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W. J. HODIN

2,565,370

MOISTENING MEANS FOR DUPLICATING MACHINES

Filed March 6, 1947

4 Sheets-Sheet 1

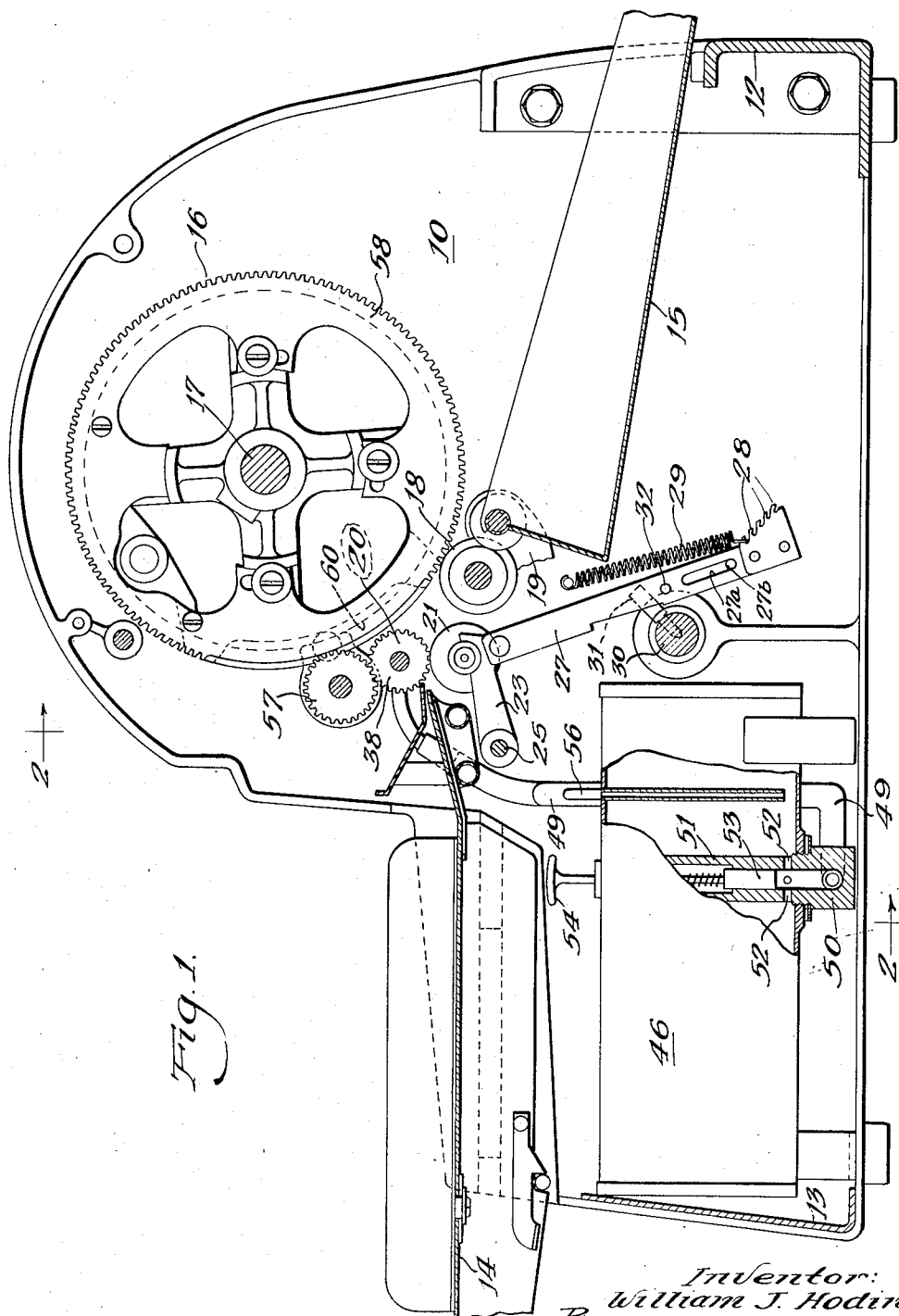


Fig. 1.

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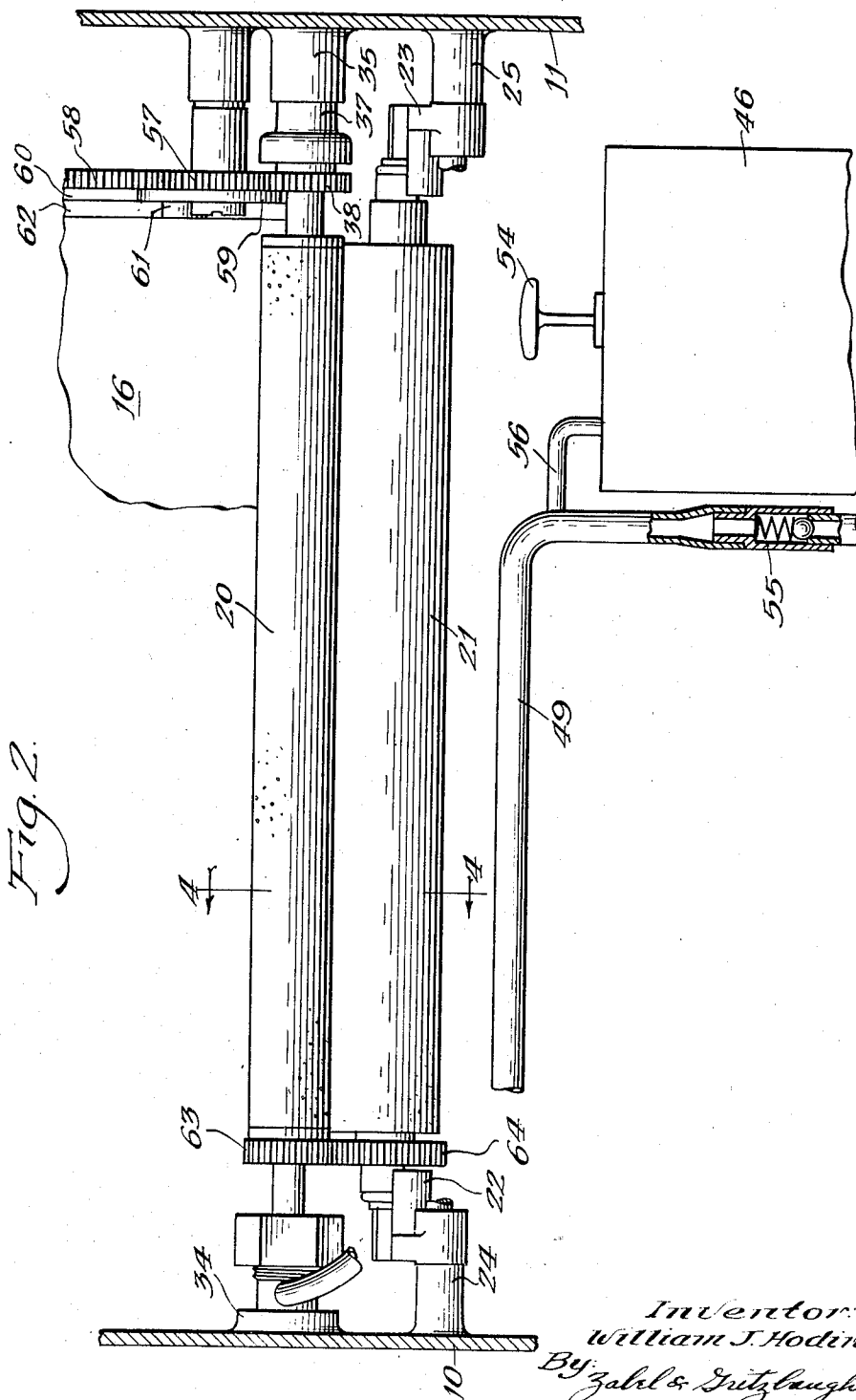
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4 Sheets-Sheet 2



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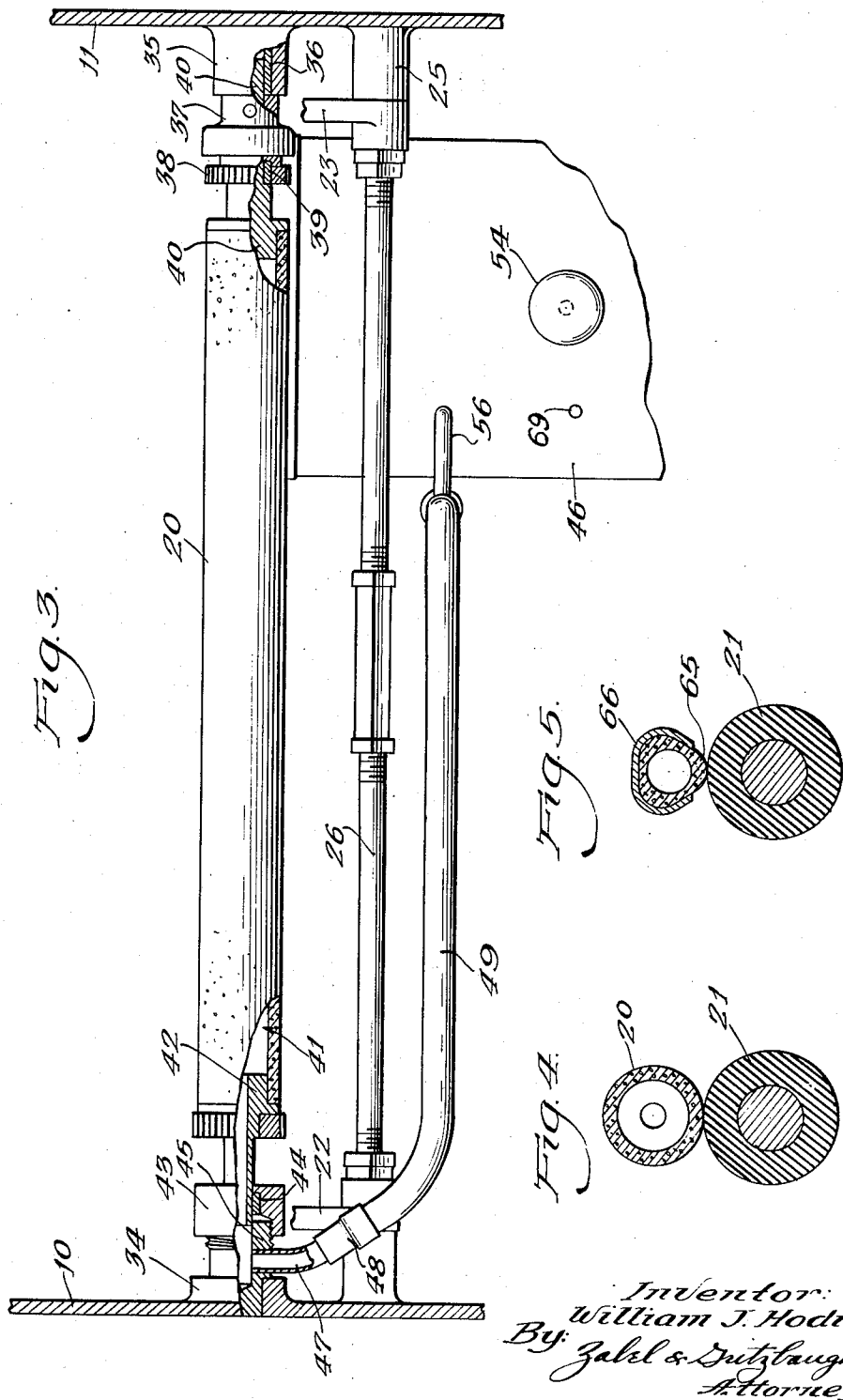
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4 Sheets-Sheet 3



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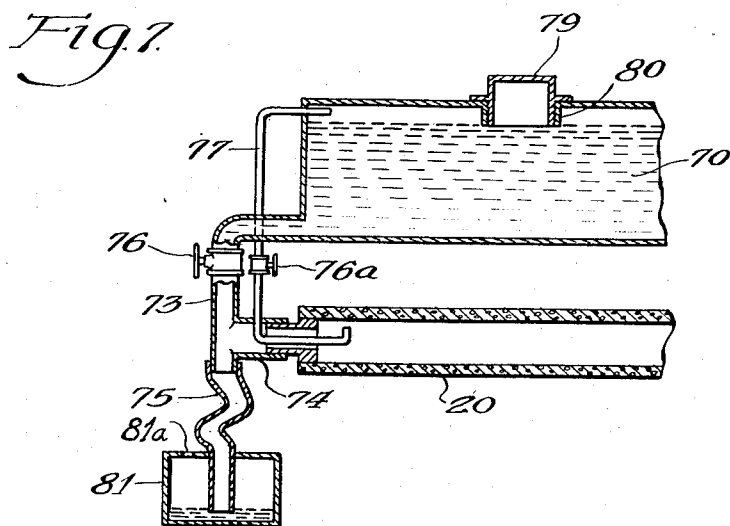
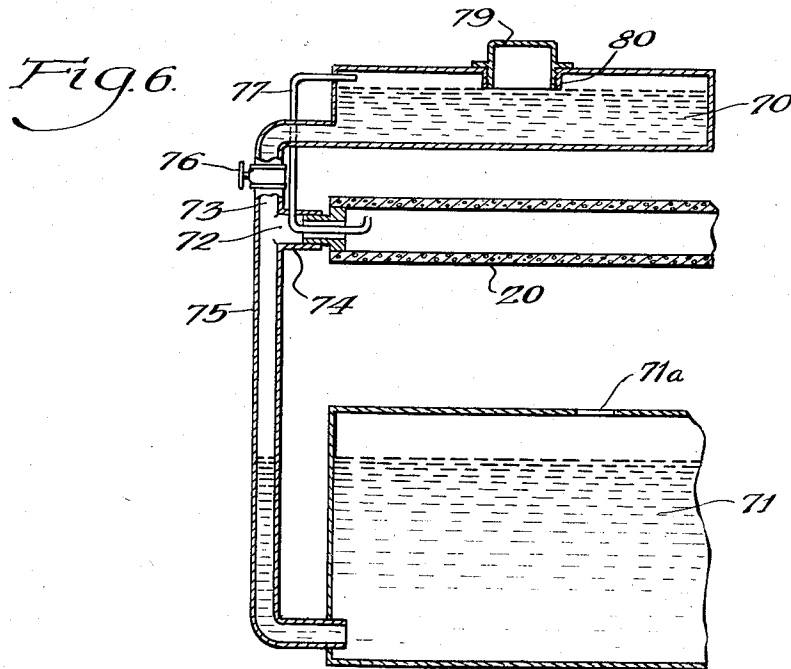
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MOISTENING MEANS FOR DUPLICATING MACHINES

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,565,370

MOISTENING MEANS FOR DUPLICATING MACHINES

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11 Claims. (Cl. 91—49)

1

2

The invention relates to moistening means for duplicating machines of the wet process type.

In that type of duplicating machine, a very small amount of a solvent is applied to the surface of each copy sheet as it is being fed into pressure contact with a master sheet. A small portion of the ink, forming the characters or other matter on the master sheet, is dissolved and transferred to each copy sheet due to the coaction of the solvent and the pressure contact. Thus, duplication is effected. It will be evident that if too little solvent is applied to the copy sheet, the duplicate copies will be too dim; if too much is applied, the ink on the master sheet will be exhausted too rapidly, and the number of copies that can be made will be correspondingly limited.

It has been proposed, for instance in Takats Patent No. 2,189,765, to provide a microporous, hollow moistening roll, in combination with means to supply solvent to the interior thereof under pressure, so that the solvent will be forced through the microporous wall of the roller to the surface thereof, for application directly to a copy sheet.

However, in such an arrangement difficulties have been experienced in regulating the amount of solvent passing through the wall of the roller. The porosity of the roller, has to be selected with reference to the pressure developed by the pumping means or the like; in operation, the amount of solvent supplied will vary in about the same proportion to the speed of the pump operation. Since it is difficult to regulate the operation of the pump so as to develop a relatively constant pressure at different speeds, as well as thruout the time that a single copy sheet is being moistened by the porous roller, it is difficult to prevent such variations in the amount of solvent applied as will render the operation of the moistening means unsatisfactory.

It is an object of my invention to provide an improved moistener of the porous applicator type, in which the amount of solvent supplied is as uniform thruout a single copy wetting cycle as is the speed of operation, being increased as the speed decreases and reduced as the speed increases. This object is accomplished by providing an arrangement in which solvent is supplied to the porous applicator under subatmospheric pressure.

It is a further object to provide means for controlling the amount of fluid supplied at any given speed of operation, said means regulating the internal sub-atmospheric pressure of the porous roller.

It is a further object to provide for an improved moistener of the porous applicator type which normally operates under subatmospheric pressure, improved priming means.

Other objects, features and advantages of my invention will become apparent as the description proceeds.

With reference now to the drawings, in which like reference numerals designate like parts—

Fig. 1 is a vertical longitudinal section through a wet process duplicating machine embodying my invention;

Fig. 2 is an enlarged transverse vertical section showing the moistening rollers taken along line 2—2 of Fig. 1;

Fig. 3 is a plan view of the parts shown in Fig. 2, portions being shown in section;

Fig. 4 is a section taken along line 4—4 of Fig. 2;

Fig. 5 is a section similar to Fig. 4, but showing a modified form of my invention; and

Figs. 6 and 7 are diagrammatic views showing further modifications of my invention.

The duplicating machine of Fig. 1 comprises a pair of side frames 10 and 11 which are connected to each other to form a rigid structure by means of front and rear cross frames 12 and 13, respectively, the parts being bolted or welded together in the usual manner.

The machine also includes the usual feed tray 14 and receiving tray 15. The drum 16, mounted on a drum shaft 17 is rotatably disposed between the side frames. Cooperating with the drum 16 is a pressure roller 18 which may be mounted in and urged against the surface of the drum 16 by suitable means, such as the cradle 19 shown in Fig. 1.

Disposed rearwardly of the bite of the drum and pressure roller are a pair of feed rollers comprising a combined feeding and moistening roller 20 and a lower feed roller 21. The latter is journaled in a pair of arms 22 and 23 which are pivoted on suitable bosses 24 and 25, as shown in Fig. 2. A tie rod assembly 26 may extend between the bosses to serve as an additional structural member. The lower feed roller 21 may be urged into engagement with the feeding and moistening roller 20 by means of a link 27 and a spring 29, as shown in Fig. 1. The link 27 extends downwardly from the arm 22, and the spring 29 is tensioned between a suitable pin in the side frame 10 and one of a plurality of hooks 28 which are provided at the lower end of the link 27. Sliding movement of the link 27 is permitted by a slot 27a which cooperates with a pin 27b mounted in the side frame 10.

3

The link and lower feed roll are retracted by means of a pin 31 which is mounted on a shaft 39, the pin 31 engaging another pin 32 which is mounted in the link 27. A suitable knob, projecting from one of the side frames, is provided for manually rotating the shaft 30 for retracting the pressure roll and link assembly when necessary. The link 27, spring 29 and associated parts are duplicated on the opposite side of the machine, and the shaft 30 which extends all the way across the machine, provides common actuating means for retracting both links.

The combined moistening and feeding roller 20 comprises a porous tubular member 41 having short aligned shaft members 40 and 42 extending from either end thereof, as shown in Fig. 3. These shaft members are rotatably mounted in means associated with bosses 35 and 34, respectively, which are formed on the side frames 11 and 10. A bushing 36, inserted in boss 35, provides bearing means for shaft member 40. A free wheeling unit, designated generally by the reference numeral 37, and including pinion 38, is mounted on the shaft 40 and serves to drive the roller 20 in a forward direction, that is, in a direction in which copy sheets are fed forwardly between the rollers 20 and 21, when the pinion 38 is rotated in the forward direction by means hereinafter described. The free wheeling unit permits the rollers 20 and 21 to be rotated or dragged by the pull of the copy sheet at such times when the pinion 38 is not being driven.

The shaft member 42, at the left end of the roller 20, as shown in Fig. 3, is journaled in a cap 43 and bushing 44. The cap is threaded on to a hollow screw threaded member 45 which is mounted in boss 34 and which serves to form means communicating with the interior of the hollow roller 20 for the supply of solvent thereto.

The means for supplying solvent to the interior of the roller 20 includes a tank 46 and a short conduit 47 which is mounted in the hollow threaded member 45. A short length of flexible tubing 48 connects the conduit 47 with the main tubing 49 which communicates with the tank 46. The lower end of the main tubing is connected to the bottom of a pump block 50, and as shown in Fig. 1, provides communication with a cylinder 51 formed in the pump block. Ports 52 formed in the pump block provide communication between the interior of the tank 46 and the cylinder 51. A piston 53 slides in the cylinder 51, and serves to force solvent from the tank through the main tube 49 into the interior of the roller 20. A handle 54 is provided for operating the piston. As shown in Fig. 2, a valve 55 is interposed in the main tubing 49 to prevent reverse flow of solvent in the lower portion of the main tubing 49.

A branch tube 56 bypasses the valve and the pump, extending laterally from the main tubing 49 through the top of the tank 46, and terminates close to the bottom of the tank, as shown in Figs. 1 and 2. In operation, the pump is used to prime the moistener. Operation of the pump handle once or twice will force solvent through the valve 55 and through the main tubing 49 into the moistening roller 20. The air displaced by the solvent will leak out through the pores of the roller 20. A portion of the solvent forced into the system by the pump will run back into the tank through the branch tubing 56, with the result that at the conclusion of the priming, a continuous liquid column will exist from the moistening roller 20 through the main tubing 49 and the branch tube 56 to the tank.

4

The tank is not sealed, due to the provision of an opening 69 formed in the top wall of tank 46, as shown in Fig. 3, with the result that the liquid surface in the tank is a free surface. Therefore, the solvent would ordinarily be expected to run out of the moistening roller 20 and back into the tank, through the branch tube. However, the surface tension of the solvent around the periphery of the roller 20 seals the tube so that whatever draining action may occur on cessation of priming will be limited and will serve to create a pressure drop within the porous tube to counter balance the liquid head of the solvent. As the solvent in the roller 20 is under a sub-atmospheric pressure, it will not leak out thru the pores to supply an excess of solvent to the surface of the copy sheet, as is the tendency in the above-mentioned porous roller moisteners of the prior art. Furthermore, it is not necessary that the roller 20 be completely filled; if it is filled half way, or two-thirds, that is sufficient, inasmuch as the solvent will tend to creep upwardly through the pores and seal the entire periphery of the roller. Due to this surface tension effect, the surface of the roller 20 is always wet, and will moisten a copy sheet as it is being fed past the roller. As solvent is thereby withdrawn from the surface of the roller, the surface tension of the solvent causes additional solvent to be withdrawn from the interior of the roller, and this in turn reduces the pressure within the roller and causes more solvent to be drawn from the tank. Whether or not the machine is used, that is, whether or not the roll is rotated, the surface will remain wet, until substantially all of the liquid from the tank is exhausted by evaporation from the surface of the roll. Priming is necessary only to fill the roll in the first instance; thereafter, no priming is necessary as long as the tank is replenished with additional solvent to maintain its liquid level above the opening of the supply tube. However, over a period of 5 to 8 days, air gradually diffuses into the tube and causes a neutralization of the internal vacuum necessitating repriming. An improved priming and supply system comprising an overhead supply tank and a level control trap mounted below the tube level with appropriate air and fluid connections, as described later, will automatically remove such air as does diffuse into the porous tube.

The amount of solvent supplied by the moistening roller 20, I have found to be the proper amount for the moistening of copy sheets for wet process duplication. Furthermore, the solvent does not tend to collect at the bite between the rollers 20 and 21, which tendency is exhibited in certain other types of moisteners. This collection of solvent at the bite is undesirable in duplicating machines wherein the feeding rollers are also used to position the leading edge of the copy sheet. This positioning occurs during a period in which the rollers are stationary, and in this particular embodiment of my invention I have provided means for intermittently driving the rollers 20 and 21 so that they may also serve as positioning means.

The roller 20 is driven by the rotation of the drum by means of an interrupted gear 58 suitably secured to the drum, which drives an idler pinion 57 which in turn meshes with the pinion 38 which forms a part of the free wheeling unit 37, as above indicated. Secured to the idler pinion 57 and rotating therewith is a locking disk 59 which co-operates with a cam 60 mounted on the drum to prevent rotation of the idler pinion during such

5

time as the interrupted portion of the gear 58 is opposite the idler pinion. A roller 61 carried by the locking disk cooperates with a second cam 62 on the drum to take up the initial impact between the drum assembly and the idler pinion assembly at the end of the dwell period. Thus, the first tooth of the interrupted gear 58 is protected from the shock of impact.

The operation is such that when the drum shaft 17 is rotated, either by a crank or by a motor, the drum will rotate continuously, but the upper feed roller 20 will be driven intermittently. The lower feed roller 21 is driven from the upper feed roller 20 by means of pinions 63 and 64, mounted at the opposite ends of the rollers from the pinion 38. The copy sheet may be positioned at the bite of the feed rollers 20 and 21 during the dwell period provided by the interrupted gearing, and the leading edge of the copy sheet is not saturated by solvent, due to the improved type of moistener, as above indicated. When the feed rollers commence their operation, the copy sheet will be fed into the desired registry with a master sheet secured to the drum 16 in the usual manner, and the upper surface of the copy sheet will have a thin film of moisture thereon which has been applied to it by its contact with the moistening roller 20.

A modified form of my invention is shown in Fig. 5, in which a copy sheet is fed only by the rotation of the lower feed roller 21. The moistening means, instead of being a rotating element, is a porous stationary tube 65, which is provided with a shield 66 which serves to cut down evaporation from the surface of the tube 65 during times that the duplicating machine is not in use. In this instance, the lower feed roller 21 is intermittently driven by means substantially the same as pointed out in connection with the driving of the roller 20. The positioning can be effected at the bite of the moistening roller 21 and the tube 65 when the roller is stationary, in the same manner as pointed out in connection with the operation of rollers 20 and 21.

A modified form of priming device is diagrammatically shown in Fig. 6. Instead of a priming pump, an upper tank 70 is provided above the moistening roller 20, and a lower tank 71, having in its top wall an opening 71a, is provided in substantially the same position as the tank 46 of Fig. 1. Communication between the upper tank 70, the lower tank 71, and the moistening roller 20 is provided by a conduit having three branches extending from a T-connection 72. The first branch 73 extends from the T-connection to upper tank 70; the second branch 74 extends from the T-connection to moistening roller 20, and the third branch 75 extends from the T-connection to lower tank 71. A manually controlled valve 76 is provided in the branch 73. The solvent in the lower tank is provided with a free surface, but the upper tank 70 is sealed. An equalizer tube 77 extends between the upper tank 70 and the moistening roller 20. In filling the upper tank the valve 76 is closed, a cap 79 removed, and the upper tank filled to a level which is determined by flanges 80 which depend downwardly from the opening. The cap 79 is replaced after filling and the tank is sealed. The lower tank 71 is similarly filled, and the condition of the liquid system will be as shown in Fig. 6. To prime the system, the valve 76 is opened for a few seconds and then closed. When the valve is opened, the solvent runs out of the upper tank, and down into the lower tank, pushing the column of air before it until the conduits

6

73 and 75 are completely filled with solvent. At the same time, some of the solvent flows into the moistening roller 20, and this flow of solvent in a lateral direction is assisted by the fact that as the liquid level in the upper tank 70 is lowered, the pressure in the tank is lowered with the result that air from the interior of the moistening roller 20 is drawn through the equalizer tube into the upper tank 70. Thus, the air pressure within the moistening roller is lowered, which causes diversion of solvent into the interior of the moistening roller. When the solvent in the moistening roller rises to the level of the opening of the equalizer tube 77, and as soon as the pores of the moistening roller have been sealed off by the solvent, the flow from the upper tank 70 will cease. At this time the valve 76 may be closed, and in operation, the solvent is drawn from the lower tank 71, in the same manner as pointed out in connection with the tank 46. With this arrangement, a single filling of the upper tank 70 is sufficient to provide enough liquid to prime the system six or eight times.

A further modification is shown in Fig. 7, which is substantially the same as Fig. 6, with the exceptions that a level control trap 81, having in its top wall an opening 81a, is provided instead of the lower tank 71, and the equalizer tube 77 is provided with an on-off valve 76A coacting with valve 76. The remaining parts have the same reference numerals as corresponding parts of Fig. 6. In the operation of this device, the valves 76 and 76A are caused to remain in their open position during operation of the machine. The solvent used by the moistening roller is supplied from the trap 81, but as soon as the liquid level in the trap drops to or below the end of the branch 75, air bubbles will pass up through the conduit branches 75 and 73 into the upper tank 70, and permit sufficient liquid to be supplied to the trap to again seal the bottom of the conduit. Any air diffusing into the porous tube will be displaced thru the equalizer tube 77 up to the fluid tank 70. Replenishment of liquid in tank 70 may be accomplished by shutting off valves 76 and 76A and removing cap 79 to admit new fluid without affecting the functioning of the porous tube. Then, on resealing cap 79 and opening valves 76 and 76A, any re-priming action necessary will take place automatically as the tank resumes its supply function. In the Fig. 7 modification, the upper tank 70 is larger than the tank 70 in Fig. 6, for the reason that in the Fig. 7 modification, the tank 70 is the ultimate source of solvent supply, both for priming and for normal operation.

In both the Fig. 6 and Fig. 7 modifications, the only free surface of liquid is below the level of the moistening roller, with the result that the interior of the roller is always maintained under a subatmospheric pressure during normal operation, just as in the case of the embodiment of Figs. 1 to 5, inclusive.

As shown in Fig. 7, the conduit 75 is flexible, thereby permitting adjustment of the position of the level control trap 81. The latter may be suitably mounted by any adjustable means. Thus, the elevation of the free surface of the liquid may be adjusted in order to increase or decrease the subatmospheric pressure, and hence to regulate the rate at which solvent is applied to the copy sheet.

The lower feed roller 21 is preferably formed from a soft or resilient material, such as rubber or sponge rubber having a skin. The surface of

the lower feed roller 21 is preferably impervious in order to avoid the absorption of solvent which would result in moistening the under side of the copy sheet.

The operation of the several embodiments of my invention has been explained in detail in connection with the description of the various parts thereof, and need not be repeated. The important feature is that in all embodiments, solvent is supplied to the applicator, whether it be of stationary type as shown in Fig. 5, or of the rotary type constituting the feed roll, under sub-atmospheric pressure.

The porous tube 41 is formed from any suitable porous material, the pores of which being preferably uniformly distributed so as to provide a roller of substantially uniform porosity. As an example of a material from which the roller may be formed, I have found that sintered metal products in the field of powder metallurgy operate satisfactorily, and in particular, a sintered bronze. However, unglazed ceramic and ceramic-like materials have been found to work satisfactorily, and also certain paper or cellulosic filter materials, such as plastic-impregnated paper tubes as are manufactured by the Skinner Filter Company of Detroit. In this particular type of material, the paper or cellulose fibers are impregnated with plastic composition so as to render them non-soluble and are formed in sheets or otherwise permanently secured in a thin sheet-like plastic matrix. The surfaces of these plastic sheets are ridged by the imbedded impregnated fibers and on positioning two such surfaces face to face, adequate passageways between them are available to permit fluid flow of the desired nature. Powdered metals in which the binding action is obtained by pressure are also satisfactory.

The porosity of the material from which the roller is made should be such that with respect to the particular type of solvent used, a capillary action will take place in the pores which exerts a force sufficient to draw the solvent upwardly through a substantial distance, such as from 3 to 12 inches. It is my understanding that at present there is no standard term for designating porosity, although in the filter art, filters are oftentimes graded on the minimum sizes of the particles that the filter would stop. As an example, a porous material of a grade ranging from .001 inch minimum particle size to .0001 inch minimum particle size has been found to be satisfactory. However, it will be understood that this is given merely by way of example, inasmuch as I have found that there may be a certain amount of variation one way or the other. The surface tension of the liquid, the wall thickness of the tube, and the nature of material also have considerable effect upon the operation of the device, with the result that porosity of the material should be selected with these additional factors in mind.

In any event, a simple test can be made as to the suitability of the material.

If a 12 inch tube, filled with solvent and having its ends sealed, exhibits no substantial leakage when held horizontally, the porosity is fine enough. If, after time enough to permit any original surface moisture to evaporate, the surface is still wet, the porosity is sufficiently coarse.

The roller is preferably fabricated to the desired dimensions as closely as possible in the first instance. This is for the reason that grinding operations on the metal roller should be avoided since they tend to seal off the pores. Certain

types of rough machining operations are satisfactory. The impregnated cellulose roll mentioned above may be ground. A ceramic roll may be dressed in the same manner as a grinding wheel is dressed. It should be as close as possible to a true cylindrical surface in order to get uniform contact with the copy sheet.

I claim:

1. Moistening means for a duplicating machine comprising a porous hollow moistening roller, a reservoir spaced from and beneath said moistening roller and having an opening therein to provide a free surface for the liquid within said reservoir, means providing unobstructed communication between said reservoir at a point below said free surface and the interior of said moistening roller to permit the flow of liquid therethrough at all times, auxiliary means providing communication between said reservoir at a point below said free surface and said first mentioned means, and a pump for forcing liquid from said reservoir into said first mentioned means and the interior of said moistening roller to establish a column of liquid by means of which the liquid in the interior of said moistening roller is maintained under sub-atmospheric pressure.

2. Moistening means for a duplicating machine comprising a hollow porous applicator, a sealed reservoir disposed above said applicator, means providing communication between said sealed reservoir and said applicator, a conduit extending from said communicating means to a point below said applicator, and means providing a free surface for the system comprising said communicating means, said applicator and said sealed reservoir at a point below the level of said applicator.

3. Moistening means for a duplicating machine comprising a hollow porous applicator, a sealed reservoir disposed above said applicator, means providing communication between said sealed reservoir and said applicator, a conduit extending from said communicating means to a point below said applicator, means providing a free surface for the system comprising said communicating means, said applicator and said sealed reservoir at a point below the level of said applicator, and means for equalizing the pressure in said sealed reservoir and said applicator.

4. Moistening means for a duplicating machine comprising a hollow porous applicator, a sealed reservoir disposed above said applicator, means providing communication between said sealed reservoir and said applicator, a conduit extending from said communicating means to a point below said applicator, means providing a free surface for the system comprising said communicating means, said porous applicator and said sealed reservoir at a point below the level of said applicator, and auxiliary communicating means between said sealed reservoir and said applicator for displacing excess air from within said applicator to said sealed reservoir.

5. Moistening means as claimed in claim 4 in which a valve is provided in said communication providing means between said sealed reservoir and said applicator.

6. Moistening means as claimed in claim 4 in which a valve is provided in said communicating means and in which a valve is provided in said auxiliary communicating means.

7. Moistening means as claimed in claim 4, including means for adjusting the elevation of said free surface providing means with respect to said applicator.

8. Moistening means for a duplicating appa-

ratus comprising a porous hollow applicator, a reservoir providing a free liquid surface disposed beneath said applicator, an auxiliary sealed reservoir spaced above said applicator, means providing communication between said first mentioned reservoir, said applicator and said auxiliary reservoir, to cause liquid to flow downwardly from said auxiliary reservoir into said first reservoir and into said applicator during priming, and to permit liquid to flow upwardly from said first mentioned reservoir at other times, and an equalizer tube extending from a point in the upper portion of said applicator to a point in the upper portion of said auxiliary reservoir tending to equalize the pressures therein in order to facilitate the flow of liquid into said applicator during priming.

9. Moistening means for a duplicating machine comprising a porous hollow applicator adapted to be contacted by a copy sheet and to apply a thin film of liquid to the surface thereof, means to supply said liquid to the interior of said applicator, means to maintain the liquid supplied thereto under subatmospheric pressure during normal operation of said moistening means, and auxiliary means for admitting liquid into the interior of said applicator under a pressure greater than said subatmospheric pressure, said auxiliary means being operable only at times.

10. A copy sheet moistener for a duplicating machine comprising a hollow applicator for contacting the copy sheets to be moistened, said applicator being formed, at least in part, of a porous material capable of providing, when wetted with a moistening liquid, an air-tight seal for maintaining a sub-atmospheric pressure within the interior of said hollow applicator, a conduit communicating at one end with the interior of said applicator and terminating at the other end at a point below said applicator, and a container providing a free surface exposed to the atmosphere for said moistening liquid, said lower end of said conduit extending into said container and terminating beneath said free surface, said container and conduit providing a trap to maintain a column of said moistening liquid in said con-

duit and in said hollow applicator, and said conduit providing unobstructed communicating means between said container and said hollow applicator to permit the upward flow of said moistening liquid as said liquid is withdrawn from said applicator, said porous hollow applicator comprising a stationary member having a shield covering the major portion of its surface, thereby exposing for contact with a copy sheet only a portion of the porous surface of said applicator.

11. A copy sheet moistener for a duplicating machine comprising a hollow applicator for contacting the copy sheets to be moistened, said applicator being formed, at least in part, of a porous material capable of providing, when wetted with a moistening liquid, an air-tight seal for maintaining a sub-atmospheric pressure within the interior of said hollow applicator, a conduit communicating at one end with the interior of said applicator and terminating at the other end at a point below said applicator, a container providing a free surface exposed to the atmosphere for said moistening liquid, said lower end of said conduit extending into said container and terminating beneath said free surface, said container and conduit providing a trap to maintain a column of said moistening liquid in said conduit and in said hollow applicator, and said conduit providing unobstructed communicating means between said container and said hollow applicator to permit the upward flow of said moistening liquid as said liquid is withdrawn from said applicator, and priming means communicating with said conduit at a point between said applicator and said container for initially filling said porous hollow applicator with liquid.

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