

Nov. 22, 1932.

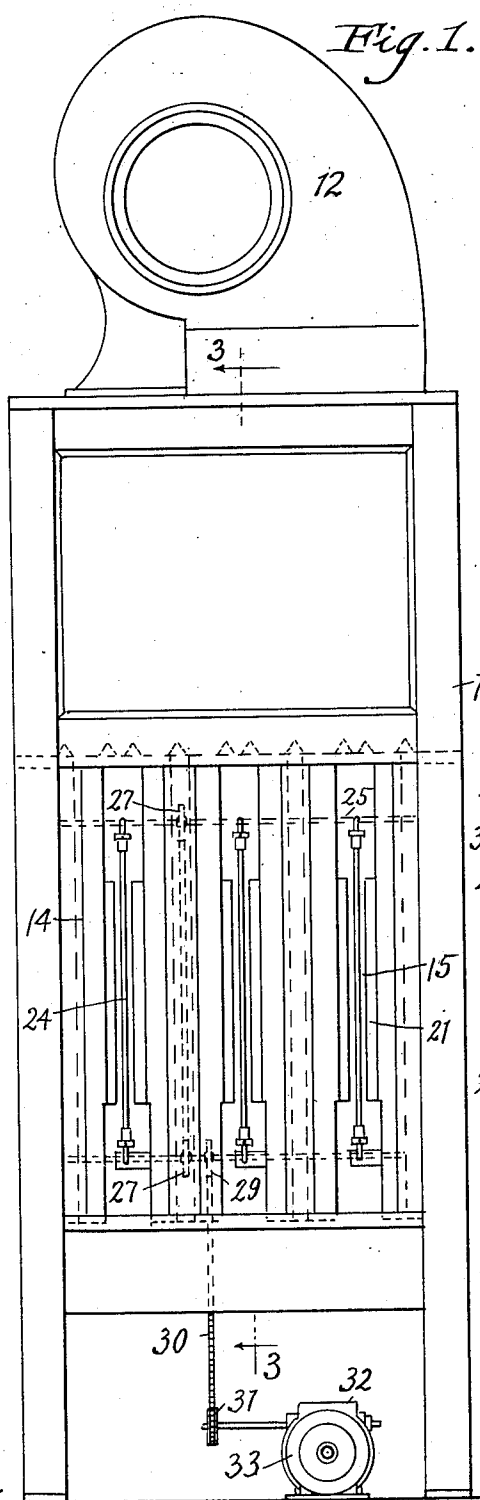
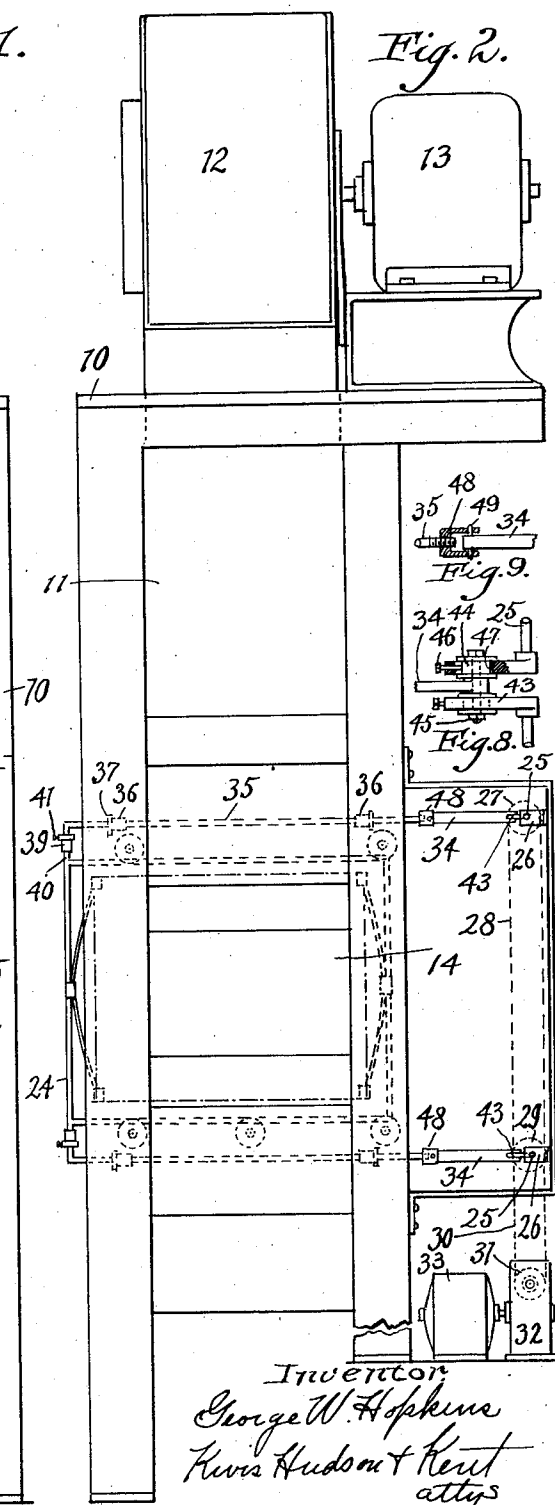
G. W. HOPKINS

1,888,596

FILM DRIER

Filed Jan. 7, 1930

3 Sheets-Sheet 1



Inventor
George W. Hopkins
Rivers Hudson & Kent
attys

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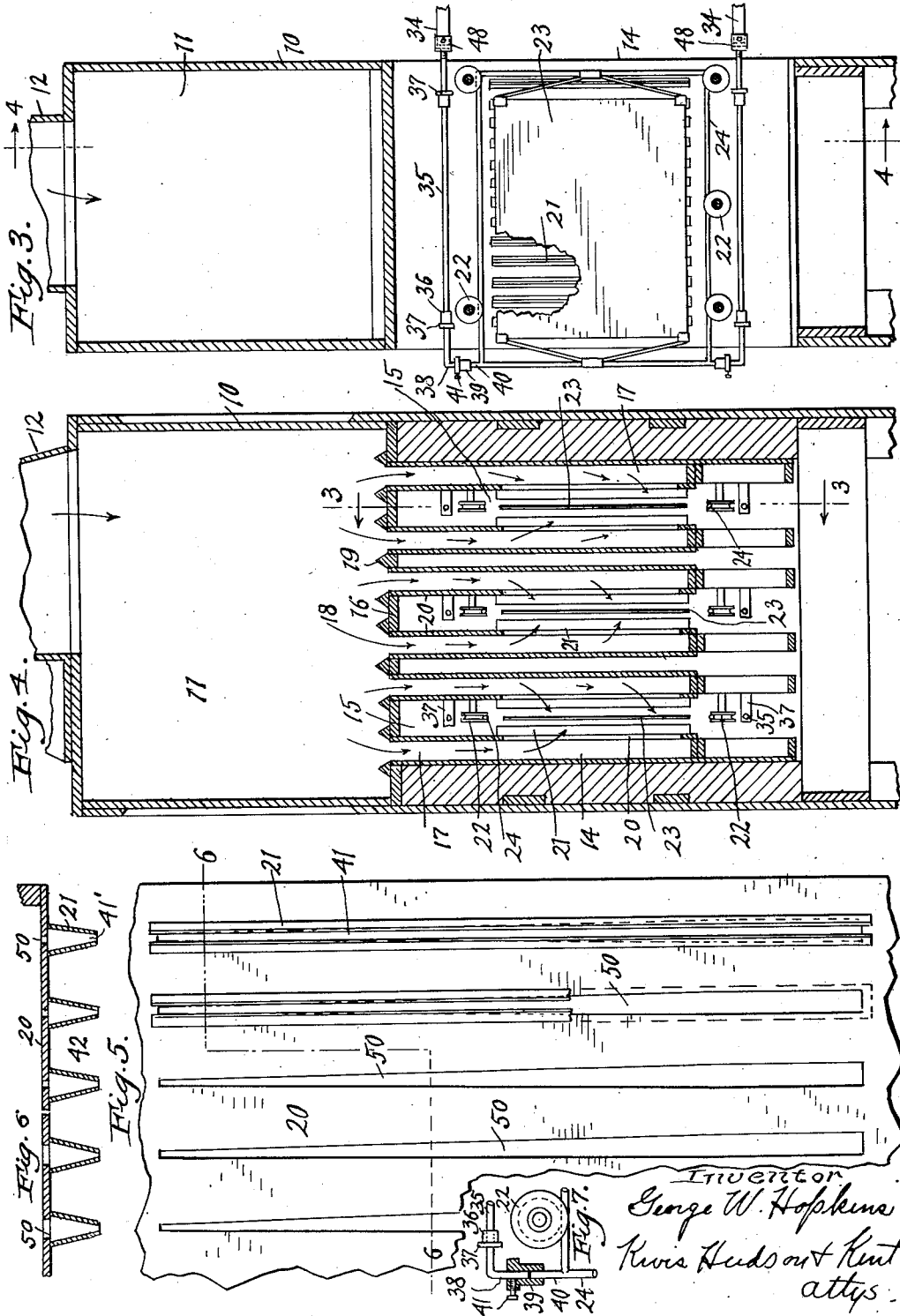
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3 Sheets-Sheet 2



INVENTOR
George W. Hopkins
Rivers Hudson & Kent
attys.

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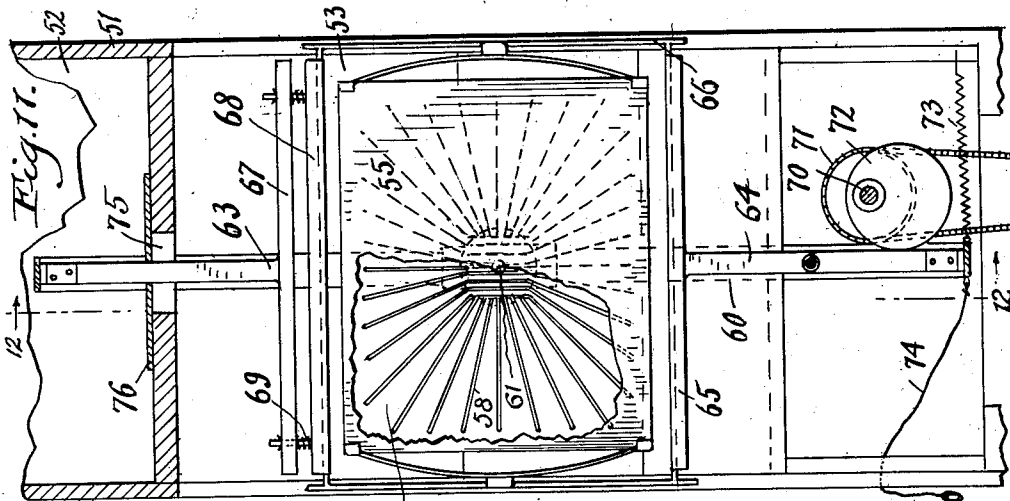
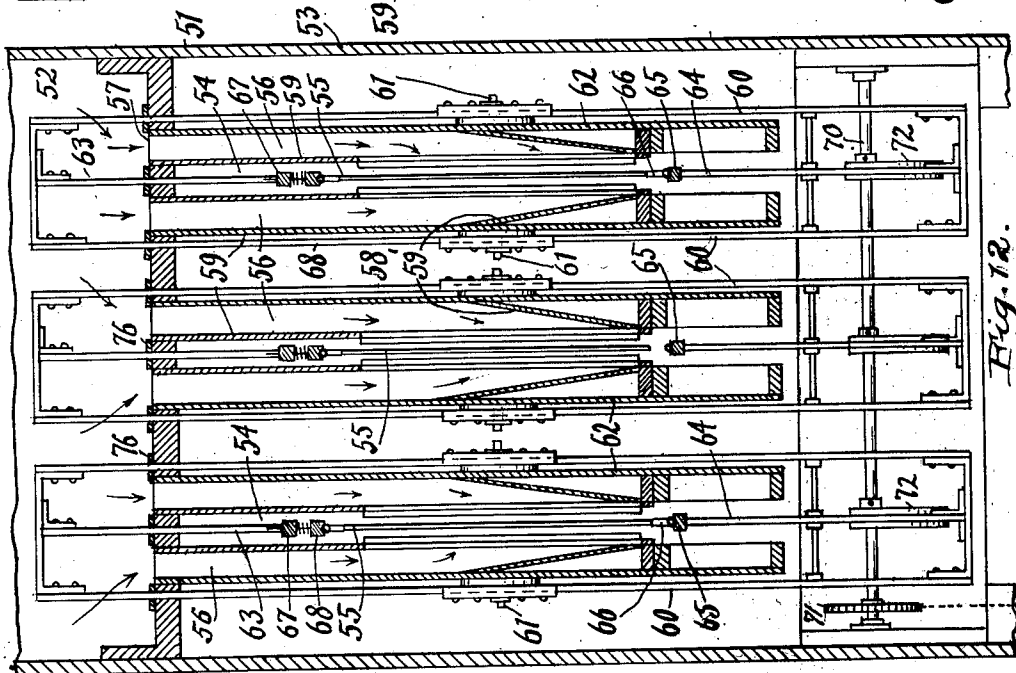
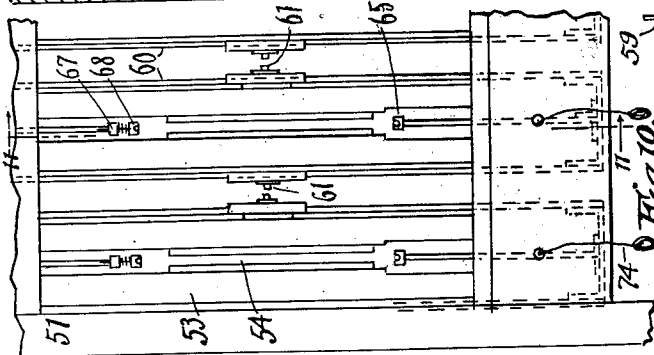
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FILM DRIER

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Inventor
George W. Hopkins
Knox Hudson & Kent
attys

UNITED STATES PATENT OFFICE

GEORGE W. HOPKINS, OF CLEVELAND, OHIO

FILM DRIER

Application filed January 7, 1930. Serial No. 419,062.

This invention relates generally to drying apparatus, and more particularly to a drier for photographic films and the like.

An object of this invention is to provide an improved form of drier for films and the like in which the various surface portions of the film are dried rapidly and substantially simultaneously.

Another object of this invention is to provide an improved form of drying apparatus having means for directing a flow of drying agent into contact with a film, and means for simultaneously causing relative traversing movement between the film and said directing means.

Other objects and advantages of the invention will be apparent from the following description, taken in conjunction with the accompanying sheets of drawings, in which:

Fig. 1 is a front elevational view of drying apparatus embodying my invention;

Fig. 2 is a side elevational view of the same apparatus;

Fig. 3 is a sectional elevation taken on line 3—3 of Fig. 1;

Fig. 4 is a sectional elevation taken on line 4—4 of Fig. 3;

Fig. 5 is an elevational view on an enlarged scale showing a portion of one of the nozzle plates;

Fig. 6 is a sectional view taken on line 6—6 of Fig. 5;

Fig. 7 is a fragmentary elevational view showing a portion of the film supporting means;

Fig. 8 is a detail view showing a portion of one of the crankshafts;

Fig. 9 is a detail view showing an adjustable connection;

Fig. 10 is a partial front elevational view of another form of drying apparatus embodying my invention;

Fig. 11 is a sectional elevational view of the apparatus taken on line 11—11 of Fig. 10;

Fig. 12 is a sectional elevation on an enlarged scale taken on the line 12—12 of Fig. 11; and

Fig. 13 is a detail view showing a portion of one of the nozzle plates in perspective.

In the drying of photographic films, it is

well known that when the films are dried rapidly they must be dried substantially uniformly or otherwise they will become distorted and spotted. In Figs. 1 to 9 inclusive of the drawings illustrating my invention, I have shown one form of drying apparatus in which photographic films may be dried very rapidly and substantially uniformly. This drying apparatus may be constructed in the form of the cabinet 10 shown in the drawings. The upper part of this cabinet forms an air chamber 11 into which air may be delivered by the blower 12 mounted on the top of the cabinet. This blower may be conveniently driven by means of an electric motor 13 also mounted on the top of the cabinet. Immediately below the air chamber I provide a drying compartment 14 which is subdivided into a plurality of drying chambers 15. The drying chambers are arranged in spaced parallel relation and are closed at their upper ends by walls 16 which form a part of the bottom wall of the air chamber. Air spaces 17 are provided on both sides of the drying chambers to which air may be delivered from the air chamber by means of elongated openings 18 formed through the bottom wall of the air chamber. Wedge-shaped members 19 arranged upon the bottom wall of the air chamber between the openings 18 break up the stream of air from the blower 12 into smaller streams and direct these smaller streams into the air spaces 17. The parallel side walls of the drying chambers are formed by the plates 20 which are each provided with a row of vertical, elongated parallel nozzles 21 arranged to direct air into the drying chambers from opposite sides thereof.

For movably supporting the films within the drying chambers, I provide grooved rollers 22 arranged in horizontally extending rows above and below the nozzles and rotatably mounted upon the nozzle or air delivery plates 20. A film 23 to be dried is held in substantially upright position in each drying chamber by means of a suitable film supporting frame 24 which is guided and supported by the rows of grooved rollers mounted in each chamber. When air is be-

ing delivered into the drying chambers and against the surfaces of the films by the nozzles, the film holders are oscillated or moved back and forth in their respective chambers, thus reciprocating the films in their own planes between the rows of nozzles. For the purpose of imparting this back and forth or reciprocating motion to the films and film holders, I provide the parallel crankshafts 25 which are supported opposite the drying chambers by means of the brackets 26. Each of these crankshafts is provided with a sprocket 27 around which the chain 28 extends for operatively connecting the crankshafts together. Power may be supplied for rotating the crankshaft in any convenient way, but in the apparatus illustrated, I have shown a second sprocket 29 secured to the lower crankshaft for this purpose. A chain 30 passes around the sprocket 29 and around the sprocket 31 of the reduction gear 32 which is driven by an electric motor 33. For connecting the crankshafts to the film holders, I provide connecting rods 34 which have one end thereof connected to the cranks of the crankshafts and their opposite ends pivotally connected to the reach rods 35. The reach rods 35 are slidably supported in horizontally aligned bearings 36 which are carried by the brackets 37 mounted upon the nozzle plates 20. For releasably connecting the ends of the reach rods to the film holders, I provide each rod with a bent end portion 38 having a slidable sleeve 39 thereon. These sleeves are adapted to be moved to telescopically surround vertically extending projections 40 provided on the film holder at the top and bottom of one end thereof. Each of the sleeves 39 is provided with a set screw 41 to enable the operator to secure the sleeve in the desired position.

During the operation of the drier, a film holder having a film therein is inserted into a drying chamber and is connected to the reach rods of the actuating means provided for that chamber, by moving the sleeves 39 into engagement with the projections on the film holder. As the crankshafts are rotated, the film carried by the film holder is reciprocated in its own plane within the drying chamber between the rows of nozzles. Air supplied from the chamber 11 is directed against the film from opposite sides while it is being moved between the rows of nozzles. The bottom and the front and rear ends of the drying chambers are left open so that the air directed against the films by the nozzles may escape freely from the drying chambers after it has impinged against the film surfaces. The air directed against the film surfaces by the nozzles is, to a large extent, deflected back from the surfaces into the spaces 42 between the nozzles. These spaces thus provide clear channels which permit the air to flow rapidly away from the

film surfaces without interfering with the discharge of additional air by the nozzles.

It should be noted that the elongated discharge openings 41' provided at the discharge ends of the nozzles are of a length which is equal to or slightly greater than one dimension of the film, or, in other words, are coextensive with one dimension of the film. It should also be noted that these openings extend for substantially the full length of the nozzles and are of uniform size throughout their extent, so that the width or thickness of the air streams delivered by the nozzles against the film surfaces will be substantially equal. Thus it will be seen that as the film is reciprocated in front of the nozzle openings the air delivered by each nozzle will impinge against a certain section of the area of the film. If the film is reciprocated in its own plane while air is being directed against its surfaces by the nozzles, it is obvious that each nozzle will dry the section of film which moves opposite that nozzle. The width of these sections will depend upon the amount of relative traversing movement between the nozzles and the film surface, or, in other words, will depend upon the throw of the cranks of the crankshafts which reciprocate the films.

In order to effect uniform drying of the entire film surface, it is important that the reciprocating movement of the film be so adjusted and proportioned as to prevent overlapping of the sections dried by adjacent nozzles, and, likewise, to prevent spaces being left between adjacent sections. Thus, for most efficient operation, the movement of the film with respect to the nozzles should be such that the edges of the sections to be dried by adjacent nozzles will just meet. Since the extent of movement of the film, with respect to the nozzles, must be accurately determined so as to bring the sections dried by adjacent nozzles into proper relation, I provide means for adjusting the throw of the cranks of the crankshafts. This means may be constructed as illustrated in Fig. 8 by providing the arms 43 of each crank with elongated openings in which are received the blocks 44 mounted on the ends of the crank pin 45. By means of the adjusting screws 46 and shims 47 of suitable thickness, the blocks may be secured in the desired position of adjustment relative to the axis of the crankshaft. For adjusting the initial position of the film holder with respect to the nozzles, I provide adjustable connecting means between the connecting rods 34 and the reach rods 35. This means, as shown in Fig. 9, comprises a U-shaped member 48 screwed onto the end of each reach rod. A pin 49 extends through the arms of each U-shaped member to form a pivotal connection for one end of the connecting rods 34.

In drying films I have found that, for ef-

fecting substantially simultaneous drying of all portions of the film surface, larger volumes of air are required by certain of the surface portions than by others. The volume of air required by the different portions depends to some extent upon the position in which the film is supported. For example, if the film is held upright, there is a tendency for water clinging to the film to run down and accumulate upon the lower portion of the film. This accumulation of moisture makes necessary an increased volume of air supply to the lower portion of the film. However, if too much air is supplied to the lower portion of the film, the flow of air will prevent the water from running down and will dry the lower portion of the film while the upper portion is still wet. Therefore, to deliver air to the various portions of the film surface in proportion to the requirements of the respective portions, I find that it is necessary to control the supply of air from the air spaces to the nozzles. For this purpose, I provide a tapered slot 50 through the nozzle plate 20 for each nozzle. As shown in Figs. 5 and 6, the openings are very narrow at the top ends of the slots with the sides of the slots diverging progressively toward the bottom ends until a point is reached a short distance above the bottom ends. From this point on toward the bottom ends, the sides of the slots extend in parallel relation. The upper portions of the film surfaces require considerably less air than the lower portions, and I find that, by employing slots of proper length and by narrowing these slots adjacent the upper portions of the film and widening the slots adjacent the lower portions of the film, the desired rate of flow through different nozzle portions is attained. As a result of careful experiments, I believe that this desired end results from the fact that the rapid flow of air into the air spaces 17 past the narrow ends of the slots causes a partial vacuum to form in the upper end portions of the nozzles. The lower ends of the air spaces 17 are closed, thus causing some of the velocity of the air entering the air spaces to be converted into pressure upon striking the bottoms of these spaces. This increased pressure causes the flow of large volumes of air through the wide lower portions of the slots. After entering the nozzles, some of the air flows upwardly within the nozzles before being discharged through the openings against the films. Thus the slots control the supply and distribution of the air to the nozzles in proportion to the requirements of the various surface portions of the films.

In Figs. 10 to 13 inclusive, I have shown another form of drying apparatus in which air is directed against the surface of a film while the film is oscillated in its own plane. In this form of apparatus, I provide a cabinet 51 having an air chamber 52 provided in the

upper portion thereof and a drying compartment 53 below the air chamber. The drying compartment is divided into a plurality of drying chambers 54 in which the films 55 are movably supported. Air spaces 56 are provided on opposite sides of the drying chambers and are supplied with air from the air chamber through the elongated openings 57 formed in the bottom wall of the air chamber. Air is supplied by the air spaces to the nozzles 58 which direct the air against the surfaces of the film. In this apparatus, it should be noted that the nozzles 58 are arranged to extend radially outwardly from the central portions of the nozzle plates 59 which form the side walls of the drying chambers. By arranging the nozzles in this manner, air is delivered to the various sections of the film surface in proper quantities to dry these various sections substantially simultaneously. Proper distribution of air by the nozzle is assisted by providing the inclined walls 59' at the lower ends of the air spaces.

While air is being delivered against the film surfaces by the nozzles, the films are oscillated back and forth in their own planes about a perpendicular axis passing through the center of the films. For the purpose of oscillating the films in this manner, I provide a vertically extending rectangular frame 60 for each drying chamber. Each frame is supported upon a pair of suitable pivots 61 secured to the side walls 62 of the air spaces in alignment with the axis of oscillation. An arm 63 extends downwardly from the upper end of each frame, and a similar arm 64 extends upwardly from the lower end of each frame. The arms 64 are provided with cross bars 65 having grooves therein which receive the lower side elements of the film holders 66. The arms 63 are each provided with a cross bar 67 to which is attached a parallel bar 68 having a groove therein to receive the upper side element of the film holder. Springs 69 are interposed between the bars 67 and 68 for causing the latter to resiliently grip the film holders.

Adjacent the lower ends of the supporting frames 60, I provide a rotatable shaft 70 which may be actuated by means of a sprocket 71 secured thereto. Eccentrics 72 are secured on the shaft 70 and are spaced apart a distance corresponding to the distance between the centers of the drying chambers. Upon rotation of the shaft, the eccentrics bear against the upwardly extending arms 64 of the supporting frames and cause the frames to be oscillated about the pivots 61, thus moving the films to and fro between the sets of nozzles. The arms 64 are held in engagement with the respective eccentrics by means of tension springs 73.

To prevent the eccentrics from oscillating the film holder while the films are being placed in or are being removed from the dry-

ing chambers, I provide chains 74 which are connected to the lower ends of the supporting frames 60 to enable the operator to pull the desired frame toward the front of the cabinet and thus move the arm 64 of that frame out of engagement with the surface of its eccentric.

The sides of the supporting frames 60 and the upper arms 63 extend through slots 75 provided in the bottom wall of the air chamber, and when the frames are oscillated, these members move back and forth in the slots. To prevent air from passing through these slots, I provide slip plates 76 which cover the slots and move back and forth with the members extending through the slots.

Thus it will be seen that I have provided efficient drying apparatus in which all of the film portions are dried rapidly and substantially simultaneously without distorting or spotting the films and without causing objectionable noises by vibrating the films.

In the forms of driers which I have shown and described in detail, I have provided for moving the film with respect to the nozzles, and while I prefer this arrangement, similar results might be obtained by maintaining the film stationary and moving the air delivery nozzles relative thereto, or by moving both the film and the air delivery nozzles relative to each other.

It is also to be noted that since the drying of the film is accomplished by the flow of air across the film surface, the driers which I have described could be operated as suction driers rather than as pressure driers by connecting the suction side of the blower 12 to the air chamber 11 rather than by connecting the delivery passage of the blower to this chamber, as illustrated in the drawings. When operated as suction driers, air is drawn into the cabinet through the drying chambers and dries the films as it flows across their surfaces. The driers which I have illustrated and described operate more efficiently, however, as pressure driers, and, therefore, I prefer to operate them as such.

While I have described the apparatus of my invention in a detailed manner, it should be understood, however, that various changes may be made without departing from the spirit of the invention and the scope of the appended claims.

Having thus described my invention, I claim:

1. In a drier for films and the like, the combination of a drying chamber, means for supporting a film in said chamber, air spaces on opposite sides of said chamber, means for supplying air to said spaces, nozzles on the walls of said chamber for directing air against the surfaces of said film, said walls having slots therethrough of progressively varying width for controlling the flow of air to said nozzles, said slots being coextensive with said

nozzles and arranged with their narrow ends extending in the general direction from which the air enters said spaces.

2. In a drier for films, the combination of a drying chamber, means for supporting a film in said chamber, means for directing a plurality of substantially parallel streams of air into contact with a plurality of correspondingly spaced surface portions of said film, and means for reciprocally moving said film in its own plane transversely of the direction of movement of said streams whereby said surface portions are enlarged to aggregate substantially the entire surface of said film.

3. In a drier for films, the combination of a drying chamber, means for supporting a film in said chamber, means for directing a plurality of substantially parallel streams of air into contact with a plurality of correspondingly spaced surface portions of said film, means for reciprocally moving said film in its own plane transversely of the direction of movement of said streams whereby said surface portions are enlarged to aggregate substantially the entire surface of said film, and adjusting means for regulating the travel of said film to thereby bring an edge of each of said surface portions substantially into tangency with an edge of the next adjacent surface portion.

4. In a drier for films, the combination of a drying chamber, means for supporting a film in said chamber, an arrangement of nozzles for directing a plurality of spaced streams of air into contact with a plurality of correspondingly spaced surface portions of said film, and means for moving said film back and forth in its own plane transversely of the direction of the movement of said streams and for substantially equal distances in opposite directions whereby said surface portions are enlarged to aggregate substantially the entire surface of said film.

In testimony whereof, I hereunto affix my signature.

GEORGE W. HOPKINS.