Oct. 19, 1965 K. MÜNNICH 3,213,256

APPARATUS FOR DEVELOPING PHOTOCOPIES BY HEAT

Filed April 24, 1963

Fig. 1

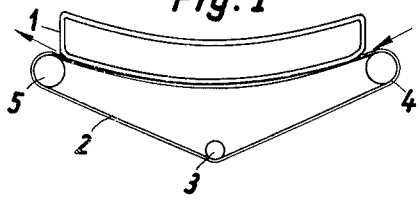


Fig. 2

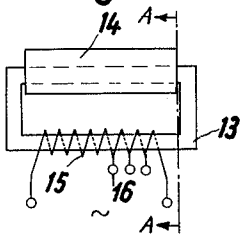


Fig. 3

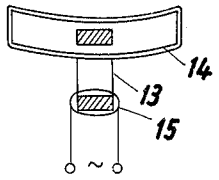


Fig. 4

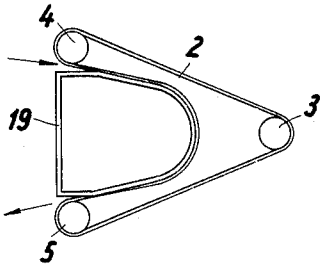


Fig. 5

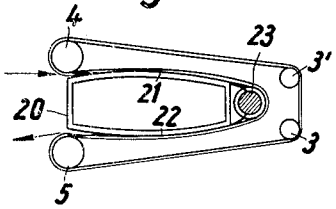
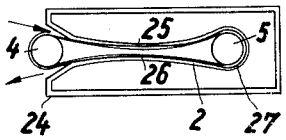


Fig. 6



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APPARATUS FOR DEVELOPING PHOTOCOPIES BY HEAT

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7 Claims. (Cl. 219—10.61)

The invention relates to an apparatus for developing photocopies by heat, wherein the photocopy is held in contact with a heat vehicle by a moving endless belt.

Photocopying papers are known which are developed solely by the action of a heat after exposure. To obtain a uniform development for such papers the paper must be heated quite uniformly.

Known apparatus for developing such photocopying papers comprises a heatable roller used as a heat vehicle, and an endless heat-resistant belt which is controlled by reversing rollers, moves across the surface of the roller, and moves the print over the roller while holding it in contact therewith. The belt may be divided up into adjacent narrow strips if desired. The roller is heated by internal or external heating sources, the heat of which is stored by the roller and then yielded to the photocopying paper by conduction.

The known apparatus only imperfectly satisfies the requirement of uniform heating of the photocopying paper. For the paper to be uniformly heated throughout, the roller itself must be heated quite uniformly. This is difficult to achieve with rotatable rollers, particularly if the papers to be developed are very wide. There is generally a temperature drop towards the ends of the roller so that the paper is less intensively developed at those places.

In addition, the heat transfer depends on the uniformity of contact between the roller and the paper. This necessitates very accurate machining of the roller surface, and this is expensive. Even if the roller surface is completely uniform, it is difficult to keep the photocopying paper in uniform contact with the roller throughout by means of an endless belt.

The object of the invention is to provide an apparatus in which the said difficulties are extensively obviated.

To this end, according to the invention, the heat vehicle has at least one fixed contact surface which forms part of a cylindrical surface and over the convex side of which the endless belt moves.

The fixed contact surface in the apparatus according to the invention can be made uniformly much more easily and cheaply than a rotatable roller. Moreover, the fixed contact surface can be heated uniformly much more satisfactorily than with a rotating roller.

It should be noted that the term "cylinder" as used in this context does not necessarily mean a circular cylinder. The cross-section of the contact surface perpendicular to the axis of the cylinder may therefore have any convex curved shape, for example be parabolic. It is only necessary that all the planes containing the cylinder axis should cut the contact surface at an axis-parallel straight line.

It is extremely simple to heat the heat vehicle if the latter consists of a metal plate bent to be partly cylindrical. The plate can then be so connected in a low-tension high-current circuit as to be heated by resistance heating.

Another possibility of heating the plate is for the plate to form the secondary part of an induction heating system.

Resistance heating and induction heating may also be used simultaneously.

Examples of embodiment of the invention are illustrated in the drawing wherein:

FIG. 1 is a diagrammatic section through an arrangement showing the basic principle of the invention.

FIG. 2 is an example of the induction heating of the heat vehicle.

FIG. 3 is a cross-section through the arrangement shown in FIG. 2, taken along lines A—A.

FIGS. 4 to 6 are diagrammatic sections of various embodiments of the apparatus.

The development apparatus shown in FIG. 1 comprises a heat vehicle **1** with a convex contact surface over which an endless belt **2** passes. The contact surface forms a part of a cylindrical surface the axis of which is perpendicular to the drawing plane, so that the belt bears closely against the contact surface over the entire width transversely to the direction of movement of said belt. The cylinder naturally need not be a circular cylinder but may have any cross-section. The only important point is that the contact surface generatrices perpendicular to the drawing plane should be straight.

The conveyor belt **2** is guided by an adjustable tensioning roller **3**, a reversing roller **4**, and a driven conveyor roller **5**. The photocopying paper to be developed is introduced between the belt **2** and the heat vehicle **1** in the direction of the arrow on the right-hand side of the apparatus in the drawing. The friction between the conveyor belt **2** and the paper is much greater than the friction between the paper and the contact surface so that the paper is driven by the conveyor belt. At the same time it is held in close and uniform contact throughout with the contact surface of the heat vehicle **1** so that there is a uniform heat transfer by which the paper is developed until it finally leaves the apparatus on the left-hand side in the drawing. During the passage through the apparatus, the exposed side of the paper may face the conveyor belt or the contact surface.

Possible means of heating the heat vehicle are shown in FIGS. 2 and 3. The vehicle consists of a bent plate **14** which is endless and which surrounds one arm of a magnet core **13**, the other arm of which carries a primary winding **15**. In this case the plate **14** forms a short-circuited secondary winding of the transformer so that after application of an A.C. voltage to the primary winding **15** currents are induced in the plate **14**. These currents very uniformly and rapidly heat the plate **14** and the temperature can be controlled by tappings **16** on the primary winding **15**.

Resistance heating and induction heating may naturally be applied simultaneously.

The endless belt and the conveying, reversing and tensioning rollers **3**, **4** and **5** are preferably also heated. This may be done by resistance or induction heating as well. FIG. 1 shows another possibility of heating the conveyor belt. To this end, heater elements **17** are disposed on the back of the conveyor belt and their heat radiation is directed to the conveyor belt. A reflector **18** concentrates the radiant energy of the heater elements **17** onto the belt.

FIG. 4 shows another embodiment of the development apparatus wherein the heat vehicle **19** has a substantially parabolic cross-section perpendicularly to the cylinder axis. The advantage of this construction is that the developed papers leave the apparatus on the same side as they were introduced. This facilitates operation of the apparatus. The construction of the endless belt **2** and rollers **3**, **4** and **5** is the same as in FIG. 1. The heating vehicle **19** may be heated by one or more of the possibilities explained with reference to FIGS. 1 to 3.

In the embodiment shown in FIG. 5, the heat vehicle **20** has two contact surfaces **21** and **22** disposed substantially parallel or at an acute angle to one another. A reversing roller **23** is disposed along the edge where the two contact surfaces abut. This construction gives the same advantage as FIG. 4, namely, that the paper enters and leaves the apparatus on the same side, with a lower overall height.

The same effect is obtained with the arrangement shown in FIG. 7, in which the heat vehicle **24** comprises two facing contact surfaces **25** and **26**. The endless belt **2** runs without any additional tensioning or reversing rollers **2** between the two conveyor rollers **4** and **5**, each run of the conveyor belt co-operating with a contact surface. The conveyor roller **5** inside the apparatus is surrounded by a reversing chute **27** which guides the paper leaving the contact surface **25** to the contact surface **26**. In this case the conveyor roller **4** is both the inlet and exit roller.

In all the embodiments illustrated and described the conveyor belt may consist either of a single web extending over the entire width of the contact surface or a number of parallel belts disposed side by side.

I claim:

1. An apparatus for developing photocopies by heat, comprising a stationary heating member having a convex contact surface which forms part of a cylindrical surface, induction heating means arranged to heat said stationary heating member by electrical induction, an endless belt, means for moving said endless belt over said convex contact surface in contact therewith, and means for introducing the photocopies to be developed between said convex contact surface and said endless belt.

2. The apparatus as defined in claim **1**, wherein the cross-section of said convex contact surface perpendicular to the cylinder axis is substantially parabolic.

3. An apparatus for developing photocopies by heat, comprising an endless bent plate having a convex contact surface which forms part of a cylindrical surface, a magnetic core having an arm extending through said endless bent plate, and a further arm carrying a primary winding connected to an alternating voltage source, said endless bent plate forming a short-circuited secondary winding on said magnetic core, an endless belt, means for moving said endless belt over said convex contact surface in contact therewith, and means for introducing the photocopies to be developed between said contact surface and said endless belt.

4. The apparatus as defined in claim **3**, wherein the cross-section of said convex contact surface perpendicular to the cylinder axis is substantially parabolic.

5. An apparatus for developing photocopies by heat, comprising a stationary heating member having two oppositely facing convex contact surfaces, each of which forms part of a cylindrical surface, induction heating means arranged to heat said stationary heating member by eletrical induction, an endless belt, means for moving said endless belt over said convex contact surfaces in contact therewith, and means for introducing the photocopies to be developed between one of said convex contact surfaces and said endless belt.

6. An apparatus for developing photocopies by heat, comprising a stationary heating member having two spaced convex contact surfaces facing each other, each of said contact surfaces forming part of a cylindrical surface, induction heating means arranged to heat said stationary heating member by electrical induction, an endless belt, means for moving said endless belt over said contact surfaces in contact therewith, and means for introducing the photocopies to be developed between one of said contact surfaces and said endless belt.

7. An apparatus for developing photocopies by heat, comprising a stationary heating member having a parabolic contact surface which forms part of a cylindrical surface; induction heating means arranged to heat said stationary heating member; an endless belt; means for moving said belt over said parabolical contact surface while in contact therewith; and means for introducing the photocopies to be developed between said convex contact surface and said endless belt.

References Cited by the Examiner

UNITED STATES PATENTS

1,575,366	3/26	Johnson	34—233
1,701,156	2/29	Heritage	219—10.61
2,994,134	8/61	Adams	34—145
3,000,106	9/61	Christgau	219—383 X

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