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Kobayashi

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[54] **WET DEVELOPING DEVICE FOR DIAZO TYPE COPYING MACHINES**

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[52] **U.S. Cl.** ..... **95/89 A**, 95/89 R, 355/10

[51] **Int. Cl.** **G03d 5/06**

[58] **Field of Search** ..... 95/89 R, 89 A, 89 G, 95/94 G; 355/10

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[57] **ABSTRACT**

A wet developing device for copying machines of the diazo type comprising a transfer roller, a central roller and a pressing roller arranged in a row and abutting each other. The central roller is made of rubberlike material, and a felt strip whose lower portion is immersed in a tray of developing fluid, is pressed against the central roller by means of a leaf spring. As the rollers rotate, excess developing fluid applied to the central roller is squeezed between the pressing roller and the central roller, and a photosensitive sheet passed between the transfer roller and the central roller receives a minimal but uniformly distributed coating of developing fluid. The diameter of the pressing roller is less than the diameter of the transfer roller such that the squeezing action between the pressing roller and the central roller is greater than the squeezing action between the central roller and a transfer roller, and hence no excess developing fluid collects at the area of contact between the transfer and the central rollers where the sheet to be developed is passed. A pressure applying roller maintains constant regulated pressure between the transfer, central and pressing rollers while the wet developing device is in operation, and removes the pressure when the wet developing device is not operating so as to avoid deformation of the central roller due to lasting pressure on the same areas of the central roller.

10 Claims, 2 Drawing Figures

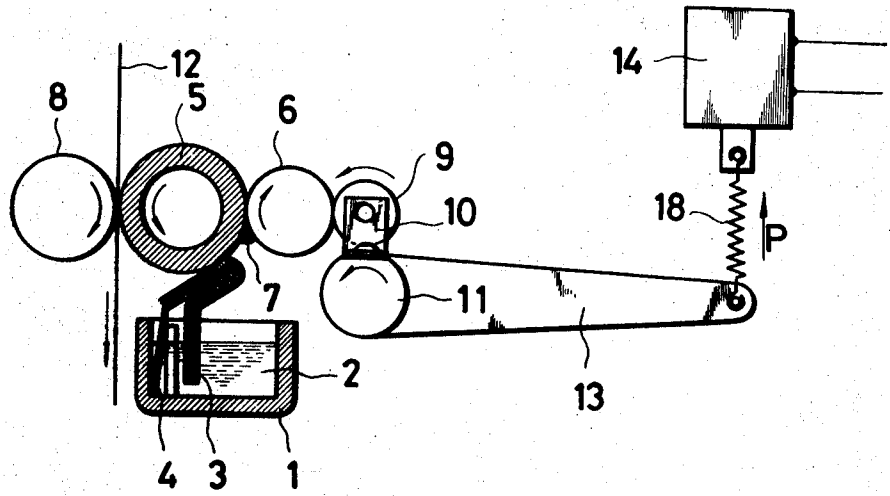


Fig.1

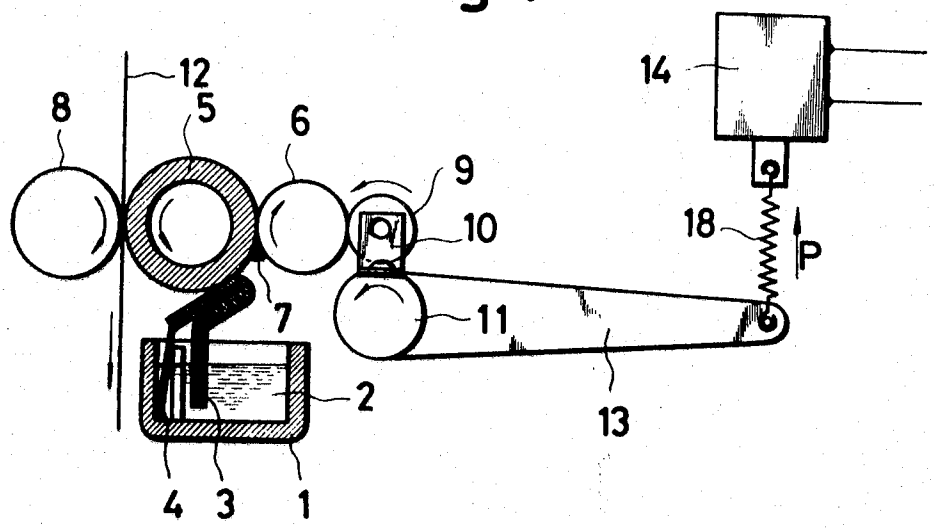
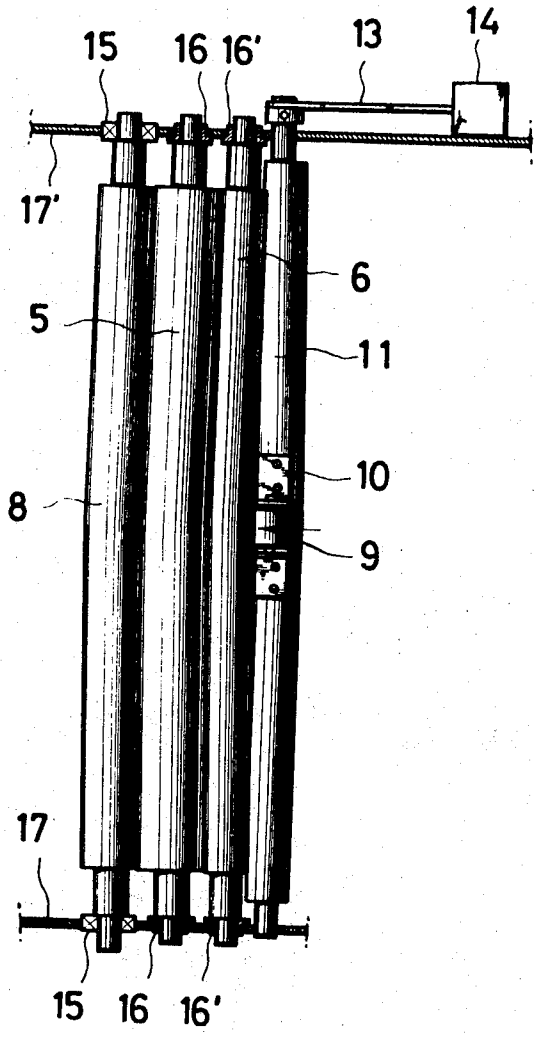


Fig. 2



WET DEVELOPING DEVICE FOR DIAZO TYPE COPYING MACHINES

BACKGROUND OF THE INVENTION

The invention relates to a wet developing device for copying machines of the diazo type in which a specially treated photosensitive sheet is exposed to the image of an original and is then chemically treated by a developing fluid to develop the image.

A common method of applying developing fluid to the photosensitive sheets in diazo type copying machines has been to use a spongelike rubber roller directly contacting the photosensitive sheets. One obvious disadvantage associated with this practice is that the quantity of developing fluid applied to the photosensitive sheets is often excessive. Hence, the sheets treated by this process tend to become soggy and to lose firmness. The sheets treated by this process often remain wet to the touch even after they are discharged from the machine. The desirable goal is to apply a uniform film of developing fluid to the photosensitive sheets but to minimize the amount of developing fluid so that the sheets remain firm and are hence easier to handle within the machine and outside the machine and have better appearance.

SUMMARY OF THE INVENTION

The invention relates to a wet developing device for copying machines of the diazo type in which specially treated photosensitive sheets are exposed to the image of an original and are subsequently treated with a developing fluid to develop the image of the original. In particular, the invention resides in the provision of three rollers rotatably mounted parallel to one another in a row, with the adjacent rollers being maintained in contact with each other, one of the rollers disposed at one end of the row being journalled by bearings immovably secured at one position while the other two rollers are supported for movement toward or away from the adjacent rollers, means for applying pressure to the movable roller disposed at the other end of the row so that the adjacent rollers may press against each other, and means for applying a developing fluid to the movable roller disposed at the middle of the row, the three rollers being arranged such that a photosensitive sheet is passed between the end fixed roller and the movable middle roller and excess developing fluid is removed from the middle movable roller by the end movable roller cooperating with the middle movable roller in squeezing out the fluid.

By virtue of this feature, the quantity of the developing fluid required for developing each photosensitive sheet is markedly reduced so that copies made by this developing device have finishes which are similar to those obtained with a dry developing device. Preferably, the photosensitive layer on the photosensitive sheets is of the binary system type including a mixture of a diazo-compound and a coupler, and the developing fluid is an amine of high efficiency. If this combination is used, the quantity of the developing fluid required in the developing device according to this invention is much lower than that in a conventional wet developing device.

This invention also resides in the provision, in a wet developing device for copying machines of the diazo type, of developing fluid applying means comprising a developing fluid tray containing a developing fluid therein, and a developing fluid applying member made of material such as felt which has a lower portion immersed in the developing fluid and an upper portion resiliently pressing against the middle movable roller for Supplying the developing fluid thereto. This feature precludes excess developing fluid from being applied to the middle movable roller. Additionally, the developing fluid applying member concurrently performs the function of cleaning the middle movable roller by removing dust or the like therefrom.

An additional feature of the invention is that the diameter of the end movable roller is less than the diameter of the end fixed roller, such that the squeezing action between the two movable rollers is greater than the squeezing action between the end fixed roller and the movable middle roller and no excess developing fluid is collected at the area where the photosensitive sheet is passed, i.e., between the end fixed roller and the adjacent movable roller.

A still additional feature of the invention is the provision for keeping the three rollers pressing against each other only while the diazo machine is operating, but removing the pressure when the machine is not operating so as to prevent lasting deformations of the rollers.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a partly sectional and partly schematic side view of the wet developing device according to the invention.

FIG. 2 is a partly sectional and partly plan top view of the wet developing device shown in FIG. 1.

DETAILED DESCRIPTION

Referring to FIG. 1 which shows in sectional view a transfer roller 8, a central roller 5, and a pressing roller 6, a developing fluid applying member 3 made of an absorbent material such as felt has a lower portion immersed in developing fluid 2 contained in a developing fluid tray 1, and an upper portion urged by the biasing force of a spring 4 into pressing engagement with the central roller 5 which is made of rubber or rubberlike material and is adapted to rotate in the direction of the shown arrow.

Referring to FIG. 2, the transfer roller 8 is journalled for rotation by suitable bearing 15 which are fixedly secured to side plates 17 and 17' respectively. The central roller 5 and the pressing roller 6 are journalled for rotation by slide bearings 16 and 16' respectively which are movably supported by the side plates 17 and 17' respectively for movement toward and away from the transfer roller 8, i.e., for movement to the right and to the left in FIG. 2.

Referring back to FIG. 1, the pressing roller 6 is urged to the left by a pressure applying roller 9 rotatably mounted on support plates 10 secured to a shaft 11 and spaced apart therefrom. The shaft 11 is rotatably supported by the side plates 17 and 17' and has a radially extending arm 13 whose free end is connected by means of a spring 18 to a solenoid 14. When the solenoid 14 is in its energized state, a force acting in the direction of the arrow P shown in FIG. 1 is exerted on the arm 13. This causes the shaft 11 to rotate counterclockwise so that the shaft 11 causes the pressure applying roller 9 to press against the pressing roller 6. Since the pressing roller 6 and the central roller 5 are movably supported by the side plates 17 and 17' while the transfer roller is fixedly supported thereby, the

pressure applying roller 9 causes the rollers 5, 6 and 8 to press against each other with equal force. When the solenoid 14 is in its deenergized state, the spring 18 is not pulling the arm 13 up in the direction of the arrow P and there is no pressing force between the rollers 5, 6 and 8.

When the wet developing device of the subject invention is in operation, each of the rollers 5, 6 and 8 rotates in the direction of the arrows shown in FIG. 1 and the solenoid 14 is energized so that the rollers 5, 6 and 8 press against each other. Developing fluid 2 is liberally applied to the lower peripheral surface of the central roller 5 by means of the portion of the felt member 3 which is pressed against the central roller 5 by the spring 4. The pressing roller 6 and the central roller 5 rotating as shown in FIG. 1 and pressing each other squeeze excess developing fluid from the roller 5 such that the excess developing fluid collects at an area 7 just below the area of contact between the pressing roller 6 and the central roller 5. The peripheral area of the central roller 5 which is above the area of contact with the pressing roller 6 thus has a uniformly distributed but thin film of developing fluid 2. This uniform and thin film of developig fluid 2 is applied to a photosensitive sheet 12 which is passed between the central roller 5 and the transfer roller 8 as shown in FIG. 1.

When the wet developing device of the subject invention is not operating, the solenoid 14 is in its deenergized state, the shaft 11 is free to rotate in the clockwise direction and there is no pressing force between the rollers 5, 6 and 8. Thus, when the copying machine is not operating and the rollers 5, 6 and 8 are not rotating, deformation of the central roller 5, which is made of rubber or rubberlike material, due to lasting pressure at the same areas by the rollers 6 and 8 is avoided.

For the purpose of properly controlling the amount of developing fluid 2 applied to the photosensitive sheet 12, the diameter of the pressing roller 6 is preferably less than the diameter of the transfer roller 8, so that the pressure per unit area applied by the pressing roller 6 on the central roller 5 is greater than the pressure per unit area applied by the transfer roller 8 on the central roller 5. The result of this is that greater squeezing action takes place between the pressing roller 6 and the central roller 5 than between the transfer roller 8 and the central roller 5. Thus, the excess developing fluid 2 is squeezed out at the area of contact between the pressing roller 5 and the central roller 5 and there is no possibility of excess developing fluid 2 squeezed out and collected at the area of contact between the transfer roller 8 and the central roller 5. Since no excess developing fluid 2 collects at the area of contact between the transfer roller 8 and the central roller 5, there is no possibility that an excess amount of developing fluid 2 would be applied to the sheet 12 which is passed between the transfer roller 8 and the central roller 5. The sheet 12 receives a uniform thin coating of developing fluid.

The invented wet developing device offers numerous advantages. For example, the arrangement of the rollers 5, 6, 8 and 9 is such that only the bearings of the rollers 8 and 9 need be strong enough to withstand the horizontal pressure applied by the pressure applying roller 9. The bearings for the rollers 5 and 6 need be only strong enough to support the rollers. Additionally, the transfer roller 8 and the central roller 5 may be of relatively small diameters. The fact that the rollers 5 and 8 may have relatively small diameters means that these rollers may be produced at lower production costs and that there is less likelihood of binding a sheet 12 than with larger diameter rollers.

A still additional advantage is that the quantity of developing fluid applied to the photosensitive sheets 12 may be regulated by adjusting the pressure applied to the rollers 5, 6 and 8 by means of the pressure applying roller 9. The pressure may be regulated, for example, by suitably adjusting the tension of the spring 18.

A still additional advantage is that the portion of the felt member 3 which is pressed against the central roller 5 by means of the spring 4 serves not only the function of applying developing fluid 2 to the central roller 5 but also the function of wiping the central roller 5 clean of dust particles and the like which the central roller 5 may have picked up from a sheet 12 or otherwise.

The solenoid 14 may be coupled to the same switch which turns on and off the copying machine of which the wet developing device described above forms a part. The connection may be such that the solenoid 14 is energized when the machine is turned on and the solenoid 14 is deenergized when the machine is turned off. By removing the pressure between the rollers 5, 6 and 8 when the machine is turned off, it is possible to prevent deformation of the rollers, and particularly of the central roller 5 which is made of rubber or rubberlike material, and to prolong the useful life of the invented wet developing device.

As a possible variation of the wet developing device described above, the solenoid 14 and the spring 18 may be dispensed with, and the arm 13 may be operated manually, i.e., its free end may be lifted up to cause the rollers 5, 6 and 8 to press against each other and may be pushed down to remove the pressure between the rollers 5, 6 and 8. The arm 13 may be mechanically connected to a switch for turning on and off the copying machine of which the invented wet developing device is a part such that the machine is turned on when the arm 13 is rotated counterclockwise and the machine is turned off when the arm 13 is rotated clockwise.

The main advantage of the invented wet developing device is that it is possible to control the quantity of developing fluid by regulating the pressure between the rollers 5, 6 and 8. By regulating the amount of developing fluid it is possible to reduce the amount of developing fluid applied to each photosensitive sheet 12 to the essential minimum to enable each photosensitive sheet 12 to be developed adequately and yet to be discharged from the developing device in an essentially dry condition, resembling a copy sheet produced in a dry copying process.

I claim:

1. A wet developing device for diazo type copying machines comprising three rollers mounted in a row for rotation about axis parallel to one another, with the adjacent rollers being maintained in contact with each other and having substantially the same peripheral velocities at the points of contact, one of said rollers disposed at one end of the row being journalled by bearings fixedly secured at one position while the other two rollers are supported for movement toward or away from the adjacent rollers, means for applying pressure to the movable roller disposed at the other end of the row so that the three rollers press against each other,

and means for applying developing fluid to the movable roller disposed at the middle of the row, said three rollers being arranged such that a photosensitive sheet may be passed between the end fixed end roller and the middle movable roller, said movable end roller having a smaller diameter than said fixed end roller whereby excess developing fluid is removed from the middle movable roller by the movable end roller cooperating therewith and collects in the area of contact between said movable end roller and said middle movable roller.

2. A wet developing device as in claim 1 including means for selectively causing the means for applying pressure to the movable end roller to stop applying said pressure.

3. A wet developing device for a diazo copying machine comprising a transfer roller, a central roller parallel to and abutting the transfer roller and a pressing roller parallel to and abutting the central roller, support means for journalling the transfer roller at a rotational axis fixed with respect to the support means and for journalling the central and pressing rollers for rotation about axes movable toward and away from the transfer roller, with the rollers having substantially the same peripheral velocities at the points at which they abut, means for applying regulatable pressure to the pressing roller to press it against the central roller and to thereby press the central roller against the transfer roller, and means for applying developing fluid to the central roller, at an area thereof which rotates from the transfer toward the pressing roller, whereby excess developing fluid applied to the central roller may be squeezed out between the central roller and the pressing roller and a sheet may be passed between the transfer roller and the central roller to contact developing fluid remaining on the area of the central roller which has contacted the pressing roller as the rollers are suitably rotated wherein the means for applying pressure to the pressing roller comprise a shaft journalled at the support means for rotation about an axis parallel to the roller axes and having radially extending support plates journalling a pressure applying roller parallel to and abutting the pressing roller, an arm extending radially out from the shaft and means acting on the arm to rotate the shaft about its axis to press the pressure applying roller against the pressing roller.

4. A wet developing device for a diazo copying machine comprising a transfer roller, a central roller parallel to and abutting the transfer roller and a pressing roller parallel to and abutting the central roller, support means for journalling the transfer roller at a rotational axis fixed with respect to the support means and for journalling the central and pressing rollers for rotation about axis movable toward and away from the transfer roller, with the rollers having substantially the same peripheral velocities at the points at which they abut, means for applying regulatable pressure to the pressing roller to press it against the central roller and to thereby press the central roller against the transfer roller, and means for applying developing fluid to the central roller, at an area thereof which rotates from the transfer toward the pressing roller, whereby excess developing fluid applied to the central roller may be squeezed out between the central roller and the pressing roller and a sheet may be passed between the transfer roller and the central roller to contact developing fluid remaining on the area of the central roller which has contacted the pressing roller as the rollers are suitably rotated wherein the central roller is made of resilient rubberlike material and the diameter of the pressing roller is less than the diameter of the transfer roller, whereby the pressure per unit area of contact and the squeezing action between the pressing and the central roller are greater than the pressure per unit area of contact and the squeezing action between the transfer and the central roller and hence excess squeezed fluid may collect at the area of contact between the pressing and the central roller but not at the area of contact between the transfer and central roller where a sheet is passed.

5. A wet developing device as in claim 4 wherein the means for applying developing fluid to the central roller comprise a developing fluid reservoir, an absorbent member having a portion immersed in the reservoir and a portion contacting the central roller, and resilient means pressing the portion of the absorbent member contacting the central roller against the central roller.

6. A wet developing device as in claim 5 wherein the means for applying pressure to the pressing roller comprise a shaft journalled at the support means for rotation about an axis parallel to the roller axes and having radially extending support plates journalling a pressure applying roller parallel to and abutting the pressing roller and disposed at the side thereof opposite the side abutting the central roller, an arm extending radially out from the shaft and spring means attached to the free end of the arm to urge the pressure applying roller against the pressing roller.

7. A wet developing device as in claim 6 including means for regulating the force applied by the spring means on the arm to thereby regulate the pressure applied by the pressure applying roller on the pressing roller.

8. A wet developing device as in claim 7 wherein the means for regulating the force applied to the shaft arm comprise a solenoid connected to the spring means and having an energized state in which it causes the spring means to apply force on the arm to press the transfer, central, pressing and pressure applying rollers together, and having a deenergized state in which it releases the spring means.

9. A wet developing device as in claim 4 wherein the means for applying pressure to the pressing roller comprise a shaft journalled at the support means for rotation about an axis parallel to the roller axes and having radially extending support plates journalling at least one pressure applying roller parallel to and abutting the pressing roller and disposed at the side thereof Opposite the side abutting the central roller, an arm extending radially out from the shaft and spring means attached to the free end of the arm to urge the pressure applying roller against the pressing roller.

10. A wet developing device as in claim 9 including means for regulating the force applied by the spring means on the arm to thereby regulate the pressure applied by the pressure applying roller on the pressing roller.

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