United States Patent

[11] 3,586,436

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[21] Appl. No. **710,266**
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[54] **TABLETOP ELECTROSTATIC COPYING MACHINE**
6 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **355/10,** 355/10
[51] **Int. Cl.** **G03g 15/10**
[50] **Field of Search** 355/10

[56] **References Cited**

UNITED STATES PATENTS

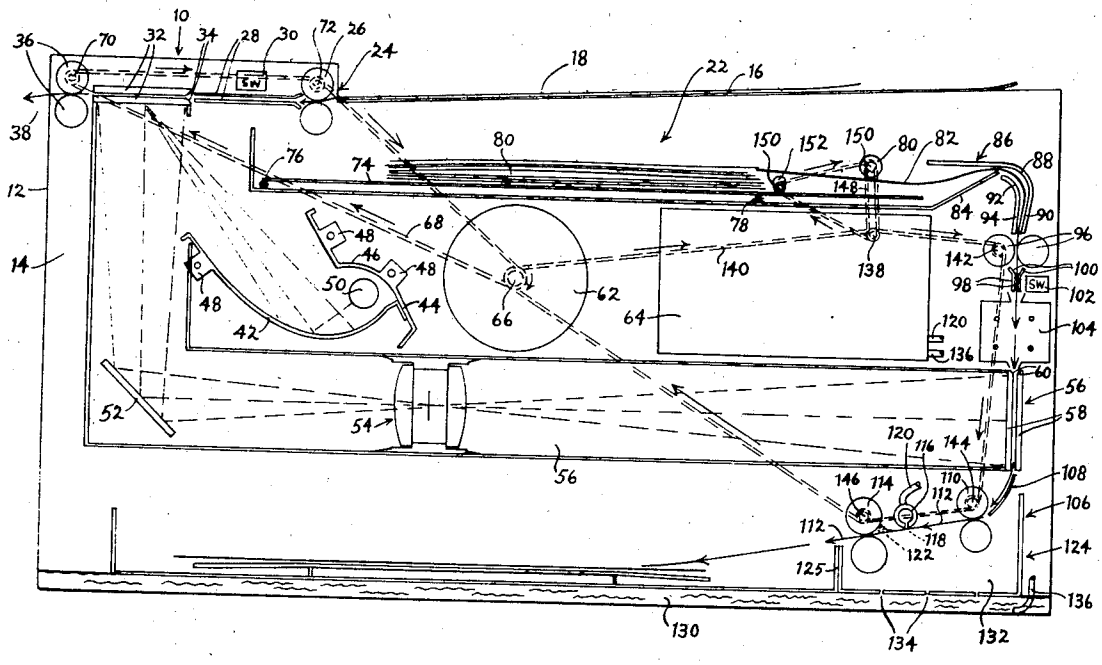
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Primary Examiner—Samuel S. Matthews
Assistant Examiner—Michael Harris
Attorney—Olson, Trexler, Wolters & Bushnell

ABSTRACT: A tabletop electrostatic copying machine has a tunnel opening for the original. The copy paper moves in a path with few bends past the exposure station synchronized with the moving original. Liquid toner is applied to only one face of the copy to minimize drying time. The bottom of the housing is a reservoir for the toner and excess toner from the copy paper falls there.



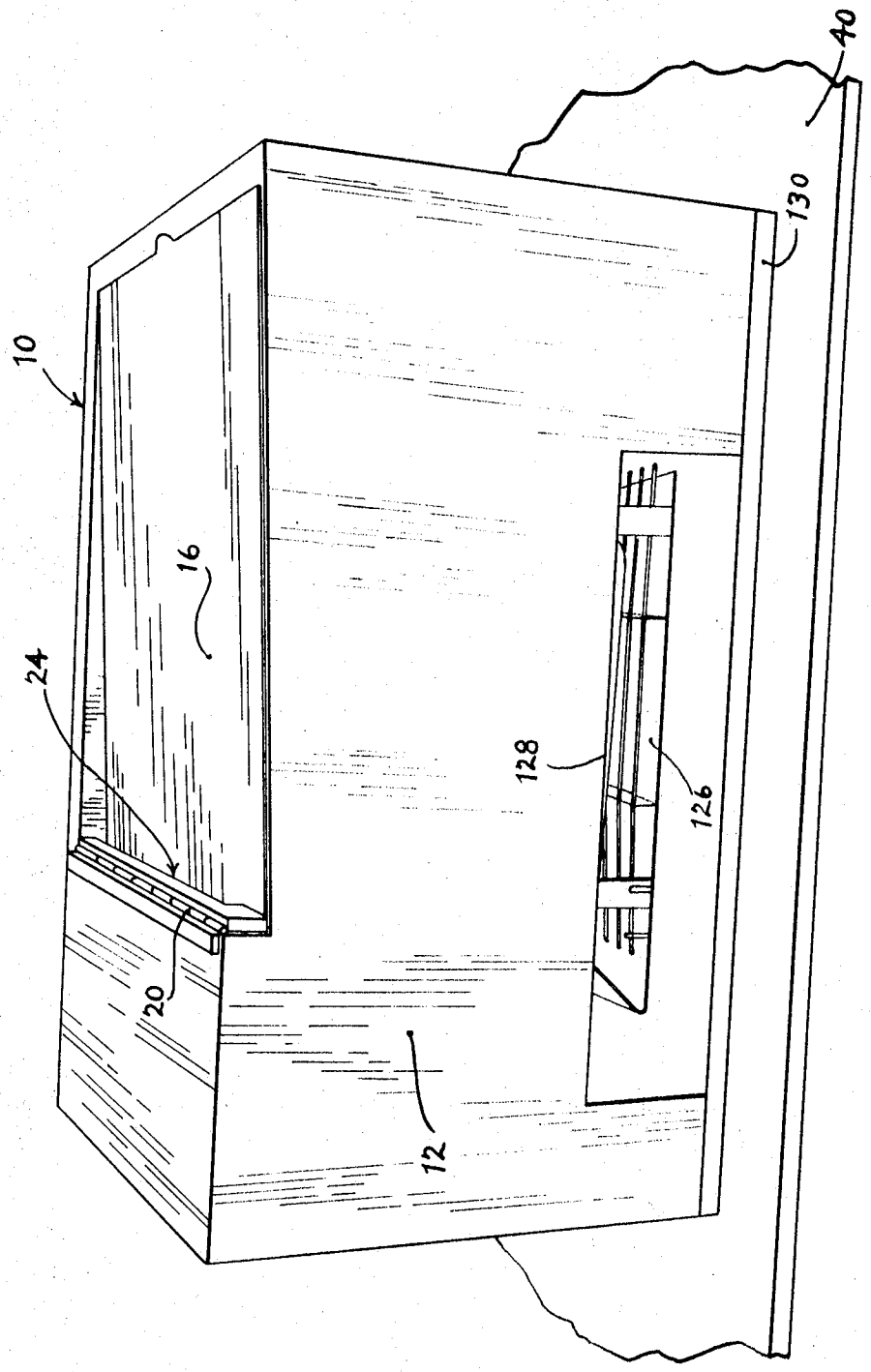
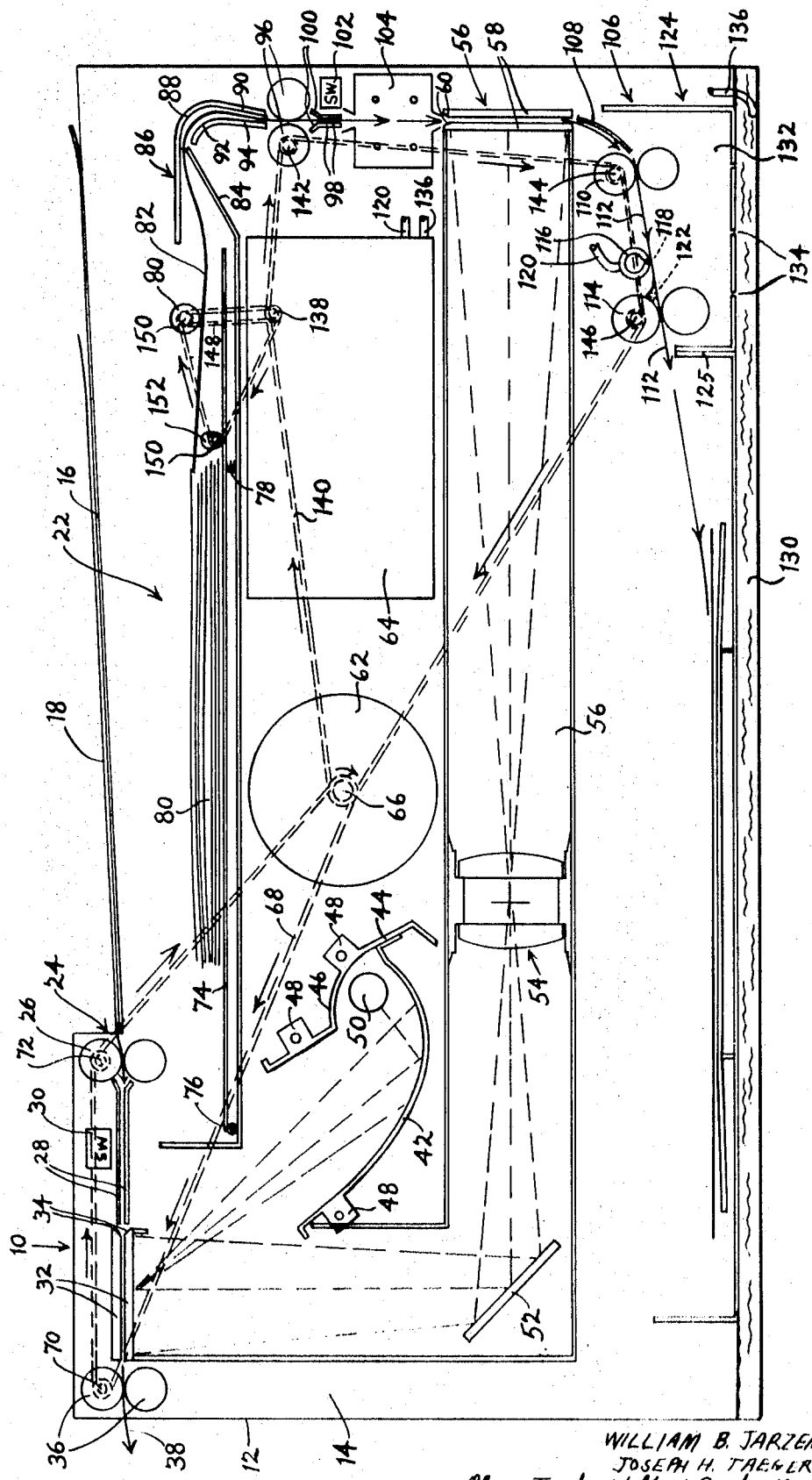


FIG. 1

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FIG. 2



WILLIAM B. JARZEMBSKI
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Olson, Trexler, Wolfert & Bushnell, Attys

TABLETOP ELECTROSTATIC COPYING MACHINE

The general principles of electrostatic printing and developing or toning are well known and need not be summarized at this point. Suffice it to say that the present machine is of the type using a paper having a coating such as zinc oxide capable of receiving an electrostatic charge which is partially or completely dispelled by light falling thereon. A toner is used to fix the electrostatic image.

There are many electrostatic copying machines now on the market. By and large, these machines are subject to certain deficiencies, mainly being too expensive and too large. Others are too noisy, while most take too long to produce a finished print. Man discharge the finished print and the material to be copied essentially at the same location thus allowing the possibility of intermixing the prints and original material.

In accordance with the present invention, it is an object thereof to provide an inexpensive and compact tabletop electrostatic copying machine of superior characteristics.

In particular, it is an object of the present invention to provide such a machine in which the paper on which prints are made to travels over short path thus making the finished print accessible at the earliest possible time.

Furthermore, it is an object of the present invention to provide a tabletop electrostatic photocopying machine wherein material to be copied is fed from side-to-side across the machine, and wherein the printing paper is fed along a curvilinear path across, down and across the machine, to be delivered from the front thereof directly to the operator.

It is a further object of the present machine to provide a liquid toner reservoir of maximum capacity for the limited size of the machine.

Yet another object of the present invention is to deliver the finished liquid toned print to a grid support for air-drying of both sides of the print.

Other and further objects and advantages of the present invention will be apparent from the following description when taken in connection with the drawings, wherein:

FIG. 1 comprises a perspective view of a tabletop electrostatic copying machine constructed in accordance with the principles of the invention; and

FIG. 2 comprises a longitudinal section therethrough.

Turning now to the drawings in greater particularity a tabletop copying machine in accordance with the present invention is designated generally by the numeral **10**, and includes an external housing or casing **12** of generally rectangular configuration. This housing or casing fits over a frame **14** to which it is held by any suitable or conventional means, such as screws. The housing is provided at the upper portion thereof with sloping plate **16** on which sheet **18** to be copied is placed. The plate **16** is hingedly secured to the remainder of the housing at **20** for lifting of the sheet to permit access to a paper safe **22**, as will be explained presently.

Immediately to the left of the plate **16**, as viewed in the drawings, is a tunnel **24** into which the sheet **18** is urged by hand. The sheet is picked up by a pair of opposed resilient rollers **26**, and is fed between a pair of upper and lower guide plates **28**. A switch **30**, shown schematically, is positioned adjacent the guides **28**, and senses the presence of paper fed therethrough. Although many types of switches could be used including photocell switches, I prefer to use one having a low travel and operates at a very low pressure. This switch turns on certain parts of the machine a will be brought out hereinafter.

From the guide **28**, the paper or other sheet **18** to be copied feeds between exposure guides **32** which are likewise horizontally disposed. These guides, like the guides **28**, are provided with beveled or flared receiving edges **34** to insure centering of the paper fed therethrough. The guides **32** alternatively may comprise metal or plastic side guides with the paper simply supported therebetween or in some cases they may comprise glass plates through which exposure is made. From the guides **32** the paper to be copied passes between roller **36** to be fed of the machine as indicated by the arrow a **38**, from whence it will drop on the supporting table **40** for subsequent handling.

A light reflector **42** is provided below and to the right of the exposure guides **32**, and has an upper reflecting surface which is curvilinear in the longitudinal section shown and which is straight across transversely thereof. The lower reflecting surface is joined at **44** to an upper reflecting surface **46**, which is likewise curvilinear but which is concave down, whereas the reflecting surface **42** is concave up. The two surface or members **42** and **46** are supported from the frame **14** by means such as ears or tab **48** secured to the frame by any suitable means such as screws or rivets. A tubular light **50** of known design is supported between the reflecting member or surfaces **42** and **46**, whereby light is directed upwardly as indicated by the diagonal lines to the area of the exposure guides **32** for illuminating the sheet **18** as it passes between the guide.

A mirror **52**, preferably of the type having a front-reflecting surface is supported from the frame a 45° angle directly below the exposure guides **32**. The image illuminated between the exposure guides is reflected from the mirror **52** through a line indicated at **54** through a tunnel **55** over to the right end of the machine to an exposing area **56** including a pair of vertically disposed guides **58**. These guides have beveled receiving upper edges **60** to center paper passing therethrough as will be mentioned hereinafter, and the guides are similar to the exposure guides **32**.

An electric motor **62** is disposed centrally of the machine, and has electric wires (not shown) connected thereto from unit indicated at **64** as "CONTROLS, POWER SUPPLY, AND PUMP." A flexible line cord of the usual variety (not shown) lead from the unit **64** to a wall outlet. The motor drive has an output shaft on which is mounted a cog unit **66** which, in the illustrative example simply may comprise two cogs mounted end-to-end with a slight spacing therebetween. The motor may drive the cogs directly, or through a gear reducing unit in accordance with the characteristics of the motor. A drive chain is indicated in broken lines a **68**, and passes over cogs **70** and **72** on the upper ones of the roller pair **36** and **26** to drive these rollers in the proper direction with the cog **66** turning in a clockwise direction. The lower rollers of the roller pairs **36** and **26** may also be positively driven by any known or suitable means, or they may be driven frictionally from the opposed rollers of each pair.

The paper safe **22** mentioned previously includes a supporting plate **74** pivotally mounted at the left-hand end a **76**, and spring-pressed upwardly by a spring **78**. A stack OF paper **80** is supported on top of the plate and the paper is of the type suitable for electrostatic charging and generally including zinc oxide coating. A rubber drive roller **80** (which may be two or more axially spaced rollers) overlie the stack of paper **80**, and is engageable with the top sheet **82** thereof to feed it between a diagonally upward lower guide plate **84**, and an upper guide plate **86**. The upper guide **86**, which preferably is continuous across the machine, progresses from the horizontal receiving portion to a curved portion **88** turning slightly back at **90**. A cured lower guide **92** underlies the guide **86**, and includes a substantially vertical trailing portion **94** opposed to the outer guide portion **90**.

The guide positions **90** and **94** lead to a pair of horizontally opposed rollers **96** which feed the sheet **82** down between a pair of guide **98** having outwardly flared receiving ends **100**. As the paper passes between the guides **98**, it activates a switch **102** of the same type as the switch **30**. From the guides **98** the paper passes through an electrostatic charging unit **104** of known design which is turned on by the switch **102**, power being supplied from the unit **64**. The electrostatically charged paper then progresses down through the exposure area **56** previously described. At this point the paper is traveling at exactly the same rate a the copy sheet **18**, and an image is formed electrostatically on the paper **82**.

From the exposure area **56**, the paper **18** progresses to a toning or developing unit **106** of the type set forth in some detail in Meyer L. Sugarman and Joseph H. Jaeger applica-

tions Ser. No. 692,234now abandoned, filed on Dec. 20, 1967 for "Compact Liquid Toner Apparatus with Straight-Through Feed". In brief summary, the developer unit **106** includes an outer curved guide **108** for directing the paper to a pair of infeed roller **110**. The paper then progresses along the path indicated by the arrows **112** to a pair of outfeed rollers **114**. In so doing, the papers passes beneath a distributor tube or pipe **116** having outlet holes as indicated at **118** along the bottom thereof, liquid toner being pumped into the distributor tube **116** as through a conduit **120**. The liquid toner collects on the surface of the paper, forming a lake as indicated at **122**. The liquid is squeegeed off of the paper by the roller **114**, and falls into sump **124**. The toned or developed paper then passes over a vertical barrier wall **124** and drops on a gridlike support **126** accessible through a side opening **128** in the housing **12**, from which it can be removed by hand in a dry state.

The entire bottom of the copying machine comprises a reservoir as indicated at **130**. Thus, a large volume of liquid toner can be stored without the necessity of an appreciable vertical height. Liquid toner passing from the sheet as it goes through the developing unit **125** drops gravitationally into a sump **132** which communicates with the reservoir **130**, such as by means of drain holes **134**, or any other suitable mean.

A drain or pickup tube or conduit **136**, shown somewhat schematically at the lower right-hand corner of FIG. **2**, is provided for draining fluid from the reservoir **130**, from whence it passes to the unit **64** including pump. The liquid so pumped then passes from the unit through the tube or conduit **120** back to the distributor **116**.

A cog **138** on a shaft on the unit **64** is driven from the motor drive cog **66** by means such as a chain indicated by the broken line **140**. This chain also passes over a cog **142** on the leftmost of the roller pair **96**, over a cog **144** on the uppermost of the roller pair **110**, and over a cog **146** on the uppermost of the roller pair **146**. As will be understood suitable idlers or tensioning cogs would be provided necessary. The cog **138** is a double cog, and an additional chain **148** passes over the second cog and over a cog **150** to drive the roller or rollers **80**. The chain **148** also passes over a cog **150** to drive a cam **152** for lowering the paper safe plate **74** to drop the stack of paper **80** out of engagement with the roller **80** after the paper **82** has been engaged by the rollers **96**. As will be set forth shortly hereinafter the roller **80** is only driven part of the time, and in a preferred embodiment of the invention, it is connected to the cog **150** by means such as a well-known electric clutch (not shown). Similarly, the cam **152** can be driven from the cog **150** by an electric clutch or this can be handled simply by the design of the cam and the speed at which it is driven.

OPERATION

The pivoted plate **16** is lifted at some time to place a supply of paper **80** in the paper safe **22**, after which the plate is returned to its normal position and this need not be considered a part of the operation each time the machine is used. The machine is turned on by means of a switch of well known character (not shown) connected to the "CONTROLS, POWER SUPPLY, AND PUMP" unit **64**.

Turning on of the switch, as just indicated, starts the motor drive **62**. Placing of a sheet **18** to be copied on the support plate **16** and moving it manually to the left causes it to be picked up by the roller **26** which are now rotating. The switch is activated by the sheet, and this acts through the unit **64** to turn on the light **50**, whereby the sheet is illuminated as it passes through the guides **32**, and between the rollers **70** and at of the machine. The light turns off with a predetermined time delay after the switch **30** no longer senses the sheet to be copied.

Meanwhile, during the last previous copying application, the roller **80** has fed the top sheet of paper **82** approximately to the position shown in FIG. **2**, with the lower end of the paper between the rollers **96**. At the start of an operation, the rollers **80** are not activated, and the cam **152** holds the plate **74** somewhat down so that the sheet **82** is not arrested in a manner by the roller **80**. Preferably the cog **142** is connected to the rollers **96** by means such as an electric clutch, and operation of the switch **30** thus starts the rollers **96** into operation to lower the sheet **82** to the exposure location or station **56**.

Passage of the paper **82** past the switch **102** turns on the charging unit **104** to charge the paper as it passes therethrough. The charging unit **104** turn off shortly after the switch **102** is deactivated. The charge is practically dispelled from the paper in the exposure station **56** in accordance with known principles and the paper then passes through the developer or toner unit **124** for development of the image thereon the paper then being dropped at the copy exit **126**, **128**.

The specific example of the invention as herein shown and described is for illustrative purpose. Various changes in structure will no doubt occur to those skilled in the art, and will be understood as forming apart of the present invention insofar as they fall within the spirit and scope of the appended claims.

We claim:

1. A tabletop photocopying machine comprising a housing having a front operating side, a top, a backside and two ends, mean at the top of said housing for receiving an item to be copied and including mean for feeding said item to be copied substantially horizontally relatively from one end toward the other end through said housing and out said other end, an exposure station having a substantially horizontal scanning window within said housing and past which said item is fed in substantially horizontal position means in said housing for illuminating said item at said copying station, a paper safe within said housing adjacent the top thereof for storing a stack of sheets of paper each having a printing face thereon, means in said housing for feeding a sheet of paper from said paper safe substantially horizontally toward said one end of said housing and then substantially vertically down, and exposing station in said housing past which said paper is fed substantially vertically down, an optical system in said housing for projecting an image of said item at said copying station onto the face of said paper at said exposing station, developing means below said exposing station and relatively away from said one end, said developing means comprising, dispensing means for depositing fluid developer on only the face of said paper, a reservoir for liquid developer, and means permitting any excess developer from the dispensing means to fall downwardly for return to said reservoir, thus minimizing the wetting of the surface of said paper opposite said face to which developer is applied, and an exit station adjacent said developing means and below said paper safe, said exit station having paper receiving means within said housing and opening through the front operating side of said housing substantially at right angles to the end through which the item to be copied exits, and feeding means within said housing for feeding said paper down from said exposing station and then substantially horizontally back away from said one end through said developing mean to the paper receiving mean at said exit station.

2. A photocopying machine as set forth in claim **1** and further including a liquid developer in said developing means, and wherein said exit station includes a grid receiving and supporting said paper said grid having open spaces above and below it for drying of both surfaces of said paper.

3. A tabletop photocopying machine as set forth in claim **1** and further including an electrostatic charger within said housing above said exposing station and past which said paper is fed vertically to said exposing station, there being feed roller means above said charger and below said exposing station, but not intermediate said charger and said exposing station.

4. A photocopying machine as set forth in claim **1** wherein said receiving means includes a substantially straight horizontal tunnel through said housing and a downwardly inclined plate leading to said tunnel and on which said item is manually fed to said tunnel.

5. A tabletop photocopying machine as set forth in claim 1 and further including feed roller adjacent said paper safe and engageable with a top sheet of paper in said safe to feed said paper edgewise from a stack thereof in said safe, and further including means for relatively moving said roller and said stack of paper vertically from one another to free said top sheet of paper from said roller as said paper is fed from said paper safe.

6. A part photocopying machine a set forth in claim 1 said reservoir for liquid developer comprising a par of said housing and of shallow height and extending substantially the entire horizontal dimensions of the bottom of said machine.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,586,436 Dated June 22, 1971

Inventor(s) William B. Jarzembski et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 8, after "toner" insert --then--;
Column 1, line 14, change "man" to --many--;
Column 1, line 21, after "are" insert --to be--;
Column 1, line 22, after "made" omit --to--;
Column 1, line 22, after "over" insert --a very--;
Column 1, line 28, after "down" insert a comma --(,)--;
Column 1, line 50, after "which" insert --a--;
Column 1, line 63, change "a" to --as--;
Column 1, line 64, change "guide" to --guides--;
Column 1, line 72, change "roller" to --rollers--;
Column 1, line 73, change "a" to --at--.

Column 2, line 9, change "surface" to --surfaces--;
Column 2, line 11, change "tab" to --tabs--;
Column 2, line 13, change "member" to --members--;
Column 2, line 16, change "guide" to --guides--;
Column 2, line 18, after "frame" insert --at--;
Column 2, line 20, change "line" to --lens--;
Column 2, line 28, after "from" insert --a--;
Column 2, line 31, change "lead" to --leads--;
Column 2, line 37, change "a" to --at--;
Column 2, line 38, change "pair" to --pairs--;
Column 2, line 45, change "a" to --at--;
Column 2, line 46, change "OF" to --of--;
Column 2, line 50, change "overlie" to --overlies--;
Column 2, line 56, change "cured" to --curved--;
Column 2, line 59, change "positions" to --portions--;
Column 2, line 61, change "guide" to --guides--;
Column 2, line 68, after "paper" insert --88--;
Column 2, line 69, change "a" to --as--.

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,586,436 Dated June 22, 1971

Inventor(s) William B. Jarzembski et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 5, change "roller" to --rollers--;
Column 3, line 7, change "papers" to --paper--;
Column 3, line 12, change "roller" to --rollers--;
Column 3, line 13, after "into" insert --a--;
Column 3, line 14, change "on" to --onto--;
Column 3, line 23, change "mean" to --means--;
Column 3, line 26, change "draining" to --drawing--;
Column 3, line 27, before "pump" insert --a--;
Column 3, line 36, after "provided" insert --as--;
Column 3, line 61, change "roller" to --rollers--;
Column 3, line 61, after "switch" insert --30--;
Column 3, line 65, change "at" to --out--.

Column 4, line 1, change "a manner" to --any manner--;
Column 4, line 9, change "turn" to --turns--;
Column 4, line 10, change "practically" to --partially--;
Column 4, line 17, change "purpose" to --purposes--;
Column 4, line 19, change "apart" to --a part--;
Column 4, line 24, change "mean" to --means--;
Column 4, line 25, change "mean" to --means--;
Column 4, line 55, change "mean" to --means--;
Column 4, line 56, change "mean" to --means--.

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U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,586,436 Dated June 22, 1971

Inventor(s) William B. Jarzembski et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 2, after "including" insert --a--;
Column 5, line 6, after "vertically" insert --away--.

Column 6, line 2, change "part" to --table top--;
Column 6, line 2, change "a" to --as--;
Column 6, line 3, change "par" to --part--.

Signed and sealed this 25th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
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