Oct. 27, 1970 G. W. PIXLER 3,536,396

APPARATUS FOR MAKING REPRODUCTIONS

Filed Sept. 28, 1967 2 Sheets-Sheet 1

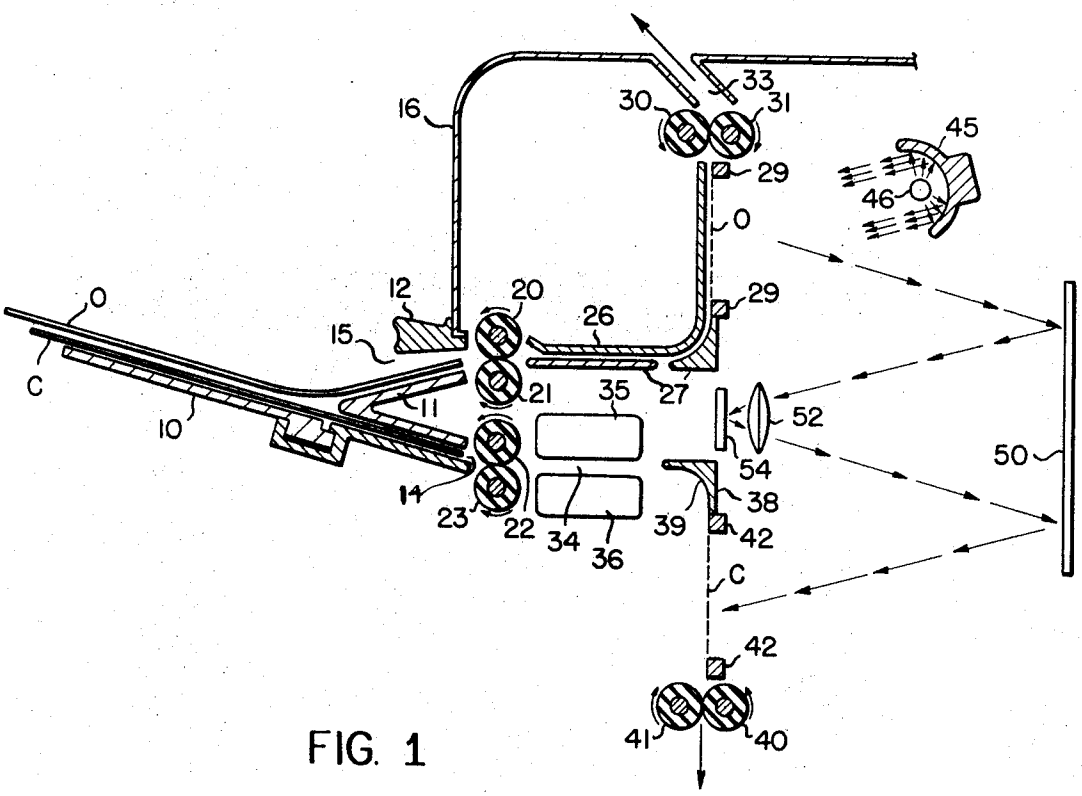


FIG. 1

INVENTOR
GORDON W. PIXLER

BY B. Schlesinger
ATTORNEY

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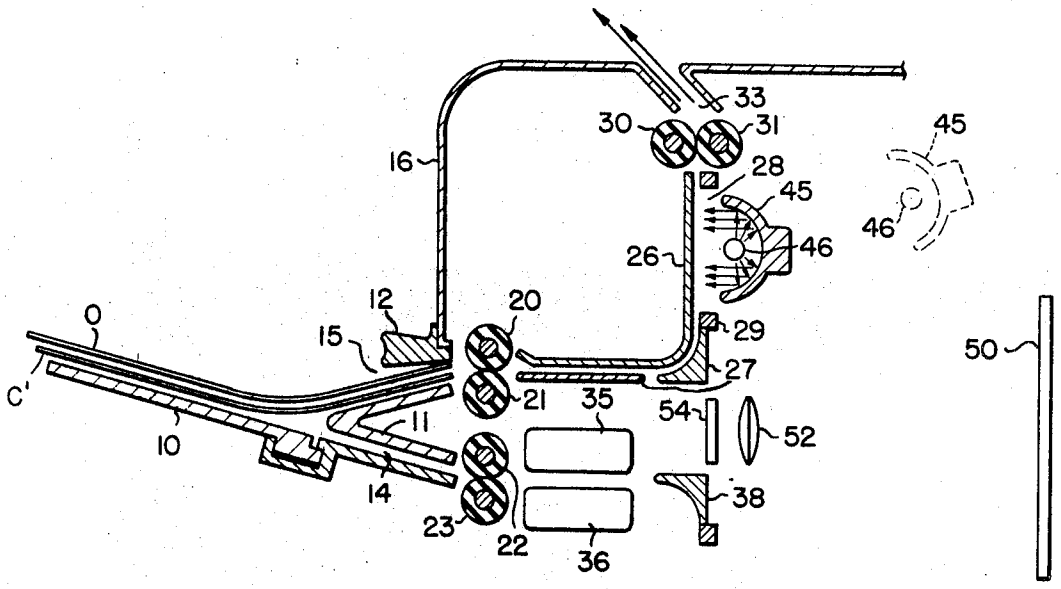
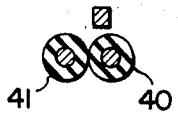


FIG. 2



INVENTOR

GORDON W. PIXLER

BY

ATTORNEY

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APPARATUS FOR MAKING REPRODUCTIONS

Gordon W. Pixler, Rochester, N.Y., assignor to Kee Lox Manufacturing Company, Rochester, N.Y., a corporation of Pennsylvania

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ABSTRACT OF THE DISCLOSURE

Thermographic copying is effected in the same machine in which electrostatic copies can be made. Electrostatic copies are made by passing zinc-oxide coated copy paper over a corona type charging unit, passing the original in front of a light source so that light is reflected from the non-image areas of the original onto the charged copy paper. The latent reproduction of the original is then developed by picking up oppositely charged marking particles. For making copies by the thermal process, both the original and thermal copy paper are passed in front of this light source which is here adjusted to be close enough to generate enough heat to make a thermal copy.

The present invention relates to office copying machines.

There are various types of office copying machines on the market. Several machines are of the electrostatic copying type, and there are machines for copying by the principle of thermography, etc.

Electrostatic copying is achieved by placing an electrical charge on a photoconductive surface by means of a high voltage corona, and then exposing the surface to light, either passing through an original, which is to be copied, or reflected from this original by means of a mirror and/or lens system. In either case, the light strikes the charged surface in conformity to the nonimage areas on the original. In these areas, through photoconductivity, the electrical charges are dissipated, leaving a latent reproduction of the original in the form of charges corresponding to the image areas of the original. These charged areas are then exposed to marking particles having an opposite electrical charge. The marking particles, because of their opposite electrical charge, are attracted to the charged areas, forming a now visible image which is a reproduction of the original.

In the Xerographic process, the photoconductive surface is a selenium drum upon which the image is formed. The drum is rotated into contact with ordinary paper, and the particles on the surface of the drum forming the image are transferred to the paper to produce a visible copy.

In another electrostatic copying process, instead of using a selenium drum as the photoconductor, zinc-oxide coated paper is employed, as the photoconductive material; and the image is formed directly on the copy paper. A number of different makes of machines use this process.

A second popular method of making copies in the modern office is by thermography. In this process, basically, two chemicals, which in their natural state are either colorless, or lightly colored, and which are relatively nonreactive, at room temperature, are incorporated into a coating on a sheet of paper. The chemicals, while nonreactive, at room temperature, are highly reactive at elevated temperatures, and form a reaction product which is highly colored. In practice, the copy sheet containing these chemicals is placed over an original on which is a heat-absorbing image. The two sheets are passed through the copying machine in close contact and subjected to heat from an infrared bulb. The heat waves generated by this

bulb pass through the copy paper, but do not heat the chemicals to the point where reaction occurs. Since the heat waves strike the original after passing through the copy paper, the heat is absorbed in the image areas only. The temperature of the copy paper in these areas reaches the point where the chemicals react, and the reaction product is formed, thus producing a reproduction of the image on the original.

Electrostatic copies provide a black image against a good white background. Normally, a heavy grade of paper is used; and copies produced by this process are considered generally to be of better quality than thermal copies, because the latter usually are made on a lightweight tissue type paper due to the necessity of passing the energy through the copy paper first. Furthermore, the electrostatic process will copy all colors of originals; whereas the thermal process will copy only those originals on which the printed material is heat-absorbing. Ball point pen writing, for example, in color other than black, is generally not capable of being copied by the thermal process. The thermal process, though, is capable of producing not merely single copies but also masters which can be used on spirit and offset duplicating equipment for long runs where a large number of copies are required. The thermal process is also capable of making overhead projection transparencies.

Copying machines based on the electrostatic principle, where a special paper is employed for making copies, are not capable of making spirit masters, and are not capable of making overhead projection transparencies, and only a few of them have the capability of making offset masters. In some electrostatic machines, for the purposes of economy and to keep the price to a minimum, the mirrors and lens systems are omitted. These electrostatic machines, however, have the disadvantage that they are capable of copying only originals printed on one side.

One object of the present invention is to provide a machine on which both the electrostatic and the thermographic processes can be practiced.

Another object of the invention is to broaden the capability of machines used for electrostatic copying.

Another object of the invention is to provide a machine capable of being employed for both electrostatic and thermographic copying which may be relatively low in price. Another concomittant object of the invention is to render an electrostatic machine, that is basically capable of copying only one side of an original which is printed on both sides, capable of copying both sides of such an original.

Other objects of the invention will be apparent hereinafter from the specification and from the recital of the appended claims, particularly when read in connection with the accompanying drawings.

In the drawings:

FIG. 1 is a somewhat diagrammatic vertical sectional view through a machine built according to one embodiment of this invention, showing the machine set up and in use for making copies according to the electrostatic process; and

FIG. 2 is a similar sectional view showing the machine set up and in use making copies according to the thermographic process.

Referring now to the drawings by numerals of reference, **10** denotes a table at the front of the machine over which the original from which a copy is to be made, and the copy paper may be fed into the machine. **11** is a divider, which is V-shaped in section, and which cooperates with the table **10** and with a guide bar **12** to form two throats **14** and **15**, respectively, at opposite sides of the divider. The divider **11** is secured to the frame of the machine in any desired manner to be disposed above the

plate **10** and below the guide bar **12**, and to have one leg spaced slightly above the table **10**, and the other leg spaced slightly below the guide bar **12** to form the two throats **14** and **15**. The guide bar may be secured in any suitable manner to the outside cover **16** of the machine.

Mounted adjacent the inner end of the throat **15** are a pair of rollers **20** and **21**; and mounted adjacent the inner end of the throat **14** are a pair of rollers **22** and **23**. The rollers **20** and **21** are driven in any suitable manner to rotate in opposite directions. They may be geared together, and one of them may be driven directly, while the other, for instance, may be driven from the first. The rollers **22** and **23** are also disposed to be driven in opposite directions. They also may be geared together, for instance, and one may be driven directly, with the second driven from the first.

The rollers **20** and **21** are disposed to receive sheets from the throat **15**, drive them through the nip between the rollers, and deliver them into a right-angular passageway formed by right-angular guides **26** and **27**. The vertical leg of the guide **26** terminates at its upper end in juxtaposition to a pair of rollers **30** and **31**, which are driven in opposite directions as denoted by the arrows adjacent thereto. These rollers may be geared together, and one may be directly driven. The vertical leg of the guide **27** is open as denoted at **29** to permit exposure of a sheet carried in the guideway.

The rollers **30** and **31**, in their rotation, convey the sheet or sheets to the passageway **33** for return of the sheet or sheets to the operator of the machine.

The rollers **22** and **23** deliver a sheet between charging units **35** and **36** of conventional construction, which produce a high voltage corona.

Mounted opposite the nip or space betwen the charging units **35** and **36** is a guide or deflector **38** having an arcuately curved surface **39** which causes the sheet, which has passed between the charging units to be deflected downwardly and delivered between two rollers **40** and **41**, which are driven in opposite directions, and which deliver an electrostatic copy, when the machine is used for electrostatic copying purposes, to the developing section of the machine, as indicated by the arrows. This developing section of the machine may be of conventional structure, and has not been illustrated. A frame **42**, which may be secured to and be dependent from the guide **38** serves to frame the area of the sheet on which a copy is to be made, when the machine is being operated according to the electrostatic process.

Mounted on guideways on the machine for adjustment toward and from the frame **29** is a parabolic reflector **45** in front of which and in cooperative relation thereto is disposed a light bulb **46** capable of emitting infrared rays.

Disposed at a point to reflect the image of the area of the original document, which is to be copied, when that area is in the frame **29**, is a mirror **50**. Light rays reflected from bulb **46** by parabolic reflector illuminate the original document; and its image is picked up by the mirror **50**. This image is reflected from mirror **50** through a concentrating lens **52** onto a small mirror **54**, which deflects the light rays back through the lens onto the mirror **50**, from whence the image is reflected onto the area of copy paper exposed in the frame **42**. The light dissipates the charge from the copy paper in the nonimage areas thereof, leaving a charged image of the original on the copy paper, which is then developed in the development section of the machine.

The parabolic reflector **45** and lamp **46** are mounted to slide as a unit on guideways provided on the sides of the machine so as to be moved toward or away from the frame **29**.

When the machine is set up as illustrated in FIG. 1, it can be used for electrostatic copying. Then the original document O, which is to be copied, is placed printed side down on top of copy paper C which has its sensitized (zinc-oxide) side up; and the two sheets are fed into the

machine manually so that the original document enters the throat **15** and is gripped by the rollers **20** and **21**, while the copy sheet enters the throat **14** and is gripped by the rolls **22** and **23**. The original document then passes from the rollers **20** and **21** into the passageway between the guides **26** and **27** while the copy sheet is conveyed by the rolls **22** and **23** into the space **34** between the charging units **35** and **36**, and is carried against the guide member **38**, which deflects it downwardly. The rollers **20**, **21**, are so driven, and the guide members **26** and **27** are so disposed on the one hand, and the rollers **22** and **23** are so driven and guide **38** is so disposed on the other that the original, which is to be copied, and the copy sheet arrive simultaneously at the frames **29** and **42**, respectively.

The light from the lamp **46** is then concentrated by the parabolic reflector **45** on the image area of the original, which is to be copied; and the image of this area is picked up by the mirror **50**, reflected through the lens **52** onto the mirror **54**, and reflected by that mirror back through the lens **52** onto the mirror **50**, which reflects it onto the copy paper C. The light thus strikes the charged surface on the copy paper in conformity to the noncharged image areas on the original O, reproducing an image thereof on the copy paper, which image can be developed in the development section of the machine (not shown) by passing the copy paper through a field of particles charged with the opposite electrical charge from that applied to the copy paper by the charging units **35** and **36**.

When the machine is to be used for copying according to the thermal process, the rolls **22** and **23** and **40** and **41** may be disconnected or let run idly, and the charging units may be cut out of circuit so that they are not operative. The reflector **45** and the lamp **46** carried thereby are adjusted, from the dash line position shown in FIG. 2 to the full line position shown in that figure, in close proximity to the opening **28** that is surrounded by the frame **29**. The original O is then placed printed side down on top of the copy paper C′, which in this case is thermosensitive; and the two are fed together through the throat **15** of the machine into the nip between the rolls **20** and **21**, which deliver both the original and the copy sheets into the guideway formed between the guide plates **26** and **27**. The light and infrared source **46** now subjects the original and the copy paper to heat, and the heat waves generated by the bulb **46**, pass through the copy paper C′, striking the original O, with the result that heat is absorbed in the image areas only of the original. The temperature of the copy paper in these areas then reaches the point where the chemicals react, and a reproduction of the image of the original is made on the copy paper. The rollers **30** and **31** then deliver both the original O and the reproduced copy of the original through the passageway **33** to the operator. The lower gripper rolls **22**, **23**, the charging units **35**, **36**, the mirrors **54** and **50**, and the lens **52**, and the developing system are not used in the thermal copying process.

From the above, it will be seen that the machine described can be used selectively to make copies according to the electrostatic or according to the thermographic process. The light source **46**, which is used in the electrostatic process to dissipate electrical charges from the zinc-oxide coated paper, when moved into proximity with thermosensitive copy paper and an original in contact therewith heats the thermosensitive copy to the point where the chemical reaction will take place in the heat-absorbing printed areas of the original and will produce a thermal copy of the original. This machine, therefore, basically is capable of producing electrostatic copies and also of producing copies by the thermal process, the heat generated from the bulb, that is used in the electrostatic process for dissipating the electrical charges from the zinc-oxide coated paper, being used in the thermographic process to produce the copy.

While the process has been described in connection

with a particular machine, it is to be understood that the invention is not limited to reproduction on this particular type of machine, since all electrostatic machines are potentially capable of making thermal copies as well as of making electrostatic copies by judicious selection and placement of the light bulb used in the machine for dissipating the electrical charges from the zinc-oxide paper. The light bulb should generate enough heat to make possible production of thermal copies in the machine.

In the prefered embodiment of the invention, the light bulb is mounted with the reflector to be movable on tracks. A lever or a dial on the outside of the machine may be used to effect the shifting of reflector and the light source. When electrostatic copies are desired, the light bulb would be in a normal position, such as shown in FIG. 1. When thermal copies are wanted, the bulb would move on the track arrangement to a position very close to the path of the thermal copy paper and original.

Instead of adjusting the bulb toward the copy paper, however, a variable speed motor may be used in the machine, and adjusted to slow down the passage of the original and the thermal copy paper as they pass in front of the light. This would merely involve a simple dial on the outside of the machine which could be turned to change the speed of the drive rolls, so that they drive the original and copy paper at relatively high speed when an electrostatic copy is to be made, and at relatively slow speed when a thermal copy is desired.

A third way in which the machine could be built would be to incorporate two bulbs in the machine, one serving the electrostatic process, and the other being positioned close to the path of the original and thermal copy paper, and one being turned on for the electrostatic process, and the other for the thermographic process.

A fourth possible method is to use a reflector which can be moved to focus the light properly for the electrostatic process and whose configuration and proximity to the light source can be changed to concentrate the energy more effectively, when making thermal copies, so as to produce enough heat for thermal copying.

By simply selecting a proper infrared generating light source and regulating the speed of transporting the original and copy to accommodate both copying processes, it will be seen, then, that both the electrostatic and the thermographic reproduction processes may be practiced on a single machine. For copying one to ten copies, the electrostatic process would preferably be used since it produces a generally more acceptable copy at approximately an equivalent copy paper cost. When a great number of copies is desired (ten to five thousand) a spirit or offset duplicating master may be made on the machine by the thermal process, and the desired number of copies run off on a duplicator. When overhead projection transparencies are required, the thermal process would of course be used. Thus, depending on his particular requirements, the user is able to take advantage of the unique features of both copying processes within a single machine.

A further advantage of this construction is that when there is a breakdown in the electrical section of an electrostatic copier, the machine still is capable of use for making either one to ten copies, or for making masters by switching totally to the thermal process while awaiting repairs in the electrostatic part of the machine. Thus, the out-of-service time of the copier would be reduced to zero as long as the light source was working.

A final advantage concerns those electrostatic machines which do not use a lens system, but use the direct "print through" process. These electrostatic machines have the disadvantage, as stated above, of being able to copy only originals printed on one side. The range of materials of which these machines are capable of copying is now broadened to include originals printed on both

sides, because it is possible with the same machine of this invention to switch from the electrostatic process to the thermal process, and copy both sides of such an original.

While the invention has been described in connection with several different embodiments thereof, it will be undesrstood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth, and as fall within the scope of the invention or the limits of the appended claims.

Having thus described my invention, what I claim is:

1. A machine for making a reproduction of an original selectively by an electrostatic or by a themographic process comprising

a pair of throats through one of which an original to be copied or an original and a sheet of copy paper may selectively be fed and through the other of which copy paper may be fed,

a first passageway deep enough for passage therethrough of an original or of an original and copy paper,

a second passageway for passage therethrough of copy paper, means for driving the material, that is fed into said one throat, through said first passageway,

means for driving the material, that is fed into said other throat, through said second passageway,

means disposed along said second passageway to charge electrically copy paper passing therethrough,

a light source,

a mirror and lens system,

said first passageway being open at one side to expose the material passing therethrough both to said light source and to said mirror and lens system whereby an image of said material is mirrored in said system, and

said second passageway being also open at one side to expose material passing therethrough to the image mirrored in and reflected by said mirror and lens system,

said light source being adjustable toward the opening in said first passageway from the position said light source occupies during electrostatic copy, thereby to apply heat to the material passing through said passageway to produce a thermographic copy of said material.

2. A machine for making a reproduction of an original selectively by either an electrostatic or a thermographic process comprising

a light source capable of emitting infrared rays,

means for selectively feeding an original to be copied or an original and copy paper past said light source,

means for charging copy paper electrically,

means for reflecting an image of the original on the copy paper after charging the copy paper, and

means for varying the distance between the light source and the original depending on whether a thermal copy or an electrostatic copy of the original is to be made.

References Cited

UNITED STATES PATENTS

3,093,039	6/1963	Rheinfrank	355—16
3,220,324	11/1965	Snelling	355—16
3,244,084	4/1966	Davis	355—16
3,354,802	11/1967	Doucette	355—10

NORTON ANSHER, Primary Examiner

R. P. GREINER, Assistant Examiner