

Jan. 20, 1948.

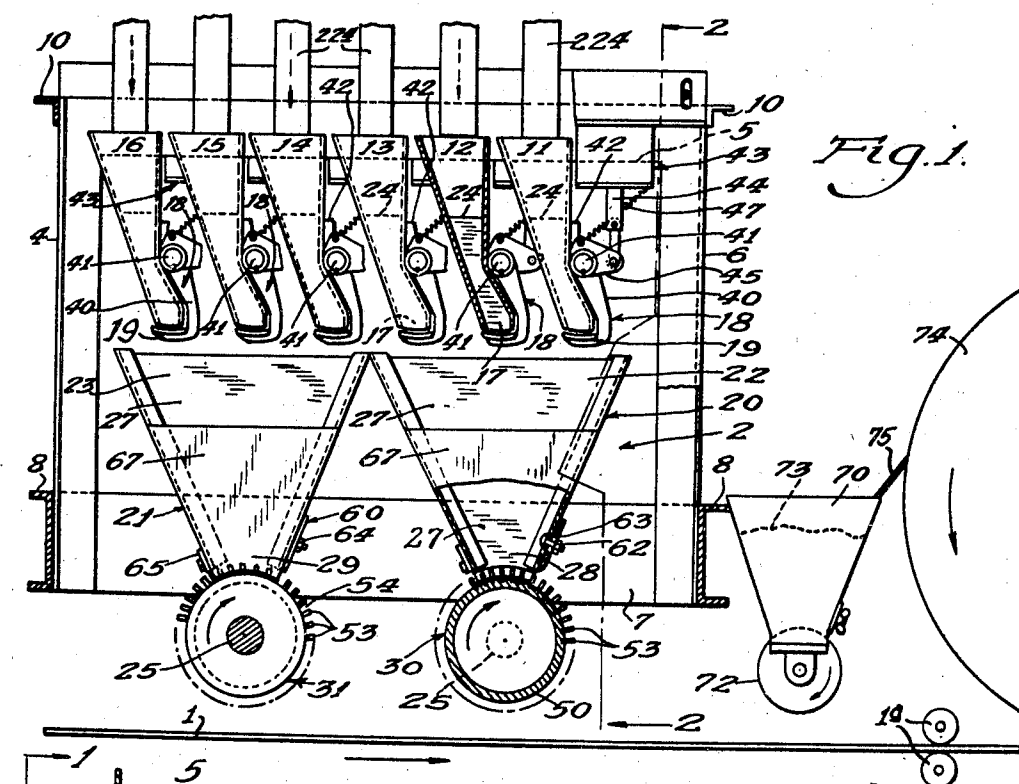
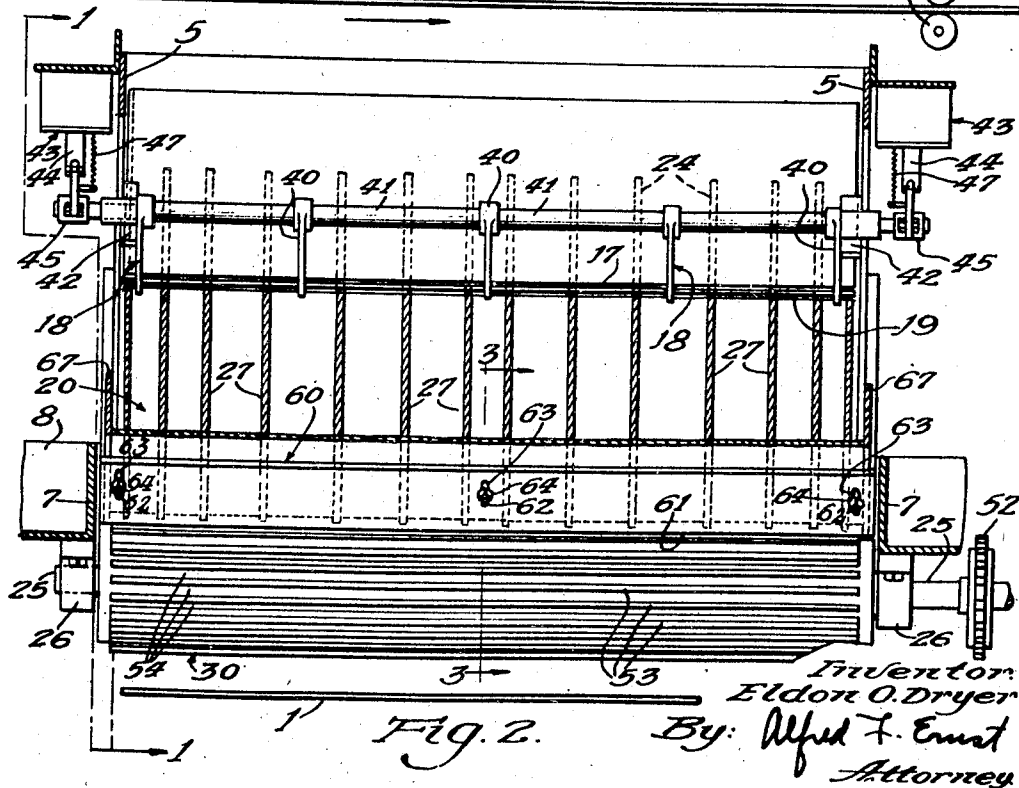
E. O. DRYER

2,434,736

APPARATUS FOR SURFACING SHEET MATERIAL

Original Filed March 5, 1941

2 Sheets-Sheet 1



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APPARATUS FOR SURFACING SHEET MATERIAL

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2 Sheets-Sheet 2

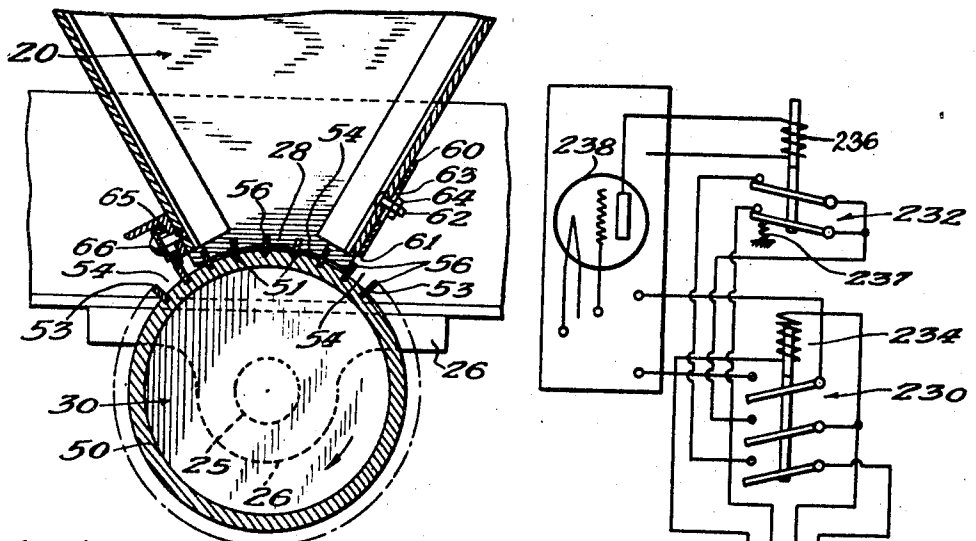
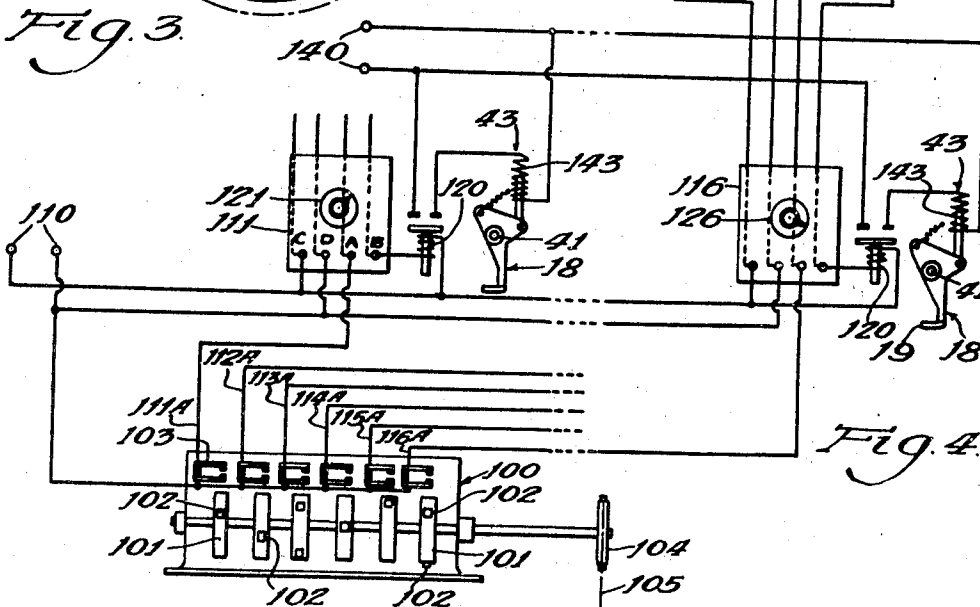
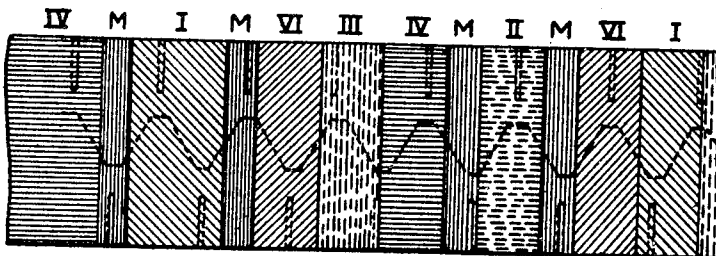


Fig. 5.

Inventor:
Eldon O. Dryer
By: Alfred F. Ernst
Attorney.

UNITED STATES PATENT OFFICE

2,434,736

APPARATUS FOR SURFACING SHEET MATERIAL

Eldon O. Dryer, Port Orchard, Wash., assignor to Certain-teed Products Corporation, Chicago, Ill., a corporation of Maryland

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11 Claims. (Cl. 91-43)

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This invention relates to an apparatus for surfacing a web with comminuted material. The invention is more particularly directed to the surfacing of composition roofing material with surfacing granules of different colors.

It is an object of this invention to provide an apparatus for producing on a face of a roofing web a variety of color areas in different predetermined arrangements, in order to make possible the cutting from the surfaced web of covering elements carrying a variety of colors.

The unsurfaced roofing sheet comprises in the usual form a felted fibrous base material impregnated with waterproofing bituminous material, such as asphalt saturant, and carries on a face thereof a coating of adhesive bituminous material, such as asphalt, in heated condition. To the coated face of the sheet may be applied by various means comminuted material, such as slate granules, to provide an ornamental and protective surfacing to be exposed to the weather.

When the surfacing material applied to the coated sheet is of one color, covering elements cut from the sheet and assembled in suitable arrangement in a building construction in many cases produce a drab and monotonous appearing surface. In order to enhance the appearance of the covered surface surfacings of different colors have been applied in regular and irregular or variegated arrangement to the face of the web and the elements to be exposed with the view of providing a harmonious arrangement of color areas on the structure which is effective to relieve the above-mentioned monotonous effects.

Various processes and forms of apparatus have been proposed by the prior art to produce these so-called "multicolor" coverings. The majority of these proposals, however, are not entirely satisfactory because of the limited selection, arrangement and sequence of color areas which can be put on the face of a roofing sheet. The usual result is a repetition of the same series or groups of color areas generally of equal length in unchanged order upon the face of the web. The forms of covering elements into which a sheet of this type may be cut without producing a regular or checked effect when the elements are assembled are limited. To lessen this objection with some of these prior art processes preassortment of the different colored covering elements by hand has been used to reduce the occurrence of a regular checkerboard or large areas of the same color when the elements are assembled on a structure.

Typical of the prior art processes and appara-

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tus are those disclosed in the patent to Heppes 1,791,560, February 10, 1931, and in the patent to Penley 2,074,131, March 16, 1937. In these and other processes and devices the determination of the amount of granular material of a given color to be applied to the web is controlled in relation to the web movement and in relation to the feeding of the granular material to the web surface. These conditions restrict the variation of color sequence and color area length. The invention makes possible much greater variation and selection in these respects.

An object of the present invention is to so modify the prior art forms of apparatus that a multi-color web having a wide variety of color areas both as to length and arrangement may be produced while making is possible readily to change the color area length and to accurately measure the material for each color area regardless of variations in web movement and other conditions.

In accordance with the invention discharge of the surfacing materials from a supply thereof is initiated at a time predetermined in relation to the movement of the web so that the position of the portion of surfacing material which first becomes deposited on the face of the web is accurately determined in accordance with the web movement. The quantity of surfacing material to be spread upon the color area, however, is determined independently of the web movement. It is a feature of the invention that separate means is provided constructed to operate in accordance with elapse of time which will maintain flow from a supply of surfacing material for a given time period independent of the rate of web movement. This time period determining means may be so adjusted either before or during operation of the surfacing machine, that the time of flow and therefore the length of any given color area on the web may be changed at will.

In order to provide a completely surfaced web and to obtain greater variety in arrangement and length of color areas on the face of the web, I may provide a plurality of different supplies and initiate discharge from the supplies successively at time intervals in accordance with the web movement, the time period for flow from each of the supplies being controlled independently of each other and independently of the web movement so that the same or different lengths of color areas may be laid in succession on the web.

By the shortening of a given time period, a short color length of surfacing material may be produced on the web with an unsurfaced area or panel left between said color length and a

succeeding color area. An auxiliary hopper may be provided which is operable to continuously apply comminuted material over the multi-color surfaced face of the web in order to surface these intermediate panels.

Another object of the present invention is to provide improved apparatus for carrying out my process which is compact and applicable to produce a roofing web with a wide variety of arrangements of color areas which may be cut into covering elements and used without necessity of pre-assortment.

A further object of my invention is to provide apparatus which will effect uniform and regular delivery of the measured quantity of the selected comminuted materials to and over the respective color areas upon the face of the web. I may provide means to catch and hold the surfacing materials which are discharged as a mass from a given supply of surfacing material, and then to feed the mass of surfacing material in subdivided quantities predetermined in relation to the web movement so as to distribute these subdivisions of said mass over a predetermined area of the face of the moving web.

A detailed description of the advantageous features of my invention will be given below in connection with the drawings in which

Fig. 1 is a section of the surfacing apparatus of the invention taken substantially on the line 1-1 of Fig. 2.

Fig. 2 is an end section taken along the line 2-2 of Fig. 1.

Fig. 3 is an enlarged end section of the feed roll of the invention taken on line 3-3 of Fig. 2.

Fig. 4 is the electrical wiring diagram of the control system.

Fig. 5 is a diagrammatic example of a roofing sheet produced in accordance with the invention.

Referring particularly to Figs. 1 and 2, positioned above a roofing sheet 1 which is adapted to be moved toward the right by rollers 1a driven by power from any suitable source, is the surfacing apparatus of the invention generally indicated at 2. Vertical frame members 4 and 6 and horizontal frame members 5 and 7 are rigidly secured together and supported above the web by channels 8 and angles 10.

Mounted on the frame members 5 at each side of the machine are a number of bins 11, 12, 13, 14, 15 and 16 for containing comminuted surfacing materials. The bins 11 to 16 are spaced apart in the direction of web movement and have lower outlet openings 17 extending transversely across the web as can be seen in Fig. 2.

The lower outlet opening 17 of each of the bins 11 to 16 is provided with a gate or valve 18 which extends the full width of the bin outlet.

Supported by the lower frame members 7 at each side of the machine are the distributing hoppers 20 and 21 arranged with the upper openings 22 and 23 thereof below the gates 18 respectively of bins 11, 12, 13 and 14, 15, 16 to receive the comminuted surfacing materials discharged therefrom. Supported on stub shafts 25 journaled in pillow blocks 26 at each side of the machine are feed rolls 30 and 31 which are positioned adjacent the outlet openings 28 and 29 respectively of the hoppers 20 and 21 to effect delivery and distribution of comminuted materials received therein to and over the upper face of the web 1.

The gate actuating mechanism for the gates 18 is duplicated on each of the bins 11 to 16 but in order to avoid confusion in the drawing is

shown only in connection with the gate 18 of the bin 11.

The gate 18 comprises a plate 19 which extends across the full length and width of the outlet opening 17 of the bin 11. The plate 19 is supported by a number of arms 40 which are keyed to a shaft 41 mounted at each side of the bin 11 in bearing blocks 42. Solenoids 43 are supported adjacent the ends of the shaft 41 by suitable means and the moving cores 44 thereof are pivotally connected to crank arms 45 keyed to the ends of the shaft 41. Bias means, such as a spring 47, serves to maintain a sufficient force on the crank arm 45 to close and bias the gates 18 to the closed position when the solenoids 43 are not energized. When the solenoids 43 are energized they exert sufficient force to overcome the bias of spring 47 and to open the gate or valve 18 to allow flow or discharge of surfacing material by gravity from the bin with which it is associated to the receiving hopper 20 or 21 therebeneath.

As can be seen in Fig. 2, each of the bins 11 to 16 is provided with a number of partitions 24 which divide the bin into a number of separate compartments for containing different surfacing materials if it is desired to apply parallel lengthwise bands differing in color across the sheet. The hoppers 20 and 21 are provided with a number of partitions 27 which define compartments of similar arrangement to those in the bins. The bins 11 to 16 are maintained with an adequate supply of surfacing material therein by means of hoses such as 22a leading from primary granular supplies not shown.

The distributing hoppers 20 and 21 and their feed rolls 30 and 31 are arranged to deliver to the face of the web 1 surfacing material from the bins 11 to 16 discharged thereinto. In order to secure even and regular distribution of the granular materials on the web, the feed rolls 30 and 31 are of unique design.

As can best be seen by referring to Figs. 2 and 3, the feed roll 30 associated with distributing hopper 20 comprises a roll body 50 mounted on stub shafts 25 extending axially from the ends of the body. Rotation of the roll 30 may be effected by power from the web moving drive transmitted to the sprocket or gear 52 secured to one end of the shaft 25.

The peripheral surface of the roll body 50 is provided with a plurality of slots or grooves 51 of substantial radial depth which are spaced about the circumference of the roll body and extend axially along the roll. A strip or bar 53 of greater radial height than the slots 51 is fitted and secured in each of the slots 51 to form walls separating a plurality of pockets 54 of substantial volume on the surface of the roll lengthwise thereof. The pockets 54 are spaced apart about the circumference of the roll by the width of the peripheral surfaces 56 of the strips 53 which are at equal radial distances from the axis of the roll.

Referring particularly to Fig. 3, the hopper 20 has extending along the lower righthand edge of the outlet opening 28 thereof a plate 60 having a knife edge 61 adjacent the path of travel of the peripheral surfaces 56 of the strips 53. The plate 60 is adjustably mounted on the hopper 20, by means of studs 62 extending through slots 63 in the plate 60 and provided with lock nuts 64, for movement toward and away from the peripheral surfaces 56 of the strips 53. In practice the knife edge 61 is adjusted to position it closely adjacent the path of travel of the peripheral wall surfaces 56 along the entire axial length thereof to provide

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a clearance space between the knife and the strips 53 successively which is not substantially greater than the size of the smallest granule of the comminuted surfacing material to be delivered from the hopper 20.

The lefthand side of the hopper as shown in Fig. 3 is provided with a soft rubber strip 55 extending along the length of the outlet opening 28 thereof which may be adjustably attached to the hopper by means of screws 56 passing through slots in strip 55. The rubber strip 55 may be adjusted to just contact the peripheral wall surfaces 56 of the strips 53 and thereby prevent leakage of granular material from the hopper 20.

It is to be understood that the feed roll 31 and the hopper 21 as shown in Fig. 1 are provided with the structural features described above in connection with the feed roll 30 and the hopper 20.

With the usual machine speeds for carrying a web of felt between 60 and 240 feet per minute it has been found that the pockets 54 of feed rolls 30 and 31 preferably should be of about $\frac{1}{4}$ " radial depth by about $\frac{1}{2}$ " width between the strips 53. The strips 53 which define the pockets 54 may provide peripheral wall surfaces 56 approximately $\frac{1}{8}$ " wide. It has also been found preferable to drive the feed rolls 30 and 31 with a surface speed of approximately three-quarters of the sheet speed.

While the above given feed roll dimensions are preferable for uniform distribution and delivery of the surfacing materials to the face of the web from the distributing hoppers 20 and 21, it has been found that as much as 50% variation greater or less may be made in size of pockets, that is, variation in the height, width and spacing of the pockets, and the ratio of roll speed to sheet speed while maintaining the function of delivery and distribution by the feed roll substantially as obtained with the preferred dimensions above given.

The operation of the machine shown in Figs. 1, 2 and 3 is as follows:

The bins 11 to 16 are each provided with a supply of different granular material by hoses 224 leading from storage spaces.

Drive of the web 1 for movement in the direction of the arrow in Fig. 1 is started and feed rolls 30 and 31 associated with distributing hoppers 20 and 21 are driven by suitable connection to the web drive to effect clockwise rotation thereof at a rate in accordance with the rate of web travel.

Discharge of a mass of granular material from a given supply such as that in the bin 11 is started by actuation of the solenoid 43 governing the gate 18 associated with the outlet opening 17 of the supply bin 11. As will be described in greater detail below, it is preferred that actuation of the solenoid and therefore initiation of the discharge be accomplished in relation to the travel of the web so that the surfacing material may be initially applied at a predetermined portion of the face of the web 1.

The solenoid 43 is actuated for a predetermined time period during which discharge of a measured mass or predetermined quantity from the bin 11 takes place. In the particular embodiment shown, metering of this quantity or batch is accomplished under the action of gravity causing flow through the area of flow of the lower outlet opening 17 of the bin 11 in proportion to the time period during which the solenoid 43 for opening the gate 18 is energized.

The mass of surfacing material discharged from the bin 11 falls into the distributing hopper 20.

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As the feed roll 30 associated with the hopper 20 is continuously driven in the direction shown in predetermined relation to the web movement the granular material discharged into the hopper 20 is fed continuously therefrom at a predetermined rate toward the face of the web.

By the unique construction embodied in the feed roll I am able to distribute this batch of surfacing material fed from bin 11 to hopper 20 evenly over the face of the web 1. The granular material fills each of the pockets 54 of the feed roll as it travels under the distribution hopper outlet and the edge 61 of the plate 60 acts to strike from above the pocket any excess surfacing material over that required to just fill it. This quantity measured by the volume of the pocket 54 is then delivered to the surface of the web by the further rotation of the feed roll and the filling operation is repeated for the following pockets passing under the mass of the granular material in the mouth of the pocket until the batch contained in the hopper 20 is exhausted.

It can be seen that by virtue of drive of the feed roll 30 in accordance with the movement of the web and the provision of a substantial volume of surfacing material in each of the pockets that predetermined subdivided quantities of surfacing material are distributed over the face of the web as it travels a given distance. In other words, as a given portion of the area of the face of the web 1 passes beneath the hopper 20, a metered quantity of surfacing material predetermined by the metering gates 18 to be adequate to cover that area is distributed over the face of the moving web in predetermined subdivisions.

By assuring delivery of a predetermined subdivided quantity of comminuted surfacing material to the face of the web for each small unit of web travel, uniformity of distribution of the batch over a given area of the web is secured. In prior art proposals provision has not been made to assure this uniform rate of flow of the surfacing material because the ordinary type of feed roll having a corrugated surface of slight degree cannot be relied upon to effect and maintain a uniform rate of feed from its associated supply. The prior art feed rolls do not produce a positive feed of the granular material without slippage and without uncontrolled flow. Due to lack of substantial volume in the corrugations and positive cut-off for each volume and due to leakage of the surfacing materials from the hopper directly to the sheet through the wide clearance space maintained between the roll and hopper to provide an orifice for sufficient feed to be effected from the hopper uneven feed may occur.

Preferably, before feed by feed roll 30 of the batch in hopper 20 to the face of the web is completed, discharge from one of the bins of the group 14, 15, 16, say 16, to its distributing hopper 21 is initiated and distribution therefrom over the face of the web by feed roll 31 immediately follows. By correctly timing the initiation of flow from the bin 16 in relation to movement of the web 1, the forward edge of the color area from supply bin 16 may just come under the discharge of hopper 20 as its supply becomes exhausted. In this manner color area material from bin 16 may be contiguous to color area material from bin 11 upon the face of the web 1. If desired, by a different timing arrangement between exhaustion of the supply in the one distributing hopper and start of delivery of surfacing from the other hopper a space may be left between the successive color areas on the face of the web. For such

cases, in order to provide a panel therebetween of suitable colored surfacing material, I may provide an ordinary hopper 70 with associated feed roll 72 to discharge surfacing material 73 continuously over the entire face of the web. The auxiliary hopper 70 preferably is positioned adjacent an embedding roll 74 and provided with a guide plate 75 for effecting delivery of the mixed off fall slate from over the embedding roll to the hopper 70 to be thereafter again fed to the face of the web.

By successive operation of the solenoids 43 associated with the bins 11 to 16 in any desired order, I may surface the roofing web 1 with any arrangement of color areas and with lengths of the individual color areas determinable and variable at will. The arrangement is such that any portion of the web 1 not covered with granular material from one of the hoppers 20-21 is covered with the granular material from the hopper 70. When granules from the hopper 70 fall on top of the granules already deposited from the hoppers 20-21, such granules from the hopper 70 are excess granules at such points and beyond the capacity of the adhesive coating in which the granules are embedded for effective bonding to the web.

I prefer to use an electrical actuating arrangement such as is shown in Fig. 4 to effect operation and timing of the solenoids for effecting discharge of the surfacing materials from the bins 11 to 16 to the distributing hoppers 20 and 21 positioned therebeneath. In Fig. 4 in schematic form is shown a preferred embodiment of such a control system arranged for timed control of the solenoid actuated gates 18. A general description of the operation will now be given and a more detailed reference to the particular means for measuring the time period will be given hereafter.

A controller 100 is constructed with commutator discs or cams 101 having raised portions 102 at predetermined angles of rotation with respect to each other. Contactors 103 in parallel circuits are arranged, upon engagement by raised portions 102, respectively to close and thereafter open said circuits. The commutator 101 is driven by sprocket 104 and chain 105 from a suitable sprocket on the roofing machine, not shown, driven from the web moving means.

A plurality of electronic timers 111, 112, 113, 114, 115 and 116, have posts C and D connected across an electrical supply 110 which may be of low voltage. Connections also are provided from the line 110 to posts A through the respective contactors 103 of the controller 100. From the posts B connections are made through the relays 120 to the opposite side of the line from that at which the contactors 103 are connected. As hereafter described, closing of a contactor 103 serves to bring into operation members of the timer connected to said contactor so as to energize the relay 120 and also to start operation of the time period determining device which is part of said timer and is effective to maintain the closed circuit through the relay 120 for a measured time period. The time period determining device may be of the type which utilizes an electronic discharge as the timing means. The knobs 121 to 126 are connected to condensers, resistors, potentiometers or other electrical circuit varying means to vary the condition of the electronic circuit in order to vary the time periods. The knob of each timer may be set or adjusted independently of the others and for a predetermined ad-

justable time period after closure of said circuit therethrough.

The relays 120 have the contacts thereof electrically connected in series with coils 143 of the gate actuating solenoids 43 across a high potential line 140. Use of the relays 120 is made in order to utilize a high power line for energizing the gate actuating solenoids to obtain a strong pull on the gate by the solenoids to effect opening thereof with substantially no time lag.

It is to be understood that although only two complete timing circuits are shown, namely, for operation of gates 18 of bins 11 and 16, that the timing system is duplicated for control of the gates 18 on the other bins 13 to 15. In Figs. 1 and 2, the feed rolls 30 and 31 associated with distributing hoppers 20 and 21 are positioned at equal heights above the face of the web 1. If desired the hoppers 20 and 21 and the feed rolls 30 and 31 may be at different heights above the web face and the difference in length of path of fall of the comminuted materials thereupon may be compensated for by suitable adjustment of the controller 100.

The operation of the electrical control system shown in Fig. 4 is as follows. The circuit from one side of the line 110 to the controller 100 is closed through the contactor points 103 thereof to complete a circuit to the post A of one of the timing relays, for example, through the lead 111A connected to the timing relay 111. Closing of this circuit energizes the relay 120 connected between post B of the timer 111 and the other side of the line 110. By virtue of the construction of the timing relay 111 this also starts the time period determining device of the electronic timer 111. Energizing of the relay 120 closes the circuits through the coils 143 of the solenoid 43 and energizes the solenoid 43 to operate the gate 18 on the outlet 17 of the bin 11, thus initiating the flow of the comminuted surfacing material from the bin 11 toward the face of the web 1.

After elapse of a period of time predetermined by the setting of the time determining device effected by the setting of selector knob 121 of the timing relay 111 the relay 120 connected thereto is deenergized and the circuit through the contact points thereof and through the solenoid coils 143 is opened thus deenergizing the solenoids 43 connected to govern the flow from the bin 11. Upon deenergizing of the solenoid 43 the bias means 47 acts to close the gate 18 on the bin 11 and flow of surfacing material therefrom toward the face of the web is stopped. It will be understood that with the electrical control devices and solenoid operation of the gate 18, the solenoids being capable of operating against a strong spring, sharply accelerated movements of opening and closing are obtained. This makes possible more accurate measurements of the granular materials.

Each of the timing relays 111 to 116 may be arranged to maintain the relays 120 respectively connected thereto energized for the time period set by the setting of time period devices, under control of knobs 121 to 126, regardless of the length of time of closure of the contact on the controller 100. In other words, whether the contactors 103 of the controller are closed for a time which is less than or which exceeds the time period set on the timing relay, the timing relay will maintain the relay 120 connected thereto energized for the pre-set time period, and will not again energize its relay 120 until the contactors 103 on the controller are opened and are closed again after the elapse of the time period. Al-

though detailed operation of only the timing relay 111 has been given above it is to be understood that the other timing relays 112 to 116 operate in a similar manner to maintain flow of surfacing materials from the bins 12 to 16 respectively toward the face of the web for pre-set time periods after the circuit is closed by the respective contacts of the controller 101 to initiate the flow of surfacing materials from respective bins.

In Fig. 5 is shown a portion of a roofing web surfaced in accordance with the process and by the apparatus of the present invention. The dotted lines thereon indicate how one type of covering element may be cut from such a web to give the desired multi-color product. For example, to apply color areas I and VI at the right of Fig. 5 of equal length and in contiguous relation upon the face of the web from the respective bins 11 and 16 through respective distributing hoppers 20 and 21, the contactors 103 of the controller 100 should be set to complete the circuit through leads 111A and 116A in proper relation to the rate of web movement and to the spacing between discharge points of hoppers 20 and 21 along the path of web movement. For example, if the lengths of the individual color areas are to be equal to the spacing between discharge points of the hoppers 20 and 21, the raised portions 102 of the controller cams may be set to initiate flow from the bins 11 and 16 simultaneously and the knobs 121 and 126 of the timing relays 111 and 116 are set to hold gates 18 open to maintain the flow of surfacing materials from the bins 11 and 16 for the period of time required for discharge to the distributing hoppers 20 and 21 respectively of metered masses or quantities of surfacing materials adequate to cover a length of web equivalent to distance or spacing between discharge points of the distributing hoppers 20 and 21. If the feed rolls 30 and 31 of the distributing hoppers are operated continuously in accordance with the rate of web movement they will distribute the surfacing materials delivered thereto over the face of the web at a rate determined by the web movement. After elapse of the time period, discharge from the bins 11 and 16 is stopped by the timers 111 and 116 but the feed rolls 30 and 31 continue feeding until they complete distribution of the metered surfacing materials contained in hoppers 20 and 21 to and over the surface of the web to cover lengths equal to the hopper spacing.

If it is desired to apply color areas I and VI as shown in Fig. 5 of lengths which are less than the spacing between the discharge points of the hoppers 20 and 21, the timers 111 and 116 may be set to reduce the time period and close the gates 18 on bins 11 and 16 sooner after their opening than in the case just described. The feed rolls 30 and 31 will then complete feed of the masses in hoppers 20 and 21 before the web has traveled the distance between hoppers. It is possible, however, to set the controller 100 to establish contacts with the leads 116A to start flow from the bin 16 to hopper 21 and then to the face of the web slightly before the contact with the lead 111A is made to start flow from the bin 11. It is thus possible to compensate for the travel of the web for a distance equivalent to the difference between the length of the color areas and the spacing between the hopper discharge points. The timing relays 111 and 116 may then be set for a time period which will cause discharge of metered masses from the bins 11 and 16 to cover the shorter predetermined length of color area

in accordance with the rate of distribution of the surfacing materials from the hoppers 20 and 21 and the movement of the web.

If the color area II of surfacing material from bin 12 is to be applied to the face of the web as shown, with a panel M of mixed slate between the color area II and the color area VI, the contactor on the controller 100 connected to lead 112A must establish the circuit through timing relay 112 after rotation of the commutator from making of contact to lead 116A a distance equivalent to the length of web covered by the color area VI plus the length of web for the panel M plus the spacing between discharge points of the hoppers 20 and 21 since the bin 12 discharges into hopper 20 instead of hopper 21. The timing relay 112 is concomitantly actuated and discharge from bin 12 is initiated and maintained for a time period dependent upon the desired length of color area II. The knob 122 controlling the time period device of timer 112 is set to deliver surfacing material for the time period predetermined to discharge a quantity of surfacing material from bin 12 requisite to cover said desired length. The panel M left unsurfaced between the color areas VI and II may thereafter be covered with surfacing 73 applied continuously from the hopper 70 over the entire face of the web 1.

If it were desired at any time to eliminate the panel M between color areas VI and II it would be possible to increase color area VI by merely changing the length of the time period of the timing relay 116. This may be done by turning the knob 126 thereof to reset the time period device and increase the time period sufficiently to cause discharge of an additional quantity of surfacing material from bin 16 to cover the length of web equal to the length of the panel M.

As shown in Fig. 5 the color areas may be applied in any desired arrangement depending upon the number of contactors on the controller 100 and the rotational angles at which the raised portions 102 of the controller are arranged so as to operate contactors 103 in accordance with the travel of the web, in order to cause initiation of feed from the different bins at proper time intervals related to the web movement. For example, the second color area VI at the left of the figure may be laid on the roofing web 1 in accordance with the closing of the contactor 103 to lead 116A a second time by the raised portion 102 at the lower part of the commutator of controller 100 in Fig. 4. By the provision, however, of a device for determining the time period of such construction that by mere adjustment of the knob setting the time period for each bin opening may be lengthened or shortened, variation of length of any of the color areas independently of the web movement and independently of each other is accomplished. Thus, for example, the color area I at the left of Fig. 5 may be made of greater length than the previously applied area I at right of Fig. 5. By virtue of this adjustability and variation I may also provide unsurfaced panels between any of the color areas, such as the areas M in Fig. 5, which areas may be later surfaced from the hopper 70.

The process and apparatus of the invention may also be used to produce a roofing sheet having a surfaced face formed with spots of different color comminuted materials upon a background area. This background may be surfaced, as from hopper 70, with granular material contrasting with the spots. From such a sheet covering elements may be cut and assembled on a

structure without the necessity of pre-assorting the elements as in prior art processes of this character in order to insure variation of colors.

To produce such a sheet of surfaced material I may supply each of the bins 11 to 16 with different arrangements of colored surfacing materials in the various compartments defined by the partitions 24. If desired, some compartments of the different bins may be left empty and the compartments used may be staggered along the path of web movement and be supplied with various color comminuted materials. The positions of the raised portions 102 on the cams of commutator 101 of the controller 100 do not necessarily have to be changed from the arrangement for color areas extending across the web but the time period for flow from a given bin may be made to be of short duration so that limited quantities of the surfacing materials from the various compartments are discharged to form spots on the face of the web separated lengthwise of the web from other spots by unsurfaced portions similar to areas M above described. The order for application of the surfacing materials from the different bins 11 to 16 is determined in a similar manner to that described in connection with Fig. 5. In place, however, of the color panels shown in Fig. 5, a plurality of spots or splotches of different colors spaced transversely of and lengthwise of the web are produced.

When such a spotted sheet is produced, the lower distributing hoppers 20 and 21 and their associated feed rolls may be eliminated, as the quantity discharged for each spot is relatively small and will be distributed sufficiently by fall from the bin outlet. In some cases a spattering of the granules upon contact with the sheet aids in giving a vignette or variegated effect. It is not necessary, however, that this distributing hopper be eliminated in order to successfully produce a spotted sheet as distribution therefrom by means of a suitable feed roll may be effected with sufficient rapidity to assure production of a satisfactory spotted sheet.

After the spots of color are applied surfacing material 73 may be applied over the entire face of the web 1 in order to effect complete coverage of the web with surfacing material. The spots may cover a relatively small portion of the total area of the roofing sheet so that the material 73 may be the predominant or basic color or a blend. On the other hand, by suitable design and adjustment of the gates, compartments, hoppers or feed rolls, the spots may cover a larger proportion of the area or may predominate.

In explanation of the operation of the electronic timers 111 to 116, by reference to Fig. 4 it will be noted that the posts C, D, A and B are connected to a triple pole switch 230 and to a double pole switch 232. These switches are provided respectively with relays 234 and 236. The relay 234, upon being energized, acts to hold the switch 230 closed. The switch 232 normally has its blades in contacting position, as shown, and the relay 236, upon being energized acts against spring 237 to open the switch 232.

Upon closing of a contactor 103 relay 234 is energized and switch 230 is thereby lifted from the open position shown in Fig. 4 to the closed position. From the diagram it will be noted that closing of the middle blade of the switch 230 acts to complete the circuit across line 110 in parallel with contactor 103 thus to maintain the solenoid 234 energized and to hold the switch 230 closed. This circuit is completed through

the lower blade of switch 232, this switch being in the closed position. The relay 234 will remain energized until the circuit is broken by opening of the lower blade of the switch 232.

Upon closing of the switch 230 the circuit is established also from one side of the line 110 through the solenoid 120, through post B, then through the lowermost blade of the switch 230 and the upper blade of switch 232, thence through the lower blade of switch 232 to post D and to the other side of the line 110. Upon opening of the contactor 103 the solenoid 234 remains energized, as above described, and the switch 230 is maintained in the closed position, thus maintaining the solenoid 120 energized.

The circuits will remain in this phase of operation until the switch 232 is opened by operation of the relay 236. Energization of the relay 236 is effected by means of the electronic circuit in which this relay is connected. The details of this electronic circuit are not shown in Fig. 4. The operation of such circuits is well known and may utilize a vacuum tube 238, diagrammatically illustrated in Fig. 4, suitably connected to variable condensers, potentiometers or other circuit varying devices which are mechanically connected to knobs 121 to 126. These connections are arranged so that upon turning of the knob the condition of the electronic circuit through the relay 236 may be changed to modify operation of said relay. To establish the electronic circuit and initiate the time period control by the relay 236, the switch 230 is arranged so that the uppermost blade of this switch 230 is closed by the relay 234 at the same time that the circuit is established through the solenoid 120.

The particular design of the timers and of the electronic timing device is not itself the subject of the invention and in place thereof other suitable devices, such as thermal relays or mechanical time delay relays which have been in common use, may in some cases be used. Because of the easy adjustability of the electronic timer and particularly the characteristic thereof which makes possible gradual variation as well as its suitability for time periods which are of short duration, the electronic timer is preferred. This is particularly the case for surfacing roofing sheets having successive color areas of relatively short length, that is, of a foot or less in dimension lengthwise of the roofing sheet. It will be understood that a slight rotation of a condenser controlling the electronic circuit of the timer, for example, makes it possible to finely regulate the length of these color areas upon the sheet. The circuits and arrangement illustrated in Fig. 4 represent one practical arrangement. Other arrangements of circuits and of electronic devices may be made to secure different timing relations and different lengths of time periods and of the time intervals.

A suitable arrangement of electronic means and cooperating parts which may be used to advantage in the timing mechanisms as shown is disclosed by Patent No. 2,183,412, granted to Marvin B. Sledd, and dated December 12, 1939.

By my invention, I have provided a mechanism which is adapted to operate at low speed movement of the web in the same manner as at normal high speed so as to produce the same pattern of granular material at both of said speeds or at any intermediate speed, this being accomplished automatically without any change in the adjustment of any of the mechanism other than the adjustment of the driving means by which the speed of movement of the web is controlled. This im-

proved arrangement is such, moreover, as to enable me readily and quickly to change the pattern of the granular materials on the web, which changed pattern will, of course, be produced at both high speed operation and at low speed operation of the roofing machine. So far as I am aware and so far as the prior art in this application shows, no one prior to this application had ever invented a machine in which means was provided for easily and quickly changing the pattern of the granular materials on the web and arranged so as to cause the machine to produce the same pattern at low speed operation as at normal high speed operation.

This application is a division of my co-pending application Serial No. 381,812, filed March 5, 1941.

Having thus described my invention I now claim:

1. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, means providing a plurality of separate supplies of comminuted surfacing materials, control means for successively initiating flow of comminuted materials from respective supplies toward a face of said web at intervals predetermined in accordance with the movement of the web, and means constructed to operate in accordance with elapse of time independently of said web movement to stop flow of said comminuted materials from respective supplies after said flow has been established for a predetermined time period.

2. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, walls enclosing a plurality of spaces for containing separate supplies of comminuted surfacing materials, flow governing means respectively associated with said walls for causing and stopping flow of the comminuted materials from said supplies toward a face of the web, control means connected to said means for moving the web and acting on said flow governing means for successively initiating flow of the comminuted material from respective supplies at intervals predetermined in accordance with the web movement, and means constructed to operate in accordance with elapse of time and acting on said flow governing means independently of said flow-initiating control means to stop flow of said comminuted material from respective supplies after said flow has been established for a predetermined time period.

3. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, a plurality of bins for containing supplies of different comminuted materials, an outlet opening for each of said bins, valves respectively associated with said openings, a plurality of valve actuating means respectively associated with said valves, control means connected to said means for moving the web and constructed and arranged to control said actuating means to cause said actuating means to actuate said valves and to initiate flow of said comminuted materials from said bins toward said web in predetermined successive relation at time intervals determined in accordance with the rate of web movement, and a plurality of means constructed to operate in accordance with elapse of time independently of said web movement respectively connected to said valve actuating means and arranged to stop the flow from the bins after flow therefrom respectively for predetermined time periods.

4. Apparatus for surfacing a web which com-

prises means for moving an elongated web in the direction of its length, walls enclosing a plurality of spaces for containing separate supplies of comminuted surfacing materials, means associated with said walls for governing flow of the comminuted materials from said supplies toward a face of said web, control means acting on said governing means for initiating and stopping flow of comminuted materials from each of said supplies, said control means being connected to said means for moving the web and being constructed and arranged successively to initiate flow of said comminuted materials from said separate supplies toward said face of said web, and means connected to act on said control means and adjustable at will to vary the time of flow of comminuted material from any given supply independently of the time of flow of comminuted material from any other supply and independently of the speed of movement of the web and thereby to vary the amount of comminuted material from said given supply for laying upon said face of said web.

5. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, walls enclosing a plurality of spaces for containing separate supplies of comminuted surfacing materials, outlet openings in said walls for each of said supplies, a plurality of flow governing means respectively associated with said outlets, a plurality of actuating means respectively connected to actuate said flow governing means, control means connected to said means for moving the web and constructed and arranged to control said actuating means to cause said actuating means to actuate said flow governing means successively to initiate flow of said comminuted materials from different supplies to a face of said web at time intervals predetermined in relation to the rate of movement of said web, and a plurality of means constructed to operate in accordance with elapse of time independently of the rate of movement of said web and respectively connected to said actuating means to operate each actuating means to stop flow through its flow governing means after elapse of a predetermined time period following initiation of flow therethrough, said means constructed to operate in accordance with elapse of time being individually adjustable to change the time period for flow from a given supply independently of the time of flow from the other supplies and independently of the rate of web movement.

6. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, a plurality of bins for containing supplies of different comminuted surfacing materials, each of said bins having an outlet opening, a plurality of valves respectively associated with said outlet openings to control flow of said comminuted materials from said bins toward a face of the web, a plurality of solenoids respectively connected to said valves, each of said solenoids being arranged upon energizing thereof to cause flow of comminuted material through its valve, means for stopping flow of the comminuted material through a valve when the corresponding solenoid is deenergized, electrical controller means having a plurality of contact points electrically connected to said solenoids and arranged to be operated in predetermined relation to said means for moving the said controller means being arranged to supply electric current successively to energize the different solenoids,

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and a plurality of electrically actuated timing relays electrically connected in series respectively with said solenoids, each of said relays being constructed and arranged to maintain the current through its solenoid for a predetermined period of time after flow of said current through said solenoid is established by said controller means.

7. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, a plurality of bins for containing supplies of different comminuted surfacing materials, each of said bins having an outlet opening, a plurality of valves respectively associated with said outlet openings to control flow of said comminuted materials from said bins toward a face of the web, a plurality of solenoids respectively connected to said valves, each of said solenoids being arranged upon energizing thereof to cause flow of comminuted material through its valve, means for stopping flow of the comminuted material through a valve when the corresponding solenoid is deenergized, electrical controller means having a plurality of contact points electrically connected to said solenoids and arranged to be operated in predetermined relation to said means for moving the web, said contact points of said controller means being arranged to supply electric current successively to energize the different solenoids at predetermined time intervals, and a plurality of electrically actuated timing relays electrically connected in series respectively with said solenoids, each of said relays being constructed and arranged to be adjustable to maintain the current through its solenoid for a selected period following the energization of the solenoid.

8. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, means for providing a supply of comminuted surfacing material, means for discharging from said supply a mass of comminuted material, means for metering the quantity of said discharged mass actuated in accordance with elapse of time and independently of the web movement, means for collecting said discharged and metered mass of comminuted material, and means cooperating with said collecting means for removing from said metered mass and feeding toward said moving web predetermined subdivided portions of said collected metered mass.

9. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, means for providing a supply of comminuted surfacing material, means for discharging from said supply a mass of comminuted material, means for metering the quan-

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tity of said discharged mass actuated in accordance with elapse of time and independently of the web movement, and means for feeding said metered mass toward said moving web in predetermined relation to the web movement.

10. Apparatus for surfacing a web which comprises means for moving an elongated web in the direction of its length, means for providing a supply of comminuted surfacing material, means for initiating flow of comminuted material from said supply toward a face of said web, means for accumulating said comminuted material flowing from said supply in an accumulating space as a mass, means for stopping flow of said comminuted material actuated in accordance with elapse of time after initiation of said flow and independently of the web movement to meter the quantity of said comminuted material in said mass to a predetermined quantity, and means acting concomitantly with said web moving means for feeding said metered mass toward said moving web in predetermined relation to the web movement.

11. Apparatus for surfacing a web which comprises means for moving an elongated web generally horizontally in the direction of its length, means for providing a supply of comminuted material positioned above said moving web, means associated with said supply means for discharging under the action of gravity comminuted material therefrom so as to fall toward the face of said moving web, means acting concomitantly with said discharge means for metering the quantity of said comminuted material being discharged in consideration of the constant force of gravity actuated in accordance with elapse of time and independently of said means for moving the web, and means acting concomitantly with said means for moving the web for applying said metered quantity to said web at a rate predetermined in relation to the rate of movement of said web.

ELDON O. DRYER.

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