April 23, 1968 W. LIMBERGER 3,379,878

THERMOGRAPHIC REPRODUCTION APPARATUS WITH MEANS TO APPLY THE RADIATION SENSITIVE MATERIAL JUST PRIOR TO EXPOSURE

Original Filed Jan. 30, 1963 2 Sheets-Sheet 1

FIG. 1

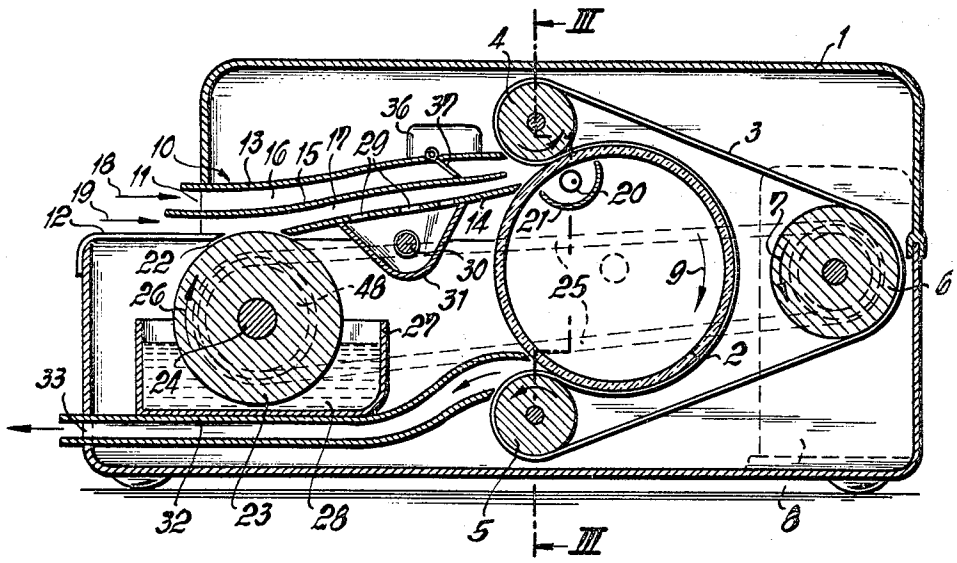


FIG. 1a

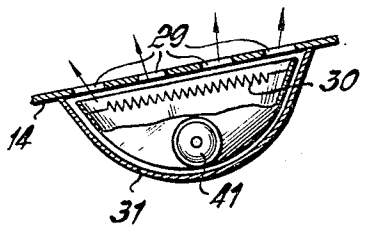
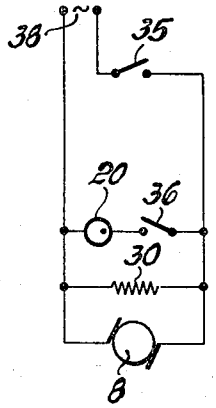


FIG. 2



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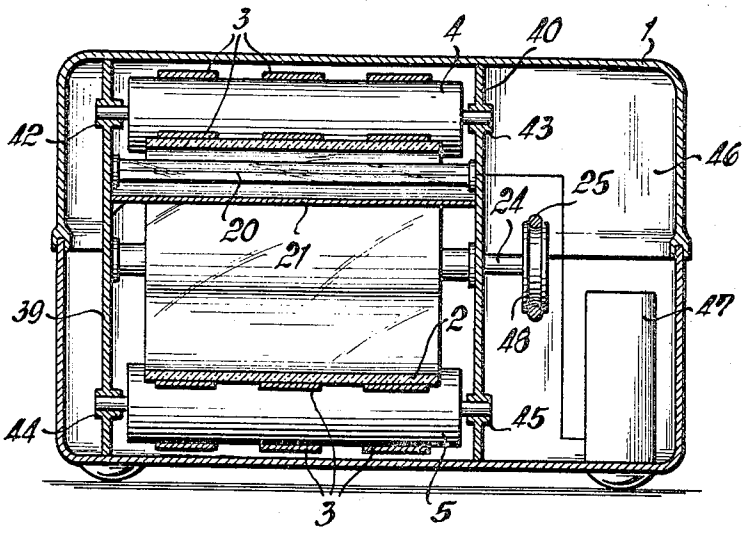
AGENT

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FIG. 3



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THERMOGRAPHIC REPRODUCTION APPARATUS WITH MEANS TO APPLY THE RADIATION SENSITIVE MATERIAL JUST PRIOR TO EXPOSURE

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Continuation of application Ser. No. 254,951, Jan. 30, 1963. This application Mar. 9, 1966, Ser. No. 533,097
Claims priority, application Germany, Feb. 15, 1962, L 41,223
10 Claims. (Cl. 250—65)

ABSTRACT OF THE DISCLOSURE

Contact copier wherein a master and a copy sheet move in contact with each other past a source of activating radiation, specifically an infrared radiator, the copy sheet being moistened on its way to the source with a sensitive fluid forming a coating thereon which is dried before the master contacts the copy sheet; the two sheets travel around the radiation source along a curved path with the sensitive layer on the concave side of the copy sheet.

This application is a continuation of my prior application Ser. No. 254,951, filed Jan. 30, 1963, and now abandoned.

The present invention relates to a method of manufacturing a contact copy from an original which, when placed in surface contact with a coated copy material, is exposed to radiation, preferably heat radiation.

Moreover the invention relates to a device for carrying out this method with a radiation source, in which an original and a copy material are exposed to radiation, while in surface contact, in order to transfer the image to the copy material.

Known copying methods utilizing radiant heat, for example, have the disadvantage that a special copy material must be used. This copy material must be stored. With the known methods this material has many undesirable characteristics, for example, the tendency to crack easily and to turn a yellowish color. Furthermore there is the disadvantage of keeping a store of this type of copy material which must be replenished at intervals.

The invention has the object of providing a method and in particular a device which avoids these disadvantages and facilitates the manufacture of contact copies (particularly thermocopies) independent of the particular copy material available, the device also being of a particularly simple construction and easy to manipulate.

This object is accomplished by the method of the invention, in which normal paper is used as the copy material and is coated directly before the onset of the copying process. According to a preferred embodiment of this method, a blank of copying material (preferably a paper sheet) is coated with a liquid substance which undergoes a definite change of color upon reaching a predetermined temperature when exposed to radiation and which will be referred to hereinafter as a thermographic substance. The conventionally applied radiant energy is reflected or scattered by the light surfaces of the original but absorbed by the dark or printed surfaces of the original and converted into heat, which is transferred to the copy material by the surface contact.

According to a particular embodiment of this method the copy material is dried after being coated with the liquid substance, for example by exposing the surface to heat and/or air. The copy sheet is preferably passed through the apparatus separate from the original or master sheet.

The heat also simultaneously effects a pre-warming up of the thermographic layer applied in its fluid state so that the radiated energy must solely bring about the change in temperature which leads to the coloring of the layer.

It is essential for the invention that the thermographic substance, preferably an emulsion, is applied just before the onset of the copying step, so that normal paper can be used as the initial material.

Preferably zinc stearate in its dissolved state serves as the coating substance. Within the scope of the invention, however, any material can be used that undergoes a definite change in color at a certain temperature limit, as by turning yellow, through an alteration it its chemical state or the like. Such a substance is for example aniline hydrochloride, or many other chlorides, alone or in combination with one another, for example aluminum chloride, bismuth chloride, iron chloride, copper chloride, zinc chloride and the like. Instead of chloride salts other salts can be used, for example, metal sulphates, bisulphates, persulphates and their agents, such as, copper sulphate, ferric ammonium, mercuric sulphate, ammonium persulphate. Furthermore, in this connection, hydrates, for example aniline hydrate, bromide, e.g. copper bromide and the like can be mentioned. Furthermore simple acids and sulphate acids alone or in combination with one another and with other substances known to the art can be used. In this connection sulphuric acid, citric acid, hydrochloric acid, phenyl sulphate acid and the like are mentioned. In particular it is emphasized that substances such as indaphenol, ammonium thiocyanate and ferric chloride as well as percentages of sympathetic inks can also be used.

The device for carrying out the method is provided with a radiation source and includes a storage container for a thermographic coating or doping substance, in combination with a device for spreading the coating substance over the copy sheet before exposure to the radiation source. This type of device may comprise a conventional spray device, or preferably a moistening device in the form of a roller dipping into the storage container and driven by the drive for the image transfer device.

Thus, one embodiment of the device has a transport path through the apparatus between an inlet and an outlet, this transport path being formed by guide elements leading into the region of a radiation source where the original and copy sheets are arranged to be squeezed together in the transport direction onto a rotatable cylinder of radiation-transmitting material inside which the radiation source is mounted; guide and pressure strips extend around the upper surface of the cylinder to press the original and copy sheets onto that surface. According to another feature of the invention, the original and the coated sheet of copy paper are briefly held relatively fixed in surface contact under pressure before they are separated.

The invention moreover provides that the original and the copy sheet are exposed to a radiation source while in relatively fixed surface contact. It is of particular advantage that the exposure to radiation occurs as a continuous step so that an apparatus is provided in which the original is inserted into the apparatus together with a normal paper sheet on which the desired copy, i.e. an image of the contents of the original or master sheet, appears as this paper sheet emerges from the apparatus.

According to a preferred embodiment the feed path for the original or master sheet and the copy sheet is divided down the middle into two parallel channel sections by a guide element while, preferably, a drying device for the copy material, for example in the form of a warm-air blower or a heating resistance, is provided in the feed channel section on the side of the device facing the coated sheet surface.

The apparatus preferably utilizes a conventional heat radiator, for example, an infrared emitter, as the radiation source.

The drying device is an essential feature of an apparatus according to the invention using a coating substance in its fluid state in order to produce a predried and therefore substantially solid layer before contact with the original. For example, on using zinc stearate a solution in benzol or xylol can be provided. In the case of a self-volatilizing-solvent the storage container is substantially closed in order to maintain the stability of the liquid substance over a longer period.

The invention is described below in conjunction with the accompanying drawing showing a preferred embodiment of the device. In the drawing:

FIG. 1 is a schematic side view of the device in section;

FIG. 1*a* is a sectional detail view of a modification of one element of the apparatus according to FIG. 1;

FIG. 2 is a circuit diagram for the electrical and driving connections of the device shown in FIG. 1; and

FIG. 3 is a longitudinal section along the line III—III in FIG. 1.

In a housing **1** a cylinder **2** is rotatably mounted in the usual manner. Cylinder **2** consists of a radiation-transmitting material, for example glass. It is encircled over more than half its circumference by one or more parallel straps **3**, which pass also over three rollers **4**, **5**, **6**, the two rollers **4**, **5** being mounted adjacent the cylinder **2**. Preferably, in the preferred embodiment, the axles of rollers **4**, **5** are mounted on a side of the vertical bisector of cylinder **2** opposite roller **6** so that the cylinder is essentially supported by the straps **3** and guided therein. At least one of the rollers **4**, **5** can be movably mounted and placed under tension, which forces this roller towards the cylinder **2**. Roller **6**, for example, is driven in the direction of the arrow **7**, i.e. counterclockwise in FIG. 1. A motor **8** mounted in the housing serves as an output whose drive shaft is coupled with the axis of roller **6**.

A heat radiator **20** is fixedly disposed inside cylinder **2**, as by being mounted on the side or intermediate walls **39**, **40** (FIG. 3) of the housing preferably inside a reflector **21**. The heat radiator **20** is for example an infrared source whose radiation is directed towards the surface of cylinder **2** by the reflector **21**. Preferably the heat radiator **20** is mounted beneath roller **4**. Reflector **21** is so constructed that the pencil of heat rays passes into the plane of contact between roller **4** and cylinder **2**. Cylinder **2** rotates in the direction of arrow **9**, i.e. clockwise in FIG. 1 or opposite to the sense of rotation of roller **6** as shown by arrow **7**. A feed channel **10** leads to the upper part of the cylinder **2**, extending from the inlet-slot arrangement **11** and ending in front of the zone of contact between roller **4** and cylinder **2**. The inlet-slot arrangement **11** is shown disposed in the housing above a forwardly projecting platform **12**. According to a particularly preferred embodiment the feed channel **10**, which is limited by an upper guide wall **13** and a lower guide wall **14**, is divided by a middle guide surface or partition **15** into two sections **16** and **17**. Section **16** serves for insertion of the original in the direction shown by arrow **18**, with the image facing downwardly, the section **17** is provided for the insertion of the copy sheet in the direction of arrow **19**. Thus, sections **16** and **17** form two adjoining channels (for the master sheet and the copy sheet, respectively) which merge in a common path around the cylinder **2**, the first channel **16** leading into the common path **2**, **3** on the convex side of its curvature whereas the second channel **17** leads into that common path along the concave side thereof.

Guide element **14** is interrupted beyond the insertion slot arrangement **11** to provide an opening **22** therein. A surface moistening device in the form of a roller **23** projects through this opening to such an extent that a paper passed through the channel section **17** runs safely over the roller. The axle **24** of the roller is mounted in the side or intermediate walls **39**, **40** (FIG. 3). This roller is for example driven by a belt **25** from motor **8** in the direction of arrow **26**, i.e. clockwise in FIG. 1. Roller **23** is associated with a liquid-storage container **27** so that a substantial part of its circumference dips into liquid **28** inside this container. Therefore, upon rotation of the roller, the liquid **28** is transported into the inlet-channel section **17** and transferred to a sheet of copy paper therein as it runs over the roller.

Guide element **14** is provided with several smaller perforations **29** between the opening **22** and the end facing the cylinder **2**, a heat-radiation source **30** being provided beneath perforations **29** inside reflector or chamber wall **31**. The heat source **30** can be in the form of an electric resistance. It should be mentioned here that in the feed channel **10**, in the region of the heat source **30** and perforations **29**, the section **16** is protected from the heat by the partition **15**, so that heat does not act directly upon the original except during surface contact of the coated copy material with the original. It should also be stated here that a ventilator **41** (FIG. 1*a*) may be provided in the apparatus to blow air into the chamber formed by wall **31**, which for example is heated by the heating element **30**. This heat is provided for the purpose of drying the substance spread onto the paper sheet by roller **23** so as to form a thermographic layer on the exposed surface of the copy sheet in channel **17**, i.e. the surface which subsequently passes along the concave side of the cylindrical path defined by elements **2**, **3**.

The storage container **27** is mounted on a substantially horizontal intermediate wall **32**, which is spaced from the cylinder **2** and also positioned higher than the lowermost point of roller **5** and extends as far as outlet opening **33**. Beneath this intermediate wall **32** there is provided a guide surface **34**, which can be fastened to the side or intermediate walls **39**, **40** of the apparatus in the same manner as wall **32** and extends to a point just below the top of roller **5** to form an opening there.

It should also be mentioned that the length of the feed channel **10** as well as the distance of the roller **5** from the outlet opening **33** is preferably shorter than the length of the material usually handled, such as a standard-size paper sheet. Consequently the arrangement eliminates the need for additional transport devices, so that the entire transport of the material through the coating and image-transferring apparatus is carried out solely by cylinder **2** and the strap or straps **3** encircling cylinder **2**. There is thus provided an extraordinarily compact construction, which facilitates the manufacture of copies with normal paper sheet and which needs no separating devices apart from the middle guide surface **15**.

The function of the apparatus will now be described in conjunction with FIGURE 2. An energy source **38** can be connected to the other apparatus parts by means of a main switch **35**. Actuation of this switch connects in the drive motor unit **8** as well as the heat source **30** to the power supply. The radiation source **20** is connectable by a particular switch **36**, which is provided in FIG. 1 at the inner end of guide element **13** and has an actuating member **37** projecting into the channel section **16**. This switch is therefore actuated in dependence upon the feed of the original through section **16** so that the radiation source is switched on only during use of the apparatus. The arrangement of the switch **36** in direct proximity to the radiation source **20** therefore enables the automatic de-energization of this source dependence upon the passage of the rear edge of the original past the switch **36**, since the residual radiation emitted after cutoff maintains the picture transference right up to the rear edge of the copy. It may, however, be mentioned that a conventional delayed circuit breaker can be provided to insure that the radiation source also remains switched on, even after pas-

sage of the rear edge of the original past switch 36, for a sufficiently long period.

In FIG. 3 the mounting of the parts on the two intermediate walls 39 40, of the apparatus can be seen. Cylinder 2 is entirely surrounded by strips 3 so that reflector 21 and the heat source 20 can be suported by these intermediate walls. It is moreover, apparent that rollers 4, 5 are journaled in the intermediate walls by means of bearings 42, 43, 44 and 45. Drive motor 8, which is not shown in FIG. 3 is preferably mounted in the side chamber 46 in which the electrical connections 47 are located and into which shafts provided with drive members 48 project as can be seen for the shaft 24 of roller 23.

I claim:

1. An apparatus for producing contact copies, comprising:

a housing provided with inlet means forming two juxtaposed entrance slots including a first slot for a master sheet to be copied and a second slot for a copy-receiving blank sheet;

a source of activating radiation disposed in said housing at a location remote from said inlet means;

guide means in said housing defining two adjoining channels including a first and a second channel respectively extending from said first and second slots to the vicinity of said source forming respective paths for said sheets and merging into a common path for both said sheets, said common path curving generally cylindrically about said source, said first and second channels leading into said common path at the convex side and the concave side of its curvature, respectively;

liquid-supply means adjacent said second channel between said inlet means and said remote location for applying to a surface of said blank sheet a fluid coating of copying material sensitive to said activating radiation, said liquid-supply means being disposed on the same side as said source with reference to the path of said blank sheet whereby the surface coated with said material passes in a stress-relieving manner on the concave side of said common path;

predrying means for said coating disposed adjacent said second channel on said same side thereof between said liquid-supply means and said source;

and outlet means on said housing for the discharge of said sheets upon traversal of said common path.

2. An apparatus as defined in claim 1 wherein said source comprises an emitter of infrared radiation.

3. An apparatus as defined in claim 1 wherein said guide means includes a pair of substantially parallel walls and partition means intermediate said walls dividing the space therebetween into said first and said second channels, one of said walls adjoining said second channel being provided with an aperture for the application of said copying material to an exposed surface of said blank sheet by said liquid-supply means.

4. An apparatus as defined in claim 3 wherein said one of said walls is further provided with at least one perforation in the region of said predrying means, the latter being disposed outside said walls in the vicinity of said perforation.

5. An apparatus as defined in claim 4 wherein said predrying means comprises a circulator of heated air.

6. An apparatus as defined in claim 3 wherein said liquid-supply means comprises a container for said copying material and a moistening roller dipping into said container, said roller extending through said aperture for contact with a blank sheet passing through said second channel.

7. An apparatus as defined in claim 1 wherein said source and said predrying means each comprises an emitter of radiant heat.

8. An apparatus as defined in claim 1 wherein said guide means include a rotatable cylinder of radiation-transmissive material surrounding said source and flexible pressure means urging said sheets into contact with an extended peripheral surface of said cylinder, said common path being bounded by said cylinder and said pressure means.

9. An apparatus as defined in claim 8 wherein said pressure means comprises at least one belt and rollers supporting said belt for joint rotation with said cylinder.

10. An apparatus as defined in claim 9 wherein said belt embraces said cylinder over an arc greater than 180°, said source being disposed near an inner periphery of said cylinder at the beginning of said arc.

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