United States Patent

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[73] Assignee **Acumeter Laboratories, Inc. Newton, Mass.**

[54] **FLUID APPLICATOR APPARATUS**
23 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **118/8,** 239/70
[51] **Int. Cl.** **B05c 11/10**
[50] **Field of Search** 118/8, 259, 302, 324; 239/67, 69, 70

[56] **References Cited**

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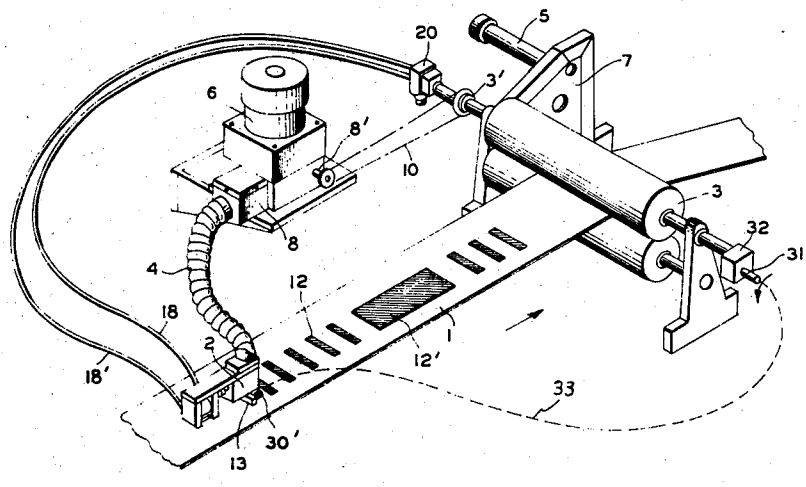
ABSTRACT: The present disclosure deals with fluid applicator apparatus wherein a substantially uniform fluid flow is produced through novel lateral-expansion nozzle design for such purposes as the intermittent application of fluid deposits upon moving sheets or articles.



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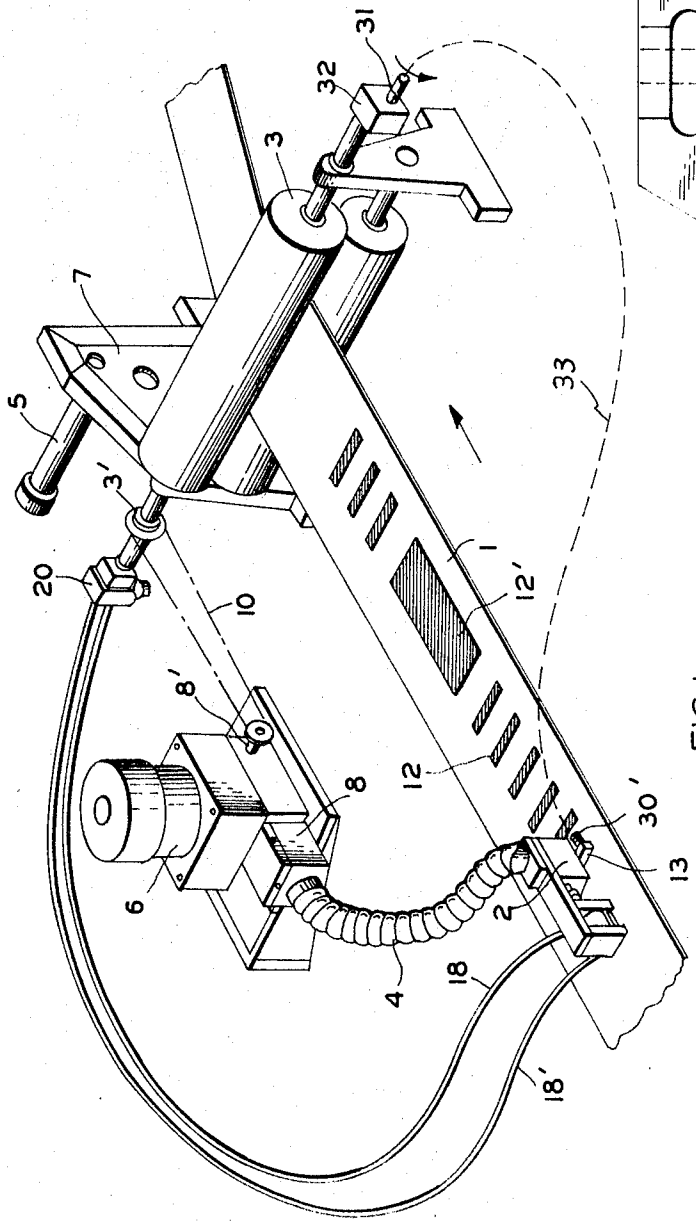

FIG.1

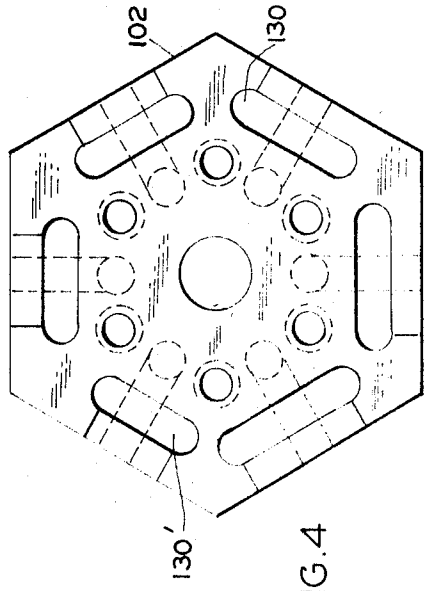

FIG.4

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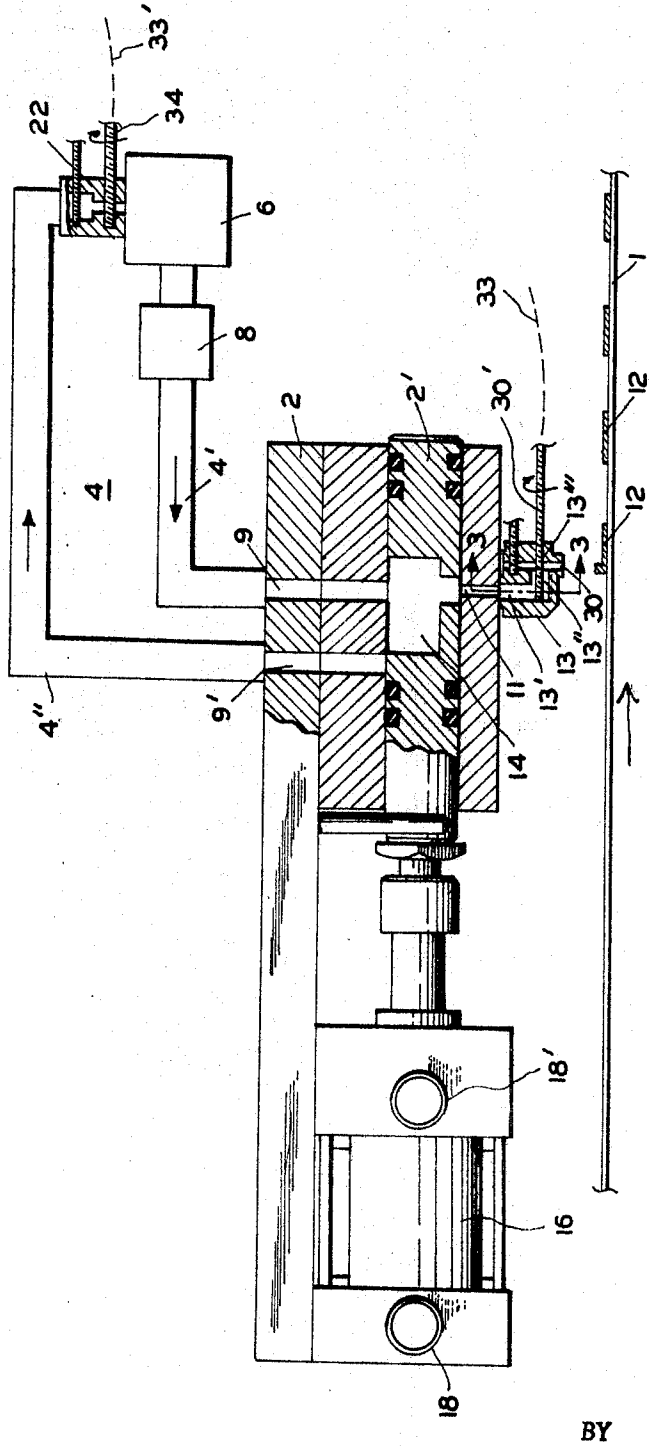

FIG. 2

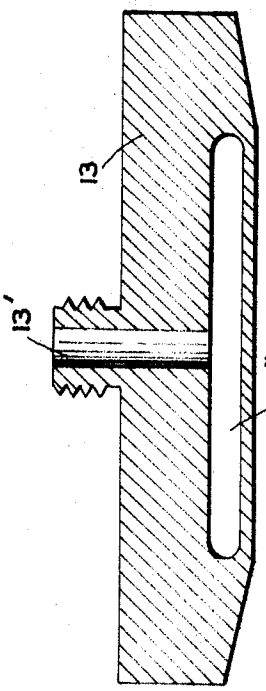

FIG. 3

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FLUID APPLICATOR APPARATUS

The present invention relates to fluid applicator apparatus, being more particularly directed to fluid distribution mechanisms for coating materials on surfaces (hereinafter generically referred to as "sheets" or "sheet means" such as, for example, hot melt adhesives, solvent-type pressure sensitive adhesives, resins, plastics or other fluid materials.

In prior U.S. Pat No. 3,323, 510 issued June 6, 1967 one of the applicants herein, Donald B. McIntyre, there is described hot melt dispensing apparatus of a type that is useful in certain applications of the present invention wherein, for example, adhesive materials or the like are converted from solid to molten form and continuously distributed along predetermined patterns for such uses as adhesively coating papers and other materials. Suitable fluid distributing mechanisms for applying the fluid materials in predetermined patterns, including intermittent configurations, to surfaces such as sheets, or the like, are also described in U.S. PAT. No. 3,174,689, issued Mar. 23, 1965, to the said Donald B. McIntyre. As will be evident from the description to follow, the invention is also useful with other types of fluid-to-be dispensed and other types of applicators or distribution apparatus.

There are applications, however, where a relatively high degree of uniformity of the fluid deposit or coating is highly desirable, as distinguished from less demanding applications for which such prior fluid applicators are entirely satisfactory and wherein a nonuniform coating thickness or small discontinuities, such as blobs or tails in the deposit, can be tolerated. It is primarily to the solution of the problem of coating control, particularly in systems where the sheets to be coated may be moved at different rates, that the present invention is accordingly primarily directed; it being a principal object of the invention to provide a new and improved distribution and applicator apparatus that shall not be subject to the nonuniform coating or deposit effects above-discussed, but that, to the contrary, provides for uniform and, if desired, adjustable fluid flow in the dispensing or application process. In summary, these ends are obtained preferably with a means responsive to the rate of presentation of successive portions of the sheet to the dispensing nozzle for correspondingly controlling the velocity of fluid ejection from the nozzle; a further feature of the invention residing, also, in a preferred nozzle distribution mechanism having direction-changing chambers and apertures for producing a uniform ejection of fluid. Preferred constructional details are hereinafter set forth.

Another object of the invention is to provide a new and improved fluid applicator apparatus of more general application, as well.

Other and further objects will be explained hereinafter and are more particularly set forth in the appended claims.

The invention will now be described with reference to the accompanying drawing,

fig. 1 of which is an isometric view illustrating a preferred embodiment of the invention particularly adapted for pattern coating of paper products or other sheet material;

FIG. 2 is a longitudinal elevation of a preferred nozzle distribution structure useful in the system of FIG. 1 and partly sectionalized to illustrate details of construction;

FIG. 3 is a longitudinal section upon a very much enlarged scale taken upon the line 2–2 of FIG. 2, looking the direction of the arrows; and

FIG. 4 is a plan view of a modified multinozzle construction.

Referring to FIG. 1, as before stated, the invention is therein illustrated as applied to the example of the application of a pattern of intermittent adhesive coatings to sheet paper, cardboard, or similar material. It is to be understood, however, that this is only one illustrative application of the invention, in that the principles thereof are obviously applicable to other fluid coating or applying processes in which similar results are desired.

A sheet 1 is shown moving in the direction of the arrow alongside the same under the control of draw rolls 3 driven from a control shaft 5 through the medium of conventional drive gears inside the gear box 7, as is well known. The sheet 1 passes a fluid distribution member generally designated by the reference numeral 2 which receives fluids along lines carried within a preferably flexible duct 4 from an adhesive hot melt reservoir 6, as of the type described in the said U.S. Pat. No. 3,323,510 or any other suitable type.

In connection with the preferred source of fluid designated at 6 and described in said patent, a metering pressurized pump 8 is preferably employed to introduce the hot melt fluid adhesive or other fluid under controlled metered conditions into the distribution member 2.

The connections within the conduit 4 are more specifically illustrated in FIG. 2 wherein the adhesive or other fluid reservoir 6 is shown feeding through the metering pump 8 and a port line 4' into an inlet 9 in he distribution member 2. The member 2 has an outlet 11 feeding a nozzle 13 for ultimate ejection of the adhesive upon the sheet 1 as successive portions of the sheet are presented to the nozzle in passing thereby or in other equivalent relative movement of nozzle and sheet.

The metering unit 8 may, for example, be of the type 1BUP2 marketed by Acumeter Laboratories, Inc., Newton Lower Falls, Massachusetts, or any other well-known type, wherein the input drive shaft 8' thereto (FIG. 1) may be synchronously controlled, as by he belt 10 from a shaft 3' associated with the draw rolls 3, thus synchronously to adjust the metered fluid volume flow in accordance with the rate of movement of the sheet 1. This is a very desirable combination because, in order to maintain uniform coating results, the volume of fluid fed to the distributing mechanism 2, hopefully should be increased as the rate of movement of the sheet 1 is increased (and vice versa), thus to allow less time for the ejection of the required metered fluid deposit upon successive portions of the sheet 1, as illustrated, for example, by the intermittent coating strips 12.

While the invention is also useful with more continuous coatings such as 12', it is particularly useful with patterns involving intermittent deposits. Such intermittent distribution may be effected with the aid of apparatus of the type disclosed in said U.S. Pat. No. 3,174,689 or other similar distributors. In the embodiment of FIG. 2, however, it is shown, effected with the aid of a valving member 2' disposed to slide longitudinally intermediate the distribution member inlet 9 and outlet 11. In the position illustrated, an opening 14 in the valving member 2' is shown permitting open communication of fluid from the inlet 9 through to the outlet 11; whereas upon operation of an air cylinder or other similar control 16 to the left, the intermediate valve member 2' will move to the left, blocking the communication between inlet 9 and outlet 11 of the distribution member 2. In such blocking position the opening 14 will communicate the port line 4' and inlet 9 with a further opening 9' that connects back to the fluid source or reservoir 6 through a bypass return line 4''.

The air cylinder 16 may be periodically operated by intake and exhaust conduits 18 and 18' operated from a valve mechanism 20, FIG. 1, that may again, if desired, be synchronously controlled with the rate of rotation of the draw roll shaft 3' and thus with the rate of movement of the sheet 1 relative to the distribution mechanism 2. A suitable device 20 for such purposes may be a cam-operated shutter valve as of the type marketed by Marsh Instrument Company, Skokie, Illinois (U.S. Pat. No. 3,020,927).

In order further to insure uniform coating thickness, distribution and deposit configuration, it is desirable to prevent a burst of fluid from ejecting through the outlet 11 of the distributor 2 when the communicating valve opening 14 is suddenly moved to the position shown in FIG. 2. If there were such a burst, then the first part of the deposition 12 would be thicker than the remainder of the deposition. This deleterious result is avoided through the use of a restricting mechanism 22, FIG. 2, later discussed, that reduces the effective cross-sectional area of the bypass return line 4'' and is adjusted sub-

stantially to match the pressure that exists between the source 6 and the outlet 11 when fluid is ejected from the distribution member 2, such that during periods of no such ejection (as when the valving member 2' is drawn to the left and causes the opening 14 to provide communication between the port line 4' and the bypass return line 4''), the pressure appears substantially the same to the source 6. In actual practice, the restrictor section 22 is preferably located as close to the distribution member 2 as is practically feasible.

Further in accordance with the invention, and particularly adapted for operation in the system of FIG. 1, a novel nozzle construction 13 is connected to the outlet 11 of the distribution member 2. The nozzle 13 is shown in more detail in FIGS. 2 and 3, having a first longitudinal or downward-direction flow section 13' and an orthogonally extending direction-changing expansion chamber section 13'' which, as more particularly shown in FIG. 3, permits lateral expansion of the pressurized fluid in the long direction of the expansion chamber 13''. Spaced from the open end of the expansion chamber 13'', shown at the right-hand end in FIG. 2, a baffle wall 13''' is disposed to define, preferably a slot aperture 30 through which the expanded fluid may be caused to eject in a substantially uniform laminar fashion upon the paper sheet 1, as at 12.

It has been found that the zigzag or circuitous path introduced by the orthogonal direction orientation of the chamber 13'' and the second orthogonal bend downward effected by the aperture 30, in a direction parallel to the longitudinal flow direction of the first section 13' of the nozzle 13, sufficiently dissipates the shock or pressure wave inherent in the ejection of pressurized fluid through the distribution member outlet 11 to result in this highly desirable uniform substantially laminar flow for attaining constant deposition results. If desired, pluralities of nozzles 130, 130', etc., FIG. 4, may be employed, as with the nozzle located on a side or section of, for example, a hexagonal head 102, carrying other nozzles for indexing, with the apertures of each nozzle 130, 130', etc., differently dimensioned, if desired, for different deposition dimensions.

As an illustration, with a hot melt adhesive of vinyl resins an waxes metered to produce a fluid input stream at the inlet 9 of about 50 lbs./sq. inch pressure, and with a nozzle section 13' of about ⅛ inch in cross section, an expansion chamber 13'' about 2inch long, ⅛ inch high and about ¼ inch in depth, for a gap between the aperture 30 and the sheet 1 of about 0.020 inch, and with sheet movement of 300 feet per minute substantially uniform coatings 12 and 12' of the order of 0.17 inch in thickness can readily be obtained in the manner above-discussed.

A further refined control is available in accordance with an additional feature of the invention in that both the volume of ejected fluid and, more particularly, the fluid ejection velocity from he aperture 30 of the nozzle 13 of the distribution member 2, can be controlled, again in accordance with variations in the rate of movement of the sheet 1, thereby to maintain uniform predetermined desired coating results. This is illustrated as effected in the embodiment of FIG. 2 by opening or closing the aperture 30 as with the aid of a rotatable drive screw 30' (or any other well-known variable aperture device), under the control of a speed converter shaft 31, FIG. 1, driven by a converter 32 of any well-known type that monitors the speed of the draw rolls 3 and indicates variations to the desired degree. The connection between the variable aperture adjustment screw 30' and the speed control shaft 31 is schematically illustrated at 33 for purposes of avoiding cluttering the drawing with known structures. As an example, for rate variations in the relative movement of the sheet 1 and the nozzle 2 from about 300 to about 500 feet per minute, the aperture 30 may correspondingly be varied from 0.020 inches to .030 inches, more or less.

In similar fashion, since the ejection-velocity-varying adjustment of the nozzle aperture 30 changes the pressure requirements of the restrictor 22 to avoid the nonuniform bursts upon the ejection of the fluid, before discussed, the cross dimension of the restriction 22 may synchronously correspondingly be varied in well-known fashion as by the adjustment screw 34, FIG. 2, again controlled by a link 33' from the speed converter shaft 31.

As before stated, many of the refinements and control features of the invention are adaptable for use with other types of nozzles than the preferred wide-band nozzle of the present invention, and it is to be understood that the various control features of the invention may also be applied to the application of other types of fluids and coatings where the advantages of the invention are desired. Further modifications will also occur to those skilled in this art, and all such are considered to fall within the spirit and scope of the invention as defined in the appended claims.

What We claim is:

1. Fluid applicator apparatus having, in combination, a source of pressurized fluid, a distribution member provided with inlet and outlet means and intermediate-valving means movable between two positions to open and block fluid communication between the inlet and outlet means, respectively, means for connecting the source of fluid with the inlet means to supply fluid to the distribution member, nozzle means connected with the outlet means to eject fluid from the distribution member when the intermediate means is in a position permitting fluid communication of the inlet and outlet means, the nozzle means having a longitudinal flow section and a direction-changing expansion chamber connected thereto for laterally expanding the fluid flow and aperture means for directing the laterally expanded fluid as a substantially uniform flow.

2. Apparatus as claimed in claim 1 an in which said aperture means comprises a wall spaced laterally from said expansion chamber to define the aperture therebetween and directing the expanded fluid outward therethrough.

3. Apparatus as claimed in claim 2 and in which the direction change effected by the expansion chamber is substantially orthogonal to the direction of said longitudinal flow, the expansion comprising lateral expansion in a direction substantially orthogonal to both the longitudinal flow and the first-named substantially orthogonal direction, and the direction of aperture-means fluid directing is substantially parallel to the direction of said longitudinal flow.

4. Apparatus as claimed in claim 2 an in which means is provided for varying the space defined by the said aperture means to control at least one of the fluid volume flow and the fluid velocity as ejected.

5. Apparatus as claimed in claim 4 and in which there is further provided sheet means adjacent the nozzle means for receiving the ejected fluid, and moving means for presenting successive portions of the sheet means to the nozzle aperture means at a predetermined rate.

6. Apparatus as claimed in claim 5 and in which means responsive to said moving means is provided for controlling the volume of ejected fluid in accordance with the said rate.

7. Apparatus as claimed in claim 5 and in which means responsive to said moving means is provided for controlling the said valving means in accordance with said rate.

8. Apparatus as claimed in claim 7 and in which means is provided for intermittently operating said valving means between its said two positions.

9. Apparatus as claimed in claim 5 and in which means responsive to said moving means is provided for controlling the fluid ejection velocity from the said aperture means in accordance with said rate.

10. Apparatus as claimed in claim 5 and in which means responsive to said moving means is provided for varying a dimension of said aperture means in accordance with said rate.

11. Apparatus as claimed in claim 1 and in which means is provided for intermittently operating said valving means between its said two positions.

12. Apparatus as claimed in claim 1 and in which said connecting means comprises an inlet line from the source to the

said inlet means and a bypass return line to the source, and restriction means is disposed in said return line substantially to match the pressure that exists between the source and the nozzle means when fluid is ejected therefrom, during periods of no ejection

13. Apparatus as claimed in claim 12 and in which means is provided for varying the said restrictions means.

14. Apparatus as claimed in claim 13 and in which means is provided for controlling said restriction varying means in accordance with means for varying said nozzle aperture means.

15. Apparatus as claimed in claim 1 and in which said nozzle means comprises a plurality of different nozzles carried by a head, movable to permit successive connection with said distribution member.

16, Apparatus as claimed in claim 15 and in which said nozzles are of different dimensions to provide corresponding variation in the output flow therefrom.

17. Fluid applicator apparatus having, in combination, a source of pressurized fluid, a distribution member provided with inlet and outlet means, means for connecting the source of fluid with the inlet means to supply fluid to the distribution member, nozzle means connected with the outlet means and having aperture means to eject fluid from the distribution member, moving means for presenting successive portions of a sheet means to the nozzle means at a predetermined rate, and means responsive to said moving means for controlling the velocity of the ejected fluid in accordance with said rate.

18. Apparatus as claimed in claim 17 an in which said velocity controlling means comprises means for varying the nozzle aperture means.

19. Apparatus as claimed in claim 17 and in which means is provided for intermittently interrupting the communication between the distribution member inlet and outlet means to provide intermittent fluid applications to the sheet means through the nozzle aperture means.

20. Apparatus as claimed in claim 19 and in which means is provided for controlling said communication interrupting means in accordance with said rate.

21. Apparatus as claimed in claim 19 and in which said connecting means comprising an inlet line from the source to the said inlet means and a bypass return line to the source, and restriction means is disposed in said return line substantially to match the pressure between the source and the nozzle means when fluid is ejected therefrom during periods of no ejection.

22. Apparatus as claimed in claim 21 and in which means is provided for varying the said restriction means.

23. Fluid applicator apparatus having, in combination, a source of pressurized fluid, a distribution member provided with inlet and outlet means and intermediate-valving means movable between two positions to open and block fluid communication between the inlet and outlet means, respectively, means for connecting the source of fluid with the inlet means to supply fluid to the distribution member, nozzle means connected with the outlet means to eject fluid from the distribution member when the intermediate means is in a position permitting fluid communication of the inlet and outlet means, means for moving said valving means between its said two positions for intermittent periods, said connecting means comprising an inlet line from the source to said inlet means and a bypass return line to the source, and restriction means disposed in said return line substantially to match the pressure that exists between the source and the nozzle means when fluid is ejected therefrom, during the intermittent periods of no ejection.