Oct. 13, 1953 F. O. TRUMP 2,655,292

STORAGE TANK AND CONVEYING MEANS FOR LIQUID MATERIAL

Original Filed Sept. 28, 1945 4 Sheets-Sheet 1

Fig. 1

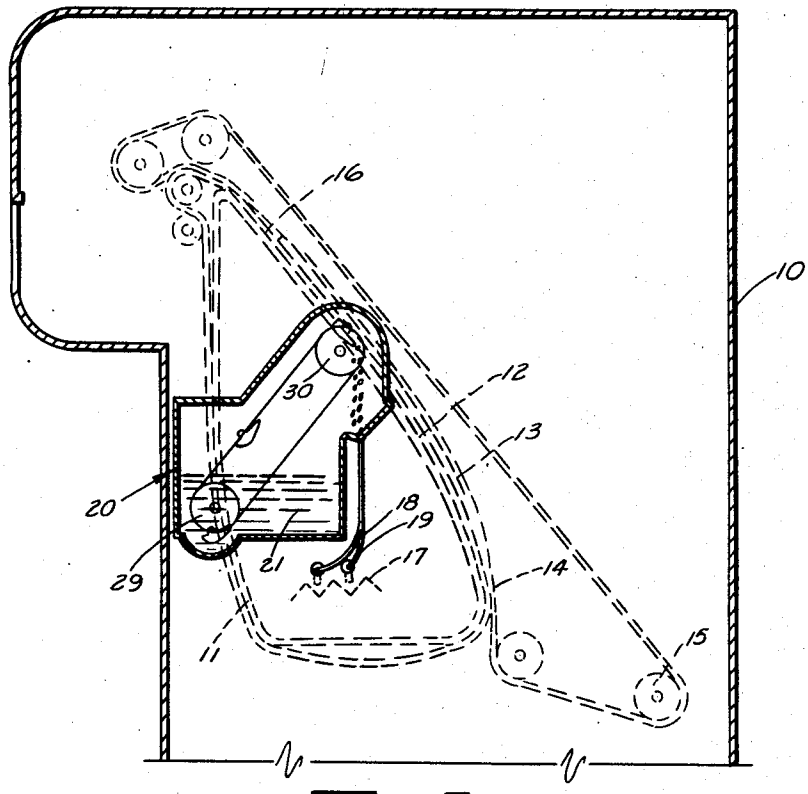


Fig. 8

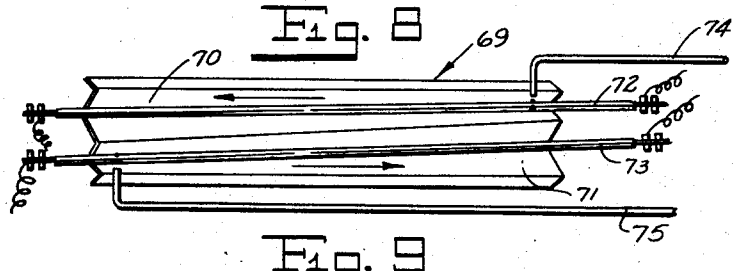
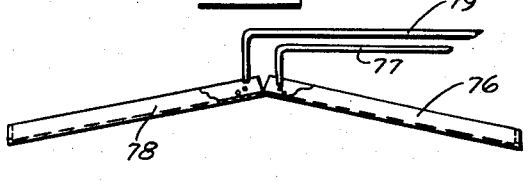


Fig. 9



INVENTOR
Frederick O. Trump
BY Thomas M. Cooley
Rodney C. Hamilton
ATTORNEYS

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STORAGE TANK AND CONVEYING MEANS FOR LIQUID MATERIAL

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Fig. 2

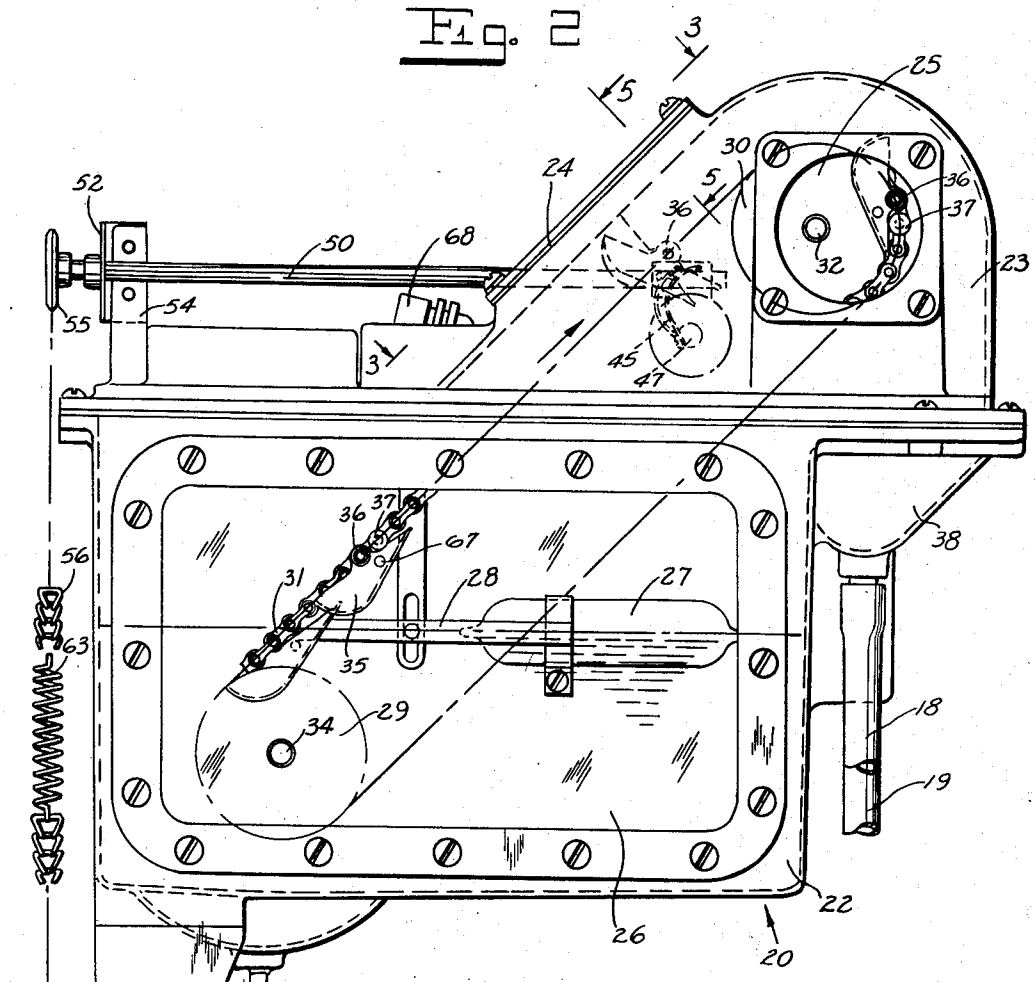


Fig. 3

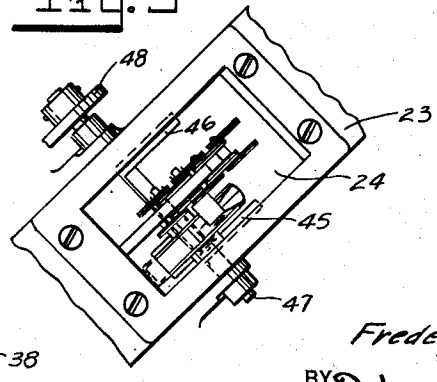
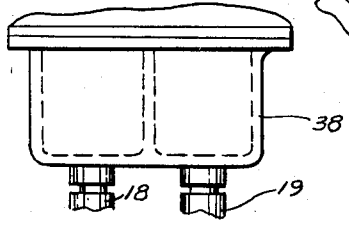


Fig. 2A



INVENTOR
Frederick O. Trump
BY
Rodney C. Gauntlett
ATTORNEYS

Oct. 13, 1953 F. O. TRUMP 2,655,292

STORAGE TANK AND CONVEYING MEANS FOR LIQUID MATERIAL

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Fig. 4

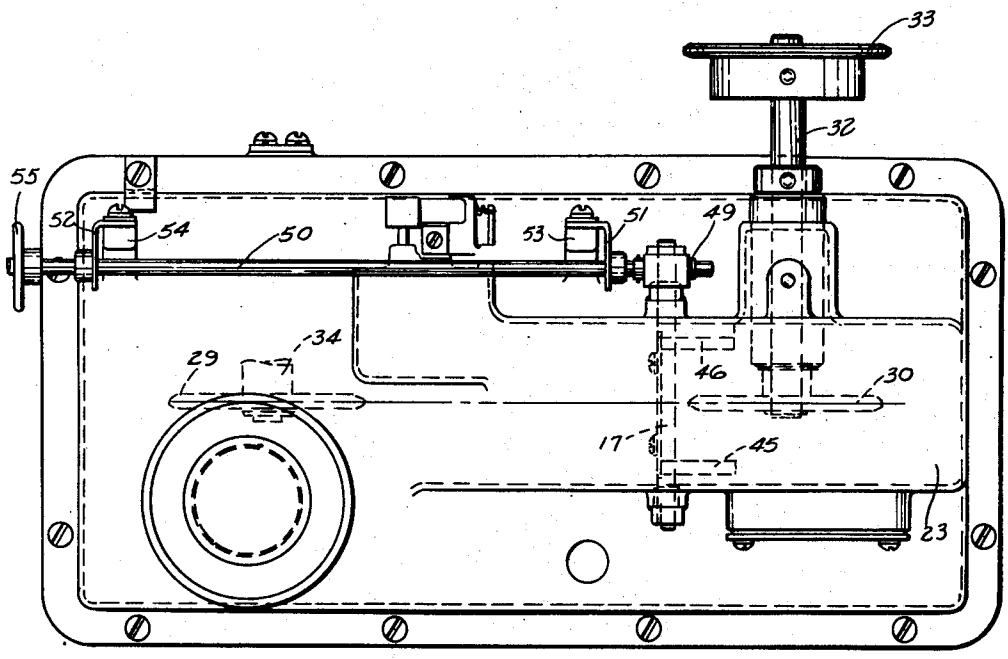
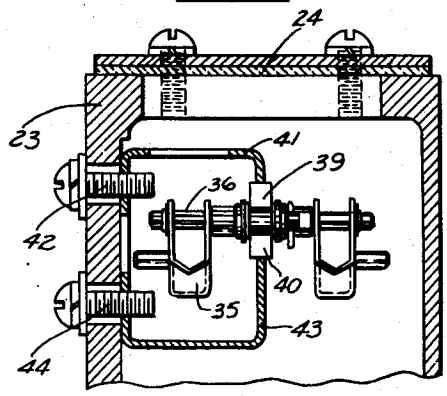


Fig. 5



INVENTOR
Frederick O. Trump

BY
Rodney C. Huntington
ATTORNEYS

STORAGE TANK AND CONVEYING MEANS FOR LIQUID MATERIAL

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Fig. 6

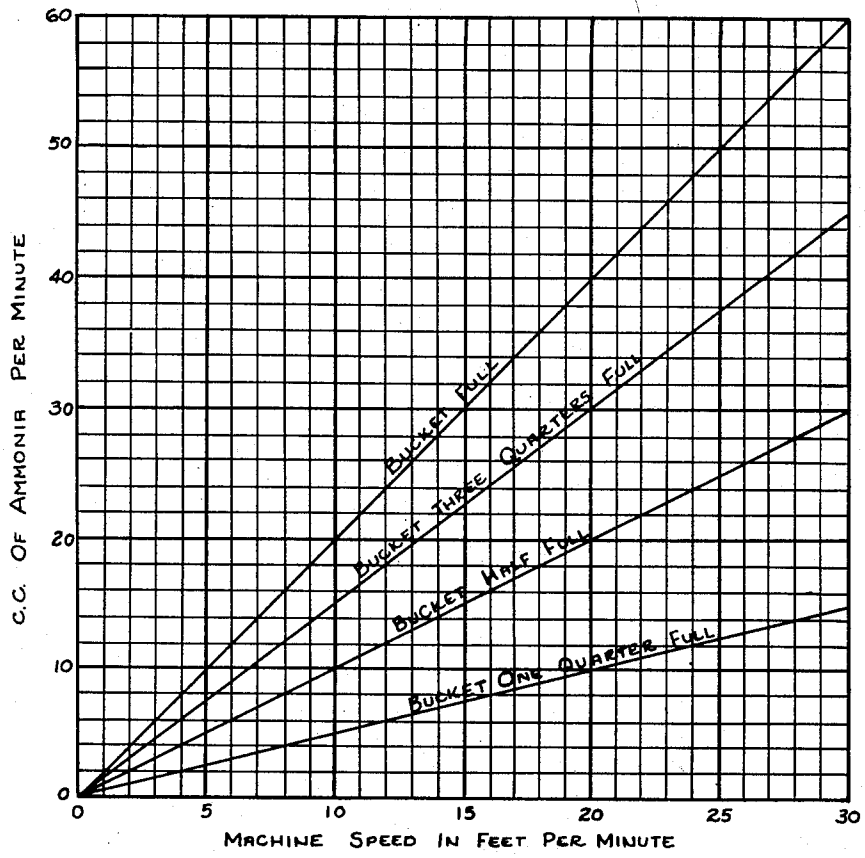
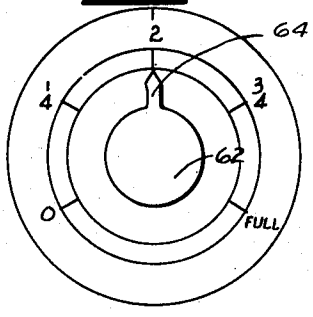


Fig. 7



INVENTOR
Frederick O. Trump

BY
Rodney C. Smithworth
ATTORNEYS

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STORAGE TANK AND CONVEYING MEANS FOR LIQUID MATERIAL

Frederick Otto Trump, Binghamton, N. Y., assignor to General Aniline & Film Corporation, New York, N. Y., a corporation of Delaware

Original application September 28, 1945, Serial No. 619,109, now Patent No. 2,475,165, dated July 5, 1949. Divided and this application August 8, 1947, Serial No. 767,462

5 Claims. (Cl. 222—305)

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This invention pertains to developing machines of the type adapted to dry development of exposed sensitized materials. More specifically, the invention concerns a device for controlling the feeding, that is, the amounts or quantities of developing material, to a developing chamber in accordance with the speed of the machine and certain other factors depending upon conditions, materials, etc. This application is a division of application Serial No. 619,109, filed September 28, 1945, now United States Patent 2,475,165, issued July 5, 1949.

Machines of this type, some of which are combined printing and developing machines and others of which are adapted to develop sensitized material which has been exposed in another machine, have a chamber in the form of a tank or other receptacle or enclosure in which the developing medium is vaporized to provide vapors or fumes for effecting the development of material, such as the well-known diazo type printing materials. Ammonia is one of the common developing mediums employed and, while the invention is not necessarily limited thereto, the following description will pertain to feeding ammonia which is thereafter vaporized and by which vapors the printing material is developed thereby to bring out and make permanent a latent image.

Machines of this type are generally so constructed that the amount of ammonia or other developing liquid fed to the vaporizing chamber is adjustable so as to bear a certain relation to the speed at which the machine is operated. These machines may be run at different speeds, that is, lineal speeds, at which the sensitized material is fed through, depending upon the nature of the original being printed and the sensitivity of the printing material, etc.

One difficulty arising with machines of this type is that there is no provision whereby the amount of developing liquid furnished bears a proper relationship to the speed at which the sensitized material passes through the machine. There has also been no provision for readily changing and definitely governing the amount of developing liquid fed as the machine is warmed up, or during other periods of abnormal operation.

One of the objects of the invention is to provide a mechanical developing liquid delivery system which will meter out a definite amount of liquid at a particular speed of the machine, this amount being adjustable at will. Moreover the delivery system will also automatically change the amount of liquid delivered at a change of

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speed of the machine proportional to the printing in lineal feet of paper passing through the machine. For example, as the speed of the machine is doubled, the device herein described and claimed will automatically double the amount of developing liquid supplied; and vice versa, if the speed of the machine is reduced the amount of liquid supplied will also be automatically reduced.

It is a further object of the invention to provide means whereby the total amount delivered within a predetermined time may be controlled independently from the rate of paper processed in lineal feet per unit time.

It is another object of the invention to provide a mechanical control which shall function very accurately to vary the amount of ammonia or other liquid which is fed at any particular speed, also to make such change effective at any and all speeds without resort to complicated adjustments and by a setting instrumentality at a convenient part of the machine, the function of which can easily be understood and controlled by the operator.

It is a further object to provide a mechanical delivery system which is not affected by changes in level of developing liquid in the container from which it is drawn so long as a minimum level is maintained.

It is also an object to provide a system in which the developing liquid fed to the vaporizing chamber may be distributed into a plurality of separate trays or channels wherein precisely the same amount of developer will be delivered to each separate channel.

The invention will be described by reference to one embodiment thereof as applied to a well-known type of dry developing machine, but it is to be understood that this disclosure is illustrative only and that the delivery system has general usefulness in other fields and applications. The following disclosure is made in reference to the accompanying figures of drawing, in which:

Fig. 1 is a section taken through a machine to which the invention is applied, so much only of the basic machine being shown as is necessary to an understanding of the invention.

Fig. 2 is a side elevation showing the invention, some of the internal parts being shown in dotted lines.

Fig. 2*a* is a detail of part of the developer delivery mechanism.

Fig. 3 is a detail view taken at an angle to the horizontal and at the top of Fig. 2 as indicated by the reference lines 3—3.

Fig. 4 is a top view showing certain parts of the device.

Fig. 5 is a partial section taken at the line 5—5, Fig. 2.

Fig. 6 is a chart showing the relationship between the machine speed in lineal feet of material processed in unit time and the amount of developing liquid supplied at various settings of the liquid conveying apparatus.

Fig. 7 is a detail view of the control panel and pointer which indicates the setting of the supplemental delivery control.

Fig. 8 is a plan view showing one form of evaporating tray and the manner of feeding liquid thereto.

Fig. 9 shows an alternative form of tray and method of feeding.

Now referring to Fig. 1, the upper part of a dry type developing machine is shown having an enclosing structure 10 in which is fixed a developing chamber or tank 11. This tank has an inclined side 12 in which there are a plurality of perforations through which ammonia vapors may pass on their way to the surface of a sheet of exposed sensitized material 13 which is moved upwardly along the perforated area of the said tank by a travelling belt 14, hereinafter called a sealing sleeve. This sleeve moves at a predetermined rate as it travels about the guiding rolls 15, etc., one of which is positively driven. The sleeve 14 is generally made of fabric impregnated with rubber, i. e., some rubber-like material which will resist the action of the ammonia vapors. While it is not necessarily to be employed, and is no part of the present invention, a metallic link chain belt 16 is positively driven in synchronism with sleeve 14 and serves to support and assists in advancing the exposed sensitized material past the developing portion of the tank. This belt 16 is pervious to the ammonia vapors, but further details need not be further described at this point. For a more detailed description of the developing tank and other parts of a machine of this type, reference is made to U. S. Patents 2,200,996 and 2,350,257.

Within the tank 11 is an evaporating tray 17 into which a stream or streams of liquid ammonia or other developing agent are discharged. Here two outlets are provided each of which conveys ammonia to the tray, these outlets terminating at the ends of the pipes or tubes 18 and 19. At the side of the machine or at any other convenient point, preferably adjacent the developing chamber, is a casing 20 which is adapted to hold a supply of ammonia such supply being indicated at 21, the level thereof varying as ammonia is drawn from it passing to the evaporating tray and as the supply is replenished. The supply may be automatically replenished or maintained, but for most purposes it is sufficient to pour amounts of liquid into the chamber 20 keeping the level well above a minimum point at which no delivery would be forthcoming. One simple manner of accomplishing this involves pumping ammonia from a receptacle at the base of the machine, that being something the operator does periodically as the liquid levels falls toward a predetermined mark at which replenishment of the supply is to be effected.

Referring to Figs. 2–5, the chamber 20 is shown in much greater detail. It comprises a main casting 22, cover or lid 23, and three windows designated by numerals 24, 25, and 26, each of which includes a glass plate clamped in position by a retaining flange. Of course, gaskets are employed so that all parts form a liquid-tight closure. These windows are not essential, but are provided so that the functioning of the internal parts and liquid level may be observed by the operator, if desired.

A float 27 connected to a pivoting arm 28 serves to show on a suitable indicator at the front of the machine the fact that the developer level has reached a predetermined minimum. It serves to make a contact for flashing a warning signal when the liquid level reaches that low point.

Within the liquid-tight casing are provided two sprockets 29 and 30 about which a link chain 31, such as a bicycle chain, passes. One of the sprockets is positively driven while the other may rotate freely about its pivot or axis. Here the sprocket 30 is fixed at the end of a shaft 32 and is driven by an externally positioned sprocket 33 connectable by a chain to some suitable rotating part of the machine. Of course, the driving of the chain may be accomplished through any suitable means so long as it is positively rotated in predetermined timed relationship to the other functioning parts of the machine. Sprocket 29 is rotatable on a bearing at the end of a stud 34. An adjustment may be provided by arranging for movement of the stud 34 to or away from shaft 32, thereby to tighten the chain to that point at which there will be no appreciable slack, yet allowing it to run freely.

To chain 31 are connected at spaced intervals a number of buckets 35. These buckets are shaped as illustrated in Fig. 2 and are freely hinged to swing about pins 36 which project from the chain links. In fact, these pins are extensions of the link pivots themselves. The center of gravity of each bucket is so disposed that normally they swing downwardly as is shown the bucket viewed through window 26, Fig. 2, being stopped at a predetermined position by a second projecting pin 37 which bears at the top inner edge of the bucket just forwardly of the pivot 36. Each bucket dips in the liquid as the chain moves in the direction indicated by the arrow thereby picking up a certain quantity of ammonia or other developing liquid and carries that liquid upwardly over sprocket 30 whereupon it is dumped, since as the chain passes about that sprocket, the change of course of the chain and effect of the pin 37 tip the bucket to a vertical position. At that time, the bucket is at a point above a small reservoir or recess 38 at the right hand side of the casting 22, Figs. 2 and 2a, to which the tubes 18 and 19 are connected. Ammonia or other liquid dumped into the recess 38 then flows by gravity through these tubes to be discharged into the evaporating tray 17, Fig. 1.

The buckets, after being dumped as above described, swivel about their pivots during the descent of that part of the chain, evenually assuming their original position and, upon passing about the sprocket 29, again pick up a predetermined quantity of liquid and repeat the process. Any convenient number of buckets may be employed, that depending upon the quantity each bucket is adapted to discharge, also upon the relative speed at which the chain travels compared to the speed of other parts and functions of the developing machine itself.

In one preferred form of the invention, buckets are provided at opposite sides of the chain. That is not entirely essential but it does eliminate a tendency toward unbalanced effects due to locating all buckets at one side. Another rea-

son for providing buckets at both sides of the chain and for spacing them laterally to an appreciable extent is that buckets at one side may dump into a reservoir or recess 38 which is divided at its center part, Fig. 2a, so that one group of buckets discharges their liquid to be carried through tube 18 to one side of the evaporating tray, while those buckets at the opposite side of the chain deliver liquid carried through tube 19 to the other side of that tray. Of course, there are an equal number of buckets at either side and they deliver practically identical quantities so that each part of the evaporating tray is fed the same quantity of developing liquid, and that condition prevails no matter what the speed of operation or rate of delivery may be.

Now referring to Figs. 3 and 5, there are shown a pair of guides 39 and 40 which confine the chain 31 to a straight line path at that portion of its travel upwardly prior to passing over sprocket 30. Each of these guides may be adjusted so that they vary their angle, but preferably they should guide the chain in a pathway so that in its travel upwardly, it passes in as nearly a straight line as is possible from the top of one sprocket to the top of the next. The guide 39 is supported by a bracket 41 attached by connecting screw 42 which passes through a clearance hole at the side of the casing 23. Likewise, guide 40 is fixed at the inner end of bracket 43 attached by screw 44. The clearance holes provide for a certain amount of adjustment. These guides bear upon the chain rollers, but permit them to pass between without unnecessary friction, and without any actual binding. The width of the guides is such that there is no opportunity for the chain to tilt or to wobble laterally during its travel.

In addition to control of the rate of delivery as effected by changing the speed at which the chain travels in direct ratio to the printing and developing speed of the machine, a supplementary control is provided. This supplementary control acts at a point prior to that at which the buckets are dumped and tilts them so that a part of their contents is discharged back into the main reservoir in the chamber 20.

The design of the developer feeding means is primarily based on delivery of the maximum quantity of liquid which may ever be demanded without resort to supplementary control. That is, as the plurality of buckets dip in the liquid carrying their full contents over sprocket 30 and dumping into the recess or recesses at 38, the amount of ammonia or other liquid actually delivered will always be sufficient. Of course, in actual practice there will be few instances where that amount of liquid would be desired for any length of time. Perhaps in starting up a machine which has been drained, or for some other reason had insufficient ammonia within the developing chamber, full delivery would be employed for a few minutes.

The form of this supplemental means is evident in Figs. 2, 3, and 4. It comprises, considering double sided delivery as herein illustrated, two cams designated by numerals 45 and 46, and actuating means for setting them. These cams are arcuate in shape and either extend from or are attached to the ends of a shaft 47 which projects through from one side to the other of the casing 23. This shaft is rotatable in bearings at either end thereof and carries a worm wheel 48 at its inner projecting end by means of which it is rocked throughout a small angular extent. The remainder of the means for rocking the shaft 47 and cams 45 and 46 includes a worm 49 engageable with the wheel 48 and fixed to the end of shaft 50. This shaft 50 is rotatable in bearings in the brackets 51 and 52 attached to the upright lugs 53 and 54 cast as integral parts of the upper casing 23. The shaft 50 has a small sprocket 55 attached at its outer end, over which runs a chain 56. This chain extends down and about a second sprocket 57 which is fixed intermediate the ends of a short spindle 58 projecting through a bearing 59 at the lower end of a downwardly extending bracket 60, Fig. 2. This spindle 58 extends through the front plate 61 at the part of the machine where controls are located and has an operating knob 62 by means of which it may be turned thereby to rotate shaft 50 and the spindle 47 and its attached cams.

Chain 56 is tensioned by spring 63 so that is no lost motion. As shown in Fig. 7, the knob 62 has a pointer 64 associated therewith, said pointer functioning to indicate in cooperation with marks from "0" to "Full" to show the actual amount of liquid reaching chamber 38 compared to the full amount originally picked up by the buckets as they pass through and leave the liquid supply.

There is considerable reduction of motion so that almost a complete revolution of the knob is required for a very slight angular movement of the cams. A projection 65 strikes a stop pin 66 so that movement never exceeds a maximum for which the device has been planned.

Each of the buckets, or at least some of them, have projecting pins 67 extending outwardly toward the cams 45 or 46 as the case may be. These pins strike against the curved surface of their respective cams and tip the buckets about their pivots. The movement of shaft 47 and the cams is such that at one extreme setting, "Full," the pins just pass by without making any contact. For other settings, there will be actual contact, and, depending upon the position at which the cams are set, the buckets will be dumped throughout varying angular extents. The extreme movement toward the "0" side is so regulated that even at the mark indicating "0" or no delivery at all, there will be a very slight amount of developer actually delivered. That prevents running the machine without some developer. That is, the machine cannot be run dry.

The general arrangement of parts herein described is that embodied in a preferred form of invention. Of course, there may be variations in the mechanical parts themselves, the disposal and shape of cams may vary, or other mechanical expedients may be employed so long as the general principles of operation are substantially the same. In place of the sprockets and chain, and the worm and gear, through which the supplemental change of delivery rate is effected, other devices may be employed, for example, other types of gears, cables, or flexible shafting may enter into the combination.

Instead of sprockets, chain, and buckets, other mechanical devices may be employed so long as they function in timed relation with other parts of the machine and so long as they act to pick up a definite quantity of liquid and to deliver it at a point where it will be conveyed or led to the evaporating tray undiminished in quantity, except as affected by the supplemental control.

The float 27 functions through linkage (not shown) to rock a switch 68 which is preferably a mercury type switch, and which makes contact

to light a warning signal only at such times as the liquid level falls to a minimum point where replenishment is desirable.

Now referring to Fig. 8, one form of evaporating tray particularly adapted to use with the previously described delivery mechanism is illustrated. That tray is indicated generally by numeral 69. It is pressed out of sheet material and has two more or less parallel channels 70 and 71, each of which is preferably of V-section, and each of which increases in width and depth from one end to the other. This increase in width and depth is oppositely directed for each channel so that the large end, that is, the low end of channel 71 is at the right while that of channel 70 is at the left. The usual heating tubes 72 and 73 are provided and ammonia is fed adjacent the narrow or high end of each channel. A tube 74 feeds channel 70 while a corresponding tube 75 projecting over to the opposite side feeds channel 71.

Referring to Fig. 9, a modified form of tray is shown in which the center point is the highest point and two V-shaped channels extend outwardly and downwardly from that central point. At the right a channel 76 receives ammonia from a tube 77 and at the left a similar channel 78 receives ammonia from a tube 79. When functioning in cooperation with the balanced and equal delivery from the mechanism above described, each of these trays will serve to evaporate the developing liquid giving off an equal amount of vapor evenly disposed over the interior of the tank 11 so long as the heating coils or other heating device (not shown) develop a similar amount of heat.

The entire combination herein described has been found to be more economical, is more easily controlled to give precisely the amount of vapor required, and gives that vapor off over the entire area of the developing portion of the machine with more even distribution than has heretofore been possible. Once set and properly adjusted, it is practically impossible for the device to get out of adjustment or to function other than as intended.

In operation, the device functions entirely automatically except, of course, for the setting for the auxiliary control. As the machine is started the delivery of developing liquid commences immediately, the amount of delivery being dependent upon the setting at the dial, Fig. 7. At "0" setting the supplementary control functions to dump most, but not all, of the developing liquid prior to its reaching the point at which it is normally discharged. That always assures delivery of a minimum amount of ammonia or other developer. As the machine speed is changed, as it must be for different originals, different materials, etc., the speed of the chain and, therefore, the delivery of developer follows that change in direct proportion so that, as seen in Fig. 6, the curves for delivery plotted against machine speed are all straight lines.

Depending upon the setting for the cams 45 and 46, i. e., ¼, ½, etc., an amount of developer somewhat less than the maximum possible of delivery will actually reach the reservoir 38, and from that, the vaporizing chamber.

The effect of the auxiliary control can be seen from Fig. 6, in which the three curves which lie below the curve entitled "Bucket full" show the actual amount of developer delivered at any particular machine speed in feet per minute. The proportion is always a direct one.

Throughout the disclosure reference has been made to ammonia and other developing liquids. For the diazo process ammonia is probably the only developing medium now employed, but it is to be understood that other developers may be employed and the mechanism herein described and claimed is equally adapted to use therewith. The quantities evident in the diagram at Fig. 6 apply to one particular machine and, of course, they may vary for other installations. The principles herein set forth would still apply.

Instead of providing for a visual signal which indicates that point at which replenishment is desired, some other signal may be used, and in fact, the control may function automatically to start a pump or other device by means of which liquid level may be brought to some predetermined point.

While one preferred embodiment of the invention has been disclosed it is to be understood that the inventive concept may be carried out in a number of ways. This application is, therefore, not to be limited to the precise details described, but is intended to cover all variations and modifications thereof falling within the spirit of the invention and the scope of the claims.

I claim:

1. A conveying system for liquid material having a storage tank from which liquid is to be conveyed at a varying rate to a point of delivery, comprising a plurality of buckets, means for successively and continuously transporting said buckets between said storage tank and said point of delivery at a varying rate of speed, said buckets being successively immersed in said liquid and tipped at said point of delivery, means for controlling the amount of liquid delivered within a predetermined time at any given rate of travel of said buckets, including means for tilting said buckets prior to said tipping at the point of delivery and means for selecting the extent of tilt, whereby a desired portion of said liquid carried by each of said buckets is returned to said storage tank prior to the tipping of said buckets.

2. A conveying system for liquid material having a storage tank from which liquid is to be conveyed at a varying rate to a point of delivery, comprising an endless chain carrying a plurality of buckets, sprockets for moving said chain over a path between said tank and said point of delivery, thereby dipping said buckets into said liquid, and tipping said buckets to discharge at said point of delivery, a drive for said sprockets having variable speed and means for controlling the amount of liquid delivered within a predetermined time at any given speed of travel of said buckets, including a cam engaging said buckets and tilting them prior to said tipping at the point of delivery and means for adjusting the extent of engagement of said cam, whereby a desired portion of said liquid carried by each of said buckets is returned to said storage tank prior to the tipping of said buckets.

3. A conveying system for liquid material having a storage tank from which liquid is to be conveyed at a varying rate to a point of delivery, comprising a pair of sprockets, an endless chain interconnecting said sprockets, drive means for at least one of said sprockets, a plurality of buckets placed in consecutive order carried by said chain, one of said sprockets being disposed within said tank, and the other at said point of delivery whereby said buckets dip into the liquid to be conveyed and discharge at said point as the chain passes about said sprockets, the speed of said driving means determining the rate of delivery of said liquid, a projection on said

buckets, cam means positioned ahead of said point of delivery and adapted to engage said projections whereby said buckets are tilted and a portion of the liquid therein is returned to said tank prior to the tipping of said buckets, and means for selectively positioning said cam determining thereby the extent of tilt and the amount of liquid to be returned independently from changes in the speed of said buckets.

4. Mechanism as defined in claim 3, wherein said cam means is movable by and is retained in any of its adjusted positions by a means which includes a control dial, a setting lever and pointer for cooperation with the dial and connecting linkage therefrom to the cam.

5. Mechanism as defined in claim 3, wherein said cam means is movable by and is retained in

any of its adjusted positions by a means which includes a setting lever and pointer, a dial marked to show effective discharge in cooperation with said pointer, and an interconnecting linkage between said lever and cam including a reduction gear drive whereby a relatively large movement of the dial affects a small movement in the position of said cam.

FREDERICK OTTO TRUMP.

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