

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN AND RELATING TO TONER METERING DEVICES

(71) We, AGFA-GEVAERT AKTIEN-GESELLSCHAFT, a body corporate organised according to the laws of the Federal Republic of Germany, of Leverkusen, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to toner metering devices for the developing unit of electrostatic copying apparatus.

In German Offenlegungsschrift No. 1,954,323 it has been proposed to use a toner metering device comprising a supply container in which a toner brush is arranged to rotate. The container is provided on its underside with a series of holes and as the brush rotates, the bristles push through these holes and allow toner to fall onto a developer transport chain of the developing unit arranged beneath the container. The amount of toner discharged to the developing unit depends on the speed of rotation of the toner brush which can be rotated either progressively or intermittently by a specific angle per unit time. For the intermittent rotation of the toner brush, an electric motor controlled by an adjustable time switch is provided in a relatively expensive and complicated manner. The progressive rotation by an adjustable angle per unit time is effected by means of a pawl swivelling periodically backwards and forwards; the pawl engages a ratchet wheel and is kept at a distance from it by means of an adjustable supporting surface for a portion, which can be varied in length, of its periodic movement. The speed of rotation of the toner brush can, however, only be relatively approximately adjusted, because the angle of the forward movement can only ever be varied by a full tooth pitch, and because the teeth of the ratchet wheel cannot be refined arbitrarily without endangering the operational reliability.

The invention provides a toner metering device for a developing unit of electrostatic copying apparatus, the metering device com-

prising transport means, the amount of movement of which in a predetermined length of time determines the amount of toner discharged to the developing unit in that time, a drive member movable between first and second positions, a free-wheel mechanism arranged to transmit drive to the transport means from the drive member as it moves from one of the positions to the other and stop means arranged to determine the location of one of the said positions, the stop means being adjustable to vary the distance between the said positions, the arrangement being such that, in use, the drive member moves to-and-fro between the said first and second positions.

This arrangement can produce in a simple manner a very reliable arrangement for metering toner, which can be controlled at will in fine stages or also continuously, if desired.

Advantageously, the device comprises means for moving the drive member from the first position to the second position and for allowing the drive member to return to the first position. Preferably, the moving means comprises rotatable cam means, preferably, an eccentric, the drive member being arranged to rest against the cam means as the drive member moves between the first and second positions.

The drive member is advantageously arranged to move between the first and second positions by pivoting on an axle on which the transport means, which is advantageously movable by rotation, and the free-wheel mechanism are mounted.

The free-wheel mechanism preferably comprises a coil spring located around an axle on which the transport means is mounted.

Advantageously, the stop means determines the location of the first position and, preferably, the stop means is formed by an eccentric connected to an adjusting handle.

In an especially simple manner the eccentric may be manufactured in one piece together with a turning knob made of plastics material, which carries a resilient stop engaging around the side of the pivot bore of

the turning knob facing away from the operating button. The stop exerts a force on the turning knob pulling it into its pivot bore and on its side facing the pivot bore the stop carries locking elements engaging with complementary locking elements fixed to the apparatus.

A toner metering device constructed in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a toner metering device installed in an electrostatic developing unit;

Figure 2 shows a portion of the toner metering device according to the invention on a larger scale, and

Figure 3 shows a section through the arrangement along the line III-III in Figure 2.

Referring to the accompanying drawings, Figure 1 shows a toner metering device in a developing unit of an electrostatic copying apparatus. A printing cylinder 3 is mounted in an apparatus frame 1 on an axle 2 and is provided with a photoconductive layer. At the periphery of the printing cylinder 3, the housing 4 of the developing unit is arranged, in the lower part of which there is located a supply 5 of developer mixture, which in known manner contains toner particles and carrier particles. A conveyor chain 8 is stretched over two rollers 6 and 7 mounted in the developing unit housing 4; this conveyor chain conveys the developer mixture from the supply 5 to a discharge point positioned higher up, from which it cascades in known manner over the surface of the printing cylinder 3 and in so doing develops an electrostatic latent image on the cylinder.

To replenish the toner particles consumed during the developing process there is provided in the developing unit housing 4 a further housing 9 in which there is a supply 10 of toner particles. In the toner supply 10 a toner brush 11 secured to an axle 12 rotates and as it rotates, brushes toner particles through apertures 10a of the housing 9 from whence they fall on to scoops of the conveyor chain 8 and thus enrich the developer mixture in circulation with toner particles. It may readily be seen that the degree of this enriching is dependent approximately linearly on the speed of rotation of the toner brush.

Naturally, instead of the toner brush, another transport element influencing the transport of the toner as a function of its speed of movement can be used, for example, a cylinder provided on its surface with transverse channels, or a perforated slider member moving backwards and forwards, or a similar element.

As shown in Figures 2 and 3, to control

the speed of the toner brush 11, a coil spring 13 is pushed onto the axle 12 of the toner brush. In its initial state this spring has a diameter such that it lies with a light pressure against the axle. One end 13a of this spring is hooked into a slot 14a of a rocking lever 14. If the rocking lever 14 is pivoted in the direction of the arrow A, then the spring 13 is opened. The force with which the spring rests against the axle 12 is thereby reduced. The axle 12 and with it the brush 11 do not participate in the movement of the rocking lever 14, provided that an adequately large braking torque is effective only on the axle 12 and the brush 11. Such a braking torque can be produced, provided that the natural friction is inadequate, by means of a spring-mounted friction brake disc 15 pushed on to the axle 12, which increases the frictional force between the core 11a of the toner brush 11 and the housing 9 of the toner dispenser.

A movement of the rocking lever 14 in a direction opposite to that indicated by the arrow A tightens the spring 13 and thus closes it closer around the axle 12 which it takes against considerable resistance in a direction opposite to that indicated by the arrow A. A force-reinforcing effect occurs because an increase in the resistance at the same time causes the contact between the spring 13 and the axle 12 to be intensified.

The rocking lever 14 is mounted on the axle 12 by means of a pivot bore 14b and is also mounted on a flange 9a of the housing 9 by means of a bearing step 14c and is secured by means of a circlip 16. The spring 13 is accommodated by a bore 14d the diameter of which is sufficiently large to permit the spring to operate properly as a free-wheeling mechanism.

The rocking lever 14 carries a pin 17 on to which a tension spring 18 is hooked. The other end of the tension spring 18 is hooked on to a pin 19 secured to the housing 9. The tension spring 18 thus exerts a torque on the rocking lever 14 effective in the direction of the arrow A.

A gear wheel 21 is pivoted on an axle 20 secured to the housing 9 and carries an eccentric 22. The gear wheel 21 engages with a gear wheel 23 which is connected, in a manner not described in more detail, with a constant drive mechanism fixed to the apparatus. For example, it could be secured on the axle of one of the two securing rollers 6 and 7 for the conveyor chain, or may be connected in another manner with the drive mechanism for this conveyor chain.

Under the action of the spring 18 an arm 14e of the rocking lever 14 rests against the rotating eccentric 22. A further arm 14f of the rocking lever 14 rests against an adjustable eccentric 24 which is secured to an adjusting knob 25. The adjusting knob 25 is

provided with grooves 25a on its outer periphery which facilitate its manipulation. It carries an extension piece 25c divided by a slot 25b and thereby rendered resilient in a radial direction, the two halves of the extension piece being provided with stop faces 25d. These sloping stop faces 25d engage resiliently behind a pivot bore 9d constructed in a flange 9b of the housing 9 for the turning knob 25, and as a result exert a force on this turning knob 25 in the direction of the arrow B. This spring force effective in the direction of arrow B holds together locking elements 25e and 9c arranged on the turning knob 25 and the housing 9 in the manner of a radial serration, which locking elements consequently effect in a simple manner a locking of the adjusting knob 25 in many different locking positions.

When the eccentric 24 is set in the position shown by a broken line in Figure 2, the locking lever 14 can follow the eccentric 22 for its entire path until it is in its final position, also indicated by a broken line. In this case, as already stated above, the toner brush 11 is always rotated a little further whenever the rocking lever 14 moves back to its initial position in a direction opposite to the direction indicated by the arrow A. If, however, the rocking lever 14 is wholly or partially prevented by means of the adjustable eccentric 24 from following the eccentric 22, then in addition to the forward movement, the backward movement also and with it the forward movement of the toner brush 11 is correspondingly reduced. When the eccentric 24 is located in the position shown in Figure 2 by a solid line, then, for example, the forward movement of the toner brush 11 is completely interrupted. Of course, as already mentioned, the speed of rotation of the drive shaft of another transport device effecting the supply of toner as a function of this speed could also be controlled in this manner.

WHAT WE CLAIM IS:—

1. A toner metering device for a developing unit of electrostatic copying apparatus, the metering device comprising transport means, the amount of movement of which in a predetermined length of time determines the amount of toner discharged to the developing unit in that time, a drive member movable between first and second positions, a free-wheel mechanism arranged to transmit drive to the transport means from the drive member as it moves from one of the positions to the other, and stop means arranged to determine the location of one of the said positions, the stop means being adjustable to vary the distance between the said positions, the arrangement being such that, in use, the drive member moves to-and-fro between the said first and second positions.

2. A toner metering device as claimed in Claim 1, which comprises means for moving the drive member from the first position to the second position and for allowing the drive member to return to the first position.

3. A toner metering device as claimed in Claim 2, wherein the moving means comprises rotatable cam means, the drive member being arranged to rest against the cam means as the drive member moves between the first and second positions.

4. A toner metering device as claimed in Claim 3, wherein the cam means is an eccentric.

5. A toner metering device as claimed in any one of Claims 1 to 4, wherein the drive member is arranged to move between the first and second positions by pivoting on an axle on which the transport means and the free-wheel mechanism are mounted.

6. A toner metering device as claimed in any one of Claims 1 to 5, wherein the free-wheel mechanism comprises a coil spring located around an axle on which the transport means is mounted.

7. A toner metering device as claimed in any one of Claims 1 to 6, wherein the stop means determines the location of the first position.

8. A toner metering device as claimed in any one of Claims 1 to 7, wherein the stop means is formed by an eccentric connected to an adjusting handle.

9. A toner metering device as claimed in Claim 8, wherein the eccentric and a turning knob are manufactured in one piece from a plastics material, the turning knob being mounted in a bore in the apparatus and carrying a resilient extension engaging the side of the bore facing away from the turning knob, the extension being arranged to exert a force on the turning knob pulling it into its bore, and the turning knob being provided with locking elements on its side facing the bore which are arranged to engage complementary locking elements on the apparatus.

10. A toner metering device substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

11. A developing unit of electrostatic copying apparatus in combination with a toner metering device as claimed in any one of Claims 1 to 10.

12. Electrostatic copying apparatus including a toner metering device as claimed in any one of Claims 1 to 10.

13. Toner metering device for the inking unit of an electrophotographic copying apparatus, in which there is arranged in a supply container a rotating transport element for the toner, which transport element, on account of the varying magnitude of its number of revolutions per unit of time, con-

provided with grooves 25a on its outer periphery which facilitate its manipulation. It carries an extension piece 25c divided by a slot 25b and thereby rendered resilient in a radial direction, the two halves of the extension piece being provided with stop faces 25d. These sloping stop faces 25d engage resiliently behind a pivot bore 9d constructed in a flange 9b of the housing 9 for the turning knob 25, and as a result exert a force on this turning knob 25 in the direction of the arrow B. This spring force effective in the direction of arrow B holds together locking elements 25e and 9c arranged on the turning knob 25 and the housing 9 in the manner of a radial serration, which locking elements consequently effect in a simple manner a locking of the adjusting knob 25 in many different locking positions.

When the eccentric 24 is set in the position shown by a broken line in Figure 2, the locking lever 14 can follow the eccentric 22 for its entire path until it is in its final position, also indicated by a broken line. In this case, as already stated above, the toner brush 11 is always rotated a little further whenever the rocking lever 14 moves back to its initial position in a direction opposite to the direction indicated by the arrow A. If, however, the rocking lever 14 is wholly or partially prevented by means of the adjustable eccentric 24 from following the eccentric 22, then in addition to the forward movement, the backward movement also and with it the forward movement of the toner brush 11 is correspondingly reduced. When the eccentric 24 is located in the position shown in Figure 2 by a solid line, then, for example, the forward movement of the toner brush 11 is completely interrupted. Of course, as already mentioned, the speed of rotation of the drive shaft of another transport device effecting the supply of toner as a function of this speed could also be controlled in this manner.

WHAT WE CLAIM IS:—

1. A toner metering device for a developing unit of electrostatic copying apparatus, the metering device comprising transport means, the amount of movement of which in a predetermined length of time determines the amount of toner discharged to the developing unit in that time, a drive member movable between first and second positions, a free-wheel mechanism arranged to transmit drive to the transport means from the drive member as it moves from one of the positions to the other, and stop means arranged to determine the location of one of the said positions, the stop means being adjustable to vary the distance between the said positions, the arrangement being such that, in use, the drive member moves to-and-fro between the said first and second positions.

2. A toner metering device as claimed in Claim 1, which comprises means for moving the drive member from the first position to the second position and for allowing the drive member to return to the first position.

3. A toner metering device as claimed in Claim 2, wherein the moving means comprises rotatable cam means, the drive member being arranged to rest against the cam means as the drive member moves between the first and second positions.

4. A toner metering device as claimed in Claim 3, wherein the cam means is an eccentric.

5. A toner metering device as claimed in any one of Claims 1 to 4, wherein the drive member is arranged to move between the first and second positions by pivoting on an axle on which the transport means and the free-wheel mechanism are mounted.

6. A toner metering device as claimed in any one of Claims 1 to 5, wherein the free-wheel mechanism comprises a coil spring located around an axle on which the transport means is mounted.

7. A toner metering device as claimed in any one of Claims 1 to 6, wherein the stop means determines the location of the first position.

8. A toner metering device as claimed in any one of Claims 1 to 7, wherein the stop means is formed by an eccentric connected to an adjusting handle.

9. A toner metering device as claimed in Claim 8, wherein the eccentric and a turning knob are manufactured in one piece from a plastics material, the turning knob being mounted in a bore in the apparatus and carrying a resilient extension engaging the side of the bore facing away from the turning knob, the extension being arranged to exert a force on the turning knob pulling it into its bore, and the turning knob being provided with locking elements on its side facing the bore which are arranged to engage complementary locking elements on the apparatus.

10. A toner metering device substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

11. A developing unit of electrostatic copying apparatus in combination with a toner metering device as claimed in any one of Claims 1 to 10.

12. Electrostatic copying apparatus including a toner metering device as claimed in any one of Claims 1 to 10.

13. Toner metering device for the inking unit of an electrophotographic copying apparatus, in which there is arranged in a supply container a rotating transport element for the toner, which transport element, on account of the varying magnitude of its number of revolutions per unit of time, con-



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5 trols the rate of toner discharge to the inking unit, and in which a device is provided for the progressive rotational movement of the transport element, characterised in that the axle of the transport element is connected by way of a free-wheeling mechanism to a rocking lever which rests positively against a rotating eccentric, and that the swivel movement of the rocking lever towards the

rotating eccentric can be limited by means 10 of an adjustable stop means.

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