

[54] **APPARATUS FOR CONTROLLING WEIGHT AND DISTRIBUTION OF A COATING**

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[73] Assignee: United States Steel Corporation

[22] Filed: Feb. 23, 1971

[21] Appl. No.: 117,894

[52] U.S. Cl. 118/63, 239/395

[51] Int. Cl. B05c 11/06

[58] Field of Search 118/63; 239/395

References Cited

UNITED STATES PATENTS

458,762	9/1891	Charonnat	239/395 UX
1,154,833	9/1915	Baker	239/395
1,980,923	11/1934	Lebel	118/63 X
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2,766,720	10/1956	Muller et al.	118/63
2,981,223	4/1961	Olszowka	118/63
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3,406,656	10/1968	Patterson	118/63

FOREIGN PATENTS OR APPLICATIONS

786,657	10/1957	Great Britain	118/63
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Primary Examiner—Morris Kaplan

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[57] **ABSTRACT**

An air knife assembly with a multiplicity of curved orifices spaced around its periphery for controlling the weight and distribution of a coating applied to a continuously moving substrate. Means are included for rotating the assembly to position any desired orifice into an operating position facing the substrate. Removable baffles prevent the flow of air to all of the knives except the one in the operating position.

3 Claims, 7 Drawing Figures

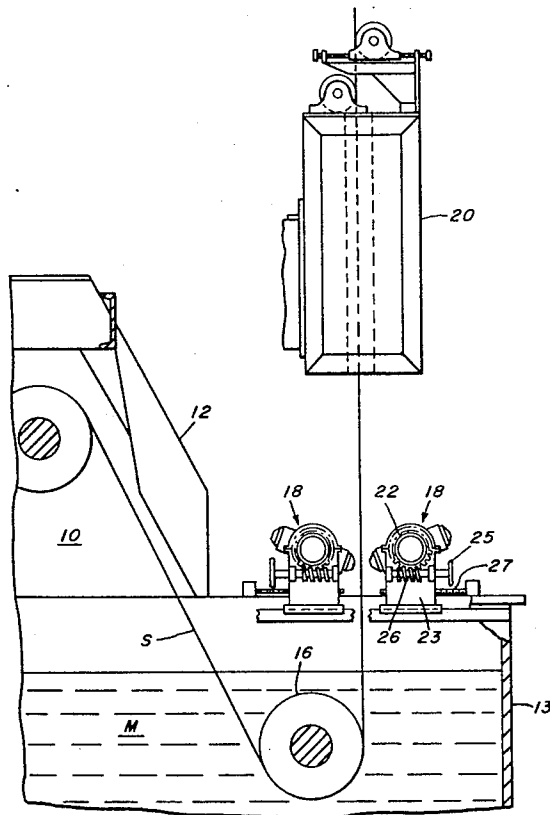
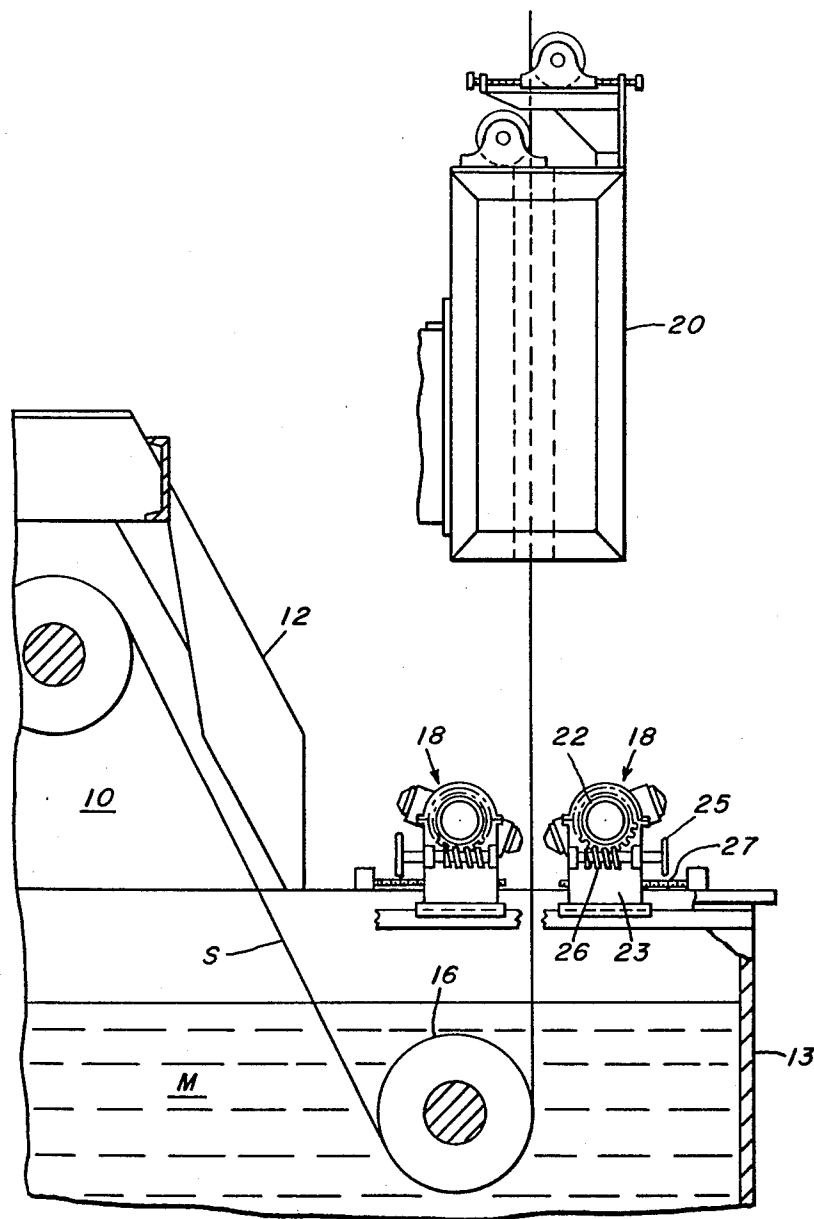
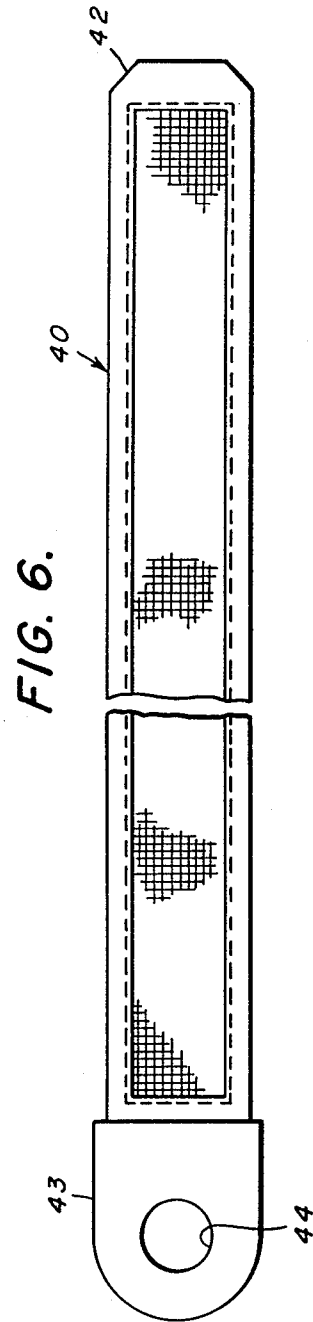
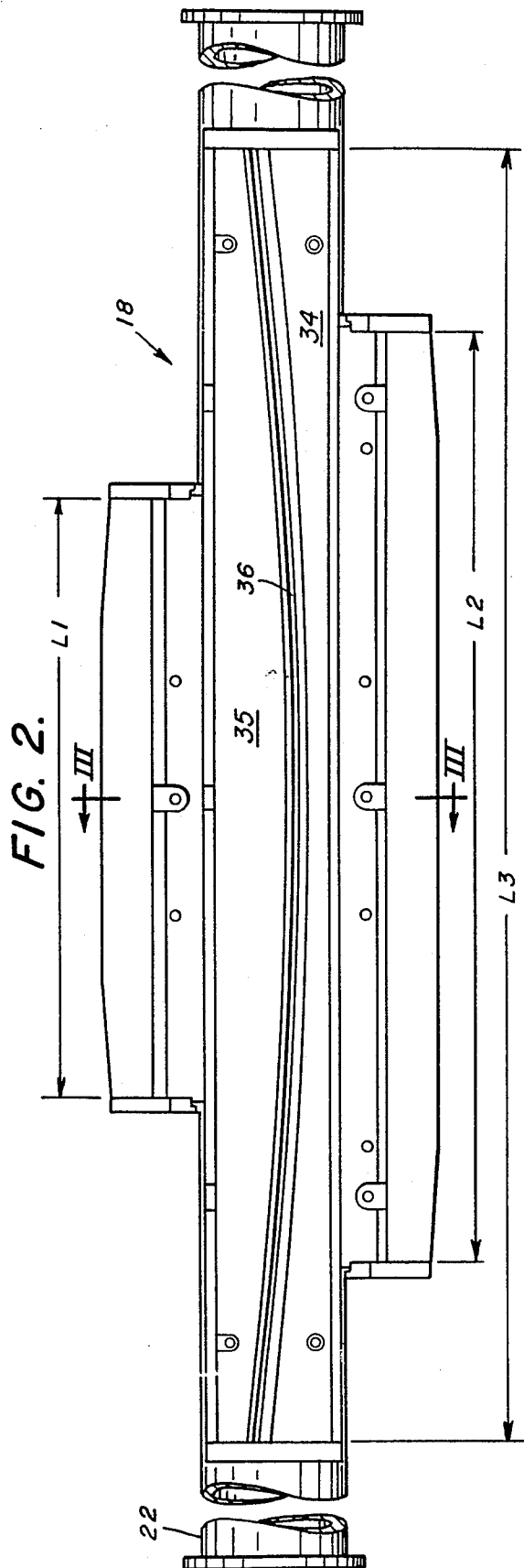


FIG. 1.



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FIG. 3.

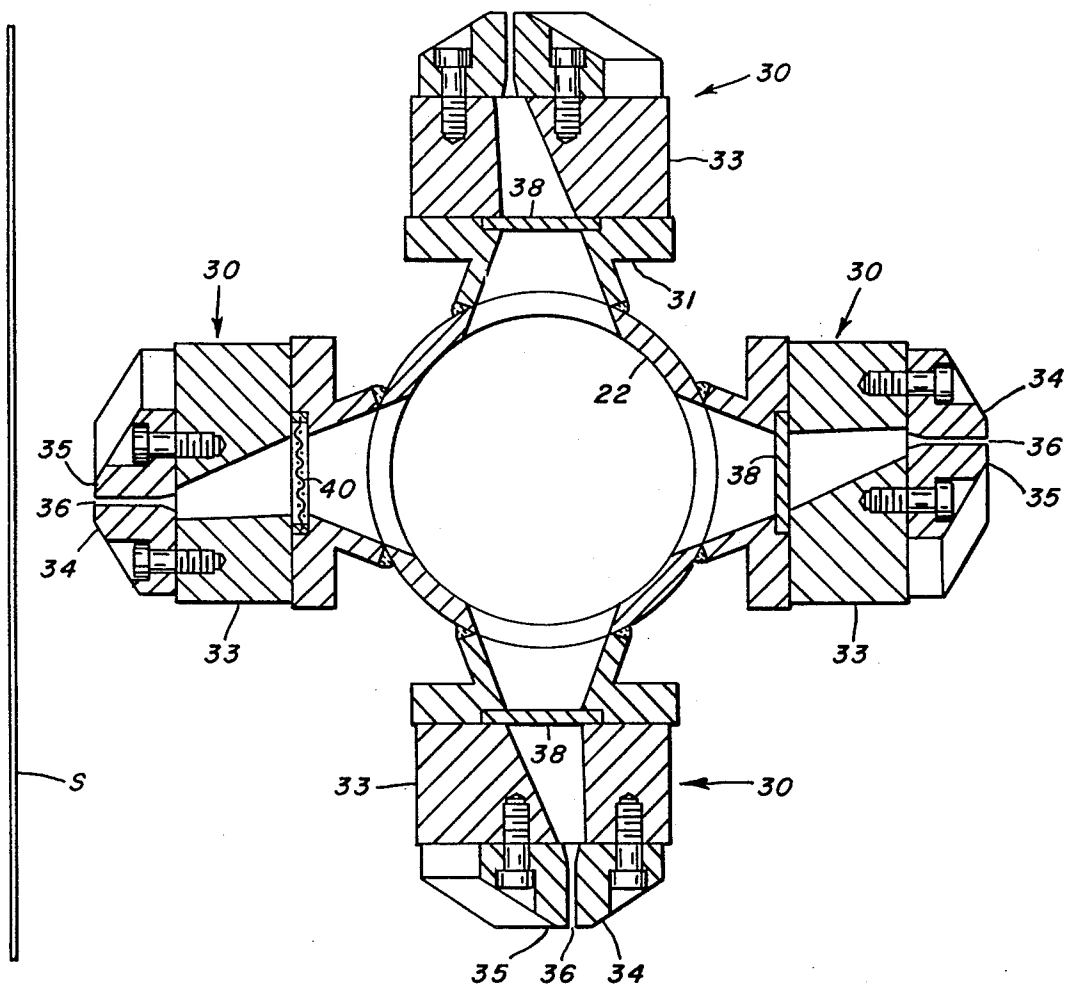
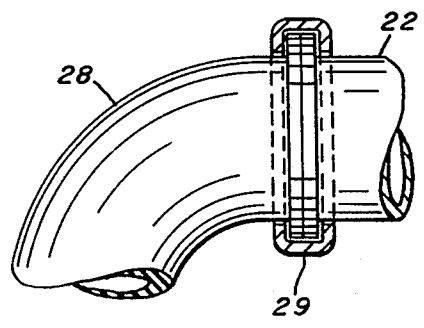


FIG. 2A.



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FIG. 4.

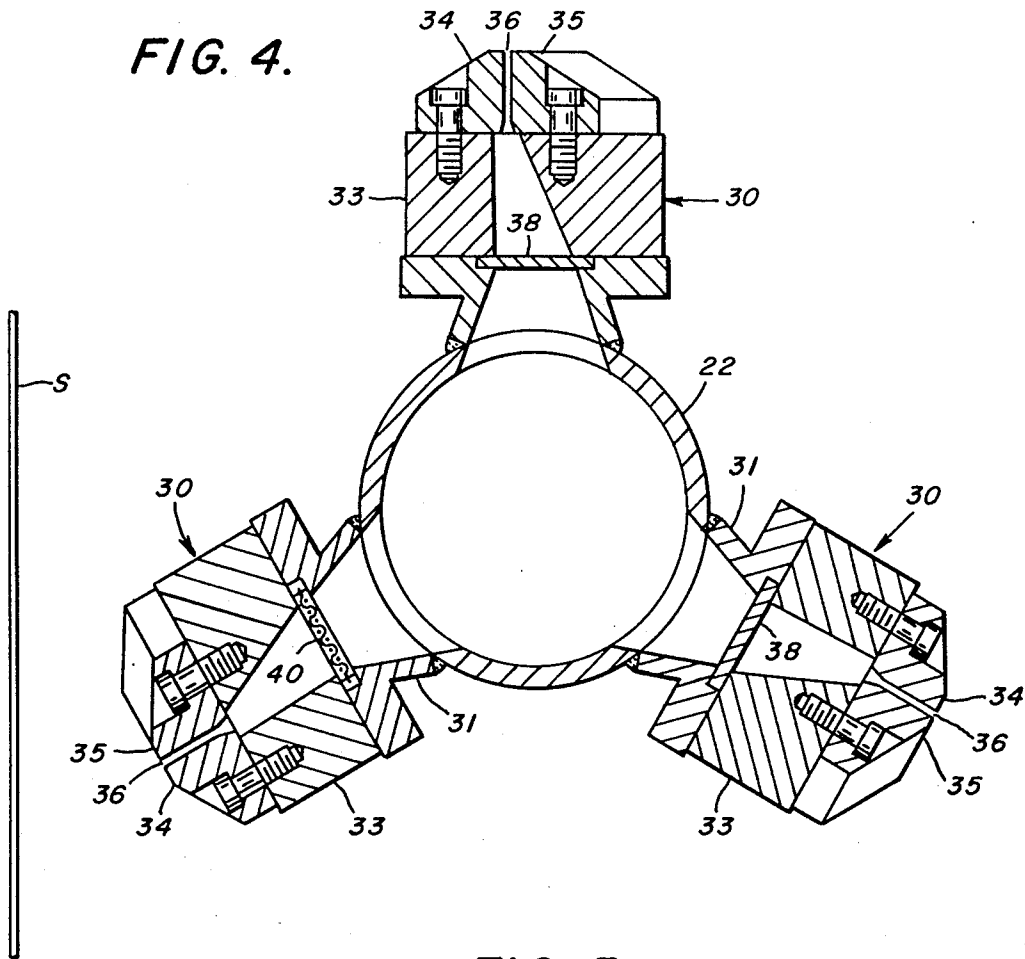
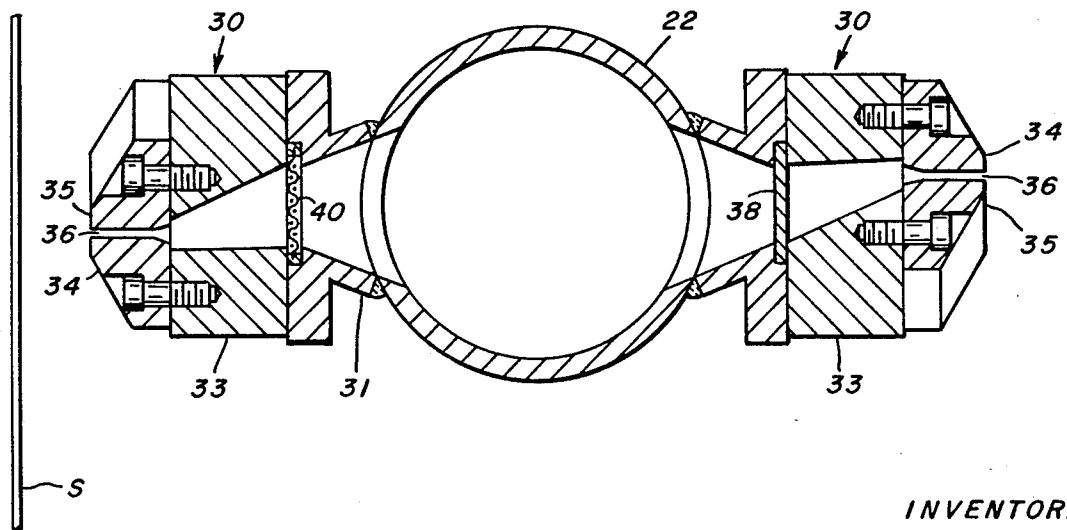


FIG. 5.



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APPARATUS FOR CONTROLLING WEIGHT AND DISTRIBUTION OF A COATING

This invention relates to an apparatus for use in controlling the weight and distribution of a coating applied to a moving substrate. More particularly, the invention relates to an appropriate for use in a process wherein substrates of varying widths are to be coated by immersion into and withdrawal from a bath of coating material. The apparatus is particularly suited for use in "hot-dip" coating operations wherein a substrate such as a steel strip, is coated with a metal, such as zinc, aluminum, tin, lead or alloys thereof.

The present invention provides apparatus for accomplishing control of the weight and distribution of a coating applied on a moving substrate regardless of the width of such substrate. This apparatus employs fluid nozzles commonly referred to as "air knives" although they are capable of use with many fluids other than air.

Heretofore air knives used for coating control and continuous coating operations have been made with a single, longitudinal orifice, the length of which is longer than the width of the widest substrate to be processed in the apparatus. Such an air knife is shown in my U.S. Pat. No. 3,406,656. The air knife disclosed in the aforementioned patent has an orifice defined by lips which curve upwardly from its center so that when the knife is rotated downwardly to deliver an air flow at an acute angle to the strip, the length of the jet of air at the center of the knife increases more rapidly than the length of the jet at the ends of the knife. Thus the molten metal coating at the center of the strip is subjected to a lower pressure air blast than the coating near the strip edges. This condition tends to cause removal of progressively greater amounts of coating metal near the strip edges and thus avoids build-up of coating at the edges of the substrate. Edge build-up is a particularly undesirable condition since it results in spooling when the coated strip is coiled.

Successful operation of any air knife requires its orifice to span the width of the substrate. Success of my curved knife requires a differential in pressure between the center and the edges of the substrate. Obviously, a curved knife designed to handle 60-inch wide substrates will not afford the same center to edge differential when used on a 30-inch wide substrate. Experience has shown that two knives of different lengths must be provided to handle the wide range of strip widths ordinarily galvanized. For instance, a 76-inch knife can be used for the widest strip processed (about 70 inches) down to a strip width of about 40 inches. For strips in the range of about 42 inches wide down to the narrowest produced (about 20 inches), a 46-inch knife is suitable. However, the use of two separate sets of knives requires extensive delays and consequent production loss during the time necessary for changing them.

My invention overcomes this difficulty by providing a common header carrying two or more knife structures of different lengths angularly disposed in such manner that rotating the header will bring one or another of the knives into operating position as required by the width of the strip being coated.

FIG. 1 is a diagrammatic elevational view showing an embodiment of the apparatus in accordance with the invention.

FIG. 2 is a side elevation of a multiple knife coating control assembly.

FIG. 2A is an elevation view of one end of an air knife external to the housing in which it is journaled.

FIG. 3 is a sectional view of the four-knife assembly shown in FIG. 2 and taken along line III—III of FIG. 2.

FIG. 4 is a sectional view of a three-knife assembly.

FIG. 5 is a sectional view of a two-knife assembly.

FIG. 6 is a front view of a removable air distributing screen.

The elevational view of FIG. 1 shows an arrangement in accordance with the preferred embodiment of the invention utilizing a two-knife coating control assembly in a conventional steel strip galvanizing line. In this illustration a steel strip S passes from an annealing furnace 10 through a snout 12 of controlled atmosphere into a receptacle 13 of coating

material M, which in the galvanizing operation is molten zinc. The strip S leaves the bath in a vertical pass line defined by sink roll 16 and a deflector roll (not shown). As the strip moves upwardly from the coating bath, it passes coating control assemblies 18 and enters a cooling box 20 in which the strip temperature is reduced below the melting point of the coating to solidify the molten coating.

The coating control assemblies 18 may be supported above the coating vessel 13 in any suitable manner, one assembly on each side of the substrate pass line. One arrangement is shown in FIG. 1. In this embodiment a tubular header section 22 is journaled in housings 23. A hand wheel 25 is affixed to worm 26, the cooperating worm wheel of which is fixed to the header. Rotation of the coating control assembly brings the knife having the correct length L1, L2, or L3, etc., (FIG. 2) into the active position at the desired time.

Horizontal adjustment of the knives with respect to the strip may be achieved by adjusting means 27 such as a motor driven screw, or by other suitable means, which moves housings 23 perpendicularly to the strip. Flexible connectors 28 and releasable couplings 29 (FIG. 2A) are used to supply fluid to both ends of the coating control assemblies 18.

The header 22 has two or more air knives 30 attached thereto. One air knife in each assembly is active and all others are inactive. Each air knife comprises a throat section 31 fixed to the header, a transition section or header block 33 detachably secured to throat 31 and curved lips 34 and 35 adjustably secured to the transition section. In the active position, lip 34 is the lower lip. A curved slot 36 is formed by lips 34 and 35. The knives are so mounted that the ends of the slot curve upwardly on the active knife when rotated into the operating position adjacent the substrate. Each knife structure has a removable baffle plate 38 which is inserted in a retaining slot 39 in the throat section when the knife is inactive and is removed and replaced by an air distributing screen 40 (see FIG. 6) whenever that particular knife is to be placed in the active position. Air distributing screen 40, which is shown in FIG. 6, has a slightly tapered end 42 to facilitate insertion of the screen in slot 39, and a large end 43 having a hole 44 therein to facilitate removal of the screen from the slot. Baffle plate 38, which is solid, has an identical exterior configuration to distributing screen 40.

While three, four, or even more blades could be provided in a single knife assembly (see FIG. 2, 3 and 4), I have found that two oppositely-disposed blades are satisfactory to handle all strip widths from 20 to 70 inches.

In operation, an air distributing screen 40 is positioned in slot 39 in the active knife, and baffles 38 are positioned in the corresponding slot of all other knives. The active knife is moved into position adjacent the pass line of strip S by actuating adjusting means 27. Handle 25, through worm gear 26, rotates the coating control assembly until the proper length knife is in the operating position, that is, adjacent to the pass line and inclined toward the substrate between about +20° above the horizontal to about -45° below a plane normal to the pass line but preferably between -5° and -45°. Flexible connectors 28 are attached to both ends of header 22 by releasable couplings 29. Fluid flow is initiated from both connections. Fluid under pressure flows into the header and convergent throat section 31. Screen 40 performs the function of diffusing the fluid and causing a uniform fluid jet to issue throughout the length of slot 36.

When it becomes necessary to change knives, coupling 29 is released, the assembly is turned by means of worm gear 26, and the connector 28 is recoupled to header 22.

From the foregoing it can readily be seen that I have provided an apparatus capable of controlling the weight of coating material applied on a moving substrate which apparatus is capable of performing on a wide range of substrate widths.

I claim:

1. Apparatus for controlling the weight and distribution of a coating applied to a moving substrate which includes a coating control assembly located adjacent the path of travel of said substrate, said assembly comprising:

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,670,695

Dated June 20, 1972

Inventor(s) Robert W. Patterson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, lines 3 and 4, "appropriate" should read
-- apparatus -- ; line 57, "being" should read -- bring -- .

Signed and sealed this 19th day of December 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents