Oct. 22, 1963 F. T. ARNOLD ETAL 3,107,596

PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 1

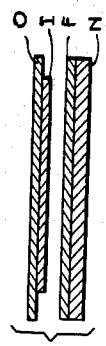


Fig. 1A.

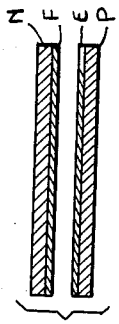


Fig. 1B.

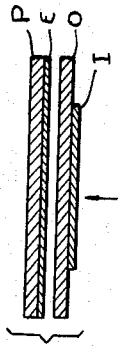


Fig. 1C.

Fig. 1.

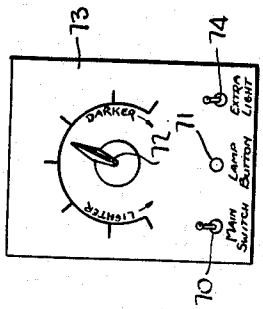


Fig. 2A.

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PHOTOCOPY MACHINE

Filed April 7, 1960

11 Sheets-Sheet 2

Fig. 2.

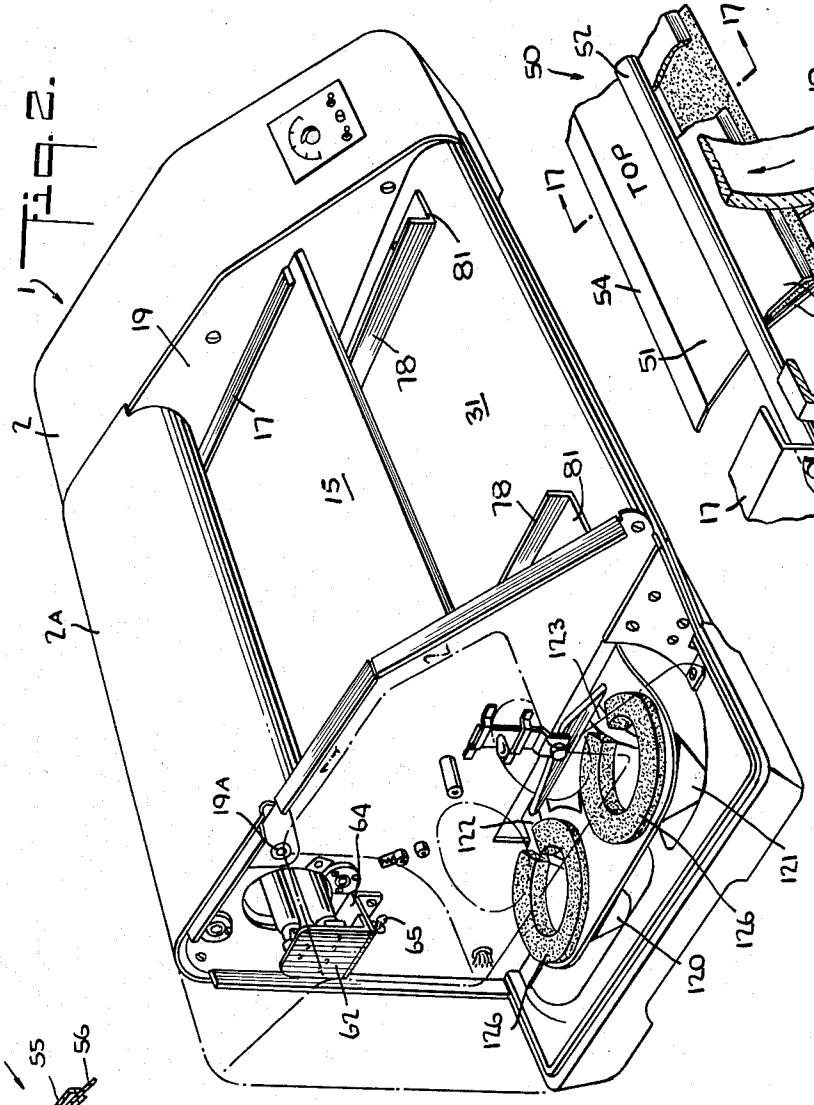


Fig. 16.

Fig. 17.

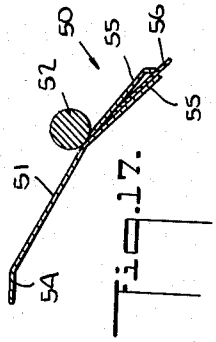
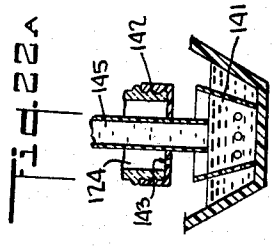


Fig. 22A



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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 3

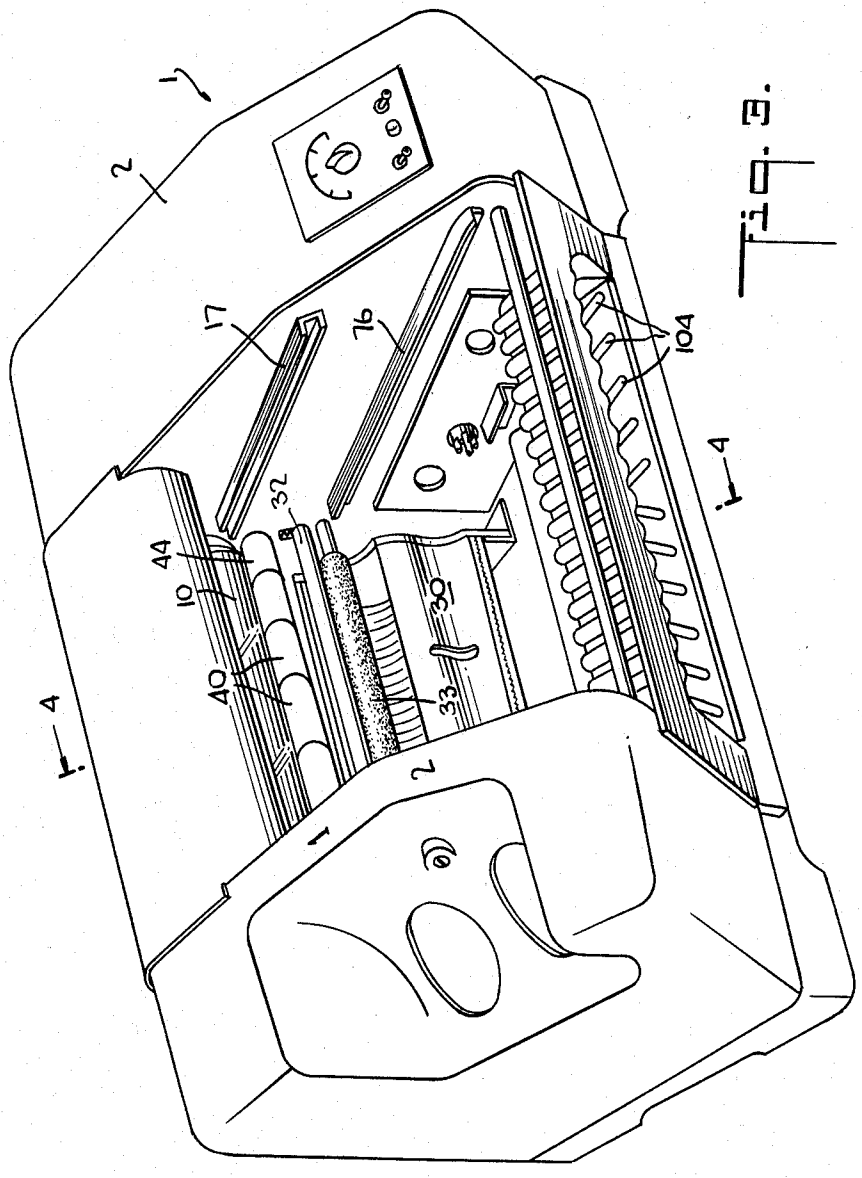


Fig. 3

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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 4

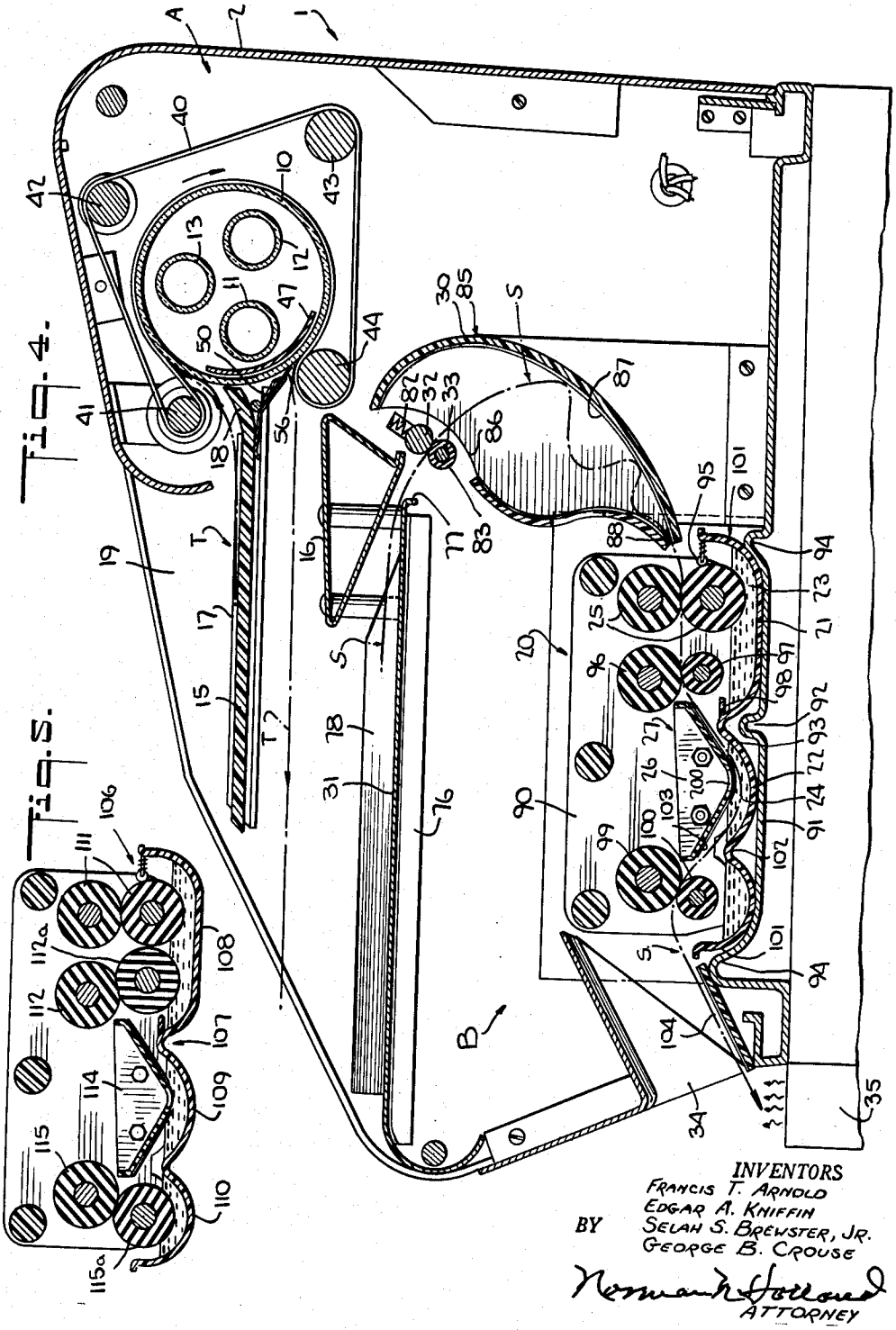


Fig. 4.

Fig. 5.

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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 5

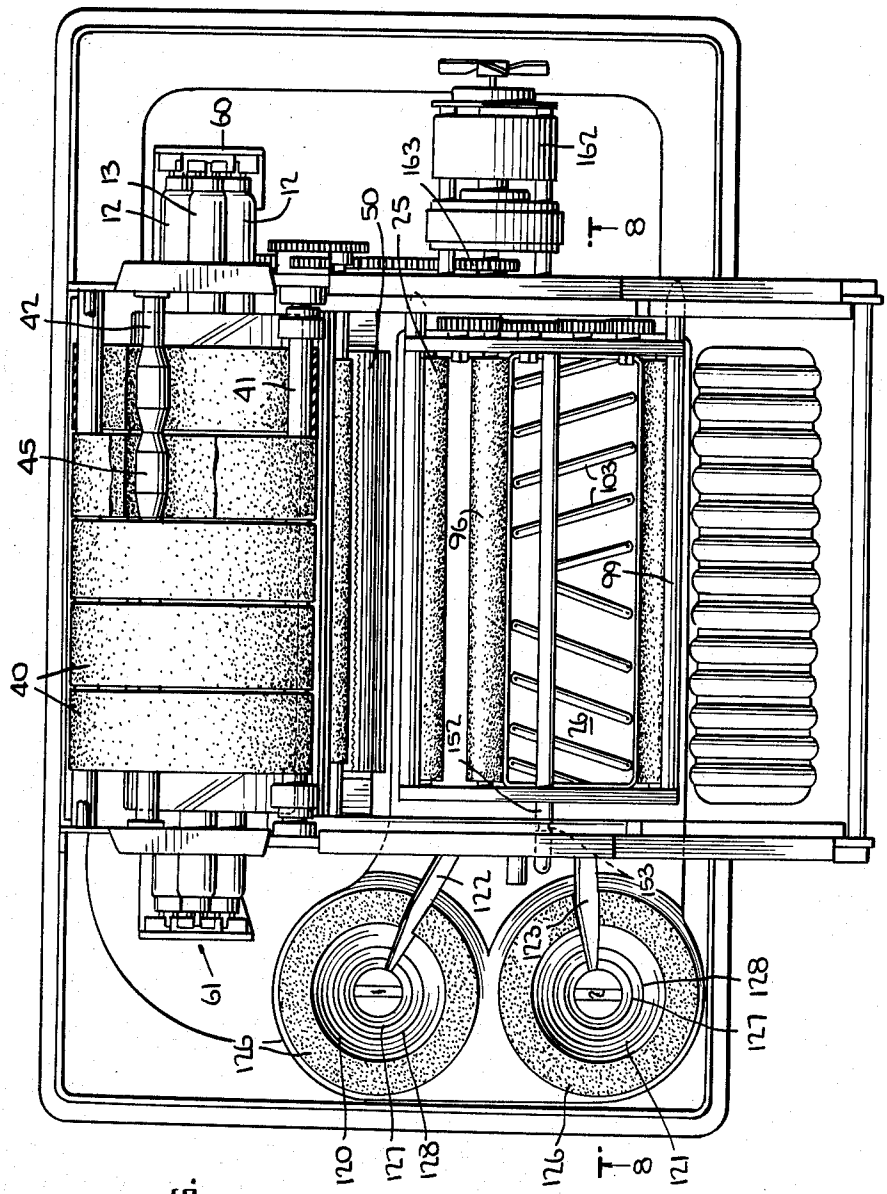


FIG. 5

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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 6

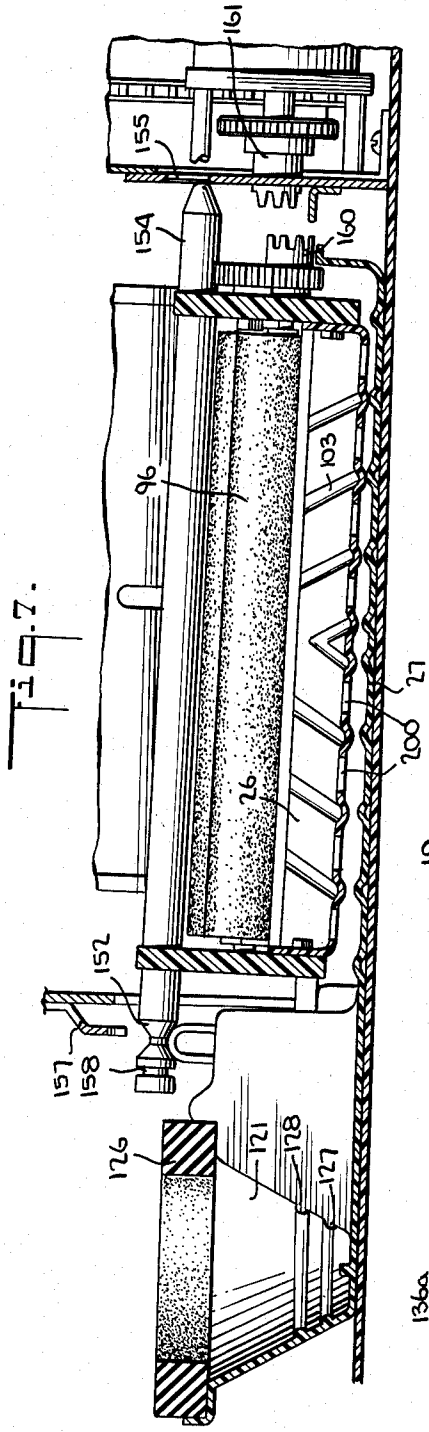


Fig. 7.

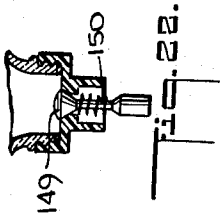


Fig. 22.

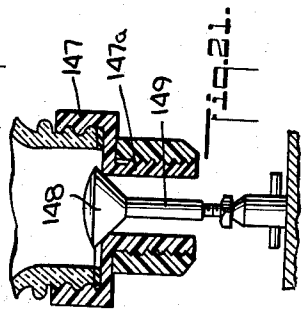


Fig. 21.

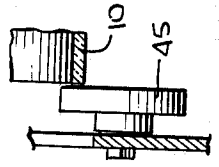


Fig. 20.

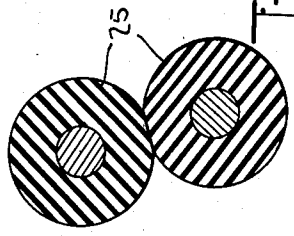


Fig. 14.

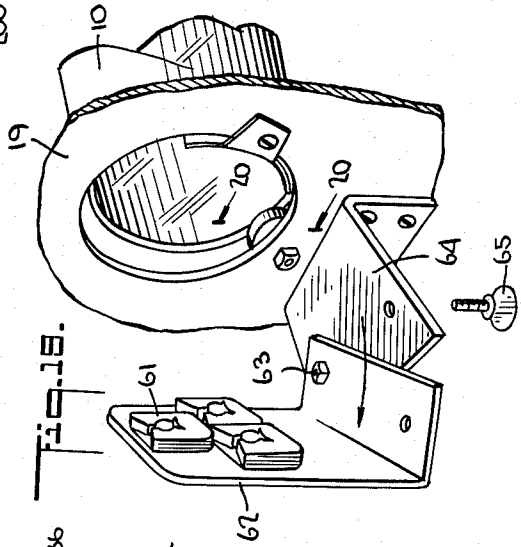


Fig. 15.

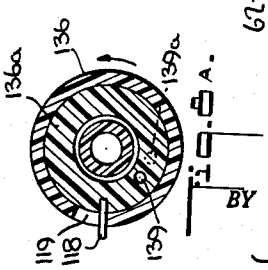


Fig. 8A.

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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 7

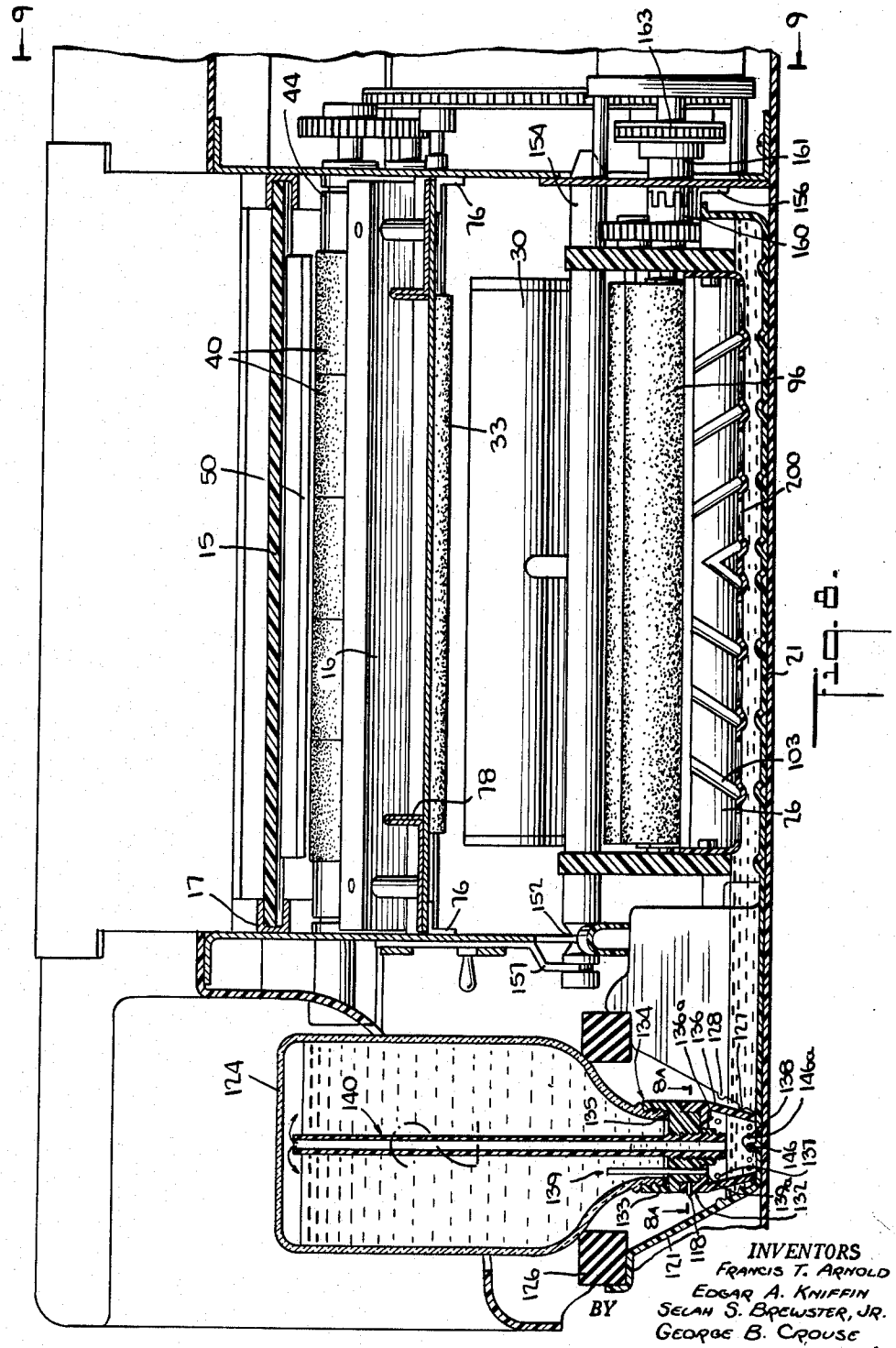


Fig. 8.

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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 8

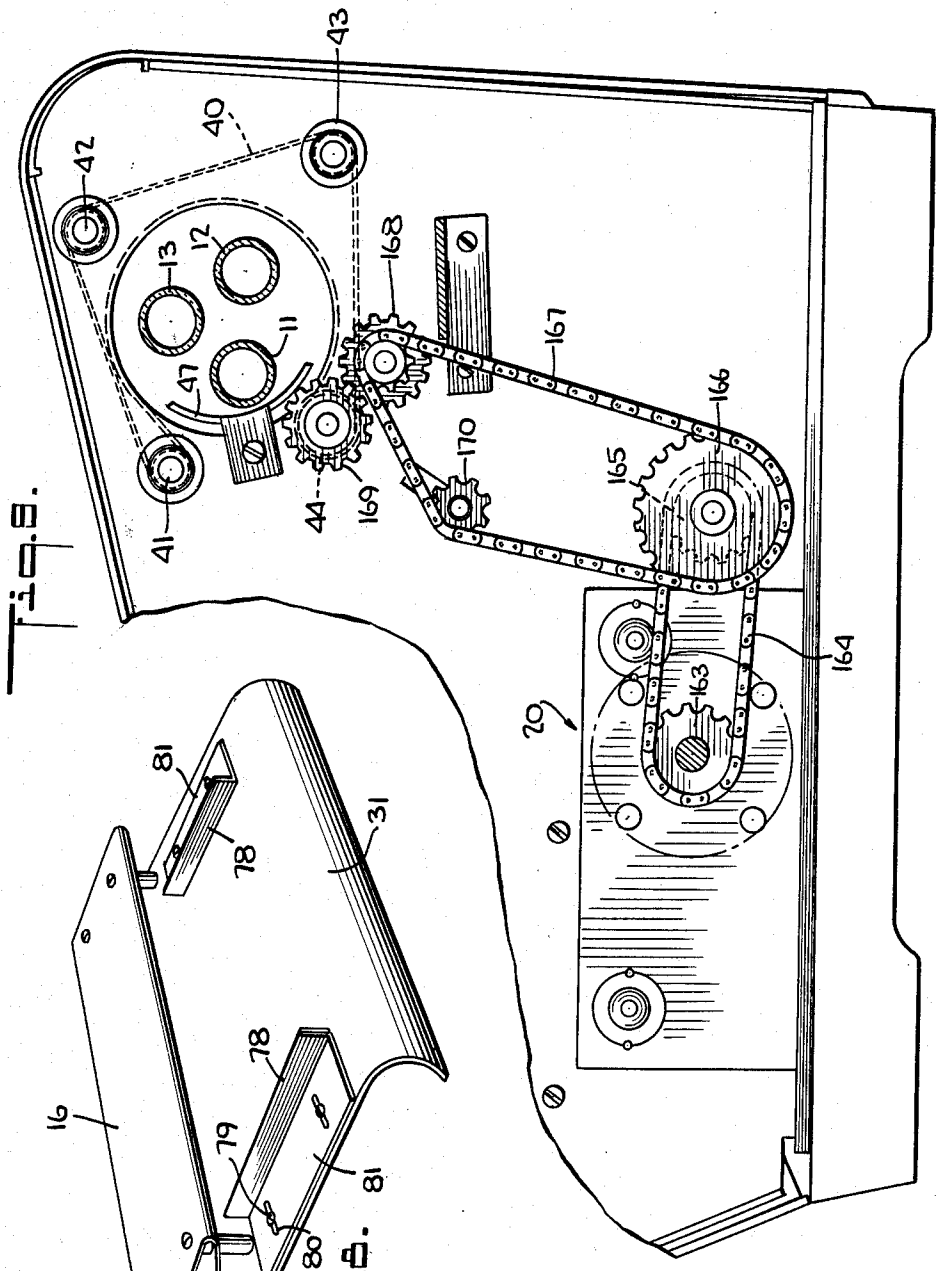


Fig. 9.

Fig. 10.

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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 9

Fig. 11.

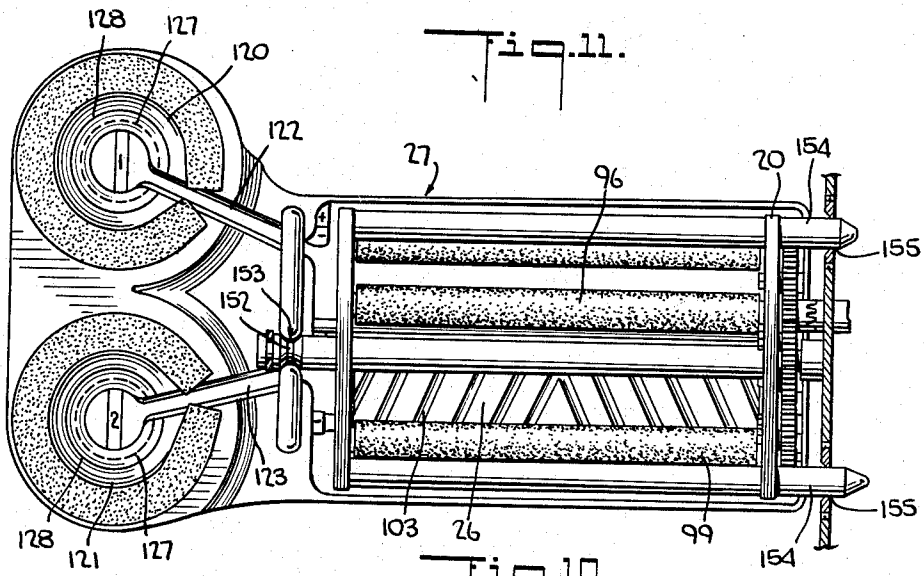


Fig. 10.

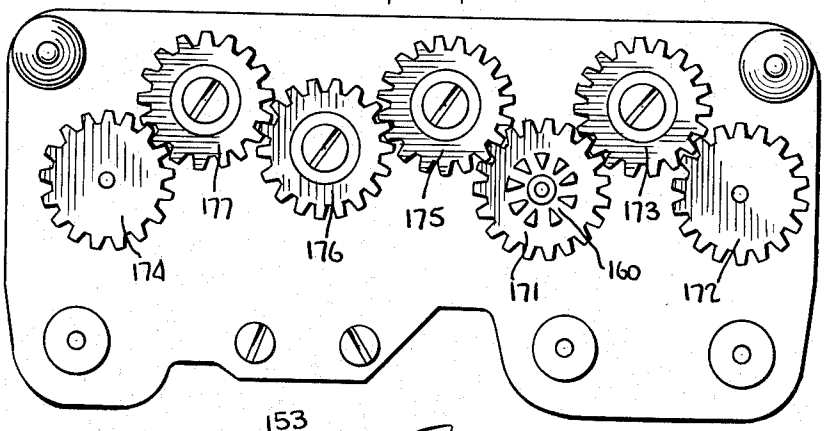
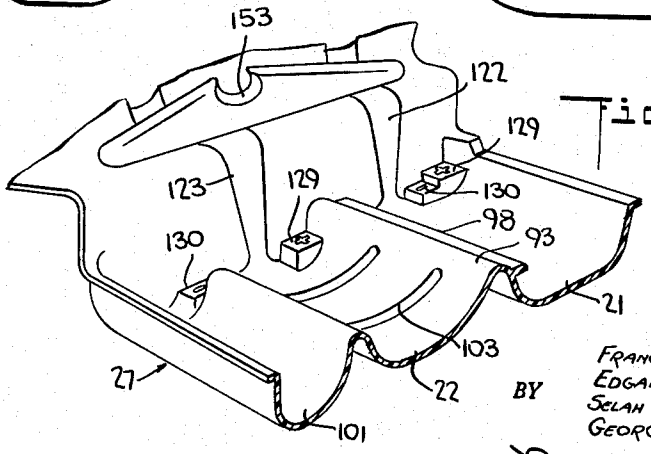


Fig. 15.



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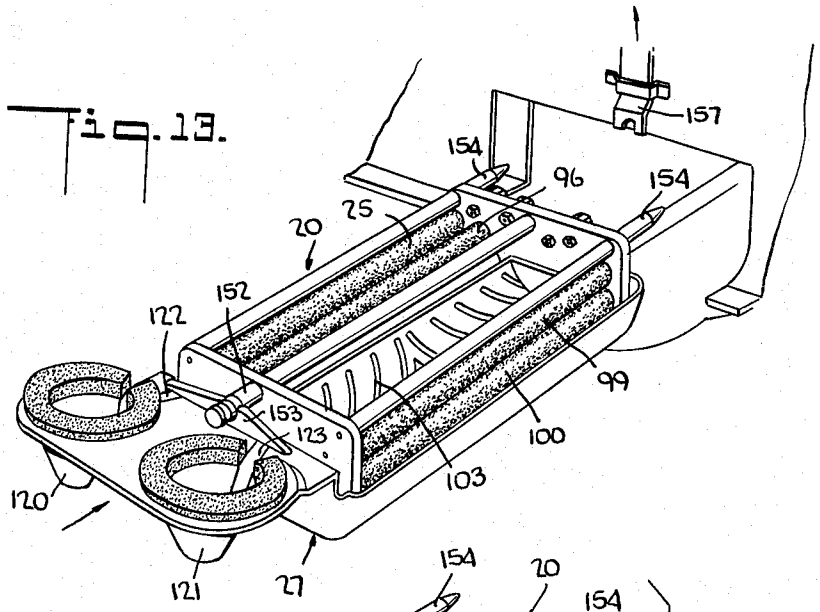
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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 10

Fig. 13.



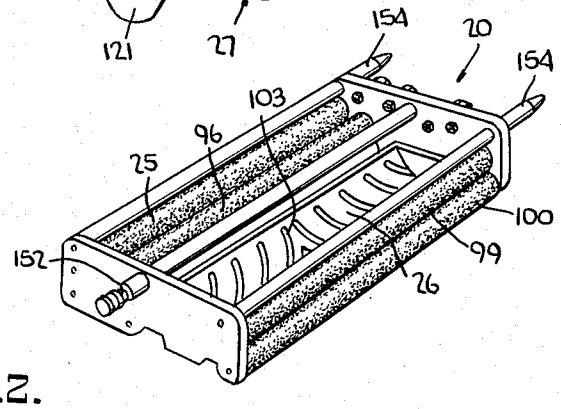
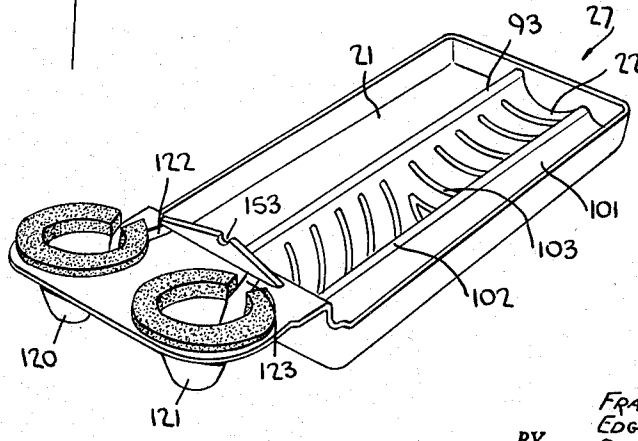


Fig. 12.



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PHOTOCOPY MACHINE

Filed April 7, 1960 11 Sheets-Sheet 11

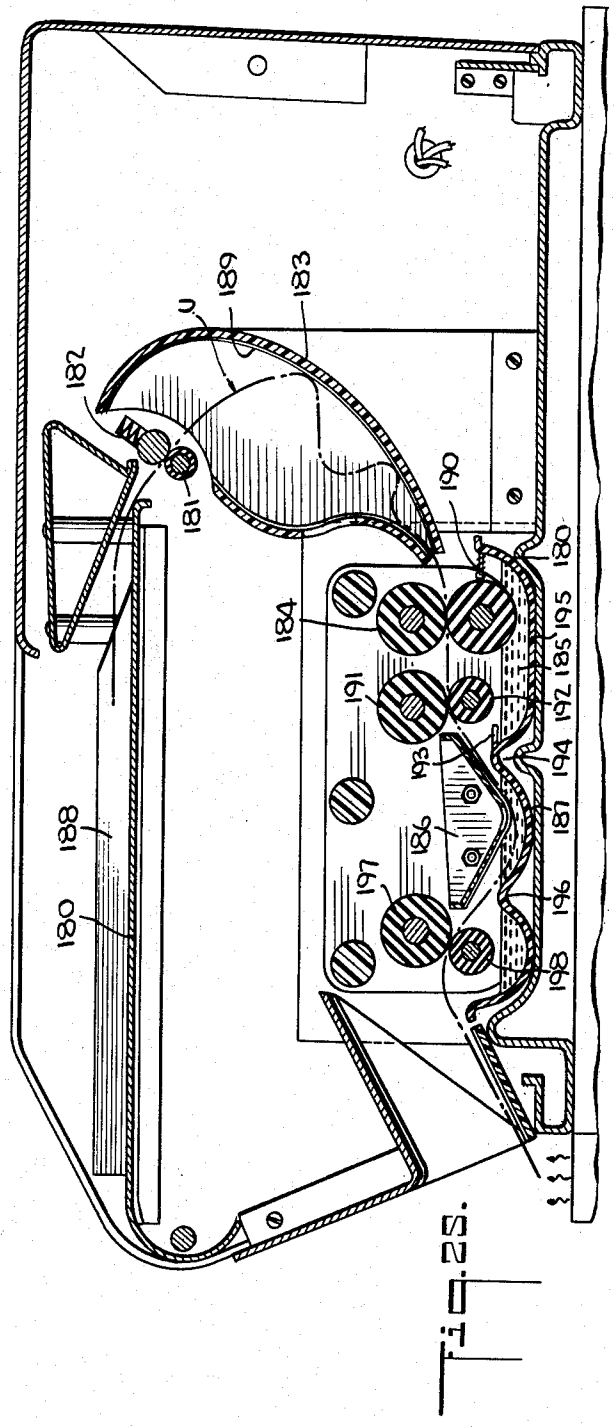


Fig. 10.

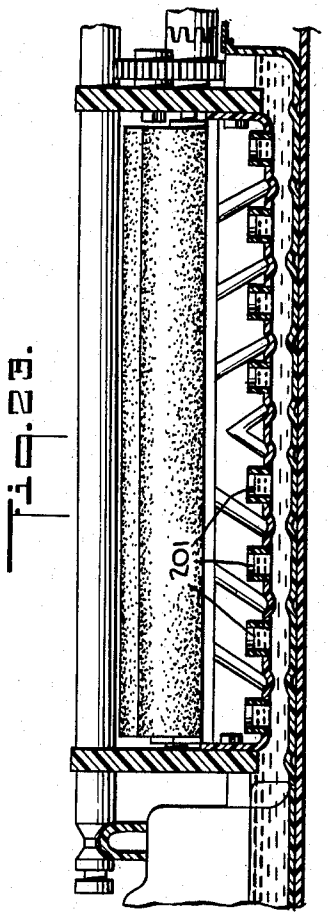


Fig. 25.

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United States Patent Office 3,107,596
Patented Oct. 22, 1963

3,107,596

PHOTOCOPY MACHINE

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Filed Apr. 7, 1960, Ser. No. 20,722
6 Claims. (Cl. 95—89)

The present invention relates to copying machines and more particularly to a machine for making photocopies which is particularly adapted to be used in offices for quickly making copies of documents.

Heretofore in the prior art several such copying machines have been in use. Some of these machines utilize a heat sensitive transfer mechanism. These heat transfer mechanisms are not suitable since copies made therefrom deteriorate in heat.

Photocopy mechanisms have also been used for many years. These machines operate by passing a photosensitive negative and an original over a glass exposing cylinder which exposes the photosensitive negative to light. The negative is then developed by passing the exposed sheet through a processing solution.

After the negative is obtained, the negative together with a positive sheet is then exposed to a light source and the positive sheet is then processed through a solution in order to develop the positive.

However, some of these machines require both the negative and the positive to be passed through the processing solution together to transfer the image from one to the other. Hence, elaborate structures are required to permit the solution to pass between the negative and the positive.

Many machines have the printing and processing mechanisms incorporated in separate units which take up space and expose the photosensitive sheet to unnecessary light when the sheet is transferred from one mechanism to the other.

It has also been difficult in the prior practice to insure that the bottles containing the different processing solutions are placed in the proper receiving cups so that sometimes the bottles are placed in the wrong cups and many prints may be damaged before the error is corrected.

Another disadvantage is that the level of the processing solutions cannot easily be determined so that it is difficult to know when more solution is needed.

It has also been a disadvantage of prior machines that the mechanism for moving the exposed sheet through the processing solution cannot easily be adjusted to the proper level to permit the proper amount of solution to be applied to the exposed sheet.

It has also been found that some prior machines do not effectively prevent mixing of the various processing solutions.

Another disadvantage of some of the prior machines is that the contents of solutions in the feed bottles sometimes become contaminated with the used contents in the processing troughs thereby necessitating replacement of the bottle.

The light sources of the printing units of existing machines are sometimes difficult to remove without the help of expert maintenance personnel.

It has also been found that prior machines do not provide for adequate control of the intensity of the light used to expose a photosensitive sheet so that the light cannot be adjusted depending upon the type of print which is desired.

Prior machines have also had the disadvantage that the sheet sticks to the several feed rollers and to the exposing glass cylinder. Also, a certain amount of curling has resulted in the sheet which sometimes damages the print or tears the sheet.

It has also been difficult in present machines to move the exposed sheet out of the light quickly and into the processing unit without an undue amount of light falling on the sheet and it has been difficult to prevent stray light from entering the processing unit.

In most machines presently in use the print is wet when it comes out so that the print must be left to dry before it can be used.

The present invention eliminates these disadvantages and has for one of its objects a mechanism for making photocopies in which it is only necessary to process the exposed sheet alone.

Another object of the present invention is to provide an improved photocopy machine which will prevent the sheet from sticking to the exposing cylinder and to other portions of the machine.

Another object of the present invention is to provide a photocopy machine which enables the level of the processing solutions to be easily controlled so that the processing solutions will always be at the proper level to give the best results.

Another object of the present invention is to provide a photocopy machine which permits the applicators for applying the processing solution to the exposed sheet to be automatically positioned to supply an accurate amount of solution to the exposed sheet without the necessity of fine measuring instruments.

Another object of the present invention is to provide a photocopy machine in which light sources can be easily removed when they are to be replaced.

Another object of the present invention is to provide an improved photocopy machine in which the intensity of the light source may be easily controlled to give the best results during exposure.

Another object of the present invention is to provide a photocopy machine which will prevent any stray light from affecting the exposed sheet until after it has been processed.

Another object of the present invention is to provide a photocopy machine in which mixing of the various processing solutions is minimized.

Another object of the present invention is to provide a photocopy machine in which contamination of unused processing solution by the used solution is minimized by a novel valve means for the feed bottles.

Another object of the present invention is to provide a photocopy machine in which the exposed print which is to be processed is quickly removed from the light and is accumulated so that it may be passed through the processing solution at a uniform speed.

Another object of the present invention is to provide an improved photocopy machine in which the feed bottles are clearly identified with the respective cups to assure that the correct bottle is mounted in the correct feed cup.

Another object of the present invention is to provide an improved photocopy machine in which the level of the processing solution may be easily determined by visual inspection.

Another object of the present invention is to provide an improved photocopy machine in which friction is minimized as to prevent the sheet being processed from wrapping itself around any rollers or the glass cylinder and to prevent the sheet from curling up at the edges during the processing operation.

Another object of the present invention is to provide an improved photocopy machine in which drying means are provided to eliminate the necessity of a separate drying operation after the prints have been processed.

Another object of the present invention is to provide

an improved combined printer and processing unit which is simple to operate and inexpensive to maintain.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1A is a diagrammatic sectional view showing the relative positions of an original and a negative sheet during exposure according to one method of operation of the present invention;

FIG. 1B is a view similar to FIG. 1A showing the position of the negative and the positive when the image on the negative is to be transferred to the positive;

FIG. 1C shows another method which may be used to transfer an image directly from an original to a positive;

FIG. 1 is a perspective view, partly broken away, showing the photocopy mechanism for the present invention;

FIG. 2 is a perspective view similar to FIG. 1 with part of the covering removed to show the position of the feed cups;

FIG. 3 is a perspective view similar to FIG. 1 with the processing solution tray removed to show the interior of the machine;

FIG. 4 is a sectional view taken on line **4—4** of FIG. 3 showing the preferred embodiment of the photocopy machine of the present invention;

FIG. 5 is a sectional view similar to FIG. 4 showing another embodiment of the processing solution tray;

FIG. 6 is a plan view of the machine with the cover removed showing the various positions of the parts;

FIG. 7 is a sectional view showing the position of the processing solution tray prior to being fully inserted into the machine;

FIG. 8 is a sectional view taken along line **8—8** of FIG. 6 showing the position of the processing solution tray after it has been fully inserted into the machine and showing the preferred valve for the feed bottles;

FIG. 8A is a sectional view taken along line **8A—8A** of FIG. 8 showing the shut off mechanism for the valve;

FIG. 9 is a sectional view taken along line **9—9** of FIG. 8 showing the driving mechanism for the machine;

FIG. 10 is an end view showing the gear mechanisms for driving the roller assembly of the processing solution trays;

FIG. 11 is a top plan view of the processing solution tray showing the position of the roller assembly therein;

FIG. 12 is an exploded perspective view showing the position of the roller assembly before it is mounted within the solution tray;

FIG. 13 is a perspective view showing the position of the roller assembly after it has been mounted within the solution tray and before the unit is inserted into the machine;

FIG. 14 is a sectional view showing the position of the applicator rollers of the roller assembly when a sensitized sheet is passed therethrough;

FIG. 15 is a perspective view showing a detail of the solution tray;

FIG. 16 is a detailed perspective view showing the operation of the preferred pick-off assembly;

FIG. 17 is a sectional view taken along line **17—17** of FIG. 16 showing the various parts of the pick-off assembly;

FIG. 18 is a perspective view showing details of the feeding platform of the machine;

FIG. 19 is a perspective view showing the means for permitting easy removal of the light source;

FIG. 20 is a sectional view taken along line **20—20** of

FIG. 19 showing the means for preventing axial shifting of the glass exposing cylinder;

FIG. 21 is a sectional view showing a modified form of feed valve;

FIG. 22 is a sectional view showing another modification of the feed valve;

FIG. 22A is a sectional view showing still another modification of the feed valve;

FIG. 23 is a sectional view showing a modified form of processing solution tray;

FIG. 24 is a plan view showing the control plate from which the light intensity may be adjusted; and

FIG. 25 is a sectional view showing a modification in which the processing section is an independent and separate unit.

General Method

Before describing the details of construction of the present invention, the general method of photo-printing and photo-processing will be described briefly.

Referring more particularly to FIGS. 1A and 1B, showing one method of exposing, an original O having an image I thereon is placed into contact with the emulsion side F of a negative sheet N. The original O and the negative N are passed over a light source so as to expose the photosensitive negative sheet N and so that the image is impressed on the emulsion F of the negative N and a so-called "mirror" image is obtained.

The negative N and the original O are then separated and the negative N is placed into contact with the positive sheet P having an emulsion E thereon so that the emulsion E of the positive P faces the emulsion F of the negative N, as shown in FIG. 1B. The negative and positive are then passed over a light source so that the image is transferred from the emulsion F of the negative N to the emulsion E of the positive P.

The positive and the negative are then separated and the positive is then passed through a processing solution to develop it. In the preferred embodiment of the invention, the processing solution comprises an activator solution which develops the positive to bring out the image and a stabilizer solution which sets or fixes the image.

FIG. 1C shows a different method of printing which is generally known as the "print-through" method. In this method the original O having an image I is placed into contact with a photosensitive positive sheet P having the emulsion E. The image I faces away from the emulsion E of the positive P. The light is passed through bath sheets in the direction of the arrow so that the image is impressed directly on the emulsion E of the positive P. No mirror image is obtained in this case and the positive can be used as a print after it is processed as described above.

For clarity in description, both the original O and the exposed negative N, when used in the exposing step, will be referred to hereinafter as the "original" and the unexposed negative N and the unexposed positive P, when used in the printing step, will be hereinafter referred to as the "unexposed sheet." After exposure the latter two sheets will be referred to as the "exposed sheet."

General Description of Machine

For convenience, the invention will first be described generally and the details of construction will be described under special headings below.

Referring more particularly to FIG. 4 the improved photocopy machine 1 is provided with a casing 2 and is adapted to be mounted on suitable stand 3 (FIG. 1) so that a suitable magazine 4 of photocopy paper may be stored beneath the machine 1 to facilitate access to the paper.

The preferred photocopy machine is of the combined exposing and processing type and comprises an exposing section A and a processing section B, as shown in FIG. 4.

The exposing section A comprises a rotating exposing

transparent cylinder 10, preferably made of glass, which has a suitable light source therein, such as fluorescent light 11, 12 and 13, and which is adapted to expose a photosensitive sheet of paper T. A suitable feeding platform 15 is provided to feed the unexposed sheet T to the glass cylinder 10 and a suitable take-off platform 16 is provided to receive the sheets after they have been exposed to the light source.

The processing section B comprises a suitable processing roller assembly 20 for passing the exposed sheet S through a processing tray assembly 27. A processing tray unit 27 has a pair of troughs 21 and 22 adapted to hold, respectively, an activator solution 23 for developing the exposed sheet and a stabilizer solution 24 for fixing the image.

A pair of applicator rollers 25 are adapted to apply the activator solution 23 to the sheet S and a suitable cam 26 is adapted to pass the paper through the stabilizer solution 24. An accumulator 30 is provided which guides the paper from a feeding platform 31 to the applicator rollers 25. The feeding platform 31 guides the sheet to a pair of feed rollers 32 and 33 which in turn feed the sheet S to the accumulator 30.

When it is desired to make a photocopy, a sheet of photosensitive paper T is removed from the magazine 4 (FIG. 1), and, together with an original, is passed first through the exposing section A and thereafter through the processing section B. The path followed by the paper is shown by the broken lines and is in the direction of the arrow shown in FIG. 4.

The photosensitive sheet and the original are passed onto the platform 15 of the exposing section A and are deposited onto the rotating glass cylinder 10 so that it is exposed to the light of the neon lamps 11 to 13. After the sheet is moved for almost 360° by the glass cylinder 10, the exposed sheet and the original are taken off the glass cylinder 10 by a take-off device 50 and deposited onto the take-off platform 16 and moved out of the exposing section A.

The exposed sheet is then separated from the original and is fed to the processing section B. The exposed sheet S is fed by the feed platform 31 to feed rollers 32—33 which quickly move the sheet out of the light and into the accumulator 30. In the accumulator 30 the sheet assumes a zig-zag position, as shown in FIG. 4, and the exposed sheet is then moved out by the applicator rollers 25 of the processing roller assembly 20. The applicator rollers 25 apply an activator solution 23 from tray 21 to the sheet to develop the image. The sheet is then moved by separator-cam 26 into the stabilizer solution 24 in tray 22 to fix the image.

The processed sheet may then be moved out of the machine through a suitable exit opening 34. As the paper passes through the opening 34, a suitable drier 35 may be activated to dry the print when it comes out of the machine.

FIG. 25 shows an embodiment of the invention in which the processing section is in a separate unit.

The operation of this embodiment is similar to the operation of the processing section B of the embodiment shown in FIG. 4, described above. The exposed sheet U is passed over a feed platform 180 between the feed rollers 181—182 and into the accumulator 183 where it assumes a zig-zag shape.

From the accumulator 183 the sheet is grasped by the applicator rollers 184 which apply the activator solution 185 to the sheet U and it is then passed by a cam 186 through the stabilizer solution 187 and out through the front opening in the machine in a manner similar to that described in FIG. 4.

Exposing Section

The exposing section A is shown in detail in FIGS. 1 and 4. The exposing section A comprises the feed platform 15 which is slidably mounted in a pair of rails 17 (FIGS. 1 and 3) mounted on side plates 19 of the machine and has a front upwardly extending portion 18 (FIGS. 1 and 4) which is adapted to direct the paper to the glass cylinder 10.

The glass cylinder 10 is supported by a plurality of endless belts 40 which pass over a plurality of rollers 41, 42, 43 and 44 arranged in a rectangular fashion around the glass cylinder 10 (FIGS. 4 and 9) so as to become wrapped around glass cylinder 10 for almost its complete periphery and to act as a support and a drive for the cylinder 10. The roller 42 (FIGS. 1 and 6) has a plurality of spaced high portions 45 bearing on the belts 40 to reduce friction.

The roller 44 is a drive roller which moves the belts 40 over rollers 41, 42 and 43. As the belts 40 are moved, the friction engagement between the rollers and the glass cylinder 10 will rotate the glass cylinder 10 and permit it to carry a photosensitive sheet around its periphery and permit it to be exposed to the light sources 11 to 13 therewithin. A pair of bearings 45 (FIG. 20) abut the edges of cylinder 10 to prevent side movement thereof.

When it is desired to remove the glass cylinder for cleaning or other maintenance purposes the casing section 2A (FIG. 2) is first removed and the fastener element 19A is then removed. This releases roller 41 which can then be lifted together with the belts 40 to permit removal of the glass cylinder 10.

A light shield 47 is provided within the glass cylinder 10 to span the portion of the glass cylinder 10 between the rollers 41 and 44 which is not covered by belts 40 to prevent light from entering the processing section B which should be in darkness.

The unexposed sheet and the original are rotated with the glass cylinder 10 during exposure for almost the full periphery of the glass cylinder 10 and is then removed from the glass cylinder 10 by the pick-off assembly 50 shown in FIG. 4.

The pick-off assembly 50 is shown in more detail in FIGS. 16 and 17 and comprises a body portion 51 mounted on a supporting rod 52 which is adapted to be mounted in a slot 53 (FIG. 16) provided in the rails 17. The rear edge 54 of the body portion 51 is adapted to abut the bottom of the feeding platform 15 (FIG. 4) and the top of body 51 may have the word "Top" or some other suitable indicia thereon to indicate the proper manner in which the pick-off assembly 50 is to be mounted into the machine. The front of the body portion 51 is provided with a pair of clamping members 55 adapted to clamp a pick-off blade 56 therebetween which abuts the glass cylinder 10 as shown in FIGS. 4 and 16. The pick-off blade 56 is adapted to be adjustably mounted between the clamping members 55 so that it will abut against the glass cylinder 10 and so that it will permit the blade 56 to be removed and inverted when one edge thereof wears out. The pick-off blade 56 is preferably made of a suitable material to prevent generation of static electricity. After exposure, the sheet T is lifted off the glass cylinder 10 by the pick-off blade 56, as shown in FIG. 16, thereby preventing the sheet T from sticking to the glass cylinder 10.

When the sheet is picked off the glass cylinder it is deposited on the take-off platform 16 (FIG. 4) from which it may be removed by the operator.

In the operation of the exposing section A, the sheet is passed over the feed platform 15 and between rotating glass cylinder 10 and the supporting belts 40. The light sources within the glass cylinder 10 are turned on so as to expose the unexposed sheet T to the light rays so that the image of the original will be impressed on to the emulsion on the sheet T.

The sheet T makes almost a complete revolution over the rotating cylinder 10 and is stripped off the glass cylinder 10 by the pick-off blade 56 of the pick-off assembly 50 and is deposited onto the take-off platform 16. The original is then separated from the exposed sheet by the operator and the exposed sheet may then be passed to

the processing section B, hereinafter described in detail, to develop it.

Lighting Control

The light for exposing the photosensive sheet T, as described above, is provided by the neon lamps 11, 12 and 13 lying within the cylinder 10. The lamps are of the elongated type and may be provided with suitable filters (not shown) to control the quality of the light. These filters may be color filters to permit exposure of the sheet to light having different colors.

The lamps 11 to 13 are mounted at opposite ends in suitable socket assemblies 60 and 61, as shown in FIG. 6. The socket assembly 61 is preferably mounted on a plate 62 (FIG. 19) which is pivotally mounted at 63 on a suitable bracket 64 and adapted to be fixed to the bracket 64 by means of a thread screw 65. When it is desired to remove the lamps 11, 12 or 13 the thread screw 65 is loosened and the plate 62 is swung out as shown in FIG. 19 and the lamps are then ready to be replaced. After new lamps are then ready in the glass cylinder 10 the swinging plate 62 is moved to its original position on the bracket 64, as shown in FIG. 2, and the thread screw 65 is screwed in place to lock the plate 62 in place.

The lamps 11, 12 and 13 are adapted to be controlled so that the intensity of the light used for exposing may be adjusted. This control mechanism is shown in FIG. 24. The main switch 70 starts the machine. When it is desired to expose a sheet, the lamp button 71 is pushed which will light up lamps 11 and 12. It will be understood of course that the suitable means may be provided so that the two lamps 11 and 12 are automatically lit when the sheet is inserted into the glass cylinder 10.

The intensity of the light of the lamps 11 and 12 is controlled by a suitable indicator 72, which may be rotated in accordance with the indicia on panel 73 to actuate suitable rheostats which control the power supply to the lamps 11 and 12 to control the intensity of the light. Thus, if the indicator 72 is moved to the right, less light will be used which makes the image darker, whereas if the indicator is moved to the left, more light is used, which will make the image lighter.

If more light is needed for a particular print the third lamp 13 may be lit by pushing the "extra-light" button 74. This will light all three lamps 11, 12 and 13 to give the necessary additional light required.

Processing Section

The processing section B is shown in FIGS. 3, 4, 6 and 8.

The processing section B comprises the feed platform 31 which directs the exposed sheet S betwen feed rollers 32 and 33 (FIG. 4). The feed platform 31 is removably mounted on a pair of rails 76 and is provided with a stop 77 at its forward end which snaps in front of rails 76 to lock the feed platform 31 in position. As shown in FIG. 18, the platform 31 has a pair of guide bars 78 adjustably mounted thereon by means of set screws 79 riding on slots 80 in plates 81, permit the machine to take sheets of varying widths.

The feed roller 32 (FIG. 4) is preferably made of metal and is pressed by a spring 82 against roller 33 which is preferably provided with a resilient rubber outer sleeve 83. This use of a metal roller together with a roller with a soft outer covering minimizes friction and reduces surface tension on the sheet S being fed thereto by the feed platform 31.

The feed rollers 32 and 33 move the sheet to the top opening 86 of the accumulator 30. Accumulator 30 has an opaque coating, such as a blank surface, on the rear outside surface 85 to prevent any stray light from the exposing section A from entering therein. The accumulator 30 is also provided with corrugations 87 on its inside surface to reduce friction and to eliminate the possibility of the paper sticking against the sides of the accumulator 30.

The accumulator 30 is shaped so as to be wide at the top opening 86 and narrow on the bottom opening 88 so that the sheet entering therein will be fed directly between the applicator rollers 25 of the processing roller assembly 20. The feed rollers 32 and 33 operate faster than the applicator rollers 25 so that the exposed sheet is taken quickly out of the light by rollers 32 and 33 and is stored in the accumulator, where it assumes the zig-zag shown in FIG. 4. The sheet is then slowly taken out of accumulator 30 by the applicator rollers 25 and is moved through the processing roller assembly 20 at a slower and more uniform rate to permit uniform processing.

The roller assembly 20 comprises a tray assembly 27 and a roller assembly 20 (FIGS. 12 and 13). The base 91 of the processing section B is provided with an integrally formed rib 92 which cooperates with a concavity formed by upstanding rib 93 in the tray assembly 27 to permit accurate positioning of the tray assembly 27 with respect to the accumulator 30 and permit the applicator rollers 25 to receive the sheet S directly from accumulator 30. The spaced upstanding ribs 94 on base 91 abut the edges of tray assembly 27 and aid in positioning the tray 27 and preventing shifting thereof.

The sheet S is moved between the applicator rollers 25 to apply the activator solution 23 thereto which develops the sheet. A suitable spring-pressed roller 95 removes excess solution from the applicator rollers 25. The sheet is then passed through a pair of squeeze rollers 96 and 97 to squeeze excess solution from the sheet S. It will be noted that roller 97 is of smaller diameter than roller 96 so that it does not enter activator solution 23 and does not apply any solution to the paper.

A suitable baffle 98 is provided on the rib 93 of the tray assembly 27 to deflect any waves set up in the activator solution 23 and prevent it from going over the rib 93 and contaminating the stabilizer solution 24.

The sheet is then passed to the cam 26 which directs the sheet into the stabilizer solution 24 in trough 22 which fixes the image. When the sheet leaves the stabilizer solution 24, it is passed between a pair of squeeze rollers 99 and 100 which squeeze out the excess stabilizer solution and let it drop into auxiliary trough 101 which is separated from trough 22 by rib 102 to prevent the used stabilizing solution in trough 101 from contaminating the fresh solution in trough 22. The squeeze roller 100 is of a small diameter so that it does not enter the used solution in trough 101.

The rollers 25, 96—97, and 99—100 preferably have soft outer coverings so that there is a slight flattening of the rollers at the point of juncture between them. This is diagrammatically illustrated in FIG. 14.

The cam 26 and the solution troughs 21, 22 and 101 are provided with divergent ribs 103 (FIGS. 6, 7, 8, 11, 12, 13 and 15) which will act as spreaders to prevent the sheet from curling. Hence, no bent sheets are obtained with the mechanism.

The sheet is then passed down to the exit opening 34. The exit opening 34 is also provided with divergent ribs 104 (FIG. 3) to form spreaders to prevent the sheet from curling. The drier 35 then dries the paper to eliminate the necessity of placing the paper on a separate drier before it is to be used.

If desired, the modified roller assembly 106 shown in FIG. 5 may be used. This embodiment is similar to the embodiment shown in FIG. 4 and comprises a tray assembly 107 having an activator trough 108, a fresh stabilizer trough 109 and a used stabilizer trough 110. The applicator rollers 111 apply the activator solution and the cam-separator 114 directs the paper to the stabilizer solution.

The squeeze rollers 112—112A and 115—115A respectively, squeeze excess activator and stabilizer solutions from the sheet. However, the lower squeeze rollers 112A and 115A enter their respective solutions instead

of being of small diameter as the rollers **100** and **97** shown in FIG. 4. It will also be noted that the metering roller **95** (FIG. 4) is not used in the embodiment shown in FIG. 5.

In the operation of the processing section B (FIG. 4), the exposed sheet S is passed over the platform **31** between the feed rollers **32** and **33** and into the accumulator **30** where it assumes a zig-zag shape shown in FIG. 4.

From the lower end **88** of the accumulator **30** the sheet is passed between applicator rollers **25** which apply the activator solution **23** thereto to develop the image on the exposed sheet S. The metering roller **95** prevents excess amounts of solution from being applied to the sheet S.

The sheet S is then passed between squeeze rollers **96** and **97** which squeeze out excess activator solution from the sheet. The sheet is then directed by the cam **26** into the stabilizer solution which fixes the image on the sheet S. The sheet then passes out of the stabilizer solution and between squeeze rollers **99—100** to squeeze out excess stabilizer solution from the sheet.

The sheet then moves out of the processing sections B through the opening **34** where it passes over the drier **35** which dries the processed sheet.

Solution Control

It is important that the proper solutions are used in the proper troughs and that the level of the stabilizer and activator solutions be maintained at the proper levels so that the sheet will be processed by the correct amount of solution in order to give the best results.

Proper Identification of Bottles

In order to insure that the proper solution enters the proper trough in the tray assembly **27**, a pair of cups **120** and **121** (FIG. 11) are provided communicating with the activator and stabilizer troughs **21** and **22**, respectively, through passageways **122** and **123**, respectively.

The cups **120** and **121** are adapted to accommodate the feed bottles **124** and **125** (FIG. 1) therein to feed the solutions to the troughs. Suitable support means, such as rubber ring **126** (FIG. 8), may be provided at the mouth of the cups to hold the bottle in place. Wire supports may also be used if desired.

To insure that the solutions in the feed bottle **124** and **125** are fed to the proper troughs, the numeral "1" may be placed in the bottle **125** to indicate that it contains an activator solution and the numeral "2" may be placed on the bottle **124** to indicate that it is a stabilizer solution. These numbers correspond with the numbers 1 and 2 on the outside of the casing as shown in FIGS. 1 and 3 and also correspond with similar numbers at the base of the cups **120** and **121**, as shown in FIGS. 6 and 11. In this manner the operator will know that the number 1 bottle (activator solution) goes into the number 1 cup and the number 2 bottle (stabilizer solution) is adapted to be placed in the number 2 cup. Hence, the number of mistakes is minimized.

Determination of Level

It is also important to permit the level of the solutions in the troughs to be determined by visual inspection. To accomplish this, the cups **120** and **121** are provided with a pair of indicator lines **127** and **128** (FIGS. 6 and 8) which may be of different colors. The inner (lower) line **127** indicates the lowest level of the solution in the trough and the outer (higher) line **128** may indicate the highest level of the solution in the troughs. If the solution is at these two points the machine will operate with optimum results. The operator may thus determine by visual inspection whether a particular trough has too little or too much solution.

The troughs **21** and **22** are also provided with level indicators. The step **129** (FIG. 15) with the "plus" sign corresponds with the high level mark of the upper ring **128** in the cups and the step **130** with the "minus" sign corresponds with the low level mark of the lower ring **127** in the cups. This permits visual determination of the solutions in the troughs by visual inspection of the troughs themselves.

Automatic Level Control

In order to insure automatic feeding of the stabilizer and activator solutions to maintain them at the proper operative levels, the improved bottle valve **132** shown in FIGS. 8 and 8A is provided. It will be understood that the bottle feed valve **132** will be described in connection with stabilizer feed bottle **124**, but the same valve may be used for both the stabilizer feed bottle **125** and the activator feed bottle **125**.

The valve **132** comprises a cap member **133** threadably mounted at its upper end **134** to the open end of bottle **124**. A suitable gasket **135** prevents seepage of the contents out of the sides of the cap **133**.

The cap member **133** has a hollow baffle **136** extending therefrom and rotatably mounted thereon. The baffle **136** has air holes **137** therein and fluid openings **138** adapted to permit fluid to pass out thereof. The baffle **136** acts as a "wave-breaker" and is adapted to prevent any turbulence or waves in the fluid in the solution troughs from affecting the contents of the bottle **124**.

The solution is fed to the cups through the filler tube **139** and the aligned opening **139A** in the cover **136A** of the baffle **136**. The filler tube is of such diameter as to prevent liquid from passing therethrough by means of capillary action.

An air tube **140** is mounted in the cap **134**. If desired, the air tube **140** may be threadably mounted so that the level of the solution may be adjusted. When the liquid in the cup falls below the opening in air tube **140**, air enters air tube **140** through air holes **137** in the baffle **136**. The air rises in air tube **140** and applies pressure to the fluid contents in the bottle thereby breaking the capillary seal made by feed tube **139** and permitting fluid to be released. When the level reaches the opening in the air tube **140**, no air enters and the feed tube **139** closes by capillary action. Fluid is fed to the troughs through openings **138** in baffle **136**.

In normal use, some of the solution will rise in air tube **140**. When the bottle is raised, the contents in the air tube **140** will spill back into the cup so that when the bottle **124** is inverted none of the used solution will flow into the unused solution in the bottle to contaminate it.

When the bottle is removed, spillage is prevented by taking the feed tube **139** out of alignment with opening **139A** in baffle **136**. This is done by providing a ridge **146** in the cup which cooperates with a notch **146A** in the lower edge of baffle **136**. When the bottle is rotated before being lifted the filler tube **139** will rotate relative to opening **139***a* and assume the position shown in FIG. 8A to cut off the filler tube **139**. The pin and slot arrangement **118–119** serve to limit the amount of rotation of the bottle.

Another modification of this valve is shown in FIG. 22A. In this embodiment the baffle **141** is a separate unit from the cap **142** instead of being in one piece, as it is in the embodiment shown in FIG. 8. The cap **142** has a filler outlet or tube **143** and an air tube **145**. The operation is similar to the operation of the embodiment shown in FIG. 8. The contaminated solution will rise in the air tube **145** so that it will not contaminate the contents of the bottle **124** when the bottle is inverted. When the level is below the opening in air tube **145**, the filler outlet **143** will release fluid until the opening is closed.

FIGS. 21 and 22 show additional embodiments of the valve. As shown in FIG. 21, the cap **147** is provided with a downward extension **147A** normally closed by a suitable valve head **148** having an arm **149** which is adapted to strike the bottom of the cup and be raised when the bottle is inserted in the cup, to permit the fluid to pass from the bottle to the cup. Fluid flows until it reaches the opening in extension **147A**. When the bottle

is raised the valve 148 will automatically shut the bottle opening to prevent any liquid from passing therefrom.

FIG. 22 shows another modification in which the valve head 149 is provided with a spring-pressed shank 150 which maintains the valve closed at all times. In order to permit additional fluid to enter therethrough the bottle must be lowered against the pressure of the spring to open the bottle.

Cam

It is also important for the cam 26 to be a certain distance within the stabilizer solution 24 so that the proper amount of solution is applied to the sheet S as it is passing therethrough. This is accomplished by providing a three-point support for the roller assembly 20 as shown in FIGS. 6 and 11. This three-point contact is accomplished by mounting the roller assembly 20 within tray unit 27 so that a pin 152 on one side is mounted on a permanent journal 153 which is integrally formed on the tray assembly 27 and pins 154 on the other side are mounted in journals 155. It will be noted that with the establishment of the single support between the pin 152 and the journal 153, the roller assembly 20 is angled, as shown in FIG. 7 with the other support pins 154 below their respective journal opening 155.

As the tray is inserted into the machine, the pins 154 will be cammed upwardly by the journal holes 155 and will be received thereby to raise the roller assembly to its preferred height as shown in FIG. 8 so that the cam 26 dips into the solution 26 for the required distance only. At the same time the clutch elements 160—161 (more fully described hereinafter) are coupled together so as to operatively connect the roller assembly to the drive assembly. Also, as shown in FIG. 7, the side of the tray assembly will abut against the bottom of the lock member 156 (FIG. 8) on the side plate to hold the tray in place. A suitable latch 157 is provided which is directed downwardly into a notch 158 in the pin 152 to lock the tray in place. With this arrangement, a three-point contact is effected which gives the proper spacing between the cam 26 and the solution in the stabilizer trough and hence insures that the proper amount of stabilizer solution will be applied to a sheet passing therethrough.

The cam 26 is provided with a plurality of openings 200 so that the solution may be raised into the inner areas of the cam 26 when a sheet is passing therethrough to provide an escapement. When the sheet is passing below the cam 26 of the tray the space taken up by the sheet will displace the stabilizer liquid. This will raise the level of the liquid. In order to provide an escapement for the liquid, the fluid is displaced upwardly through the openings 200. After the sheet passes through, the fluid will descend again to its own level. Hence, every time a sheet is passed through the stabilizer solution a pumping action is effected which will raise and lower the level of the fluid.

In order to adjust the level of the stabilizer solution when an excess of stabilizer solution is in the trough, the modification shown in FIG. 23 may be used. Conduits 201 are mounted in the openings 200 so that if the solution is beyond a certain level the solution will seep over the conduits 201 and remain inside of the cam and hence, excess solution will be removed from the stabilizer trough.

Drive Mechanism

The drive mechanism for the machine is shown in FIGS. 6, 8, 9 and 10. A suitable motor 162 of any desired design is adapted to drive the rollers 41 to 44 (FIG. 9) which support glass cylinder 10 through belts 40, through the intermediation of the master gear 163, sprocket chain 164, double gears 165, 166, sprocket chain 167, and driven gears 168 and 169. Gear 169 is on the same shaft as the roller 44 which will rotate the belts 40 and frictionally rotate the glass cylinder 10. The chain 167 also operates a gear 170 which is mounted on the same shaft as the guide rollers 32 to rotate the guide rollers 32—33 when the machine is in operation and feed the paper to the processing section. The master gear 163 is operatively connected to a clutch member 161 as shown in FIG. 8. The clutch member 161 is adapted to be coupled with gear 171 of the clutch member 160 of the roller assembly which is coupled to several gears on the roller assembly to permit rotation of the rollers in the roller assembly (FIG. 10). The clutch member gear 171 is mounted on the same shaft as the squeeze rollers 96 to rotate the squeeze rollers 96 and 97.

The gear 171 also drives gear 172, through idler gear 173, which is mounted on the shaft of the activator applying rollers 25 to rotate those rollers. Gear 171 also rotates gear 174 for stabilizer squeeze roller 99, through the intermediate of idler rollers 175, 176 and 177, to rotate squeeze rollers 99 and 100.

The several gears used may be nylon gears to make the operation a silent one. However, metal gears may also be used, as may be desired.

Separate Processing Machine

If it is desired to use a separate processing machine, the negative is first exposed on a separate exposing machine (not shown) and is then processed by the machine shown in FIG. 25. This machine is similar to the processing section B of the machine shown in FIG. 4 and will be described briefly herein.

The usual feed platform 180 has the adjustable guide rails 188 to permit the sheet to be fed between the feed rollers 181—182. The feed roller 182 is spring-pressed and is preferably made of metal and the other feed roller 181 preferably has a resilient outer covering so as to reduce friction. The feed rollers 181—182 feed the sheet U to the accumulator 183 which has corrugations 189 on its inside surface to reduce friction and to prevent the sheet from sticking thereto. The accumulator 183 is preferably painted black on the outside to prevent any stray light from entering therein. The sheet U assumes a zig-zag shape and is then taken up by the applicator rollers 184 which apply the activator solution 185 to the sheet. The spring pressed metering roller 190 prevents excess solution from being applied thereto.

The sheet U is then passed between the squeeze rollers 191—192 to squeeze the solution from the sheet. A suitable baffle 193 is provided in the wall 194 between the activator solution trough 195 and the stabilizer solution trough 196 to prevent the activator solution from spilling over into the stabilizer solution. The cam 186 then forces the sheet U into the stabilizer solution to set the image.

The sheet then passes between a pair of squeeze rollers 197—198 to squeeze out the excess solution and the sheet then passes out of the processing machine through an opening in the front thereof and over a suitable drying mechanism to dry the sheet.

As will be noted, the separate processing machine shown in FIG. 25 is similar to the processing section B shown in the combined machine of FIG. 4.

Operation

The operation of the machine will be obvious from the above description. However, the operation will be summarized hereinbelow for convenience.

Referring to FIG. 4 of the drawings, the original and the unexposed sheet are passed in the exposing section A by being inserted over the feeding platform 15 and fed between the belts 40 and cylinder 10. The lighting assembly is turned on to open the light sources 11 and 13 and to expose the sensitive sheet to the light. After the sheet has been exposed the sheet is stripped off the glass cylinder 10 by the pick-off assembly 50 and is deposited onto the take-off platform 16.

The original is then separated from the exposed sheet which is passed to the processing section B by passing the sheet over platform 31 and between the feed rollers 32 and 33 and into the accumulator 30 where it assumes a zig-zag shape. The sheet is then taken out of the accumu-

lator 30 by the applicator rollers 25—25 where the activator solution 23 is applied thereto.

The sheet is then forced by the cam 26 into the stabilizer solution 24 where the image is stabilized. The sheet is thereafter passed to the squeeze rollers 99—100 and out of the machine through opening 34.

The fluid level of the two solutions may be determined by the plus and minus signs in the troughs and by the two concentric lines 127—128 in the cups. The fluid level is maintained constant by the automatic feeding valve on the bottles described above.

As pointed out above, if desired, the single processing machine shown in FIG. 25 may also be used when it is desired to expose the sensitized sheet on a separate exposing machine.

It will be seen that the present invention provides an improved photocopy machine in which only the exposed sheet need be passed through a processing solution and in which the level of the solutions may be easily determined and controlled.

The present invention also provides an improved photocopy machine which prevents sticking of the sheet to the exposing cylinder and minimizes friction so that the sheet will not wrap itself around feed rollers during the operation. Another object of the present invention is that the curling up of the sheet is prevented.

The present machine also has an effective means for controlling the level of the processing solution and of automatically positioning the means for presenting the sheet to the processing solution so that the right amount of solution is automatically applied to the processed sheet.

Mixing of the various solutions and contamination of the solutions in the bottles is also prevented by the present invention and easy identification of the bottles with the proper solutions is provided to prevent any mistake.

The present invention further provides for removing the exposed sheet from the light quickly and preventing any stray light from entering the processing section.

The intensity of the light may be controlled and the light source may be easily replaced if desired. The present invention also has the advantage of permitting the sheet to be dried as it is being moved out of the unit so that the need for an additional drying operation is eliminated.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim:

1. A photocopy machine comprising means for applying a processing solution to an exposed photographic sheet, means for feeding said sheet to said applying means, and accumulating means interposed between said applying means and said feeding means, said accumulating means having a receiving opening at one end adjacent said feeding means to receive the photographic paper and having an exit opening at its other end adjacent said applying means adapted to direct photographic paper to said applying means, a tray assembly for said processing solution, said applying means comprising a roller assembly mounted in said tray assembly, said roller assembly being supported in said tray assembly at three points and wherein one of said points of support is on the tray assembly and the other two points of support are on a frame of said machine.

2. A photocopy machine as claimed in claim 1, wherein means are provided for locking said tray assembly and said roller assembly in position in said machine.

3. A photocopy machine comprising a tray assembly having a trough for an activator solution and a trough for a stabilizer solution, means separating said activator trough from said stabilizer trough, applicator rollers in said activator trough adapted to apply an activator solution to a photographic sheet, means for feeding a photographic sheet to said applicator rollers, an accumulator interposed between said feeding means and said tray assembly, said accumulator having an opening at the top adjacent said feeding means and an opening at the bottom adjacent said applicator rollers to direct the photographic sheet to the applicator rollers, a hollow cam removably mounted in said stabilizer trough adapted to direct a photographic sheet into a stabilizer solution in said stabilizer trough, said hollow cam having a guide surface extending across the entire stabilizer trough substantially at right angles to the direction of movement of the photographic sheet, and an opening in said hollow cam for receiving from said stabilizer trough stabilizer solution displaced by the photographic sheet entering said trough.

4. A photocopy machine as claimed in claim 3, wherein one of said applicator rollers is submerged and wherein a doctor roller is in contact wtih the submerged applicator roller above the level of the activator solution to limit the amount of activator solution applied to the photographic sheet.

5. A photocopy machine as claimed in claim 3, wherein an upstanding conduit is mounted in the hollow cam in communicating relationship with the opening in the cam to prevent excess stabilizer solution from returning to the stabilizer trough.

6. A photocopy machine as claimed in claim 3, wherein said stabilizer trough has an unused solution section and a used solution section and wherein said hollow cam is in said unused solution section and wherein squeeze rollers are in said used solution section.

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