforations are released. This machine can then be tilted on a pivot pipe with rollers and rollers on a plane of channel iron fixed to the advanced position, righted and reset for the next succeeding cycle without having been lifted during the transfer.

All of the units (34, 42 and 52) function together as a unit to make it possible to mechanically roll form and apply full length sheets of roofing in one continuous operation at the job site. The synchronized interconnected functioning of the units constitute the overall system and while the unit as shown is primarily designed for use in applying a roofing design as shown in my aforesaid patent 3,335,530, by attaching skid runners with concave bottoms to lift the conveyor belts across cross purfins, the machine is useable to produce and safely convey full length sheets of other roofing designs using various types of anchorage.

In operation the roll former and power unit 34 is operated at a roof eave line from the platform of a mobile elbow-crane with dual controls. It uses electrical power and a gear shift to run the drive shaft which controls both the roll formers and the sprocket wheels with their perforated steel conveyor belts, thereby maintaining constant synchronization of the various functions of the unit. The clutch of the drive shaft frees the sprocket drive wheels during the initial period when the sheet is being fed through the rolls and clamped to the conveyor unit 42. If desired a winch system can be substituted for the motor type drive as hereinbefore indicated.

The conveyor unit 42 conveys the sheet across the deck, keeping it in perfect alignment for anchoring, and holds the steel belts tightly over the sheet at all times to prevent wind damage, then drops the sheet at the exact point to start anchorage. On the reverse, on return movement of the unit it completes the closing of the flanges by compressing them tightly against the rail, it, beds and roll compresses the sheet into proper position and then permanently anchors the sheet by punch forming material thereof into the apertures in the rails. As this cycle is completed, the machine is engaged upon arms on roll former 116, 118 on 120 to be lifted and shifted to a next set of rails and the next cycle initiated.

Manifestly changes in details of construction and operation can be effected in the shown and described embodiments without departing from the spirit and scope of the invention as defined in and limited solely by the appended claims.
1. In a system for in situ application of sheeting to a roof, a plurality of operatively interconnected units including:
A. a roll forming unit for initial sheet flange shaping of individual sheets;
B. a movable conveyor unit for conveying, in one direction of movement, a sheet across a roof deck to a spaced position for placement thereof, and on a return movement for completing flange closing, bedding and roll compressing a sheet into a finalized position, and permanently anchoring the sheet;
C. a guide and placement unit for controlling conveyor unit movement for sheet alignment and permanently positioned sheet release; and
D. means synchronously operatively interconnecting said units and, in conjunction with said conveyor unit, constituting a sheet hold down and drive for said conveyor unit.

2. In a system as claimed in claim 1, drive means for said roll forming unit and said movable conveyor unit, said drive means being commonly drivingly connected to said units for synchronized operation thereof and initial formation and movement of a sheet to a placement position and anchoring thereof.

3. A system as claimed in claim 2, transversely spaced perforated belts interconnecting said units synchronously driven through said commonly associated drive means, said perforated belts being positioned above a roof to which sheeting is to be applied, said units and said perforated belts coacting whereby full length of flat sheets are mechanically roll formed, conveyed across a roof deck, securely held to prevent wind damage, placed into proper position and anchored on the roof structure.

4. A system as claimed in claim 3, and including sprocket wheels of constant spool diameter operatively associated with each said unit and in engagement with said perforated belts and through the common drive of the roll formers and conveyor unit maintaining synchronization of production and towing speeds of sheets which remains constant and automatically adjusts with speed changes resulting from variations of load requirement in towing across wide spans.

5. A system as claimed in claim 3, sprocket wheels of constant spool diameter operatively connected with said units and in engagement with said perforated belts and winch means for movement of said conveyor unit in synchronization with sheet discharged from said roll forming unit.

6. A system as claimed in claim 4, said roll forming unit and movable conveyor unit being catenated and adapted for joint selective positioning along a roof surface for juxtaposed sheet placement thereon.

7. A system as claimed in claim 6, wherein said guide and placement unit is individually movable with respect to the other said units for positioning alignment over a roof for proper sheet alignment.

8. In a system as claimed in claim 7, said system including sheet support and anchoring rails adapted for sheet width spacing and support on a roof structure, said rails having spaced apertures extending lengthwise thereof in proximity to the rail upper edges, said conveyor unit including sets of coating punching wheels movable into and out of operative association with punched sheet edges positioned on said rails and operable on said return movement for attaching sheets to the prepunched apertures in the rails by punching material of the sheet thereinto.

9. A system as claimed in claim 8, the sheets as applied being adapted for overlapping engagement of a sheet of next succeeding one prior to final anchorage of the sheets, said perforated belts serving as hold down means for the overlapped sheets prior to final attachment of the sheet edges on said return movement of said conveyor unit.

10. A system as claimed in claim 9, means carried by said conveyor unit operatively engageable with the upper surface of sheet upon return movement of said conveyor unit for compressing a sheet into position between adjacent ones of said rails and with the edges thereof in a pressure bearing relation to the rails whereby the sheet can be punch formed into permanent place by using elastic memory within the sheet and produced lateral tensions thereon.

11. A system as claimed in claim 10, the compression means including spaced rollers engageable with the upper surface of a sheet and being of sizes and disposition to concavely depress and form the sheet upon movement therethrough and weight means operatively associated with said rollers, said rollers and said weight being movable to operative and inoperative positions.

12. A system as claimed in claim 11, and including clutch means associated with said drive means operable to disengage drive of said sprocket wheels during movement of sheet through the rolls of said forming unit and clamping means on said conveyor unit for clamping engagement with a leading sheet edge operable upon movement in said one direction for conveying a sheet across a roof deck and being disengageable for said return movement of said conveyor unit for positioned placement of a said sheet.

13. A system as claimed in claim 12, said guide and placement unit constituting a stop block for said conveyor unit to space and drop a sheet and a cutoff switch on said roll forming unit operable by coaction with a sheet trailing edge to stop the conveyor unit movement in proper spaced relationship away from said guide and placement unit for subsequent manual final positioning of said conveying unit with respect to said guide and placement unit for proper sheet spacing prior to the return movement of the conveying unit.