United States Patent

[11] 3,607,340

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Continuation of application Ser. No. 645,675, June 13, 1967, now abandoned.

[54] APPARATUS AND METHOD FOR SPOT-COATING SHEET AND WEB MATERIALS

10 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **117/10,** 117/37, 117/64, 117/120, 118/2, 118/8, 118/407

[51] **Int. Cl.** **B05c 3/18,** B05c 11/00

[50] **Field of Search** 118/407, 2, 8; 117/10, 64, 120, 34, 37, 43, 44

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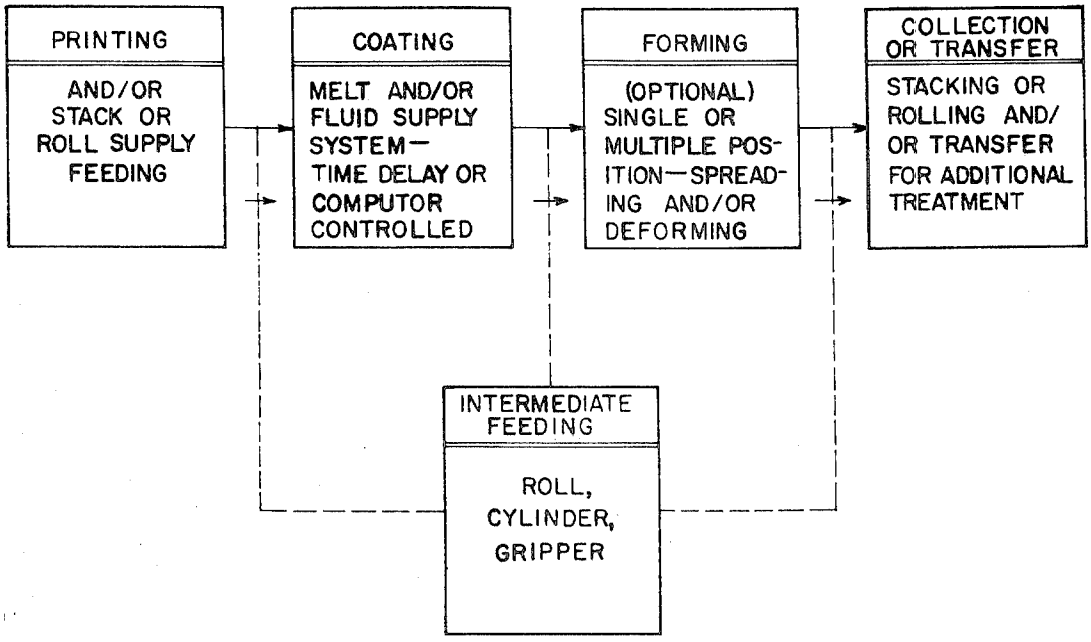
ABSTRACT: A method of and apparatus for accurately and rapidly spot or continually coating either sheet or weblike materials, to place a protective and/or functional coating thereon. A photoelectric or other control mechanism triggers the deposition of the coating material through an "antidrool" valve and nozzle arrangement after which the coated areas may be smoothed or otherwise deformed such as, for example, to form lenticulated lenses on the surface of the coating. These subsequent forming or deformation steps may, of course, be omitted if only very minute amounts of the coating are being deposited or if contoured or patterned surface areas are desired.



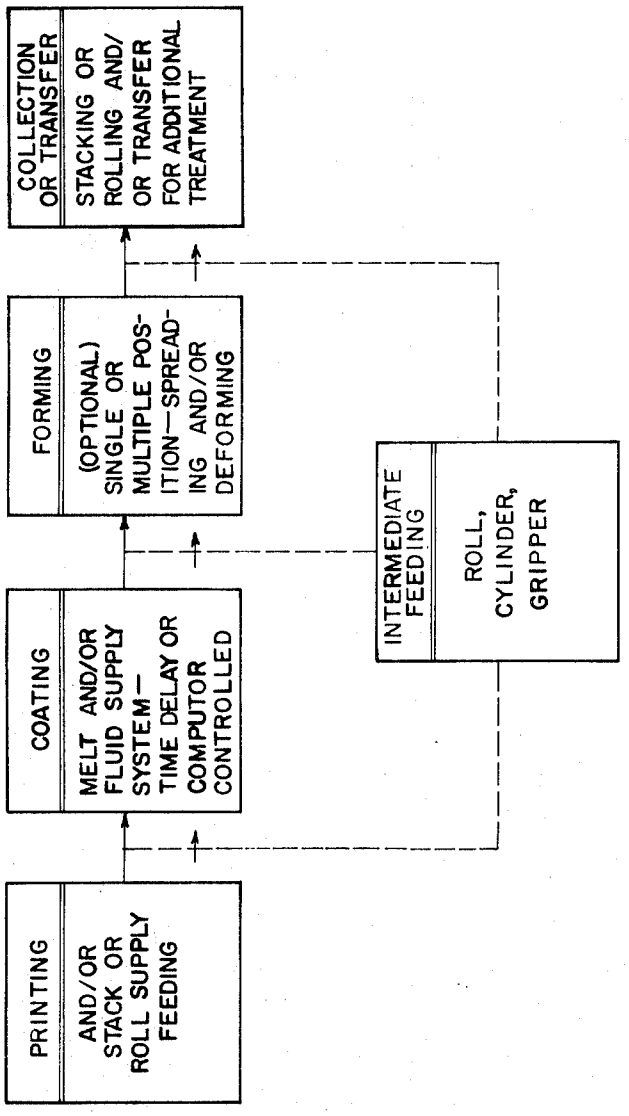


FIG. 1

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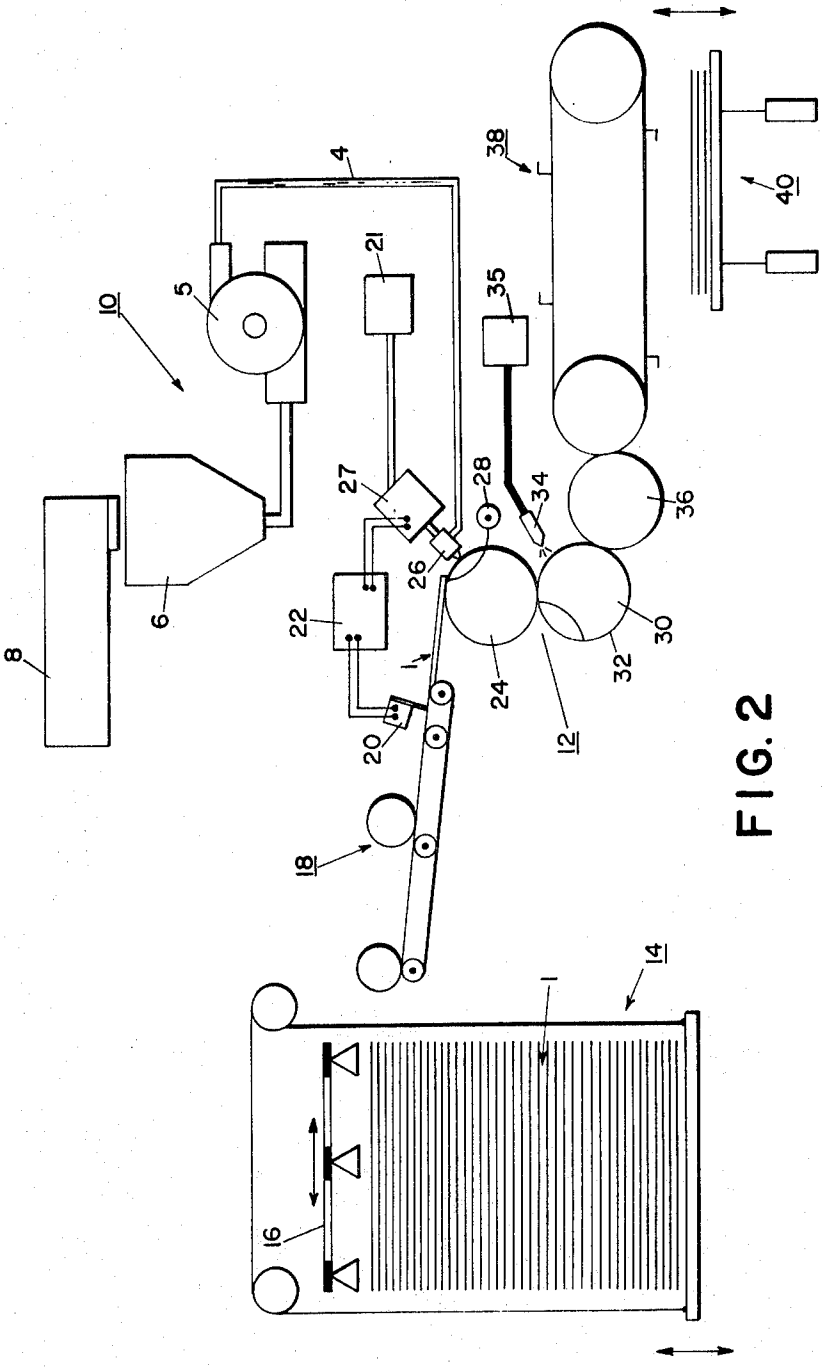

FIG. 2

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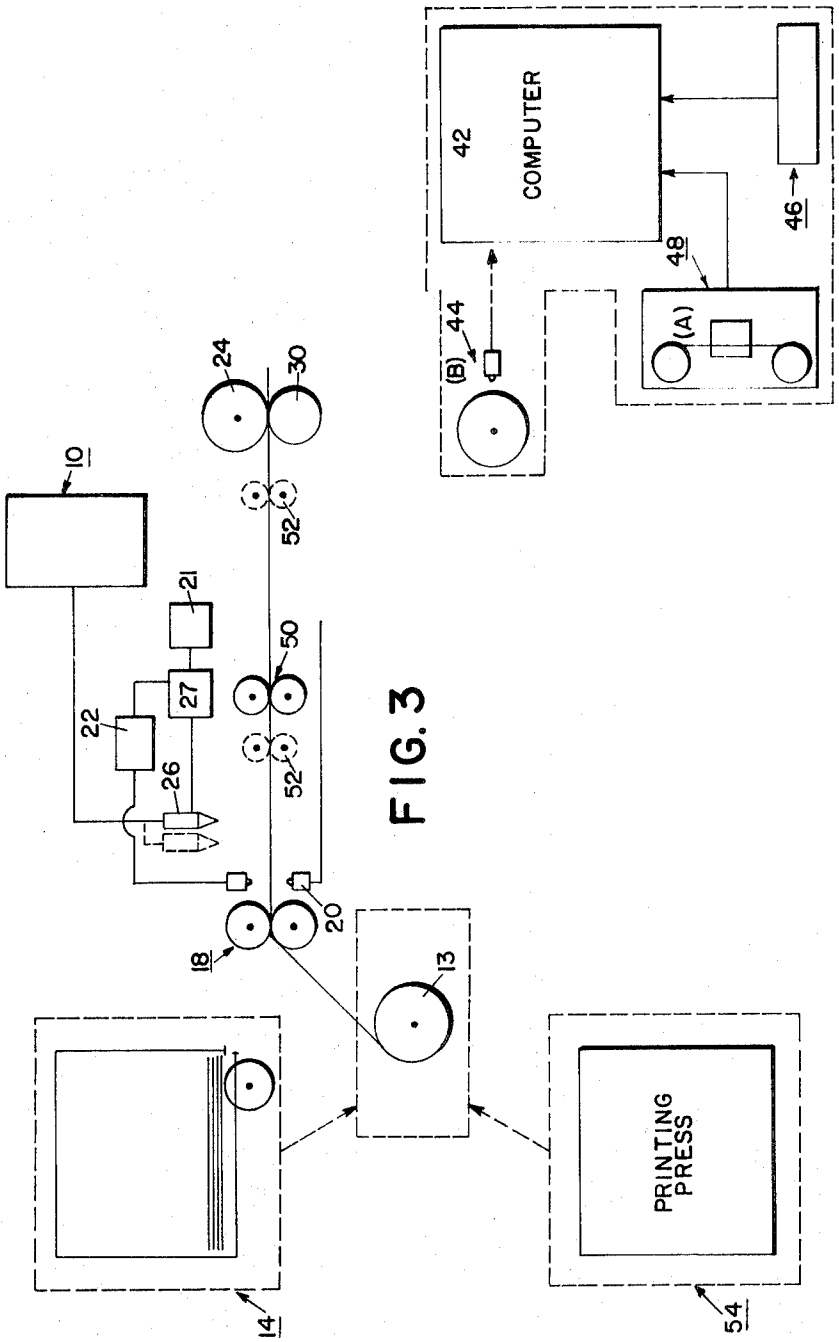

FIG. 4

FIG. 3

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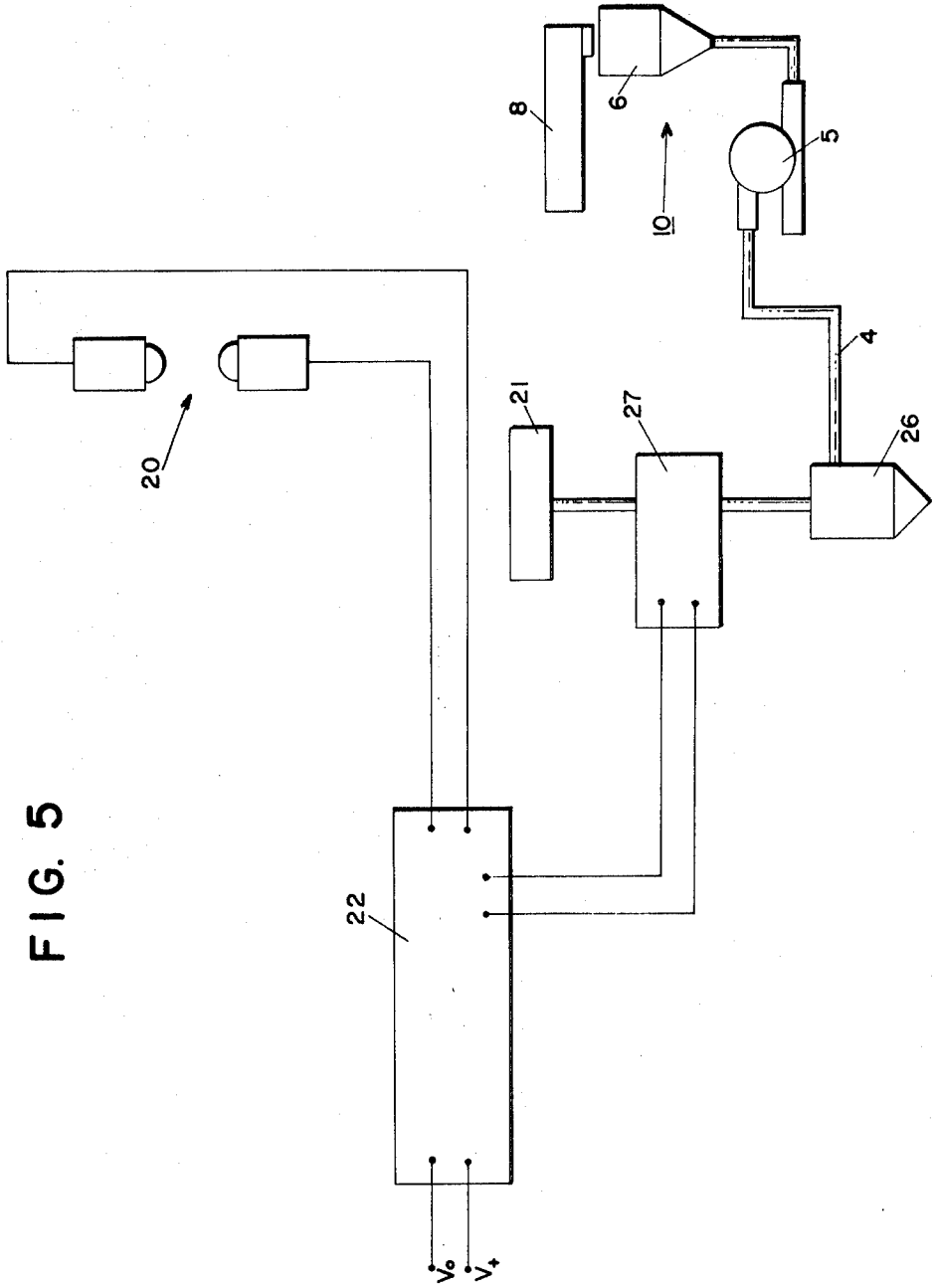

FIG. 5

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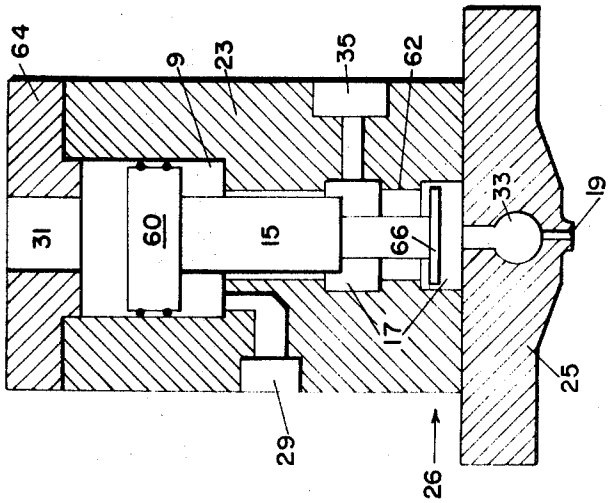

FIG. 7

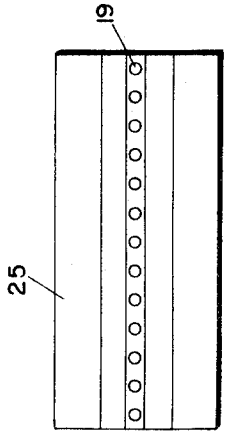

FIG. 8

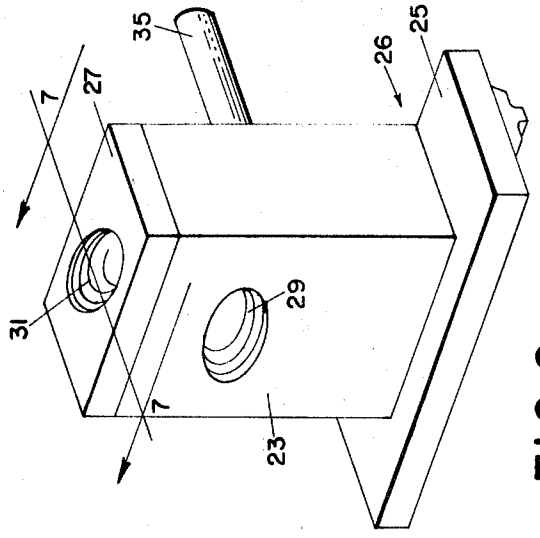

FIG. 6

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APPARATUS AND METHOD FOR SPOT-COATING SHEET AND WEB MATERIALS

This application is a streamlined continuation of Stroupe U.S. Ser. No. 645,675, filed June 13, 1967 now abandoned.

This invention relates to a new method and apparatus for economically and accurately coating selected areas on a moving surface or plane. More particularly, the invention relates to spot coating a surface with apparatus having incorporated therein an "antidrool" valve similar to that described in Quarve U.S. Pat. No. 3,315,899 dated Apr. 25, 1967.

Most prior art concepts and devices suggested for use in coating various surfaces employ either roll or spray applicators. Neither of these systems has been fully satisfactory for the application of plastic or other viscose materials for several reasons, and it is the prime object of this invention to provide a method and means to accomplish this end.

As can be appreciated, the roll application of coating materials, and particularly plastic coatings, has been severely limited because the coating cylinder design must include adequate control apparatus as well as specially designed and etched roll plates. Additionally, if it is desired to deform the coated surface, the impression or compression rolls must be provided with recessed grippers to allow for the accurate and controlled gripping of the sheet material without interference with the associated rolls. The rolls system is further limited to dry ink treatments which obviously require undesirable delays between the printing and coating of stock material.

Neither roll nor spray systems can be relied upon to deposit a uniform coating and a clean startup and cutoff is practically unattainable. Therefore, a further limitation of small printed areas on relatively large sheets is necessary in order to catch the excess spillover of coating material inherent with these applicators. These techniques further require that specific coating and substrate materials be used in order to obtain the necessary thicknesses, adherence, and freedom from cobweb formations, all of which are limiting and costly factors within the coating field.

According to this invention a method and apparatus is provided for deposition of a fluent or fluidlike coating, and in particular plastic material coatings, upon a variety of substrate materials, thus providing either a protective or functional final coating thereon. The system and method employed involves the use of at least a single, and generally a plurality of "antidrool" type valve and nozzle arrangements with which the coating material is controlled. Upon receipt of control signals, these valves will accurately startup or cutoff with minimal tailing because of the vacuum and holding action that is effective during a selected part of their operating cycle.

Therefore, one object of this invention is the elimination of the need for a special roller-type coating mechanism employing recessed grippers and other necessary and special design features as above noted.

Another object of this invention is to provide a simplified method and apparatus which will allow, in sheet or roll coating applications, an intermittent deposition of a coating over a specified area of substrate material with the assurance that only the predesignated area will be so treated.

Yet another object of this invention is to provide a method and apparatus which will not only allow particular areas of either the sheet or web material to be accurately coated, but will also permit the production of contoured areas as well.

Further objectives of this invention include:

1. the design of manifold-type valve and nozzle systems so that the coating apparatus can easily accommodate different sheet or web sizes without extensive modifications being made to the equipment;
2. making possible the deposition of a coating of practically unlimited and uniform thicknesses; and
3. simplifying the installation and modification steps involved in setting up a typical printing press for use with the disclosed process and apparatus.

These and further objectives and advantages of the present invention will become more apparent upon reference to the following description, claims, and appended drawings wherein:

FIG. 1 is a simplified flow diagram outlining the various method steps of the invention;

FIG. 2 is a schematic diagram of a preferred embodiment of the apparatus intended to carry out the method of the invention;

FIG. 3 is a schematic diagram of another embodiment of the apparatus which may be used to carry out the method of the invention and in which the substrate material has a substantially straight line flow-path;

FIG. 4 is a schematic diagram of a representative control system which may be used with and incorporated in the apparatus of the invention;

FIG. 5 is a simplified schematic diagram of a typical timing circuit which may be used in controlling the coating operation;

FIG. 6 is a perspective view of one of the valve and nozzle arrangements used in the coating apparatus;

FIG. 7 is a cross section taken along lines 7—7 of FIG. 6; and

FIG. 8 is a bottom view of the valve and nozzle arrangements as shown in FIG. 6.

With continued reference to the accompanying figures wherein like reference numerals designate similar parts throughout the various views, and with initial attention directed to FIG. 1 which illustrates the general method of the invention, it can be seen that the use of substrate materials, which may be printed or unprinted and in either sheet or roll form is contemplated.

The method further contemplates the possibility of intermediate storage prior to the coating operation, and therefore it may be necessary to feed to the coating zone from a stacked formation of the substrate. The multiple capabilities of this system thus presents a versatile overall method of coating in addition to achieving the prime objective of the invention; that being the development of a satisfactory spot-coating method which is either adaptable to existing equipment or easily manufactured as an integral self-contained unit.

From the as stored area, or in an in-line operation, the substrate material used in practicing this invention is fed to a coating zone in which the presence of the material or the area thereon to be coated is sensed and the depositing system is activated. After deposition, the inherently beaded formation is evenly spread so that the entire area to be coated is uniformly covered. Immediately thereafter, or in conjunction therewith, the coated area may be deformed in any pattern desired after which the coated substrate is forwarded to another stacking mechanism. Of course, should it be so desired, the substrate may be rerolled or forwarded to subsequent treatment areas such as, for example, cutting and slitting stations where the coated stock may be trimmed to size.

In addition to the above, certain aspects of the invention anticipate the desirability of leaving a beaded or layered formation upon the substrate material without the performance of any subsequent forming steps. This would result in the formation of a predetermined design, configuration, or contoured shape.

It is unnecessary in the practice of the invention that a completely integral single line system be used. A partial system where the substrate is transferred from stack to stack with intermediate coating may at times be desirable or necessary. In such cases the feeding mechanism will remove a particular sheet, or the web material, from its respective stack or roll, pass it through the coating area to the smoothing and deforming station, and it will subsequently be recollected in its original form, assuming no further treatment is desired.

As will be appreciated, this invention is readily adaptable for use with practically all fluent materials, including plastics, inks, dyes, or other suitable fluids which are applicable to being applied as a spot-coating. However, for sake of illustration, particular emphasis is hereinafter placed upon the use of plastic materials as the coating media. Likewise, any number of suitable substrate materials such as paper, ceramics, cloth, wood, metals or the like may be used in practicing this invention. However, for illustrative purposes, particular emphasis will be placed hereinafter upon the use of paper substrates.

As will be apparent to those skilled in the art, the invention can be used in decorative and/or functional applications. Decorative applications most commonly employ the use of inks, dyes, or other similar fluids, whereas for functional and protective purposes waxes, plastics, or the like will normally be employed. Functional uses include, for example, lenticulated surfaces, contoured surfaces, braille systems, and computer tapes and cards, any or all of which may require deformation during their formation. Of course, in protective applications it is only necessary to thinly, evenly, and smoothly coat the substrate material.

In a preferred embodiment of the apparatus encompassing the invention, a fluent or plastic melt storage and pumping system **10** is attached to a modified printing press generally designated as **12**. Within this press is located a sheet stacker **14** containing paper or other substrate sheet materials **1** which may be grasped by the suction device **16** and transferred to the belt and roll feed systems **18**. As a sheet **1** is forwarded through the roll system **18**, its presence is sensed by a sensing means **20** such as a flag switch or photoelectric cell which thereupon emits a signal to activate a timing or other delay mechanism **22**. The sheet **1** continues to be advanced and is grasped by grippers contained upon compression cylinder **24** and is thus transferred beneath an "antidrool" valve and nozzle head **26**, which will be more fully described hereinafter, and through which the fluent material is deposited upon any particular portion of the sheet **1**.

After the deposition, a rod or roller **28** functions to smooth the beaded material deposit preparatory to a transfer of sheet **1**, to compression cylinder **30**. Cylinder **30** has a deforming surface **32** acting in conjunction with cylinder **24** to deform the coating into the particular configuration desired. A steam or water spray system **34**, including a supply source **35**, is directed upon a cylinder **30** in order to provide for the easy release and transfer of the plastic coated substrate therefrom and to takeoff cylinder **36**. From cylinder **36** it can be seen that the sheet **1** will be grasped by the roller-chain delivery system **38** and subsequently deposited upon the stacking mechanism **40**. Both of the stackers **14** and **40** can be seen as being movable in the vertical direction by any suitable powered means, so that multiple sheets may be adequately removed or deposited without difficulty.

Referring now to FIG. **5**, it can be seen that a sensing means **20**, for example, the photoelectric cell shown will, in response to the presence of a sheet or indicia thereupon, generate a signal to be received by a timer or delay device **22**. The timer **22**, of course, may be preset according to the speed of travel of the substrate material, the position where the deposit is desired, and the size or length of the deposit desired. These variables being controlled therein, the timing mechanism **22** will subsequently signal solenoid **27** which upon its activation will allow air or some other suitable activating media from a pressure source **21** to enter valve **26**. This will open the valve and effect a properly placed deposit of a plastic or other fluid material, from system **10**, upon the substrate.

It should be recognized that this particular timing device and sensing mechanism may be replaced by any suitable computerized or like system which may be made integral therewith. Where a computer **42** (FIG. **4**) is adapted to the overall coating system, sheet or web feed, as well as fluid material deposition may be controlled by the computer itself. Template **44**, card **46**, tape **48** or other similar computer means may be employed therewith.

One possible modification of the preferred embodiment contemplates the use of roll-stock material which can be fed into and through the coating system. This, of course, would be particularly adaptable to a system as shown in FIG. **3** wherein there is a generally straight-through flow pattern of the substrate within the apparatus as it is being coated. Again it should be noted that a feeding mechanism **18**, in this case feed rolls, advance the material through a sensing area where sensor **20** detects the substrate presence and activates a fluid control delay device **22**. This control delay device in turn energizes the solenoid **27** thus allowing for the deposit of the coating fluid supplied under pressure from the storage and feed system **10**. After deposition intermediate feed rolls **52** advance the stock between the smoothing rolls **50** and onward to the deforming rolls **24, 30**. In a manner similar to that previously described, stacked sheets may be fed through the system of FIG. **3**. For example, a stacker **14** or a direct feed from a printing press **54** can be used to supply the sheets, either of which may replace the roll stock supply **13**. In most cases it is conceived that printed materials of various forms will be coated by this method and apparatus. One specific item of particular interest are lineiform pictures which when covered by a lenticulated plastic coating give a three-dimensional effect. These pictures would first be printed, then coated, and the coating surface deformed as hereinbefore mentioned.

The "antidrool" valve and nozzle **26** system may be placed in tandem, [as is shown in phantom in FIG.3], along the path of movement of the substrate if a layering type effect is necessary or desirable. Thus, by simply removing the smoothing rolls **50** and deforming rolls **24, 30**, a controlled countered effect can be given to the surface of the substrate being passed through the tandem nozzle system. By employing a second supply system **10** and related conduit system, the second or added tandem nozzles could be supplied with a different fluid thus giving the added capability of placing different fluid in a laminate array or in alternate positions upon the substrate.

Referring again to FIGS. **2** and **5**, it can be seen that the fluid feed and storage may consist of an extruder **8** or other suitable feed means capable of depositing the fluent material to be used as the coat into a storage tank **6**. From this holding reservoir, pump **5** transfers the viscose fluid through a piping or conduit system **4** to the valve **26**. Due to the viscosity of the materials generally being handled, such a system must be under a relatively high positive pressure, as for example, on the order of 200 p.s.i.g.

Referring now to FIGS. **6, 7**, and **8** where the valve and nozzle manifold **26** used with the apparatus of the invention is more clearly depicted, one can see that, while using only a single valve **23**, a plurality of nozzle openings **19** can be supplied from the head **25** which has a fluid reservoir **33** therein. The nozzles **19** are preferably spaced approximately 0.10 inch apart, but, of course, such spacing depends upon the orifice size, fluid viscosity, and pressure.

It will be obvious from the drawings that in order to get increased lateral coverage it is only necessary to abut the ends of heads **25** in any suitable mounting upon the coater. These head lengths can range in length from about 4 inches to 12 inches, but with increased fluid pressure, the length may be as much as 107 inches or more. As will be appreciated, these valve and manifold heads **25** are closely adjacent the substrate path and preferably are between 0.002 inch and 0.250 inch above the substrate surface.

In FIG. **7** it can be seen that the fluent coating material enters valve **26** at opening **35** and depending upon the position of valve stem **15** may be conducted via passages **17** to the reservoir **33** and nozzles **19**. Valve stem **15** is activated by the introduction of a hydraulic or some other fluid medium through openings **29** and **31** which are at opposite ends of the cylinder **9**. Piston **13** is connected to valve stem **15** and is free to ride within cylinder **9** between its upper and lower ends which are defined by cap **64** and valve body **23**.

When piston **60** is in an intermediate or lower position, as is shown in FIG. **7**, the pressurized fluid is allowed to enter at opening **35** and be deposited through nozzles **19** as above-discussed. However, as the piston **60** and valve stem **15** move upward the headed portion **66** of the valve stem enters the cylindrical area **62** of body **23** and shuts off the fluid flow. The upward movement of piston **60** is thereafter continued and because of this, a partial vacuum is created in reservoir **33** and nozzle **19**, thus withdrawing the tailings outside of the nozzle area into the reservoir thereby effecting a clean cutoff. A more complete discussion of similar valve actions and constructions can be found in the above-mentioned Quarve patent. The fluid handling portion of the apparatus, in the case

of highly viscous plastic materials, must be maintained in a heated condition to preserve the desired viscosity of the particular fluids being used, and, of course, the degree of heat will also be dependent upon these materials.

It will be apparent from the foregoing that the method and apparatus of this invention provide solutions to many long-standing problems within the coating field. It is now possible through use of the invention (1) to accurately spot-coat either sheet or weblike materials; (2) to uniformly apply coatings in a wide range of thicknesses, and (3) to efficiently deposit contoured or raised surface areas upon a substrate material.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. Apparatus for forming a coating of material on a substrate comprising:

a. means for advancing said substrate along a path which carries a surface thereof past a device for depositing said material,

b. means for detecting an approaching area on said substrate where deposition of said material is to begin,

c. a device positioned adjacent the path of the substrate for depositing material on the surface of said substrate, said device comprising:

1. a nozzle manifold including a plurality of spaced apertures positioned across the direction of advancement of said substrate through which said material is adapted to flow and be deposited on the substrate in a plurality of generally parallel beads,

2. means for forcing said material through said apertures in response to detection of the area to be coated, and

3. means for abruptly terminating flow of said material through said nozzle apertures including a displacement piston operable to decrease the pressure on the upstream side of said apertures relative to the environmental pressure in response to a given signal.

2. Apparatus according to claim **1** in which the apertures of said nozzle are substantially equally spaced.

3. Apparatus according to claim **1** in which the apertures of said nozzle extend substantially perpendicular to the direction of substrate travel.

4. Apparatus according to claim **1** which includes means for uniformly distributing the coating on the substrate.

5. Apparatus according to claim **1** which includes means for imparting a particular surface configuration to said coating.

6. Apparatus according to claim **4** which includes means for imparting a particular surface configuration to said coating.

7. A method for applying a coating of material to a selected area of substrate material which comprises the steps of

a. advancing said substrate along a path which carries a surface of said substrate past an applicator for receiving an application of material,

b. detecting an approaching area on said substrate where application of said material is to begin,

c. in response to detecting said area, initiating application of a plurality of substantially equal and substantially parallel beads of a coating material to said selected area of the substrate extending in the direction of advancement of said substrate, and

d. terminating application of said plurality of parallel beads by creating a pressure differential at said applicator whereby discharge from said nozzle is abruptly terminated.

8. A method according to claim **7** which includes the additional step of smoothing said beads to form a coating of substantially uniform thickness.

9. A method according to claim **7** which includes the additional step of imparting a particular surface configuration to said coating.

10. A method according to claim **8** which includes the additional step of imparting a particular surface configuration to said coating.