Jan. 23, 1968 J. H. GRUVER 3,364,594

DRYING PROCESSED PHOTOGRAPHIC MATERIAL

Filed July 8, 1965 4 Sheets-Sheet 1

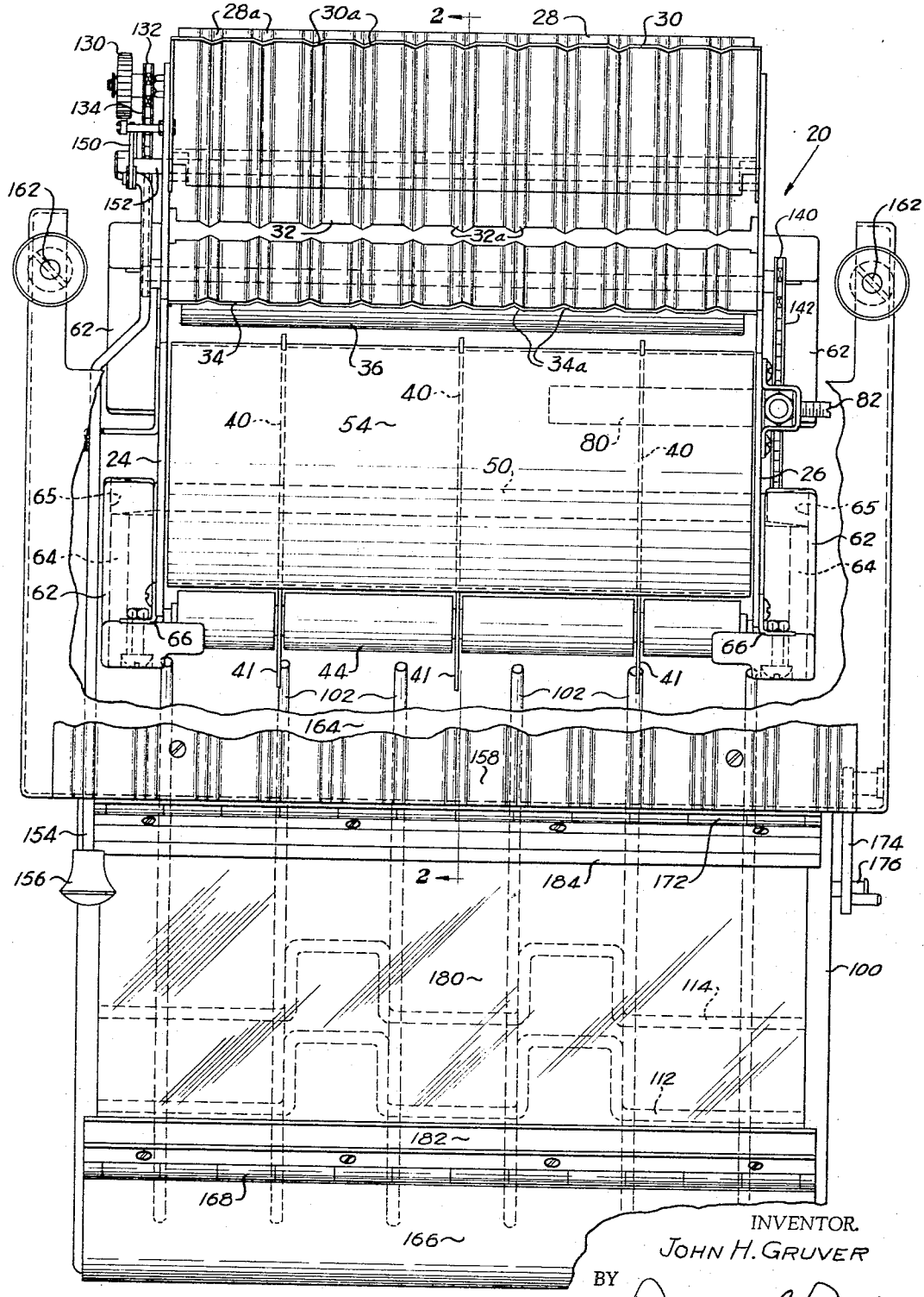


Fig. 1

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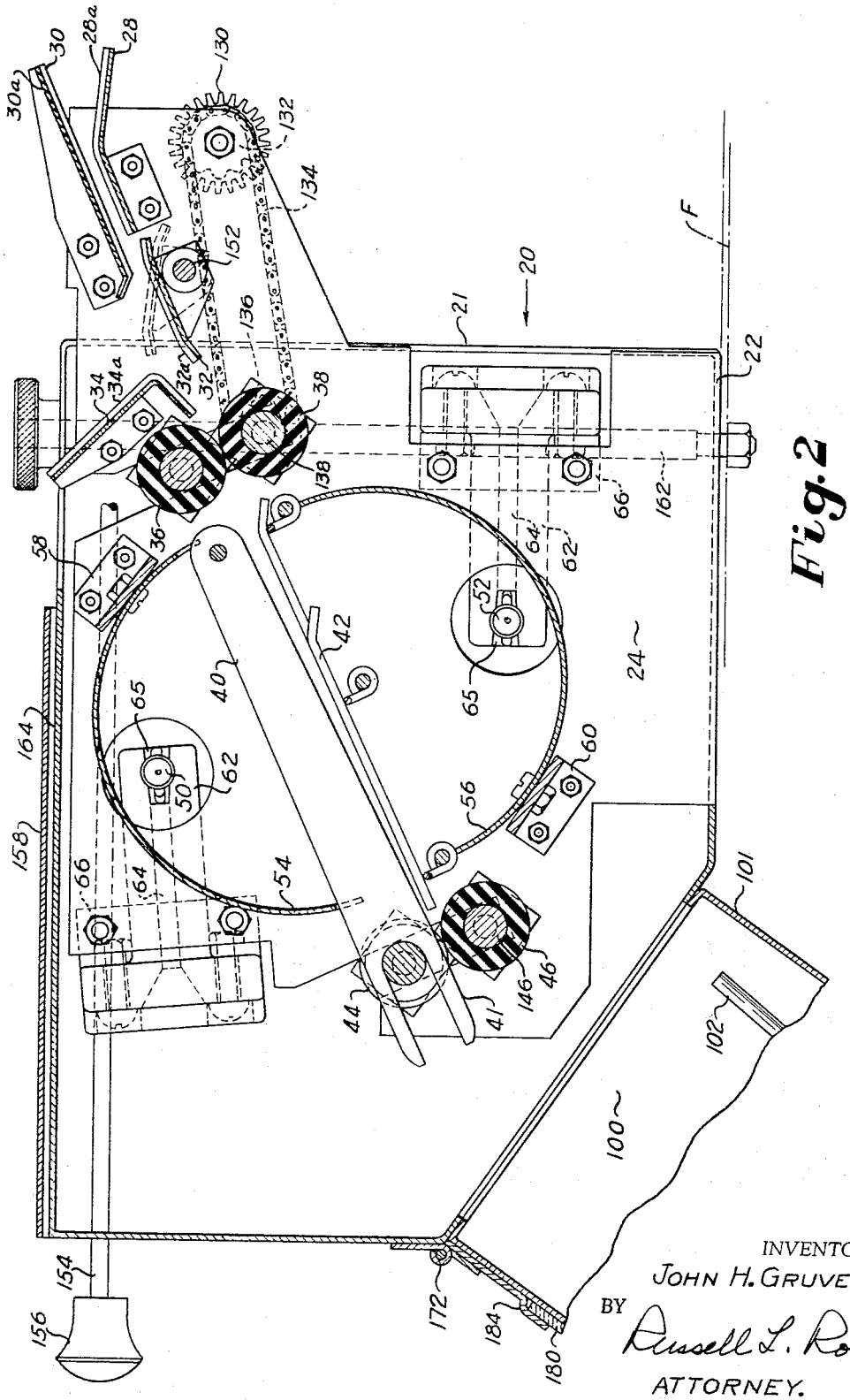


Fig. 2

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Filed July 8, 1965 4 Sheets-Sheet 3

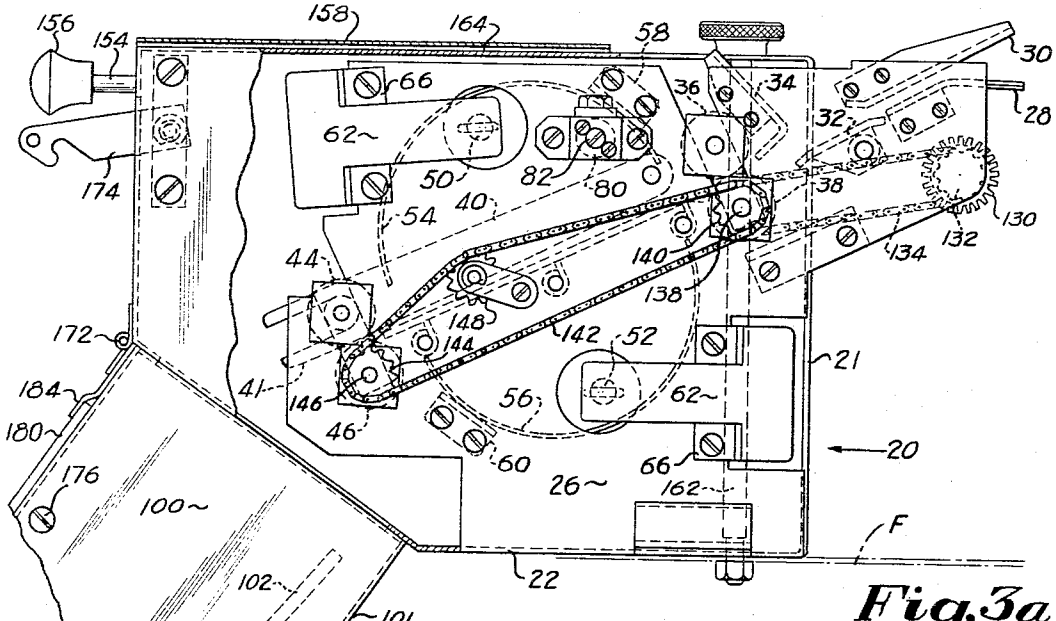


Fig. 3a

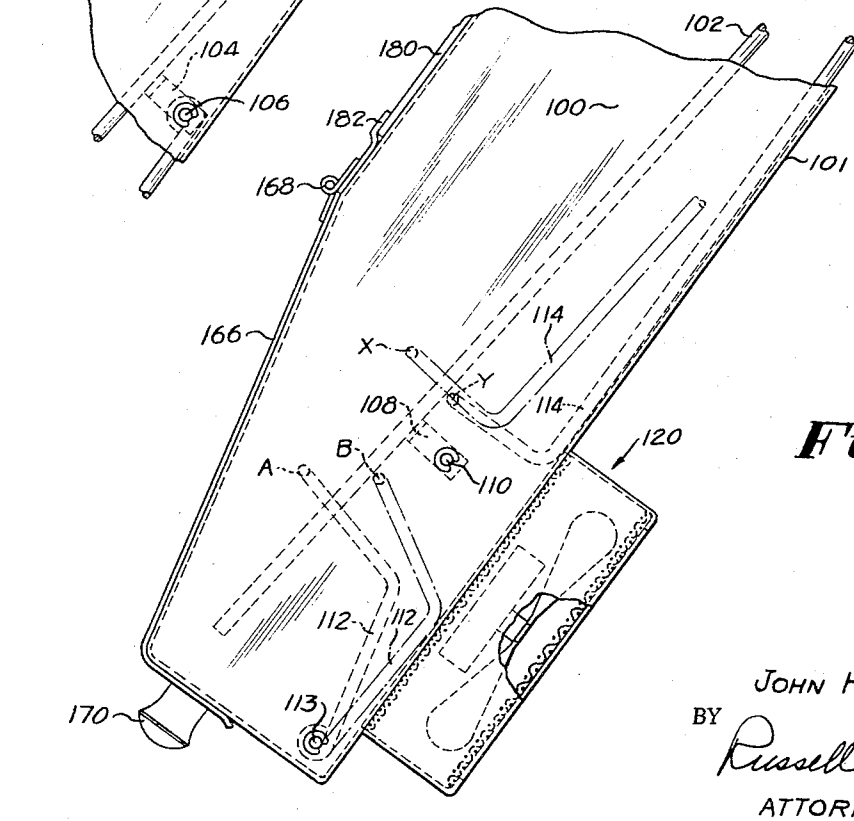


Fig. 3b

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Filed July 8, 1965 4 Sheets-Sheet 4

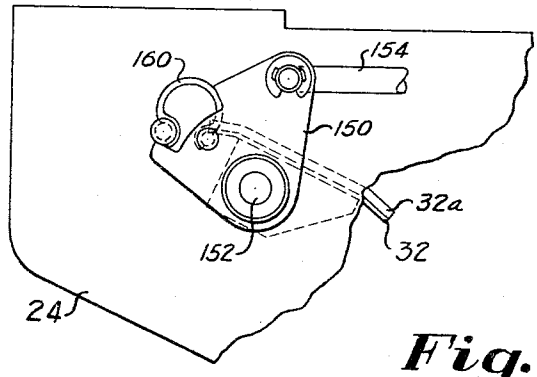


Fig. 4

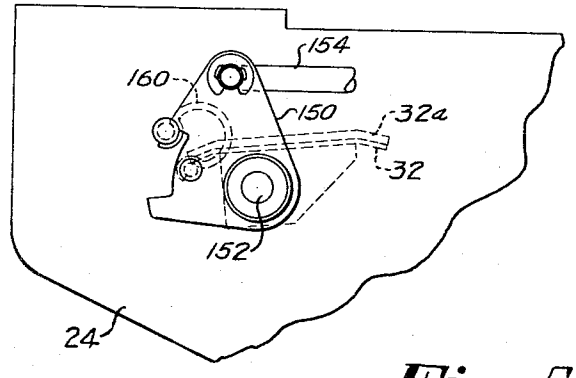


Fig. 5

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United States Patent Office 3,364,594 Patented Jan. 23, 1968

3,364,594

DRYING PROCESSED PHOTOGRAPHIC MATERIAL

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Filed July 8, 1965, Ser. No. 470,426
4 Claims. (Cl. 34—162)

ABSTRACT OF THE DISCLOSURE

Apparatus for rapidly drying moist processed photographic sheet material, such as planographic duplicating masters, issuing from a processing unit to thereby permit storage of the dried sheets for subsequent use, as in an offset duplicating machine. The material is fed into a guideway and then between a pair of rollers which feed the material into a second openwork guideway located within a drying chamber. Also within the drying chamber, and arranged on each side of the guideway, are a pair of heat lamps and their associated heat reflectors for directing heat to both surfaces of the material as it passes through the drying chamber. A second pair of rollers picks up the dried material as it emerges from the drying chamber and discharges it into a receiving chamber. An exhaust system is provided in the receiving chamber for rapidly exhausting the moist air from the drying chamber and the receiver which are connected.

Included is a manually controlled guide plate for selectively causing the material to by-pass the drying apparatus so as to be available for immediate use in moist condition in a duplicating machine.

This invention relates to drying processed photographic material and, more particularly, to automatically drying processed photographically imaged duplicating masters.

In equipment heretofore known, photographic duplicating masters, after processing, are ejected by power-driven rollers from the processing apparatus whereupon they can then be placed on the master cylinder of an offset duplicating machine and copies run off in the conventional manner. Such procedure has proven highly successful in all instances where the duplicating master is run immediately or shortly, after removal from the processor.

However, on many occasions it has been found to be of greater benefit to customers to process a group or series of masters at one time, store them, and then run them on the duplicating machine at such time as the machine is not being otherwise used. In such instances a problem arises in the storing of the duplicating masters due to the fact that they are in a moist condition as they leave the processor. The preferred manner of storing the masters is to stack them one on top of the other. However, since the masters are damp and limp, they are difficult to stack. In addition, if left to dry in stacked relationship, they tend to stick together, thus impairing the images to be duplicated. Therefore, there is a distinct advantage in removing moisture from the duplicating masters immediately following the developing step in all instances where the master will not be run immediately.

Still another advantage in drying the masters is that a large supply of masters may be developed and stored for future use. Accordingly, the primary object of this invention is to provide a means for removing moisture from duplicating masters or material which has been photographically processed immediately following the processing procedure. However, equipment, such as drying tunnels, and the like, for processing materials of this nature are normally prodigal in their use of space and totally unsuited to equipment of this kind designed to be installed in offices or other places where space is at a premium.

Another object of the invention, therefore, is to remove the moisture from freshly developed duplicating masters by drying them through the use of a small but efficient heating unit which does not add significantly to the space requirements of the processing equipment.

Still another object is to provide a drying unit which is a small, separate attachment and may be installed on processing apparatus already in use without necessitating any modification whatsoever of such apparatus and without requiring manipulation of any of the parts of the processing apparatus.

Another object is to remove the moisture in such a manner that the image on the master is unimpaired and completely retains its reproducing or duplicating properties, and to do so in a manner such that the masters remain substantially flat and easily stackable.

These and other objects, features, and advantages of the invention will become more apparent from the following description and drawings wherein:

FIG. 1 is a plan of the drying unit of the invention;

FIG. 2 is a section taken on the line 2—2 of FIG. 1 to a slightly larger scale;

FIG. 3*a* is a right side elevation of the device of FIG. 1 with parts broken away;

FIG. 3*b* is a right side elevation of the lower portion of the receiving chamber of the drying unit of FIG. 1 and should be viewed in association with FIG. 3*a*;

FIG. 4 is a detail left side elevation, on an enlarged scale, of a means for guiding the duplicating master along one path;

FIG. 5 is similar to FIG. 4, showing the guide means in an alternate position.

Referring to FIGS. 1 and 2, there is shown a dryer unit indicated generally at **20**, including a housing **21**, a base **22** and a pair of side plates **24** and **26**. Mounted between the side plates **24** and **26** in the manner indicated are guide plates **28**, **30**, **32** and **34**. The term "first guideway" will be used hereinafter to designate the area between top guide plate **30** and lower guide plates **28** and **32**. Each of the guide plates is formed so as to embody a series of spaced-apart ribs **28***a*, **30***a*, **32***a* and **34***a*, the purpose of which will be explained hereinafter.

Also mounted between the side plates **24** and **26** are a pair of feed rollers **36** and **38** of soft resilient material, e.g. rubber which are utilized to initiate movement of the photographic material or masters through the drying unit and to provide a preliminary drying action thereon.

Adjacent the rollers **36** and **38** there is provided another guideway through which the material passes. This second guideway is defined by upper guide members **40** and lower guide members **42**.

A second pair of rollers **44** and **46** is also mounted within the side plates **24** and **26**. It is pointed out that the roller **46** has an uninterrupted surface whereas the roller **44** has peripheral grooves at intervals. As can be readily seen in FIG. 2, the grooves permit the upper guide members **40** to extend beyond the bight of the rollers **44**–**46** and thus provide an additional guiding surface **41** for the photographic material.

Spaced above the upper guide member **40** there is provided a heating element **50**. In like manner, there is a heating element **52** spaced below the lower guide member **42**. Various types of heating elements may be utilized in the practice of this invention. However, it has been found that the preferred form of heating element having the required properties of economy, capacity and endurance is one rated at 1,000 watts, 230/250 volts, manufactured and sold by General Electric Company under their designation No. 1000T3. Such a heating element is known as a general purpose tungsten quartz infrared lamp.

In association with the heating element 50, there is provided a reflector 54 for the purpose of directing radiant heat generated by the heating element 50 in a direction toward the guideway for the material, i.e., between guide members 40 and 42. In like manner, and for the same purpose, a reflector 56 is provided in association with heating element 52. Reflector 54 is held in a rigid manner by being affixed to a tie-bar 58 as shown. Similarly, reflector 56 is affixed to a tie-bar 60. Tie bars 58 and 60 extend between side plates 24 and 26 and are fastened thereto in the manner shown.

The reflectors 54 and 56 are generally semi-circular in cross section, and are formed of a material having heat reflecting properties such as, for example, aluminum. It has been found that an aluminum sheet which has been treated, as by chemically etching the same, provides a preferred type of heat reflecting surface. Perhaps it can best be stated that the etching process, which embodies an electrolytic or chemical brightening treatment followed by anodic oxidation, gives a durable, transparent protective film. The etching treatment provides a comparatively open grain finish which affords efficient heat reflectivity and also removes surface impurities. The anodic coating serves to prohibit future impurities which, of course, insures continued efficient reflectivity. Thus, the aluminum sheet is an excellent reflector for infrared radiation. At any rate, it was discovered in the course of the present invention that a lower voltage was permissible when an etched-surfaced aluminum reflector was utilized, as compared to a plain sheet of polished aluminum. Bearing in mind that the present invention is concerned with the drying of photographic material and duplicating masters, the lower voltage requirement becomes important in that the drying unit will function efficiently and uniformly under conditions of both extreme humidity and dryness by broadening the voltage range without reaching maximum operating voltage, resulting in lesser voltage required to dry the material under changeable atmospheric conditions.

It will be noted that the guide members 40 and 42 are narrow elements, rather widely spaced to provide an openwork guideway, so as to provide minimum shielding of the sheet to be dried from the radiation emanating from heating elements 50, 52, and to minimize any tendency of the master to stick to the guide members while it retains its moisture.

The heating elements are held in position in a manner now to be described. Thus, with reference to heating element 50, there is provided a pair of substantially T-shaped members 62, 62 formed from an insulating material such as porcelain or the like. The members 62 preferably are each formed so as to provide a passageway 64 housing the wires leading to the heating element 50 an opening at one end into a socket 65 supporting the coresponding end of the heating element. Insulating members 62 are each fastened to the side plate 24 by a right angle bracket 66, in the manner shown in FIG. 1. The heating element 52 is fixed in place in the same manner, the supporting parts being designated by the same reference characters as those for element 50.

Control of the heat generated by the heating elements is governed by a temperature control unit 80, FIG. 3*a*. It has been found that a satisfactory unit is of the type manufactured by Fenwal Incorporated, Ashland, Mass., and sold under the trademark Fenwal Thermoswitch. This unit has a temperature range of between −100° F. and 400° F. which is more than adequate for the purpose here intended. For example, in the practice of this invention, ideal results have been obtained by setting the temperature control unit 80 to a maximum temperature of approximately 160° F. This is accomplished by turning a control screw 82 to the right or left, as the case may be, until the control unit 80 is de-activated upon reaching temperature of 160° F. It has been determined that 160° F. is the desired maximum temperature since at temperatures higher than 160° F., the surface of the material will scorch or the material will blister if low humidity conditions also prevail. If the material being processed were a duplicating master and the above condition of excess heat were permitted, the image on the master would be impaired and its reproduction qualities greatly lessened. So far as the lowest satisfactory temperature is concerned, such a condition will not harm the material but will merely result in incomplete drying of the material. It has been discovered that such will be the case if the temperature falls to below about 140° F. While this condition is not to be expected with the capacities of the heating elements and feeding speeds selected, if this condition should present itself, as determined by a cursory inspection of the photographic material issuing from the drier, it is only necessary to be certain that the heating elements 50, 52 are switched on, and stop the feeding of the material into the drying unit for a few seconds to permit the temperature to rise about 140° F. If masters are being continuously processed, this can be done by merely causing one or several of the issuing masters to bypass the drying unit as will be subsequently described, and drying these bypassing masters by ordinary evaporative measures.

There will now be described a means for receiving or collecting the material or duplicating masters as they are ejected from the drying unit 20.

With particular reference to FIGS. 1, 3*a* and 3*b*, it is again pointed out that as the material is fed through the second guideway between the upper guide member 40 and lower guide member 42 within the drying unit 20, it enters the bight of ejector rollers 44 and 46. Immediately beneath these rollers there is provided a collecting bin or receiver 100 in a housing 101 attached to the drying unit housing 21. Within the bin, and starting at a point close to the ejector rollers 44 and 46 are a series of spaced support rods 102. Any number of such supports as are practical may be utilized, it being suggested that the number be sufficient to receive the material in a substantially flat manner. The supports may be round or flat or of any desired configuration in cross section, so long as they provide a smooth, sliding minimum-contact surface for the material.

The supports 102 may be conveniently retained near their upper ends by a transverse flat wire 104 which is held in position within the side walls of the receiver 100 by a rod 106. In like manner, the lower ends of the supports 102 are held in position by a transverse flat wire 108 which, in turn, is positioned within the side walls of receiver 100 by a rod 110.

Also positioned within the side walls of the receiver 100 is a stop member 112, projectable between the supports 102, pivotally mounted on rod 113 and shiftable between operative and inoperative positions, A and B respectively. The stop 112 may be formed with any suitable portion (not shown) frictionally interfering with the support rods for the purpose of retaining the stop in the raised position when desired. Additional stop members such as 114 may be provided at spaced intervals for a purpose to be explained presently. The stop member or members 114 may also be movable between operative and inoperative positions X and Y respectively, and detented similarly to stop 112, their pivotal point being on the rod 106. The stop members 112 and 114 as shown in FIGS. 1 and 3*b* is a rather simple but efficient expedient to provide a surface or stop against which the leading edge of the material will abut.

The stop member 112 will have universal application in that it will serve as a stop against which the leading edge of the longest sheet of material (within the capacity of the apparatus) will come to rest. When it is desired to feed shorter sheets of material, it has been found advantageous to provide the additional stop members, such as 114, in order that travel of the material immediately following its ejection from rollers 44 and 46 will be smooth and uninterrupted, i.e., the trailing edges of the already ejected sheets will be close enough to rollers 44, 46 that

the leading edge of a shorter sheet of material will not hang up on previously ejected material in the receiver **100**. As many additional stop members **114** may be provided as are necessary to accommodate as many different lengths of material as are intended to be fed through the drying unit **20**.

In order to remove the moist air, and continually replace the same with drier air, there is provided a pair of exhaust fans **120**. These are rated at about 100 cubic feet per minute each, and are mounted preferably near the bottom of the receiver **100** so that they will exhaust air not only from the drying unit but also from the interior of the receiver. While one large fan could be used instead of two smaller fans, the dual arrangement is preferred since it is less awkward and since the fans may be placed in side-by-side relationship closely adjacent the bottom of the receiver **100** thereby providing a greater amount of circulation within the drying unit and the receiver.

The mechanism effective to feed the material into, through, and out of the drying unit will now be described with reference to well-known processing apparatus. In such processing apparatus, the main drive mechanism (not shown) also provides the drive for the rollers of the instant application. Thus, gear **130** is meshed into the material discharge end of a gear train powered by the main processing apparatus, and through its sprocket **132** and the chain **134** drives roller **38** through its sprocket **136**, which is mounted on one end of shaft **138**. At the opposite end of shaft **138** there is provided another sprocket **140** which, through the chain **142** and sprocket **144**, mounted on shaft **146**, drives the roller **46**. Sprocket **148** is movably mounted to act as a take-up means, i.e., to take up any slack in chain **142**.

As mentioned hereinbefore, a series of guide plates are provided to guide the material into the drying unit. One of these guide plates, indicated at **32**, serves a dual purpose in that it is movable into alternate positions, one of which is effective to guide the material into the drying unit, while the other position serves to by-pass the drying unit so as to deliver wet material to the operator. With reference to the drawings, and particularly to FIGS. 4 and 5, there is shown a lever **150** fixed at its one end to shaft **152**. Pivotally connected to the other end of the lever there is provided an operating rod **154** having a handle **156** at the remote end thereof. Thus, when it is desired to feed the material through the drying unit, the rod **154** is pulled out to the position shown in FIGS. 1 and 2. This sets the lever **150** and guide plate **32** in the position shown in FIG. 4 and guides the material toward the rollers **36** and **38**. On the other hand, if moist material is called for, the drying unit **20** will be by-passed. In such instance, the rod **154** is pushed in, or toward the right as viewed in FIGS. 1 and 2, and the latch plate **150** and guide plate **32** assume the position shown in FIG. 5 and in dotted lines in FIG. 2. The material is guided upwardly over guide plate **34** and onto a receiving shelf **158**. From there the material or master can be immediately placed in a duplicating machine and copies run off.

As can readily be seen in FIGS. 4 and 5, a substantially C-shaped over-center spring **160** is afforded to retain the latch plate **150** and guide plate **32** in either of their alternate positions.

The complete drying unit **20** is mounted on the frame F of the processing apparatus by means of bolts such as **162**, such bolts also serving to hold in place the covers **164** for the drying unit.

As mentioned hereinbefore, the dried masters or photographic material are collected in the receiver **100**. When a supply has thus been collected, it is desirable, of course, to empty the receiver. For this purpose, a door **166** has been provided at the lower portion of the receiver **100**, as shown in FIG. 3*b*. The door is hingedly mounted at **168** and a knob **170** affixed to door **166** permits ready access to the receiver **100** as by lifting the door upwardly.

On occasion, for example, for purposes of cleaning, servicing, or the like, it may be necessary to attend to certain of the structure mounted within the drying unit **20**. This is readily accomplished by mounting the receiver **100** on the drying unit **20** by the hinge construction **172**. Thus, the receiver **100** normally rests in the position shown in FIG. 3*a*. However, it may readily be tilted upwardly **174** with stud **176** which is fastened to the side cover **178** and held in the up position by engagement of the latch **174** with stud **176** which is fastened to the side cover **178** of receiver **100**.

As a matter of convenience, a window **180** is provided in the top of receiver **100** to enable the operator to visually inspect the masters as they drop into the receiver, or to determine the quantity of masters stored within the receiver. The window **180** may be held in place in any known manner as, for example, by the clips **182** and **184**.

To summarize the drying operation, the heating elements are activated to enable the drying unit to warm up. When the temperature has reached operating range, i.e., 140° F. to 160° F. which occurs in very short time, the guide plate **32** is moved to the position shown in FIGS. 1 and 4 and also in the full line position of FIG. 2. The material or master is fed into the first guideway between the guide plates **28** and **30** and is gripped by rotating rollers **36** and **38** in the heating unit **20** which feed it forward and, in addition, lift films of moisture from both surfaces to provide a predrying action. The moisture films on the rollers are progressively evaporated by the action of the heating elements and the flow or air through the heating chamber so that fresh moisture-receptive surfaces of the rollers are continually presented to the master. The master then feeds over the lower guide member **42** and under upper guide member **40** into the second guideway, at the same time passing between heating elements **50** and **52**. The master is then pulled from the drying unit **20** by the ejecting rollers **44** and **46** which maintain a steady motion of the master as long as it is in the drying chamber and after it leaves rollers **36**, **38**. The master is then dropped into the bin or receiver **100**.

As mentioned previously, if a moist master is desired for immediate running on a duplicating machine, the guide plate **32** is moved to the position shown in FIG. 5 and in broken lines in FIG. 2. Then, as the master is fed between guide plates **28** and **30**, it is diverted by the guide plate **32** to pass over guide plate **34** and finally comes to rest on the receiving shelf **158** in plain view of the operator.

In either case, the master is initially fed in a moist condition. However, it is again pointed out that each of the guide plates **28**, **30**, **32** and **34** is formed to provide spaced-apart ribs **28***a*, **30***a*, **32***a* and **34***a* respectively. The ribs support the moist masters on the guide plates at a few spaced points and thus eliminate the possibility of the master material sticking to the guide plates, which condition would otherwise prevail if the moist master material were brought into contact with a smooth, uninterrupted plane surface.

One of the problems associated with the development of a drier for the present purposes was the operating speed of the processor which feeds it and which is capable of rapid treating of the masters, substantially at the rate of one every thirty seconds (i.e., at a feeding speed of about ½ inch per second). Preliminary tests indicated that about one minute would be needed, at temperatures which the sensitive surface of the master could tolerate, to dry each master to a condition such that it could be properly handled and stored without danger of sticking or curling. This would indicate a drying tunnel of at least 30 inches in length.

A feature of the invention is the discovery that this situation could be taken care of without adding an extensive drying tunnel to the equipment. It was found that relatively high speed air passing over the surface of the masters could be relied upon as an accelerator of the drying procedure for unexpected reasons. It appears that by selecting the capacity of the heating elements so as to be able to maintain an air temperature in the drying chamber about as high as the photographic material can stand

(140° F. or a little more) even though cooler air is moving into the chamber at about 200 cubic feet per minute, and by assuring equal drying application of hot air and/or radiant heat to both surfaces of the sheet, a thin layer at each surface can be super-dried to a condition which will permit stacking of the masters without sticking together. When the outside layers of a sheet are thus dried at high speed, the moisture is apparently withdrawn from their exterior surfaces at a rate much higher than it can be redistributed from the core material of the sheet. This preferential drying action forms a sort of dry skin on each surface with a much moister core therebetween, and it has been found that this status can be reached in a much shorter time than would be the case when drying the sheet to proper surface condition in the ordinary way. The surface layers are, in fact, dry enough after 12 seconds of treatment in a 6 inch drying treatment length that any excess core moisture can be dispelled in other ways, e.g. through the sheet edges, before it has any tendency to return the sheet surfaces to a condition such that the photographic material again becomes tacky or the stacked sheets tend to stick together.

The sheets in this specially dried condition, apparently because of the still undried core, or perhaps because of the uniformity of treatment applied to the two surfaces, or both, tend to handle easily and lie flat with virtually no tendency to curl, and are actually in a preferred form for use in a lithographic process because they do not require the extent of pretreatment that would be needed of a normally dried sheet. They can, however, be stacked for as long as necessary and remain altogether free of any tendency to stick together so as to become damaged on separation.

While preferred embodiments of the invention have been described and illustrated, it is to be understood that these are capable of variation and modification. Accordingly, the aim in the appended claims is to cover all such variations and modifications as may fall within the true spirit of the invention.

What is claimed is:

1. In apparatus for drying processed photographic material issuing from a processing unit, the combination of a drying unit including a housing attachable to the processing unit, a first guideway in the housing adjacent said processing unit for guiding the material to be dried into the drying unit, a first pair of rollers within said housing for feeding the material into the drying unit, a second guideway of openwork construction within said drying unit, heating means and associated heat reflecting means adjacent the second guideway, a second pair of rollers effective to take the material from said second guideway and eject the same from the drying unit, and the receiver in a housing attached to said drying unit housing for collecting the material so ejected, said receiver housing including means effective to exhaust moist air from the drying unit and the receiver housing in a direction from the former to and through the latter.

2. In apparatus for drying processed photographic material issuing from a processing unit, the combination of a drying unit housing attachable to the processing unit, a first guideway in the housing adjacent said processing unit for guiding the material to be dried into said drying unit, a first pair of rollers within said housing for feeding the material into the drying unit, a second guideway of openwork construction within said drying unit, a pair of heating elements positioned one on each side of the second guideway, means for so controlling said heating elements being that the same are maintained at a temperature such that the air temperature in the drying unit does not exceed 160° F., heat reflecting means associated with each of the heating elements, a second pair of rollers for taking the material from said second guideway and ejecting said material from the drying unit, a receiver including a housing attached to said drying unit housing for collecting the dried material, and means for exhausting moist air from the drying unit and receiver housings in a direction from the former to and through the latter.

3. An apparatus according to claim 2 in which said heating elements are tungsten quartz infrared lamps.

4. In apparatus for drying processed photographic material issuing from a processing unit, the combination of a drying unit including a housing attachable to the processing unit, a guideway in said housing including a guide plate for receiving the material from the processing unit and shiftable to alternate positions, one of such alternate positions permitting guidance of the material so as to bypass said drying unit and guide the material out of the housing, the other of such alternate positions being effective to maintain the material within the housing and guide the same into and through said drying unit.

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