United States Patent [19]

Kaminstein

[11] **3,752,076**

[45] **Aug. 14, 1973**

[54] **METHOD FOR DUPLICATING A PRELIMINARY COPY**

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[22] Filed: **Mar. 12, 1971**

[21] Appl. No.: **123,632**

[52] **U.S. Cl.**..... **101/450**, 101/467, 101/471, 250/65 T

[51] **Int. Cl.**..... **B41m 1/06**, B41m 5/08

[58] **Field of Search**..... 101/450, 451, 465–468, 101/470, 471

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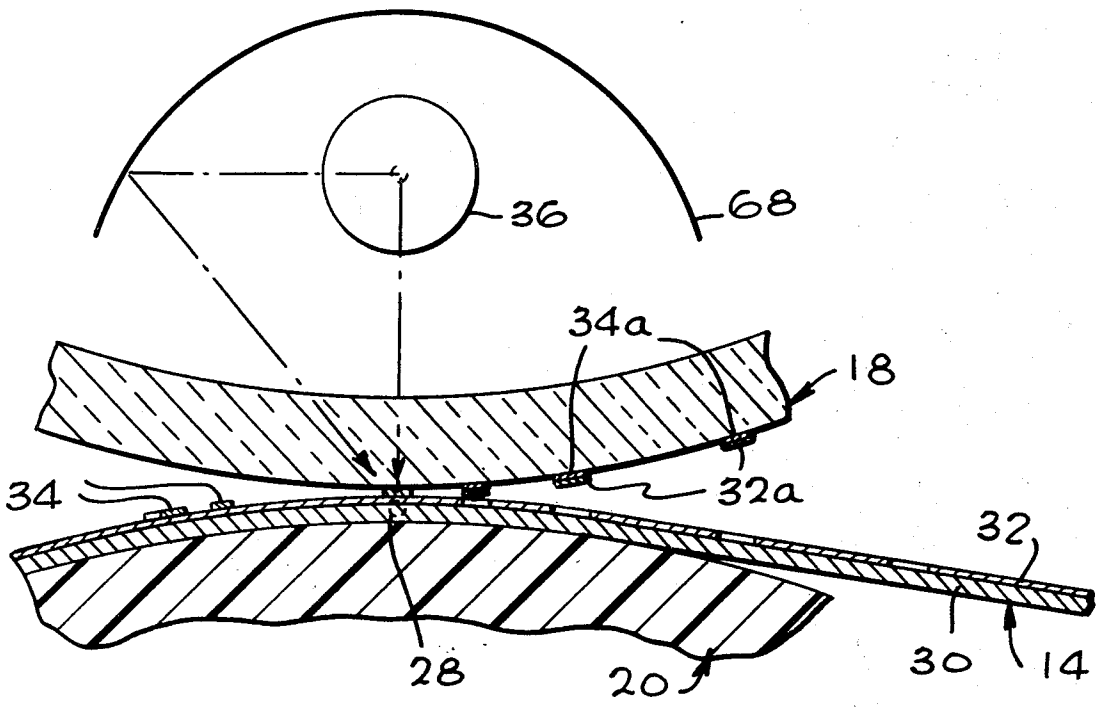
Primary Examiner—Clyde I. Coughenour

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[57] **ABSTRACT**

A simple machine for making multiple printed copies from a zinc oxide preliminary copy, including a glass cylinder and a transport drum which presses against the cylinder. The machine has a stack holder which is initially filled with a stack of paper sheets and a zinc oxide preliminary copy on top of the paper sheets. Sheet feeding apparatus first moves the preliminary copy onto the transport drum so it moves between the drum and glass cylinder to heat the dark areas on the preliminary copy which represent the image, so that these image regions are transferred to the glass cylinder. Inking rollers then apply ink to the image areas on the cylinder while successive sheets of paper to be printed upon are fed between the roller and glass cylinder.

3 Claims, 6 Drawing Figures



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SHEET 1 OF 2

Fig. 1

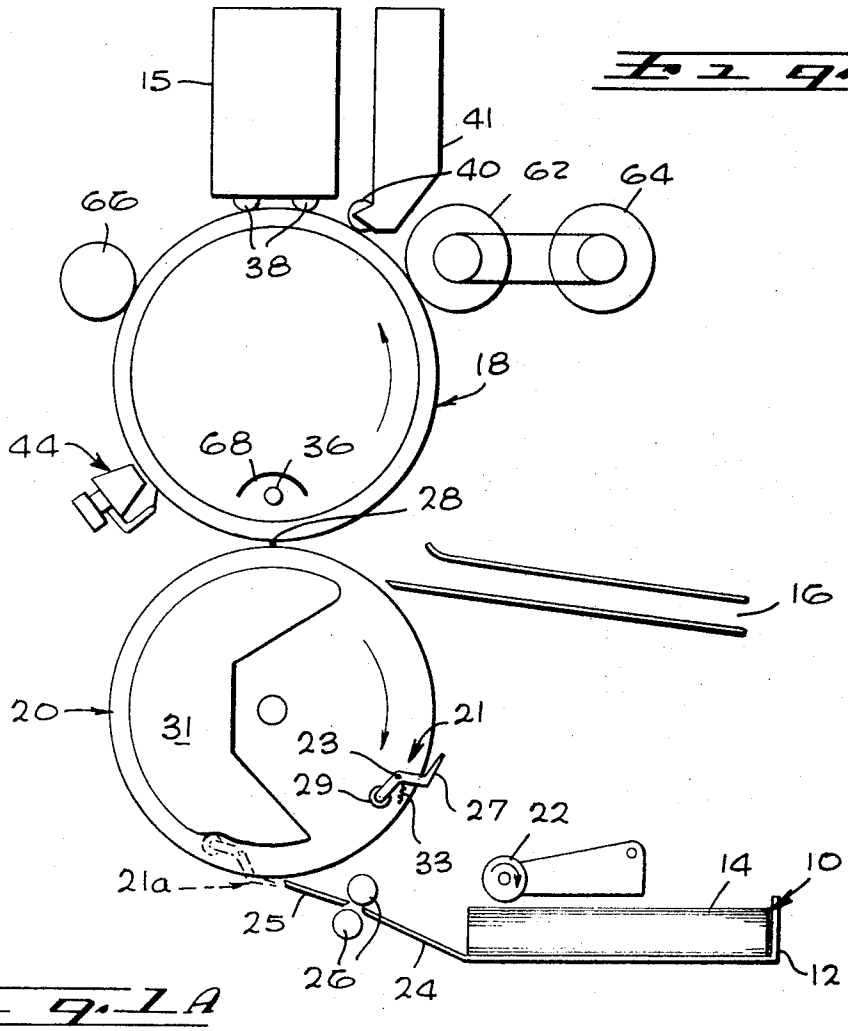


Fig. 1A

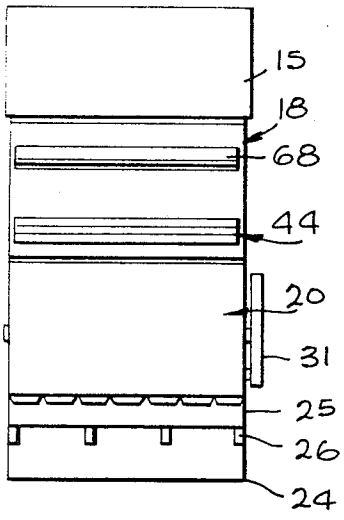
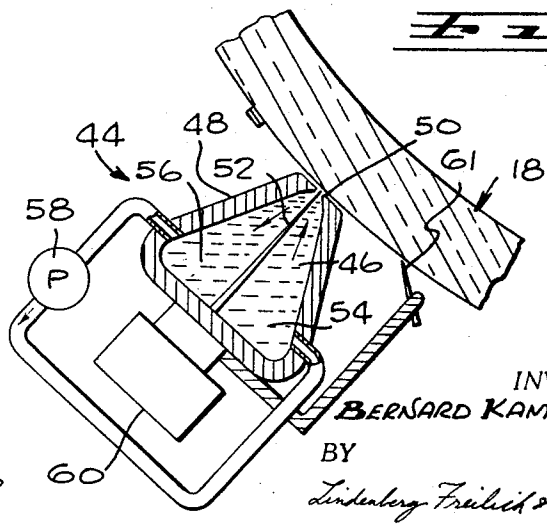


Fig. 4



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Fig. 2

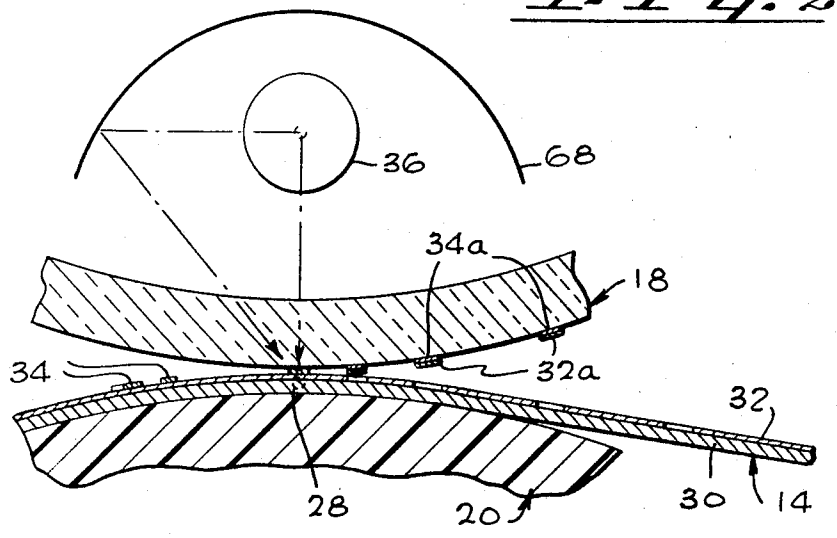


Fig. 3

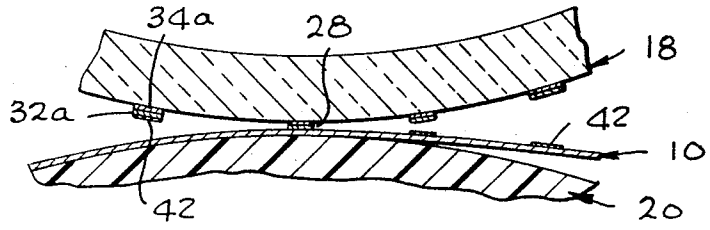
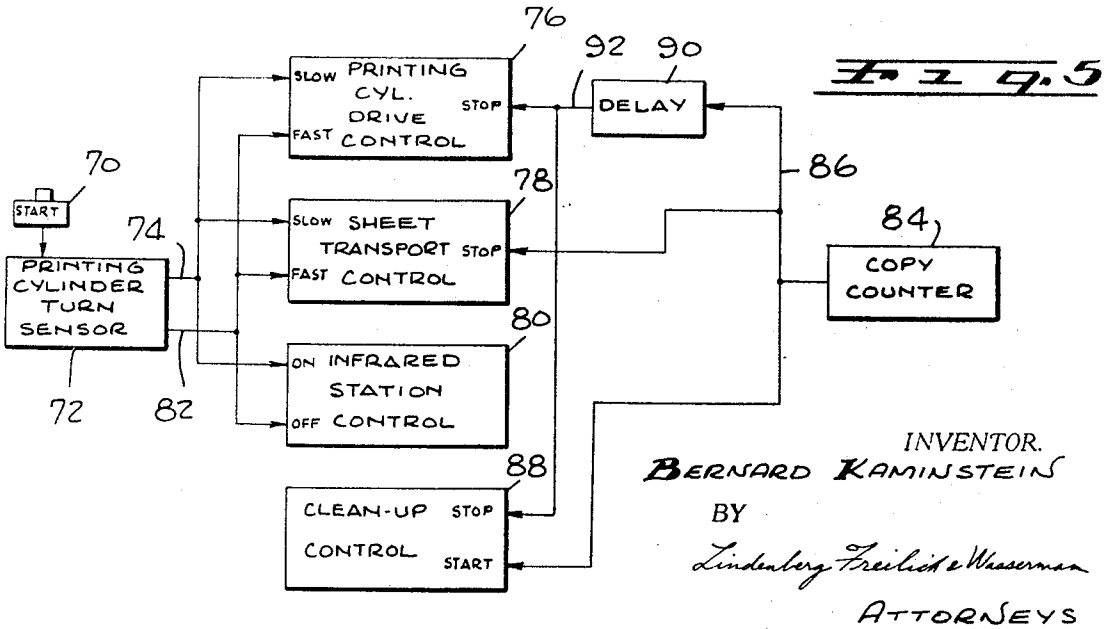


Fig. 5



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METHOD FOR DUPLICATING A PRELIMINARY COPY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to apparatus for copying or duplicating documents and the like.

2. Description of the Prior Art:

Multiple copies of documents can be made inexpensively on bond paper by first producing a preliminary copy on zinc oxide paper and then producing an offset printing master from the preliminary copy. One method that has been employed to produce the offset master involves laying a sheet of transparent plastic on the preliminary copy and directing infrared radiation through the transparent sheet. The toner particles on the preliminary copy, which form the image thereon, are heated and they stick to the transparent sheet. When the sheets are separated, the toner particles and the zinc oxide under them remain on the transparent sheet. The trans-parent sheet can then be mounted on the printing drum of a lithograph machine in the same way as other printing masters.

An important obstacle to the widespread use of the foregoing duplicating method is the difficulty sometimes experienced by office workers in mounting a printing master on the printing drum of a lithograph machine. Sheet handling devices can be produced which will automatically mount a master on the drum. For example, a duplicating machine which utilizes the foregoing duplicating method and employs sheet mounting devices is described in my U.S. Pat. application, Ser. No. 39,772 filed May 22, 1970. However, the use of automatic sheet mounting devices results in somewhat increased complexity and cost. A simple machine that could utilize a copy made on zinc oxide paper or other material to produce multiple copies on bond paper, utilizing a minimum of simple sheet handling apparatus, would permit the construction of simple duplicating machines that were simple to use.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention is to provide a simple and easily operated duplicating machine.

Another object is to provide a simple machine which can make multiple printed copies from a copy that has been made on zinc oxide paper or the like.

In accordance with one embodiment of the present invention, a machine is provided which is of relatively simple construction and which can be operated in a simple manner to make multiple printed copies on bond paper. The machine includes a print-ing cylinder of glass or other transparent material, a transport drum that bears against the printing cylinder, and apparatus for feeding sheets from a stack holder to the nip between the cylinder and drum. The stack holder initially contains a stack of paper and the preliminary zinc oxide copy on top of the stack of paper. When the machine starts, it feeds the preliminary copy through the nip between the glass cylinder and drum while an infrared lamp shines through the cylinder. The infrared rays heat the image regions of the preliminary copy, which are formed by toner particles on the zinc oxide coating. As the preliminary copy leaves the nip between the cylinder and drum, the toner image regions and the zinc oxide material directly under them are torn out of the preliminary copy and adhere to the glass drum. An ink cartridge supplies ink to the drum, which is received only at the image areas that are now on it. Sheets of bond paper are then moved from the stack holder through the nip between the cylinder and drum, so that the paper can be printed upon by the inked regions on the cylinder.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified side view of a duplicating machine constructed in accordance with one embodiment of the invention;

FIG. 1A is a simplified rear view of the machine of FIG. 1;

FIG. 2 is a partial view of the apparatus of FIG. 1, showing the manner in which it produces an offset printing master;

FIG. 3 is a partial view of the region shown in FIG. 2, but showing the manner in which the printing cylinder prints on paper;

FIG. 4 is a partial view of the cleaning mechanism of the apparatus of FIG. 1; and

FIG. 5 is a block diagram view of control apparatus of the machine of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a machine for making multiple printed copies on ordinary bond paper from a preliminary copy of the type that is produced by common copying machines. Such preliminary copies are typically made on paper coated with photo-conductive material such as zinc oxide, with image areas formed by toner particles applied to the coating. The machine of FIG. 1 enables the printed copies to be made with a minimum effort on the part of the operator. Basically, the operator merely loads a stack of paper 10 in a stack holder 12 of the machine and then lays a preliminary copy 14 on top of the stack with the image side facing down. The operator then pushes a button to start the machine, and after less than a minute, multiple printed copies made on bond paper begin to leave an output chute 16 at a rapid rate. The machine utilizes ordinary water-based ink held in a cartridge 15, so that the multiple copies can be made at very low cost. In addition, the machine is of relatively simple construction. The duplicating machine is especially useful in offices which already have a copier that can make the preliminary copy, although it can be incorporated in a more complex machine that also makes the preliminary copy.

The machine includes a printing cylinder 18 constructed of a substantially rigid and transparent material such as glass. A sheet transport drum 20 is rotatably mounted adjacent to the cylinder 18 to bear against it. Sheets in the stack holder 12 are removed by a pick-up roller 22, and moved along a predetermined path formed by guides 24 and 25 and additional rollers 26 to the transport drum 20. The drum 20 carries a gripping lever 21 that is pivotally mounted on a shaft 23 fixed to the drum. The lever 21 has a row of fingers 27 that can grip the leading edge of a sheet as it leaves the

guide 25. The guide 25 has a row of slots to permit the fingers 27 to pass by it. As the drum 20 rotates and the lever approaches the position 21*a*, a roller-type cam follower 29 on the lever rides up a portion of a stationary cam 31. This causes the lever 21 to pivot so that the fingers 27 close on the leading edge of the sheet to hold it to the drum. As the lever 21 reaches the output chute 16, the cam 31 releases the lever and a spring 33 pivots the lever to allow the sheet to pass into the chute. The sheets received by the drum 20 are carried through the nip 28 formed between it and the cylinder 18, and the sheets then pass into the output chute 16 to an output basket (not shown) where they can be collected. The preliminary copy 14 with the image thereon that is to be duplicated, as well as the bond paper sheets 10 which are to be printed upon, all follow along this path which leads around the drum 20, through the nip 28 between it and the cylinder 18, and into the output chute 16.

The printing of the bond paper sheets is performed by using the glass cylinder 18 as the printing master. In order to make it a printing master, image regions on the image face of the preliminary copy 14 are transferred to the surface of the glass cylinder. This is accomplished by slowly feeding the preliminary copy 14 through the nip 28 between the drum and cylinder in the manner shown in FIG. 2. As shown in that Figure, the preliminary copy 14 includes a backing 30 of paper or other material and a coating 32 of zinc oxide or other photo-conductive material on the backing. In addition, the preliminary copy includes image regions 34 on the coating 32, the image regions typically being formed by toner particles that adhere to the coating. As the preliminary copy 14 passes through the nip 28 between the drum 20 and cylinder 18, an infrared lamp 36 is energized to direct heating radiation through the cylinder towards the nip 28. The infrared radiation is absorbed primarily by the dark image regions 34 of the preliminary copy, so they become hot. The heated toner particles at the image regions 34 adhere to the surface of the glass cylinder 18.

As the preliminary copy 14 leaves the nip 28 and separates from the glass cylinder 18, the image regions 34a break away from the copy and remain on the cylinder. During breakout from the preliminary copy, the image regions 34a pull out regions of the zinc oxide coating 32 which lie immediately beneath them. Thus, after the preliminary copy has completely passed through the nip of the cylinder and roll, the cylinder 18 has image areas thereon which contain toner particles with a layer of zinc oxide thereon. The cylinder can then serve as an offset printing master for printing multiple copies on ordinary paper. The preliminary copy 14 continues on the transport drum 20 until it reaches a position near the output chute 16, when it is released into the chute.

After the cylinder 18 has received the image areas, it can be inked by inking rolls 38 of the ink cartridge 15. The glass surface of the cylinder 18 rejects the ink, but the zinc oxide surface which is present at the image areas now on the cylinder absorbs water-based ink. In order to enhance the ink-rejection properties of the glass cylinder, it may be first coated with oil from a roll 40 of an oil dispenser 41, which distributes a hydrophobic oil (resists water and water-based inks) onto the cylinder. Oil that is dispensed onto the glass surface remains thereon, while oil which is coated on the zinc oxide is absorbed into it, so that the zinc oxide areas remain receptive to the ink. After the cylinder with the image areas thereon has been oiled, ink can be applied by the rolls 38 of the ink cartridge 15. The cartridge 15 dispenses oil with the ink to maintain an oil film on the cylinder. After oiling and inking, the cylinder is ready to print copies. It may be noted that the oiling rolls and the need for oil in the inking cartridge can be eliminated, so that only ink is applied, if squeegees are placed about the cylinder 18 to remove ink from the background areas.

The printing of copies is accomplished by feeding the sheets of bond paper from the stack against the inked cylinder 18. The pick-up roll 22 picks sheets from the stack and sends them along the guides 24 and 25 and rollers 26 leading to the sheet transport drum 20. The sheets of paper move in the same manner as the preliminary copy, except that the paper can be moved considerably faster. As each sheet passes through the nip 28 between the drum 20 and cylinder 18, it receives a printed impression. FIG. 3 illustrates the manner in which ink 42 on the zinc oxide regions of the cylinder are deposited on the bond paper sheet 10 to form a printed image thereon. After each sheet is printed, it moves along the output chute 16 to the output basket. The printing continues until the desired number of copies have been made. It is then desirable to clean the glass cylinder so it can be later used to make printed copies from a different preliminary copy.

Cleaning of the glass cylinder 18 is accomplished by moving a clean-up device 44 against the glass cylinder 18 while it is rotating. Of course, during the clean-up period, the pick-up roll 22 no longer feeds sheets past the cylinder (although the roll 20 can idle) and the inking rolls 38 are moved away from contact with the cylinder. FIG. 4 illustrates the clean-up device, which applies a solvent 46 to the glass cylinder 18. The clean-up device includes a housing 48 with a narrow elongated opening 50 positioned adjacent to the cylinder 18. A divider 52 within the housing divides it into two chambers 54 and 56. A pump 58 connected between the two chambers pumps the solvent into one chamber 54 while withdrawing it from the other chamber 56. The solvent therefore moves rapidly across the opening 50 from one chamber 54 to the other 56, picking up particles of ink, zinc oxide and toner that are on the glass cylinder. After one or more complete revolutions of the glass cylinder, it is clean and is ready for the next preliminary copy to be duplicated. It may be noted that various filters and catches can be employed in the pipeline leading to or from the pump 58 to trap particles picked up from the glass cylinder, so that the solvent can be used many times before it has to be changed or new solvent added. The clean-up device 44 is normally maintained away from the cylinder 18. However, when the cylinder must be cleaned, a solenoid 60 moves the clean-up device against the cylinder to clean it and then withdraws it from the cylinder. In addition to the solvent apparatus, the clean-up device includes a scraper blade 61 fixed to the solenoid to move against the cylinder and scrape off any particles that have not been flushed away by the solvent.

The glass cylinder 18 is constructed as a cylindrical shell in order to accomodate the infrared lamp 36. The cylinder is driven by a drive roll 62 of rubber or the like which bears against the surface of the cylinder and is driven by a motor 64 connected thereto by a belt. An additional roller 66 is utilized to press the cylinder to-

wards the transport drum **20.** If a more definite drive is desired, a collar with gear teeth on it can be attached to the cylinder **18,** and the collar can be driven by a gear, instead of employing the drive roll **62.** The cylinder **18** is relatively rigid and is preferably constructed of a heat resistant glass to prevent breakage when the infrared lamp **36** heats the portion of the preliminary copy in contact with it. The lamp **36** is preferably used in conjunction with a reflector **68** to help concentrate the energy at and immediately in front of the nip **28** between the cylinder and roll **20.** The apparatus for picking up sheets from the stack holder **12** and moving them onto the vacuum transport drum **20** is well known in the art, as is the inking apparatus in the cartridge **15,** and therefore such apparatus is not described in detail herein.

FIG. **5** is a simplified representation of a control system for operating the duplicating machine of the invention. When a start button **70** is depressed, it delivers a signal to a printing cylinder turn sensor that senses when the glass printing drum has made a predetermined number of turns. When a start signal is received from the button **70,** the sensor **72** delivers a pulse on a line **74.** The pulse on line **74** is delivered to a "slow" input of a printing cylinder drive control **76** to begin slow rotation of the printing cylinder. The drive control **76** may include a pair of relays (one for slow and one for fast rotation) that control energization of the motor **64** that turns the cylinder driving roll **62.** The pulse on line **74** also enters the "slow" input of a sheet transport control **78** that controls the delivery of sheets from the stack holder past the printing cylinder. The sheet transport control **78** can include a group of relays that control energization of a motor (not shown) that drives the pick-up roller **22,** intermediate rollers **26,** and transport drum **20.** The pulse on line **74** is also received at an infrared station control **80** to turn on the infrared lamp **36.** During the next couple of revolutions of the glass printing cylinder, the preliminary copy at the top of the sheet stack is moved across the printing cylinder to transfer image areas thereon.

After a predetermined amount of rotation of the printing cylinder sufficient for image transference thereto, printing on sheets of paper can begin. The printing drum turn sensor **72** senses when sufficient rotation has occurred and it then delivers a pulse over a line **82.** The pulse on line **82** enters a "fast" input of the printing cylinder drive control **76** to cause the printing cylinder to begin turning at the higher speed which is used during printing. The pulse over line **82** also enters a "fast" input of the sheet transport control **78** to cause sheets to be delivered at a more rapid rate commensurate with the increased speed of the printing cylinder. The pulse on line **82** also enters an "off" input of the infrared station control **80** to cause deenergization of the infrared lamp. After the pulse on line **82** is delivered, sheets of bond paper are successively delivered past the rapidly rotating printing cylinder to create multiple copies.

After the desired number of copies have been printed, the machine should stop feeding sheets and the printing cylinder should be cleaned. A copy counter **84** which has been preset to the desired number of copies, senses when the required number of copies have been printed, and it then delivers a pulse over a line **86** to the sheet transport control to stop the delivery of any more sheets of paper. The pulse over line **86** is also delivered to a "start" input of a clean-up control **88** that operates the clean-up device **44** to remove the image areas on the printing cylinder **18.** During such clean-up, the printing cylinder continues to rotate. The pulse over line **86** which stopped the sheet transport is also delivered to a delay circuit **90** which is connected to a "stop" input of the printing cylinder control **76.** After a period of time sufficient for the printing cylinder to have been cleaned by the cleaning device, the delay circuit **90** delivers a pulse on line **92,** to a "stop" input of the printing cylinder control **76** to stop further rotation of the printing cylinder. The pulse on line **92** is also delivered to a "stop" input of the cleanup control **88** to terminate its operation. The machine is then stopped with the printing cylinder in a clean condition. If a person wishes to make multiple copies from another preliminary copy, he merely places the preliminary copy on top of the stack of paper in the stack holder, sets the copy counter **84** to the desired number of copies, and again presses the start button **70.** It should be understood that a variety of systems can be employed to control operation of the duplicating apparatus, and the system of FIG. **5** is only one simplified example of such a control system.

The duplicating machine can be made relatively inexpensively because there is a minimum of sheet handling involved in its operation. That is, the same sheet transport that moves sheets of bond paper through the device also moves the preliminary copy that is to be duplicated. Such simplicity is permitted by the fact that the image is transferred directly to a cylinder that serves as the printing master, as compared to transference to an intermediate printing master sheet that must be then mounted on the drum. Use of an intermediate master sheet would necessitate the operator mounting the master sheet on the drum, or the provision of apparatus for automatically engaging the master sheet and mounting it on the drum. The fact that the preliminary copy moves along the same path as the sheets of bond paper that are to be printed upon simplifies the role of the operator. The operator does not have to be concerned with the operation of two separate input devices, but merely lays the preliminary copy that is to be duplicated on the stack of paper. The laying of the copy on the stack of blank paper is a natural and logical arrangement which is easy for an operator to understand and remember.

The use of a hollow glass cylinder facilitates the transference of an image from the preliminary copy to the surface of a drum that is to serve as the printing master. This is because an infrared lamp then can be easily mounted for directing heating radiation against the portion of the preliminary copy adjacent to the printing drum. Various other arrangements can be employed, such as directing infrared rays from a lamp located outside the boundaries of the glass cylinder against a preliminary copy, but it is then more difficult to adequately concentrate the rays. Instead of employing a cylinder of glass, it is possible to employ a cylinder constructed of a heat resistant plastic or other material which is substantially transparent to infrared radiation, or to cover or coat either a glass or plastic cylinder with a transparent material which is more adhesive to the heated toner of the preliminary copy. The outer surface of the printing cylinder is preferably slick so that it resists ink or can retain hydrophobic oil on its surface.

What is claimed is:

1. A method for making multiple copies of an image on a preliminary copy comprising:
providing a preliminary copy having a layer of heat sensitive ink absorbing material which has thereon darkened image regions;
rotating a rigid printing cylinder that is substantially transparent to infrared radiation;
pressing said preliminary copy against the surface of said cylinder;
directing infrared radiation through said cylinder and against said preliminary copy as it is pressed against said cylinder, thereby enabling the image regions of ink absorbing material thereunder to leave the preliminary copy and adhere to the cylinder;
removing said copy from contact with said cylinder and tearing out the portions of said layer of material which absorbs ink which lie under the image regions;
applying ink to said cylinder; and
pressing sheets of paper against said cylinder to print on the paper.

2. The method described in claim 1 wherein:
said step of pressing said sheets of paper includes moving sheets from a paper stack holder along a predetermined path that leads past said printing cylinder; and
said step of pressing said preliminary copy against the surface of said cylinder includes moving said preliminary copy from said paper stack holder along said predetermined path.

3. The method described in claim 2 including:
placing a plurality of sheets in said stack holder, one directly on top of the other, with the top sheet being said preliminary copy and a plurality of sheets under it being substantially blank sheets of paper.

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