

[54] **MOISTENING APPARATUS AND METHOD FOR DUPLICATOR SHEETS**

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[58] Field of Search..... **101/132.5, 147, 148,**
101/348, 349, 350; 118/264, 265, 266, 268; 318/483

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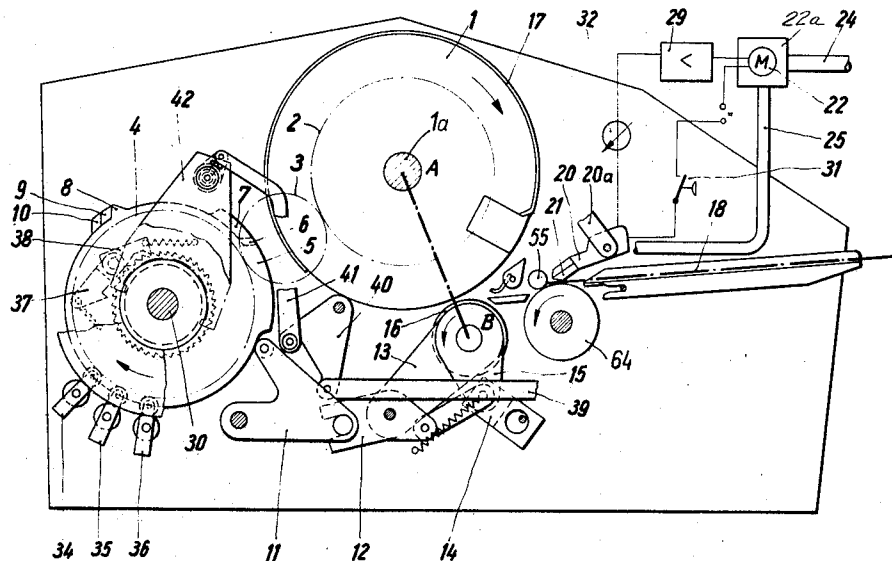
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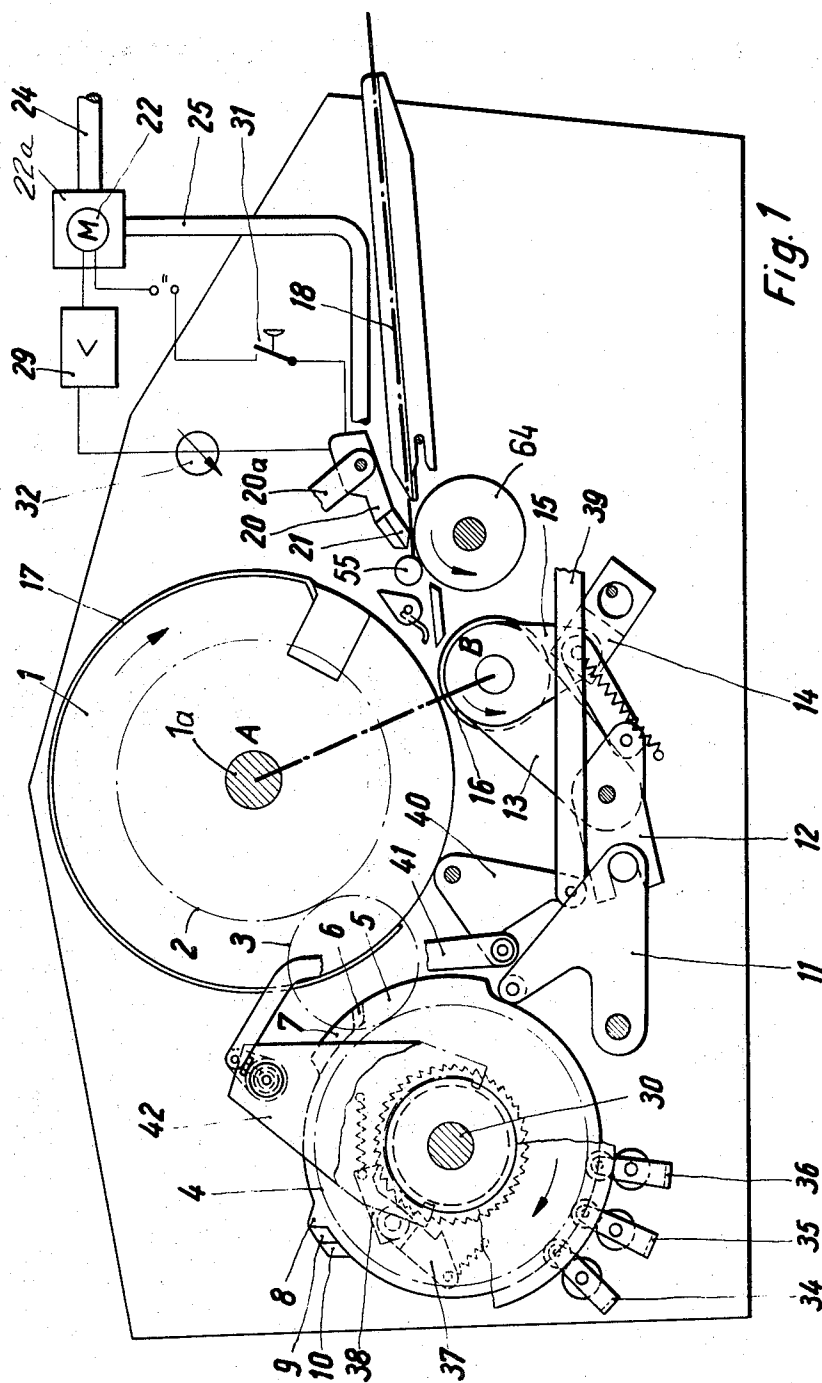
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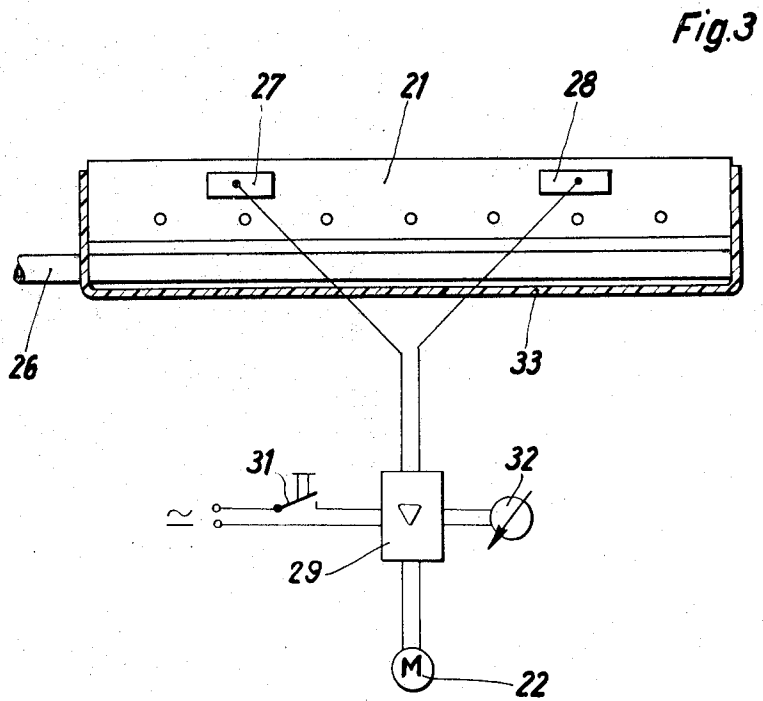
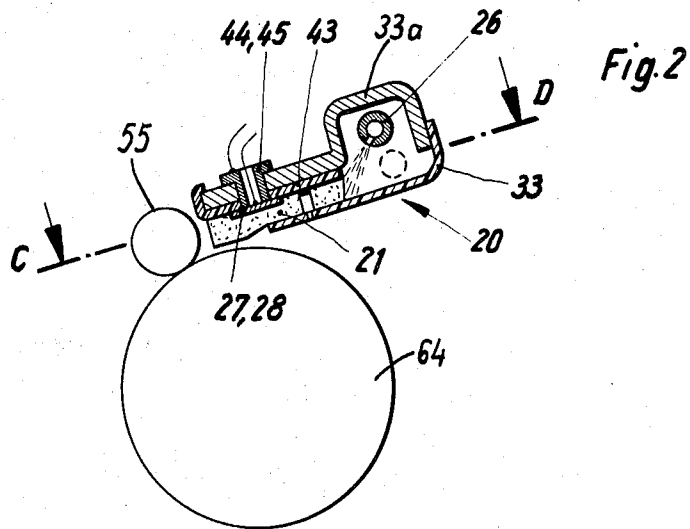
ABSTRACT

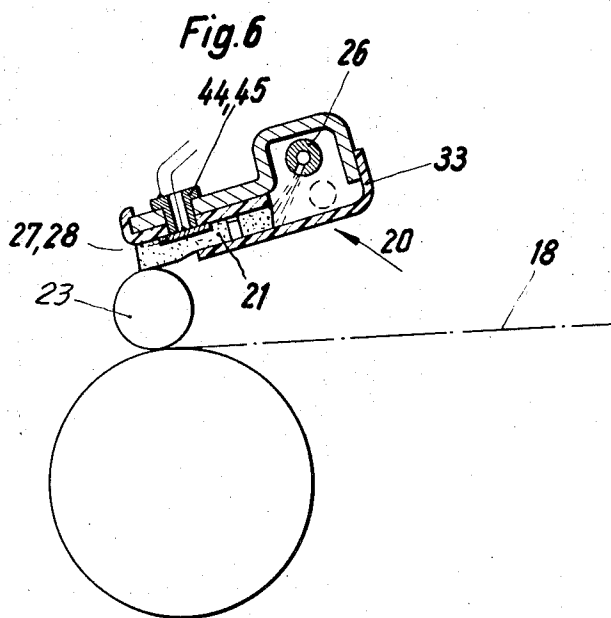
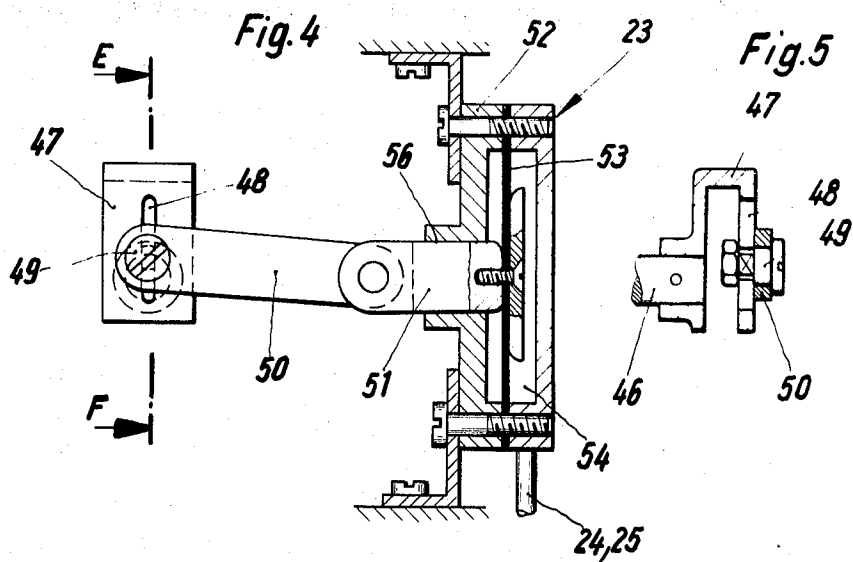
A liquid absorbent applicator for applying a liquid to the copy sheets of a duplicating machine, is maintained at a constant moisture content. Two sensing electrodes engage the applicator and are connected with control means for a motor driving a supply means for the liquid, such as a pump or liquid elevator roller. When high resistance between the electrodes, and consequently low current between the same, indicates that the applicator is too dry, the control means actuate the electric motor which drives the pump or elevator roller to increase the moisture content of the applicator to a desired constant value. When the moisture content is too high, the control means respond to the sensing means to stop the motor and the supply of moistening liquid.

14 Claims, 9 Drawing Figures









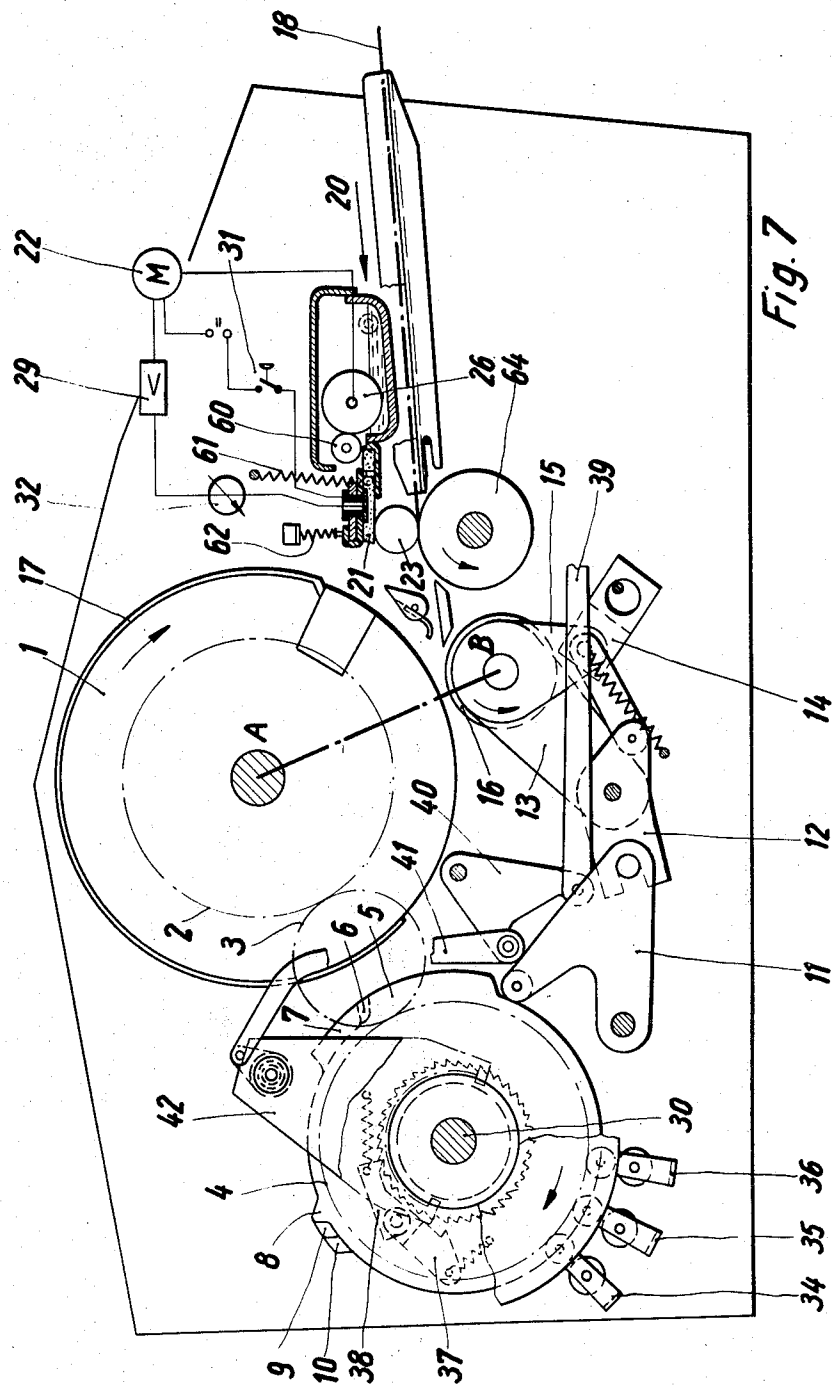
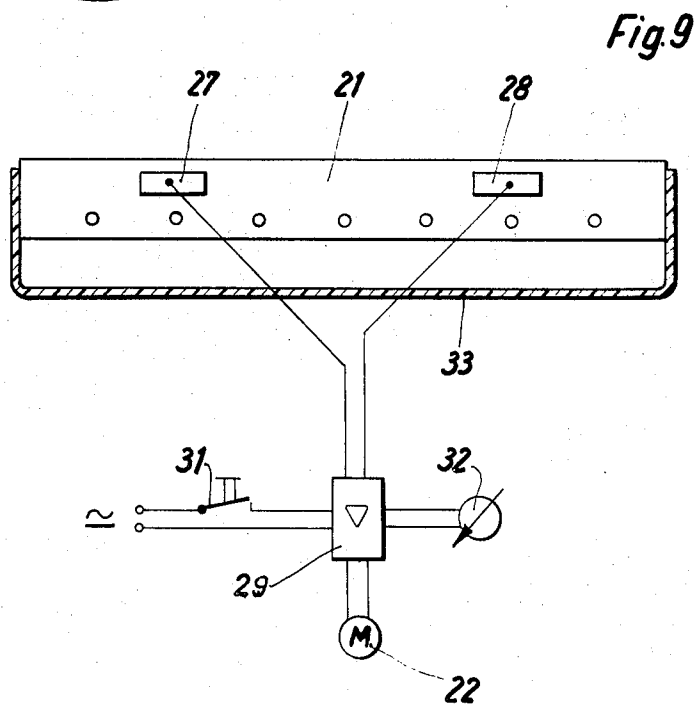
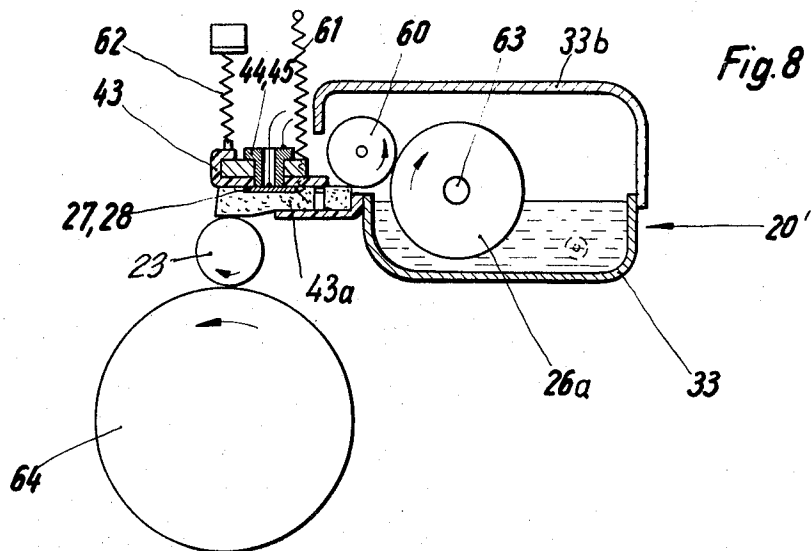


Fig. 7



MOISTENING APPARATUS AND METHOD FOR DUPLICATOR SHEETS

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for moistening the transported copy sheets of a rotary duplicator in which moist copy sheets are pressed against a master sheet. In known rotary duplicating machines, a pump, or a valve, controls the amount of liquid flowing to the felt pad by which the copy sheets are moistened. The valve or the pump has to be manually operated or periodically actuated under the control of a rotary cam. The actual amount of supplied liquid is either uncontrolled; or a constant amount of liquid is supplied to the absorbent moistening pad. In both ways of operation, the actual moisture content of the absorbent pad is not considered. If long copy sheets have to be moistened in rapid succession, a greater amount of liquid is taken from the absorbent moistening pad, then when the copy sheets are narrow cards or slips are moistened. This is particularly the case in rotary duplicators which print from a master sheet containing the entire text, selected lines on some copy sheets, and a series of lines on another copy sheet which are accordingly short or long. Some of the copy sheets have full length, other half length and other quarter length, each type of copy sheets being supplied in different numbers, and may also have different paper qualities, absorbing different amounts of liquid when moistened by the applicator felt pad:

In the arrangement of the prior art, the applicator pads may contain an insufficient amount of liquid, and insufficiently moisten the respective copy sheets, or sometimes have too much liquid absorbed. In the first case, more liquid has to be supplied by manual operation, and in the second case a valve had to be operated to reduce the amount of liquid supplied to the applicator pad. Under practical conditions, frequently the copy sheets are moistened too much, resulting in the transfer of a too great amount of duplicator ink from the master sheet, and a premature wearing off of the mirror-reversed characters of the master sheet.

Furthermore, since rotary duplicators use an alcoholic liquid as a moistening liquid, the moisture content of the applicator felt pad also depends on the temperature of the room in which the machine operates since at higher temperatures, the alcohol evaporates faster than at low temperatures.

SUMMARY OF THE INVENTION

It is one object of the invention to overcome the above-explained disadvantages of the prior art, and to effect a uniform moistening of all copy sheets supplied to the duplicator, irrespective of the size and number of the copy sheets, and of the prevailing temperature.

Another object of the invention is to maintain the moisture content of liquid absorbent applicator means constant.

Another object of the invention is to obtain uniformly clear printed texts on successive copy sheets by properly moistening each copy sheet.

Another object of the invention is to regulate the amount of liquid supplied to absorbent applicator means in accordance with the moisture content of the absorbent applicator determined by sensing the moisture content.

With these objects in view, the moistening method of the invention comprises electrically sensing the moisture content of a liquid absorbent pad when the pad transfers absorbed liquid to duplicator copy sheets; and automatically supplying under the control of the sensing means, a replenishing liquid to the pad when the sensed moisture content is insufficient. In this manner, a substantially constant moisture content is maintained in the absorbent pads.

An apparatus according to the invention comprises applicator means including a liquid absorbent means, such as a felt pad; sensing means, preferably including two sensing electrodes for sensing the moisture content of the absorbent means; motor means; control means controlled by the sensing means; and supply means such as a pump, or an elevator roller partly immersed in a liquid, driven by the motor means for supplying liquid to the absorbent means.

The absorbent means supplies the moistening liquid to successive duplicator copy sheets so that the moisture content of the absorbent means is decreased by transfer of the liquid to the sheets.

When the sensing electrodes sense a low moisture content of the absorbent means, which would be insufficient for properly moistening the copy sheets, the control means respond to the sensed moisture content to start the motor means so that the supply means, for example the motor driven pump, supplies the liquid to the absorbent means. Consequently, the sensed moisture content cannot decrease below a predetermined minimum, and on the other hand, when the moisture content becomes too high, which may cause dripping, the control means respond to a signal from the sensing means to stop the motor and thereby the liquid supply means.

In the circuit of the motor and of the electrodes, electronic control means are advantageously provided for controlling the motor of the supply pump depending on the amount of current flowing through the absorbent means.

In a modified embodiment of the invention, a container contains a moistening liquid at a constant level, and an elevator roller, partly immersed in the liquid, is driven by the motor to raise the liquid to the level of a transfer roller which transfers the liquid to an absorbent applicator pad.

The applicator pad either directly cooperates with the duplicator copy sheets, or transfers liquid to a transporting roller by which the duplicator copy sheets are transported so that liquid is transferred by the transporting roller to the duplicator copy sheets.

It is advantageous to provide in the circuit, a potentiometer or variable resistance for setting the minimum current and maximum current flowing through the motor. The applicator pad is advantageously made of an absorbent felt consisting of wool fibers.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation, partially in section, illus-

trating a rotary duplicator with one side wall omitted, and including a diagrammatic illustration of the circuit of the apparatus of the invention;

FIG. 2 is a cross-sectional view illustrating applicator means in accordance with one embodiment of the invention;

FIG. 3 is an enlarged sectional view taken on line C-D in FIG. 2;

FIG. 4 is a fragmentary cross-sectional view illustrating the driving connection between the motor and the pump in the embodiment of FIG. 1;

FIG. 5 is a sectional view taken on line E-F in FIG. 4;

FIG. 6 is a sectional view corresponding to FIG. 2, but illustrating the applicator means cooperating with the transporting roller for duplicator copy sheets;

FIG. 7 is a side elevation, partially in section, illustrating a duplicating machine provided with a second embodiment of the invention, with one side wall omitted, and including a diagrammatic illustration of the circuit of the apparatus according to the invention;

FIG. 8 is a sectional view illustrating a detail of the embodiment of the invention shown in FIG. 7 on an enlarged scale; and

FIG. 9 is an enlarged sectional view illustrating a portion of FIG. 9, and including a diagrammatic illustration of the circuit of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, a duplicator drum 1 is rotated on a shaft 1a by a motor, not shown, through a one revolution clutch, not shown, in the usual manner, and is connected by a gear train 2, 3, 4 with a shaft 30 carrying cams 5, 6, 7 which can be shifted in axial direction by lever means 39, 40, 41 and 42, and which cooperate with a stepping mechanism including pawls 37 and 38 and activators 34, 35, 36 so that cams 8, 9 and 10 cooperating with text lines are circumferentially displaced so that by means of the printing linkage 11-15, the counter pressure roller 16 is pressed against the duplicator drum 1 and the master sheet 17 for imprinting moistened copy sheets 18 supplied to the printing plane AB by a pair of transporting rollers 55, 64 after being moistened with an alcoholic liquid by the applicator pad 21 of a moistening device 20. Duplicator machines of this type are known and described, for example, in my U.S. Pat. Nos. 2,868,116 and 3,283,701. The moistening device 20 with the applicator pad 21 is shown in FIG. 1 in a position turned by a linkage 20a to a position in contact with the top surface of a duplicator sheet 18 for moistening the same while it is transported by the transporting rollers 55, 64 towards the printing plane AB.

As shown in FIGS. 1, 2 and 3, the flow of the liquid to the absorbent applicator pad 21, which is held in an insulating container 33, is supplied by a supply pump driven by a motor 22. Pump 23 sucks through an inlet conduit 24, the moistening liquid from a reservoir or container, not shown, and discharges the liquid through the outlet conduit 25 to a spray pipe 26 which has radial holes through which the liquid is sprayed in container portion 33a toward the absorbent applicator pad 21, as best seen in FIG. 2. The absorbent applicator pad 21 preferably consists of a felt made of wool fibers. Other absorbent materials, consisting of Dralon, Teflon and like fibers may also be used. In order to prevent an

excessive supply of liquid to the absorbent pad 21, motor 22 drives pump 23 only when the absorbent applicator pad 21 has a certain degree of dryness, or such a low moisture content, that the duplicator sheets 18 are insufficiently moistened and cannot receive the ink imprint from master sheet 17 while passing through the printing plane AB.

In order to measure the moisture content of the absorbent applicator pad 21, sensing means including spaced electrodes 27, 28 are used, which are insulated by a non-conductive wall 43 from the conductive parts of the device 20. Insulating sleeves 44 and 45 envelop the connector wires leading to the electrodes 27 and 28. A switch 31 is connected with a source of voltage, as shown in FIG. 3, and also connected to the motor 22, and to an electronic control means 29. An adjustable potentiometer 32 is connected in series with the other sensing electrode 28. The voltage is transformed in control means 29 to a lower voltage required for the circuit 27, 28, 29, 32.

A current flows between electrodes 27, 28 through the respective part of the absorbent applicator pad 21, and also through control means 29, and the amount of current flowing between the electrodes 27 and 28 is determined by the resistance of the respective applicator pad portion which depends on the moisture content of the applicator pad 21. If the absorbent applicator pad 21 is heavily saturated with the liquid, the resistance between the electrodes 27, 28 is low, and a strong current will flow to control means 29 which stops motor 22 when the current reaches a maximum. If additional duplicator sheets 18 are transported to the moistening device, and the absorbent applicator pads 22 transfer such an amount of liquid to the duplicator sheets that the pad becomes too dry, the resistance between the electrodes 27 and 28 is increased, and a smaller current flows through the control means 29.

When a predetermined minimum current is reached, the electronic control means 29 generates a starting pulse for motor 22 which then operates pump 23 to moisten the absorbent applicator 21 with the liquid until the pad 21 is again sufficiently saturated. If the applicator pad becomes too moist, the electronic control means 29 generates a pulse by which the motor 22 is disconnected.

Switch 31 is operated when the main switch of the duplicating machine is actuated, and starts motor 22 with pump 23 if the applicator pad 21 is dried out so that even after a prolonged standstill of the duplicating machine, the applicator pad 21 is applied with the required amount of liquid so that even the first fed duplicator sheet 18 is properly moistened. The potentiometer 32 is manually operated, and adds its variable resistance to the resistance between the electrodes 27 and 28. In this manner, the amount of liquid supplied to the absorbent applicator pad 21 can be regulated by varying the resistance of potentiometer 32 in such a manner that motor 22 starts at different selected resistances so that an individual amount of liquid, dependent on different absorbent properties of the paper of which the sheet 18 are made, can be supplied to the applicator pad 21.

As shown in FIG. 2, a container 33, and a closure 33a form a space in which the applicator pad 21 is held. The spray tube 26, supplied with liquid from pump 23, sprays liquid in the closed space against the absorbent applicator pad 21 on which the electrodes 27, 28 abut,

insulated from the closure part 33a by the wall of insulating material 43.

FIGS. 4 and 5 illustrate a driving connection between the motor 22 and the pump 23 which is schematically shown in FIG. 1. Pump 23 is shown in FIG. 4 to be a membrane pump. On the motor shaft 46, an angular flange 47 is secured as best seen in FIG. 5, and has a portion with a slot 48 in which a slide bolt 49 is mounted for adjustment, and is articulated to a link 50 whose end is pivotally connected with a member 51 guided in a bore 56 of the pump housing 52 of the membrane pump 23.

When motor shaft 46 is rotated, member 51 is reciprocated so that in chamber 54 alternately low pressure and high pressure prevails so that by means of conventional valves, not shown, the liquid can be sucked through conduit 24 and discharged from conduit 25 into the spraying tube 26. By adjusting the position of bolt and nut means 49 in slot 48, the stroke of member 51 and of the membrane 53 can be increased or decreased so that the amount of liquid transported by the pump 23 can be adjusted.

FIG. 6 illustrates an applicator device 20 which fully corresponds to the applicator device 20 described with reference to FIGS. 1 to 3, but the applicator pad 21 is not in contact with the duplicator copy sheet 18 as shown in FIG. 1, but in sliding contact with the rotary transporting roller 55 which cooperates with a larger transporting roller 64 to transport the duplicator sheets 18. Evidently, liquid from the applicator pad 21 is transferred by transporting roller 55 to the surface of the duplicator sheets transported by transporting rollers 55, 64.

The embodiment of the invention shown in FIG. 7 is provided in a duplicating machine as described with reference to FIG. 1, and consequently, corresponding reference numerals are used in FIGS. 1 to 7 for like parts. The moistening device includes an absorbent applicator pad 21 cooperating with transporting roller 23 which corresponds to roller 23 in FIG. 6. Applicator pad 21 is held between insulating walls 43, 43a secured to container 33. A closure 33b closes container 33 which is filled with a liquid to a predetermined level maintained by overflow openings, as shown in FIG. 7.

At the beginning of a duplicating operation, the moistening device 20' is turned to a position in which applicator pad 21 is in contact with the transfer and transporting roller 23 while the moistening device 20' is tilted rearward with reference to the free end of the applicator pad 21, so that no drops of the supplied liquid can fall onto the transfer roller 23 during the moistening operation, as required for the production of a clear imprint. An excess amount of liquid in the applicator pad 21 may flow through the openings, not shown, in the adjacent side wall into container 33.

The applicator pad 21 is held between the non-conductive insulating parts or walls 43, 43a. A spring 62 presses insulating part 43 and applicator pad 21 against transporting roller 23, while the inner end of the applicator pad 21 is urged by spring 61 against a transfer roller 60 which is in rolling contact with an elevator roller 26, partly immersed in the liquid in container 33.

The shaft 63 of elevator roller 26 is rotated by the electric motor 22, shown in FIGS. 7 and 9. The rotated elevator roller 26 frictionally drives transfer roller 60, which is also mounted for rotation in container 33, so

that liquid is transferred from the elevator roller 26 to the transfer roller 60 and from the same to the applicator pad 21, as best seen in FIG. 8. Transporting roller 23 further transfers liquid from the applicator pad 21 so that a duplicator sheet 18 transported between rollers 23 and 64 is moistened. Consequently, roller 23 has two functions, namely moistening the copy sheet 18, and transporting the copy sheet 18 to the printing line AB of the duplicator.

Excessive moistening of the applicator pad 21 is prevented since motor 22 drives the elevator roller 26 only if the applicator pad 21 is so dry, and has such a low moisture content, that a clear imprint on the duplicator sheet 18 by the master sheet 17 is no longer assured.

As in the embodiment of FIGS. 1 to 6, the insulated electrodes 27 and 28 engage spaced portion of the applicator pad 21. As shown in FIG. 9, a switch 31 is connected in series with a source of voltage and with control means 29, which is connected with electrode 28 by potentiometer 32 and controls motor 22.

Dependent on the moisture content of the applicator pad 21 sensed by the sensing electrodes 27 and 28, different currents flow to the control means 29 which includes an amplifier for supplying current for drive motor 22. If the applicator pad 21 is highly saturated with liquid, the resistance between electrodes 27 and 28 is low, and a strong current flows which effects a disconnection of motor 22 by the electronic control means 29. If more duplicator sheets 18 are fed and moistened, the applicator pad 21 becomes dry, the moisture content is reduced, and the resistance between sensing electrodes 27, 28 is increased so that a smaller current flows.

When a predetermined minimum current is obtained, the control means 29 generates a starting impulse for motor 22 which then drives through shaft 63 the elevator roller 26 so that liquid is supplied through transfer roller 60 to the applicator pad 21 until the same is sufficiently saturated, and the sensing electrodes 27, 28 sense a maximum current and cause control means 29 to stop motor 22.

Switch 31 is operated at the same time as the main switch of the duplicator, and starts motor 23 with elevator roller 26 when the applicator pad 21 is dried out, so that even after a prolonged standstill of the duplicating machine, the applicator pad 21 is properly moistened, so that even the first duplicator sheet 18 is sufficiently moistened for obtaining a clear imprint from the master sheet 17.

The manually operated potentiometer 32 regulates the flow of liquid supplied to the absorbent applicator pad 21 varying the predetermined resistance between the electrodes 27 and 28, so that motor 22 also starts at different resistances between electrodes 27, 28 whereby individual amounts of liquid can be transferred to the duplicator sheets 18, depending on different properties of the used duplicator sheets 18.

From the above description it will become apparent that in the embodiment of FIGS. 1-6, the pump 23 and in the embodiment of FIGS. 7-9, the elevator roller 26 and the transfer roller 60, constitute supply means driven from motor 22 to supply liquid to the liquid absorbent applicator pad 21 of the applicator means, which may either directly moisten the duplicator sheets 18, or moisten the transporter roller 55 which transfers the liquid to the duplicator sheets. In all embodiments of the invention, the speed of the motor 23 and of the

respective supply means 23, 25, 26 or 26a, 60, depends on the resistance of the portion of the applicator pad 21 between the sensing electrode 27 and 28, the resistance being dependent on the moisture content of the absorbent applicator pad 21.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of moistening apparatus for duplicator sheets differing from the types described above.

While the invention has been illustrated and described as embodied in a liquid supply means for an absorbent pad driven by a motor operating only if the pad becomes too dry, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. Moistening apparatus for duplicator sheets, comprising, in combination, applicator means including a liquid absorbent means, and adapted to apply a moistening liquid to successive duplicator sheets so that the moisture content of said absorbent means is decreased by transfer of said liquid to the sheets; sensing means for sensing the moisture content of said absorbent means; motor means; control means controlled by said sensing means to start and stop said motor means depending on the sensed moisture content of said absorbent means; and movable supply means for said liquid driven by said motor means for supplying said liquid to said absorbent means when the sensed moisture content decreases below a predetermined minimum so that the sheets are maintained at a substantially constant moisture content.

2. Duplicator moistening apparatus for moistening duplicator copy sheets comprising, in combination, applicator means including a liquid absorbent means, and adapted to apply a moistening liquid contained in said absorbent means to successive duplicator sheets so that the moisture content of said absorbent means is decreased by transfer of said liquid to said duplicator copy sheets, said absorbent means having an electric resistance dependent on the moisture content thereof; sensing means including two spaced electrodes in contact with said absorbent means for sensing the resistance of the portion of said absorbent means for sensing the resistance of the portion of said absorbent means between said two spaced electrodes; motor means; control means controlled by said sensing means depending on the resistance and the moisture content of said portion of said absorbent

means to start and stop said motor means when said moisture content is a predetermined minimum and maximum, respectively; and movable supply means for said liquid driven by said motor means to supply said liquid to said absorbent means when the

sensed moisture content decreases below said predetermined minimum, and to stop with said motor means when the moisture content is increased to said predetermined maximum whereby said copy sheets are substantially uniformly moistened.

3. Apparatus as claimed in claim 2, wherein said control means are electronic control means; and wherein said motor means includes an electric motor connected with and started and stopped, respectively, by said electronic control means when the current flowing between said electrodes is a predetermined minimum and maximum current, respectively, due to reduced and increased moisture content, respectively, and correspondingly increased and reduced resistance, respectively, of said portion of said absorbent means.

4. Apparatus as claimed in claim 2, wherein said supply means include a means for spraying the moistening liquid onto said absorbent means; and a pump driven by said motor means for pumping said liquid to said spraying means.

5. Apparatus as claimed in claim 2 wherein said applicator means include insulating container means supporting said absorbent means and said sensing means; and wherein said supply means are at least partly located in said container means for supplying liquid to said absorbent means.

6. Apparatus as claimed in claim 2 wherein said absorbent means includes an absorbent pad in contact with transported sheets; and comprising transporting roller means for transporting the sheets.

7. Apparatus as claimed in claim 2 wherein said applicator means include a transporting roller for transporting the sheets while rolling on the surface of the sheets, and wherein said absorbent means include an absorbent pad slidably abutting said transporting roller so that said transporting roller is moistened by said liquid and transfers said liquid to the sheets.

8. Apparatus as claimed in claim 2 wherein said supply means include a pump driven by said motor means for pumping said moistening liquid onto said absorbent means when the sensed moisture content is insufficient.

9. Apparatus as claimed in claim 2 wherein said supply means include a container for said moistening liquid, an elevator roller partly immersed in the liquid in said container, and a transfer roller in rolling contact with said elevator roller and in sliding contact with said absorbent means; and wherein said motor drives said elevator roller when the sensed moisture content of the absorbent means is insufficient.

10. Apparatus as claimed in claim 9 wherein said container is closed and envelopes said elevator roller, said transfer roller, and the part of said absorbent means engaged by said transfer roller, and includes means for maintaining a pre-determined highest level of said moistening liquid in said container so that said absorbent means and said transfer roller are located above said constant level.

11. Apparatus as claimed in claim 2 wherein said motor means includes an electric motor, and circuit means connecting said motor with said control means; and a variable resistor in said circuit means for adjusting the maximum and minimum currents supplied to said control means for stopping and starting said motor.

12. Apparatus as claimed in claim 11 wherein said circuit means include a switch for stopping and starting said motor by disconnecting and connecting, respectively, said motor from and to a source of voltage.

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13. Apparatus as claimed in claim 2 wherein said absorbent means includes a pad consisting of fibrous felt; and wherein said two spaced electrodes abut said felt pad, and circuit means connecting said electrodes with said electric control means.

14. A moistening method for duplicator sheets comprising electrically sensing the moisture content of a liquid absorbent pad while said pad transfers absorbed

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liquid to a roller rolling on duplicator sheets for moistening the same; and automatically supplying under the control of said sensing means replenishing liquid to said pad when the sensed moisture content is insufficient, so as to maintain a substantially constant moisture content in said absorbent pad.

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