Sept. 30, 1941. F. W. VON MEISTER ET AL 2,257,207

APPARATUS FOR THE DRY DEVELOPMENT OF LIGHT SENSITIVE MATERIAL

Filed June 23, 1938 4 Sheets-Sheet 1

Fig. 1.

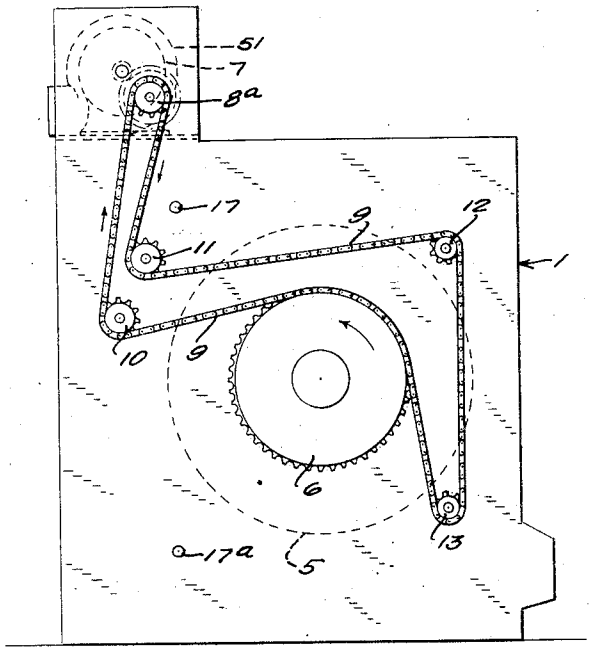
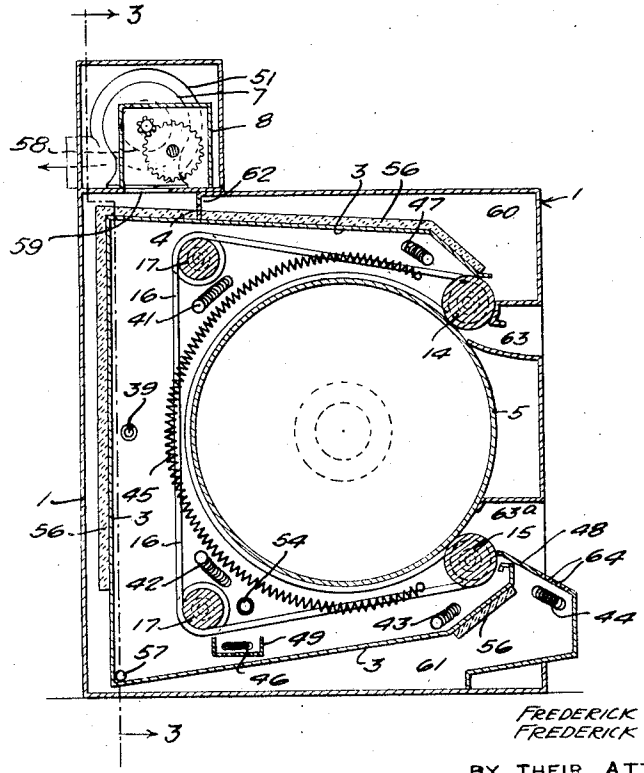


Fig. 2.



INVENTORS
FREDERICK W. VON MEISTER
FREDERICK W. ANDREW

BY THEIR ATTORNEYS
Hutz and Jolin

Sept. 30, 1941. F. W. VON MEISTER ET AL 2,257,207

APPARATUS FOR THE DRY DEVELOPMENT OF LIGHT SENSITIVE MATERIAL

Filed June 23, 1938 4 Sheets-Sheet 2

Fig. 3.

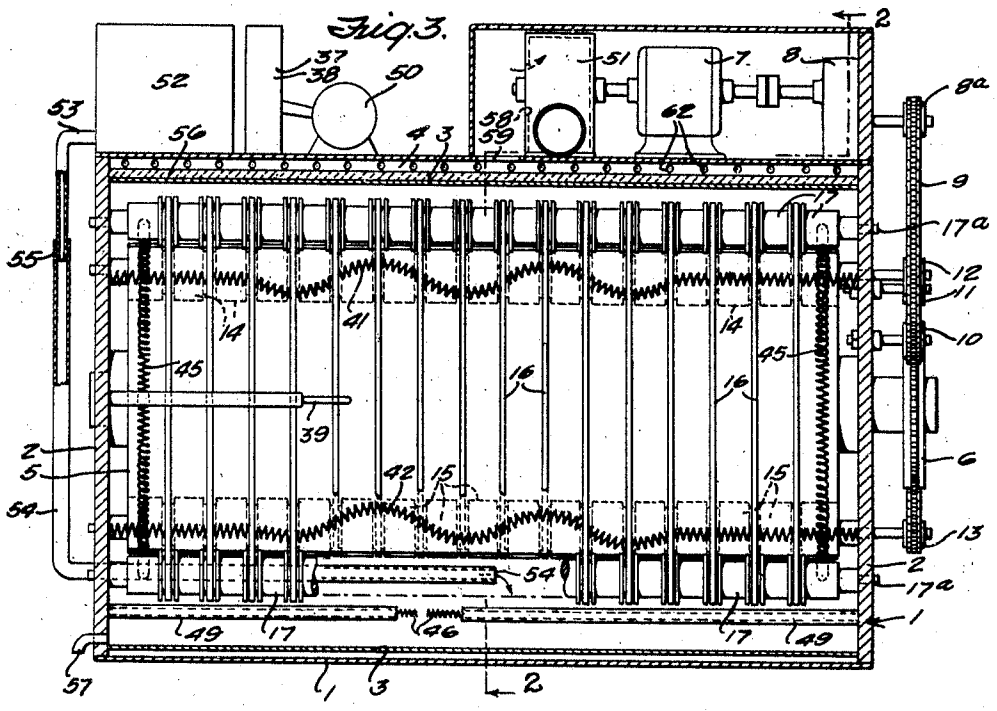


Fig. 4.

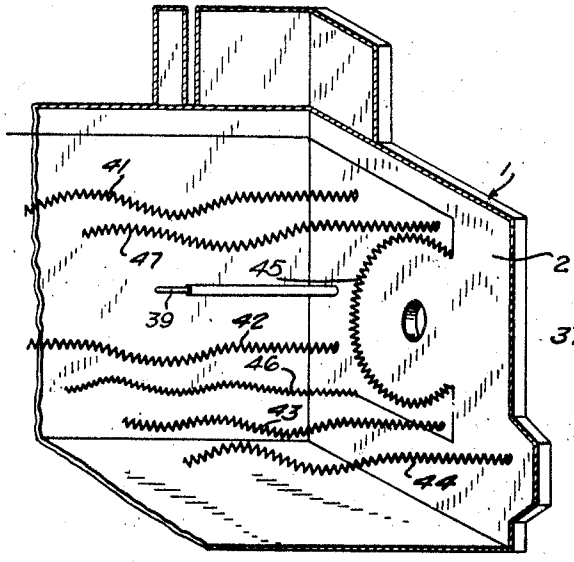
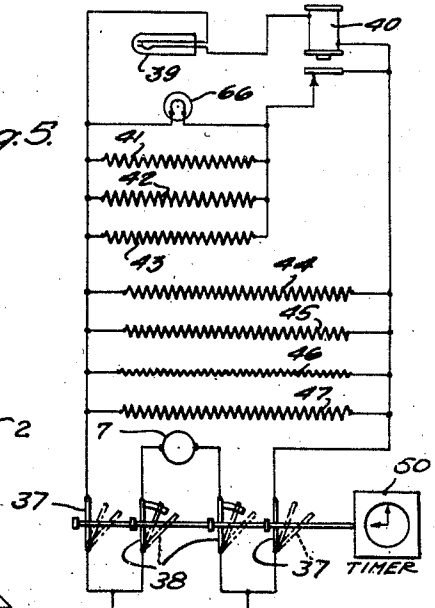


Fig. 5.



INVENTORS
FREDERICK W. VON MEISTER
FREDERICK W. ANDREW

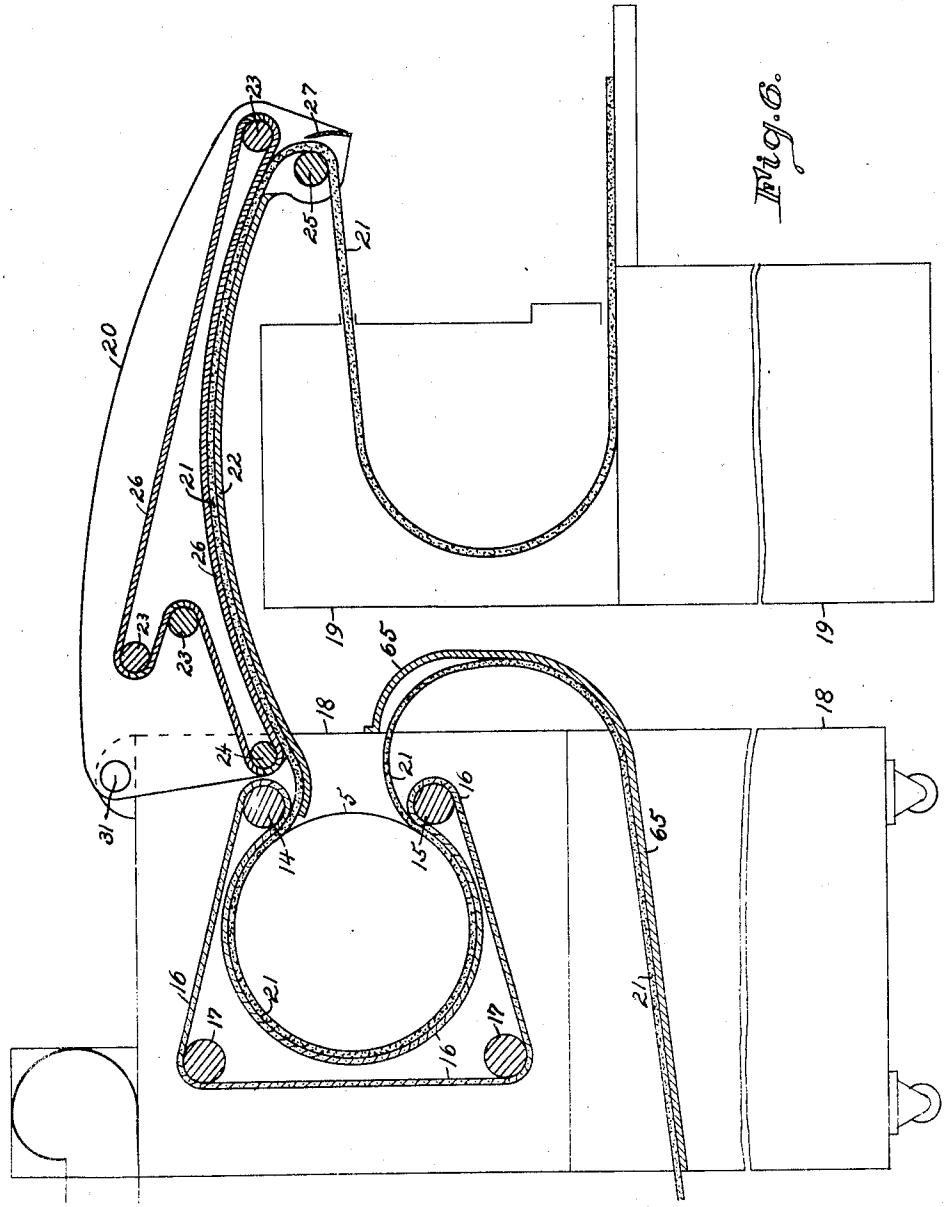
BY THEIR ATTORNEYS
Hirsch and Julian

Sept. 30, 1941. F. W. VON MEISTER ET AL 2,257,207

APPARATUS FOR THE DRY DEVELOPMENT OF LIGHT SENSITIVE MATERIAL

Filed June 23, 1938 4 Sheets-Sheet 3

Fig. 6.



Frederick W. von Meister
Frederick W. Andrew
INVENTORS

BY

THEIR ATTORNEYS

Sept. 30, 1941. F. W. VON MEISTER ET AL 2,257,207

APPARATUS FOR THE DRY DEVELOPMENT OF LIGHT SENSITIVE MATERIAL

Filed June 23, 1938 4 Sheets-Sheet 4

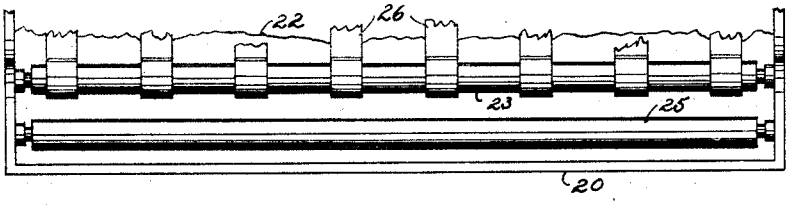
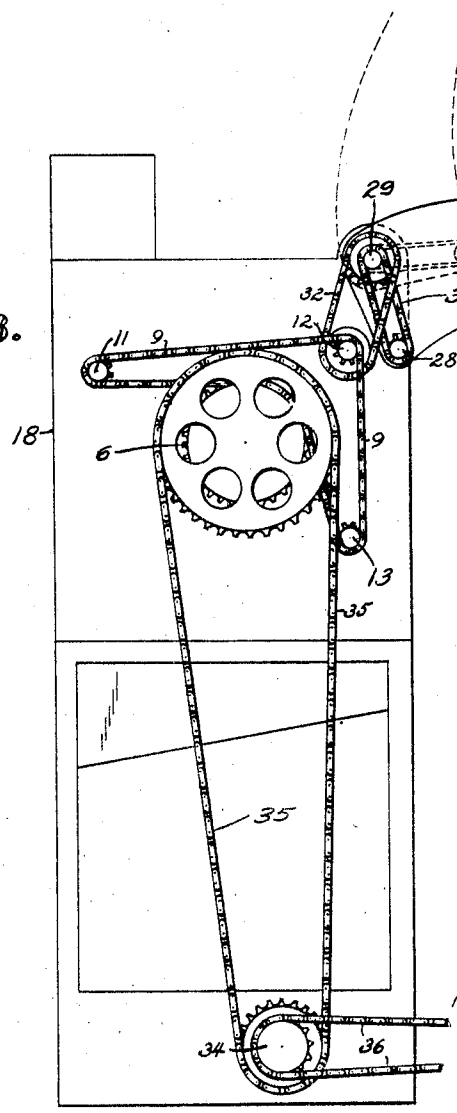


Fig. 7.

Fig. 8.



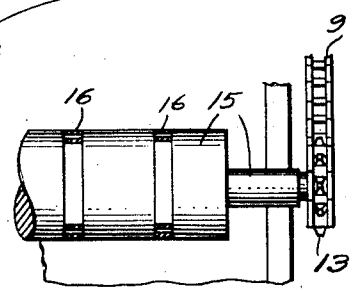


Fig. 9.

Frederick W. von Meister
Frederick W. Andrew
INVENTORS

BY

THEIR ATTORNEYS

Patented Sept. 30, 1941

2,257,207

UNITED STATES PATENT OFFICE

2,257,207

APPARATUS FOR THE DRY DEVELOPMENT OF LIGHT SENSITIVE MATERIAL

Frederick W. von Meister, New York, and Frederick W. Andrew, Glen Head, N. Y., assignors, by mesne assignments, to General Aniline & Film Corporation, New York, N. Y., a corporation of Delaware

Application June 23, 1938, Serial No. 215,416

4 Claims. (Cl. 95—94)

This invention relates to apparatus for developing light-sensitive material, particularly light-sensitive material which is developed by a dry process in which ammonia or other active developing gas is the developing medium. More particularly this invention relates to that type of light-sensitive developing apparatus wherein a revolving drum is employed to convey the exposed light sensitive material through a developing chamber.

Several types of apparatus have been suggested for the development of light sensitive materials using in one way or other a large revolving drum as the conveyor for the light-sensitive material. For the most part such apparatus are not practical for the development of small cut sheets and have, therefore, never achieved commercial success. It is generally necessary to use continuous or large sized sheets which are threaded around the drum. It is also necessary to remove exposed light-sensitive sheets from the printer and insert them in the developer manually with much inconvenience, loss of time, and injury to the work piece. Another disadvantage of such suggested apparatus has been the fact that condensation of the developing medium within the developing chamber could not be prevented to the detriment of the results obtainable.

One of the objects of this invention, therefore, is to provide an apparatus of this type which is capable of uniformly developing relatively small sheets and large individual or continuous sheets with equal ease and speed and without wrinkling or creasing them.

Another object of this invention is to prevent condensation of the developing medium anywhere within the developing chamber where such condensation would be undesirable.

A further object of this invention resides in the provision of a double-walled developing chamber with a blower arrangement so as to provide for the positive expulsion of developing gases which might escape during the operation.

An object ancillary thereto is the provision of a delayed timing mechanism which serves to keep the blower system in operation for a period of time after the developing mechanism has been shut off in order to prevent the escape of residual developing gases into the room in which the apparatus is situated.

Yet another object of this invention is to provide a novel type of hinged conveyor which will facilitate the use of a developer such as described in combination with a printer.

These objects are attained by the apparatus illustrated in the accompanying drawings, in which:

Fig. 1 is a side elevation of the machine.

Fig. 2 is a sectional side view of the machine taken on section line 2—2 of Fig. 3.

Fig. 3 is a sectional rear view of the machine taken on section line 3—3 of Fig. 2.

Fig. 4 is a perspective view of a section of the developing chamber showing the location of the heaters.

Fig. 5 is a wiring diagram of the electrical circuit.

Fig. 6 is a diagrammatic side view showing the path of travel of a continuous print when the apparatus is operated in conjunction with a printer.

Fig. 7 is a front view of the hinged conveyor shown in Fig. 6.

Fig. 8 is a side view of the driving mechanism when the apparatus is used in conjunction with a printer as shown in Fig. 6.

Fig. 9 is a detailed sectional view showing the manner in which roller 15 is driven.

Similar numerals refer to similar parts through the several views.

The framework of the machine comprises outer casing 1, end plates 2 and stiffening member 4. An inner casing comprising walls 3 is supported by end plates 2. Revolving drum 5 is driven by sprocket 6 to which the power from motor 7 is transmitted through gear reduction 8 by way of sprocket 8a and chain 9. Chain 9 passes over idlers 10 and 11 and, besides driving sprocket 6, also passes over and drives roller sprockets 12 and 13 attached to rollers 14 and 15 respectively. Said rollers 14 and 15 are mounted in positions contiguous to drum 5 and serve as guiding and driving means for a series of endless flexible members such as chains, wires and the like, preferably the so-called "fox-tail" chains, designated by numeral 16 and spaced at regular intervals as shown in Fig. 3. Said chains 16 pass around rollers 14 and 15 in grooves, the depth of which substantially corresponds with the thickness of the chains, so that no more of an air space than is absolutely necessary will be left between roller 14 and drum 5 on the one hand, and roller 15 and drum 5 on the other. As a further means of reducing the space between rollers 14 and 15 and drum 5, the rollers may, if desired, be mounted upon floating bearings which, by spring action, tend to push said rollers toward the drum. Rollers 14 and 15 are driven at a rate of speed that will make

the peripheral velocity of said rollers substantially equal to the peripheral velocity of drum 5. In order to provide for a possible difference between these velocities, the surfaces of the grooves of rollers 14 and 15 are of such construction that chains 16 will assume the peripheral velocity of drum 5 rather than that of rollers 14 and 15 by providing for a slight amount of slippage in the grooves of the latter. It has been found that the use of steel chains and chromium plated roller surfaces is particularly suitable and will allow a slight amount of slippage to take place in the grooves of the rollers. Light-sensitive paper being conveyed around drum 5 underneath chains 16 will, therefore, not be damaged by or subjected to any relative motion between drum 5 and chains 16. In order to prevent the parts of chains 16 traveling in a direction opposite to that of the periphery of drum 5 from coming into contact with drum 5, chains 16 are made to pass over and partly around idling rollers 17 resting on hubs 17*a*.

When the developing apparatus 18 herein described is used in combination with a printing machine 19 of the type wherein the work piece travels around the periphery of a curved glass within which a light source is located, a novel hinged conveyor 20 is used to convey the printed paper 21 from the front of printer 19 to the developing apparatus 18. Said conveyor 20 comprises a smooth, curved bottom plate 22 extending the entire length and width of conveyor 20, a series of freely rotating rollers 23, a driven roller 24, a guide roller 25 and a series of conveyor belts 26 spaced at regular intervals across the breadth of conveyor 20. A guide flange 27 may also be used in conjunction with guide roller 25 to aid in guiding paper 21 emerging from printer 19 between plate 22 and conveyor belts 26 which slide the paper 21 over a smooth bottom plate 22 and thus feed it into the space between roller 14 and drum 5. Driven roller 24 receives its power from sprocket 28 connected to double sprocket 29 by means of chain 30. Said double sprocket 29 is mounted in a position coaxial with that of conveyor hinge 31 and derives its power from chain 32 connected to roller sprocket 12. Reference to Fig. 8 will show that this arrangement obviates the necessity of disconnecting the driving mechanism when conveyor 20 is raised to allow for servicing the printer and that said conveyor may be operated at any position. When developer 18 is operated in conjunction with printer 19, it is preferable, although not necessary, to obtain the driving power from the printer motor by means of sprockets 33 and 34 and chains 35 and 36, sprocket 33 being connected rigidly or by means of a clutch arrangement to sprocket 6. It is, of course, to be understood that in any or all instances the chain drive may be supplanted by gears.

In order to facilitate the vaporization of the developing medium and to accelerate the development of the paper passing through the developer, said developer is provided with an electrical heating and heat control system, which is diagrammatically shown in Figs. 4 and 5. When main switch 37 is closed, the various heaters and the pilot light 66 are turned on, and by virtue of the closing of timer switch 38, due to its interconnection with main switch 37, motor 7 is also started. When the temperature inside the developing chamber has risen so as to equal the operating temperature, pilot light 66 and some of the heaters are automatically shut off by means of thermostat 39 acting through relay 40, while operation of the remaining heaters and the motor is continued. In the preferred arrangement, heaters 41, 42 and 43 are those subject to being "cut-out" by thermostat 39 and are therefore generally termed "cut-out" heaters. Heater 44, located under paper chute 48, heater 45 around the ends of drum 5 at endplates 2, heater 46 in tray 49 and heater 47 in the top front section of the developing chamber adjacent to the surface of drum 5 remain in operation until main switch 37 is opened. Longitudinal heaters 41, 42, 43, 44, 46 and 47 are preferably given a serpentine form as illustrated, for example, by the appearance of heaters 41 and 42 in Fig. 3. Most of the heaters have been purposely omitted from Fig. 3 for the sake of clarity. When main switch 37 is opened, a timing device 50 which serves to open timing switch 38 at a certain period of time after main switch 37 has been opened, is also started in order to keep motor 7 and blower 51 in operation until substantially all the residual fumes of the developing medium have been forced out of the machine.

The developing medium, preferably ammonia, is stored in tank 52, led downwardly through pipes 53 and 54 and transparent drip device 55. At a suitable elevation, pipe 54 is bent so as to direct it, at a slight downward inclination, along half the length of the developer above tray 49. The liquid developing agent passes there-through and is thus fed into the center portion of tray 49 which extends the entire length of the developing chamber. Said tray 49 may be straight and level or it may have a slight negative dihedral angle. To insure rapid vaporization of the liquid developing agent, heater 46 is placed in the tray preferably in a serpentine position. To prevent the condensation of the vaporized developing medium on the surface of inner walls 3 at undesirable places, said walls are provided with heat insulating material 56. The condensed and spent developing medium flows to the bottom rear portion of the developing chamber and is drained off by means of drain 57.

The intake 58 of blower 51 is, by means of opening 59, connected to the space between inner walls 3 and outer casing 1. While the blower is in operation, a partial vacuum is created in said space and, as a result, air is drawn through said space toward opening 59 and blower 51. In order to substantially equalize the paths of resistance through the upper front portion 60 and the rear and lower portion 61 of said space, a partition 4 provided with a suitable number of openings 62 is inserted into the path leading from space 60 to opening 59. The partial vacuum of air spaces 60 and 61 serves to divert the developing gas fumes that tend to escape through paper entrance 63 and exit 63*a*, into said air spaces and out through the blower exhaust instead of allowing said fumes to contaminate the air in the operating room. Paper chute 48 is provided with perforations 64 so as to withdraw as much of the developing gas that has occluded in the developed paper as is possible. In order to vaporize, and thus make more susceptible to removal by suction, any of the developing medium that may have condensed on the emerging paper, heater 44, extending the entire length of chute 48, is placed directly under perforations 64.

If delivery of the developed sheets at the rear of the machine is desired, a partly curved paper guide and chute 65 may be provided as shown in Fig. 6.

The many advantages of this machine over similar devices for the development of light-sensitive material may be readily ascertained from the foregoing detailed description. The use of fox-tail chains or the like at regularly spaced intervals to insure positive and continuous travel of the material to be developed is especially noteworthy. Heretofore, such gaseous developing apparatus, wherein a revolving drum was used, were usually provided with stationary guide wires and resilient rollers placed around the drum. The disadvantages of the latter apparatus, namely, that small sheets are apt to stay between the rollers or be wrinkled or creased, have been eliminated by the use of fox-tail chains as herein described. For ordinary purposes, these chains may be spaced at intervals of about three inches, but, if the machine is to be used to develop only large sheets, this spacing may be increased accordingly. Similarly, of course, if sheets of less than three inches in width or length are to be developed, a smaller spacing may be used.

Provision for a novel method of conveying light-sensitive material from a printer to the developer has also been made. The use of a hinged conveyor such as is described in detail above is of very material value, especially when large machines are used and large quantities of light-sensitive material are printed and developed. The operator need not carry the material from the printer to the developer but need only insert one edge of it into the mouth of the conveyor. Time and labor are thereby saved, and possible wrinkling, creasing and/or soiling of the undeveloped sheets are obviated.

A novel arrangement of the heaters within the developing chamber has been devised to provide an even distribution of heat and to prevent condensation of the developing gases on the walls, particularly the end plates and the top and rear walls, the walls also being provided with heat insulating material. Another refinement described is that of the blower system provided to prevent leakage of the gases during operation and to remove residual gases after operation has ceased.

It is thought that this invention and its numerous advantages will be understood from the foregoing description. It is obvious that various changes can be made in the arrangement, form, construction, and type of the various elements without departing from the spirit or scope of this invention. Modification and mechanical departures which do not impair the operating efficiency of the machine and which fall within the scope of the present invention will, therefore, readily suggest themselves.

We claim:

1. In an apparatus for developing light-sensitive material with a gaseous developing medium, in combination, a casing, a rotatable drum substantially enclosed therein, openings in the casing for the entry and exit of light-sensitive material the rotatable drum extending from the entrance opening to the exit opening, a roller in the casing adjacent each opening, the periphery of the rollers being slightly spaced from the periphery of the drum, means for introducing a gaseous developing medium into the space bounded by the casing, the periphery of the drum and said rollers, continuous means trained about the rollers and said drum for feeding light-sensitive material through the entry opening to the periphery of the drum and for expelling said light-sensitive material from the exit opening, said means further operating to maintain the light-sensitive material against the periphery of said drum and to convey said material about said drum while permitting access of the gaseous developing medium to the light-sensitive material.

2. A device as defined in claim 1 which includes other rollers located within the casing, wherein the continuous conveying means are trained about all of said rollers and said drum, the outer run of said means being directed over said rollers and the inner run of said means being directed over said drum.

3. In an apparatus for developing light-sensitive material with a gaseous developing medium, in combination, a casing, a rotatable drum substantially enclosed therein, openings in the casing for the entry and exit of light-sensitive material the rotatable drum extending from the entrance opening to the exit opening, a pair of driven, grooved rollers extending substantially the length of the drum mounted adjacent said openings in positions adjacent to the periphery of the drum of the casing, means for introducing a gaseous developing medium into the space bounded by the casing, the periphery of the drum and the grooved rollers, a series of flexible members travelling over and in substantially stationary contact with the periphery of said drum and the grooves of said rollers operating to feed the light-sensitive material to the periphery of the drum, to maintain said material against said periphery, to convey the light-sensitive material about said drum while permitting access of the gaseous developing medium to said light-sensitive material and to expel said material from the exit opening.

4. In an apparatus for developing light-sensitive material with a gaseous developing medium, in combination, a casing, a rotatable drum substantially enclosed therein, openings in the casing for the entry and exit of light-sensitive material the rotatable drum extending from the entrance opening to the exit opening, a pair of driven, grooved rollers extending substantially the length of the drum mounted adjacent said openings in positions adjacent to the periphery of the drum of the casing, means for introducing a gaseous developing medium into the space bounded by the casing, the periphery of the drum and the grooved rollers, a series of flexible members travelling over and in substantially stationary contact with the periphery of said drum and the grooves of said rollers operating to feed the light-sensitive material to the periphery of the drum, to maintain said material against said periphery, to convey the light-sensitive material about said drum while permitting access of the gaseous developing medium to said light-sensitive material and to expel said material from the exit opening, and a conveyor means pivotably attached to the casing adjacent the entrance opening and having a guide member curved at the end to engage the roller and flexible member at the entrance opening for delivery of the light sensitive material conveyed from the printer.

FREDERICK W. VON MEISTER.
FREDERICK W. ANDREW.