

Jan. 8, 1963

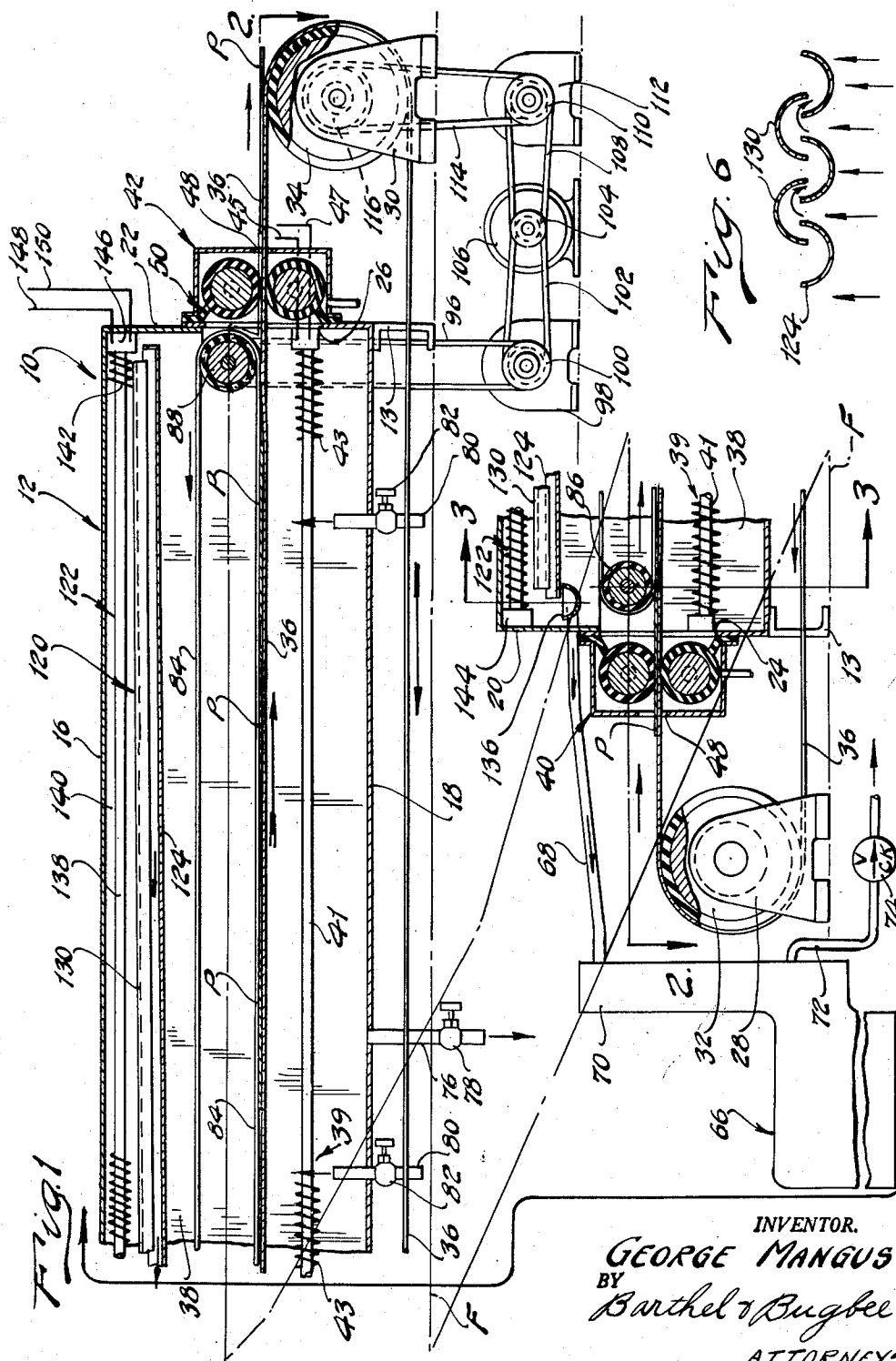
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3,071,866

HIGH SPEED PHOTOGRAPHIC PRINT DRYING MACHINE

Filed Sept. 14, 1959

3 Sheets-Sheet 1



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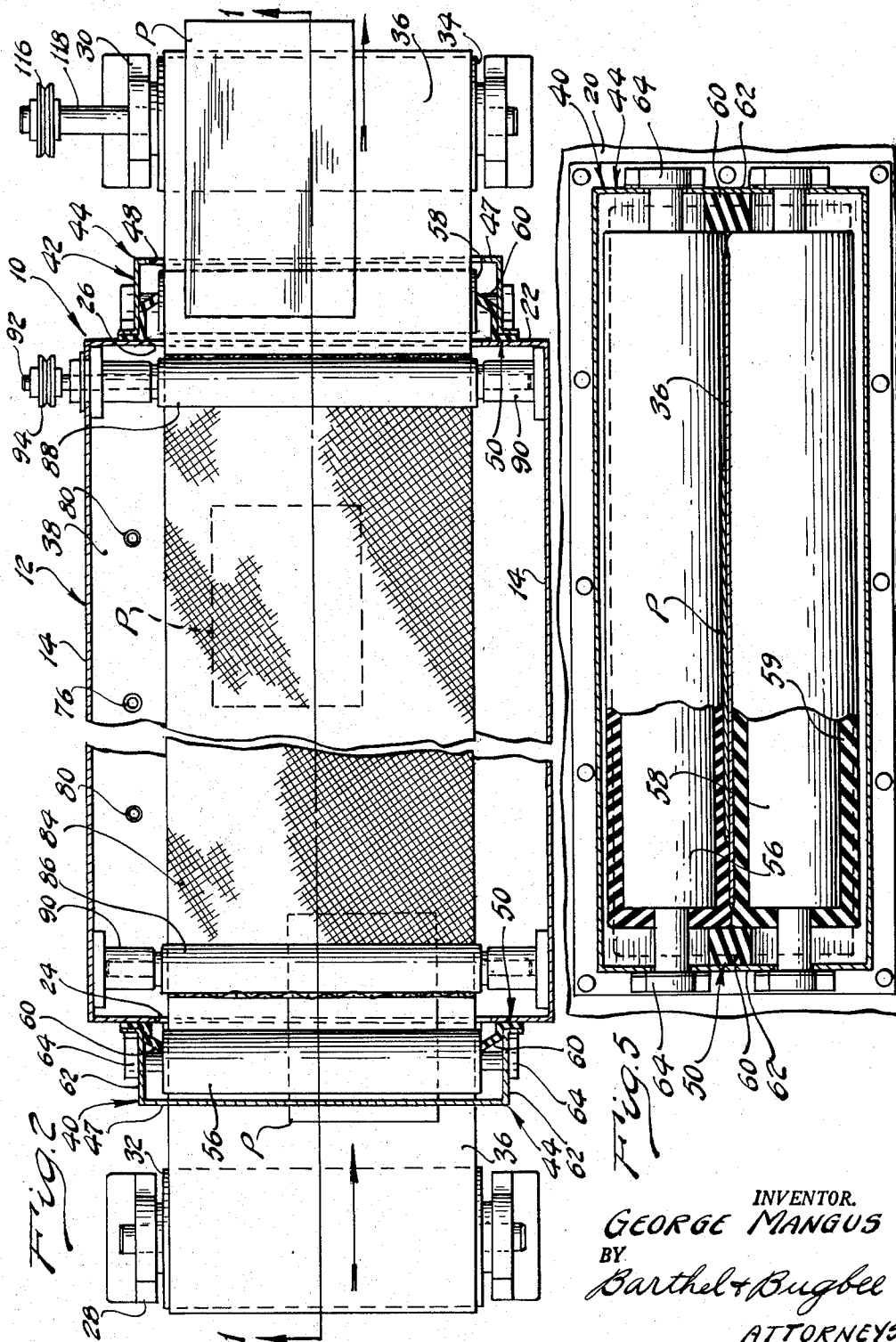
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Fig. 3

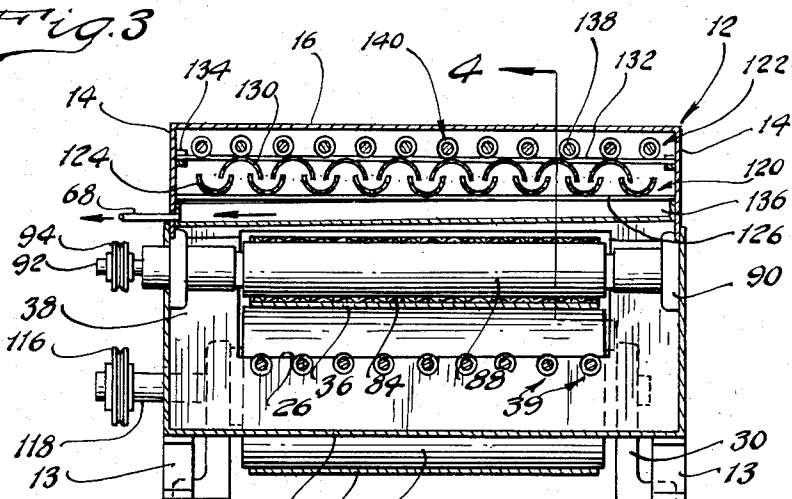
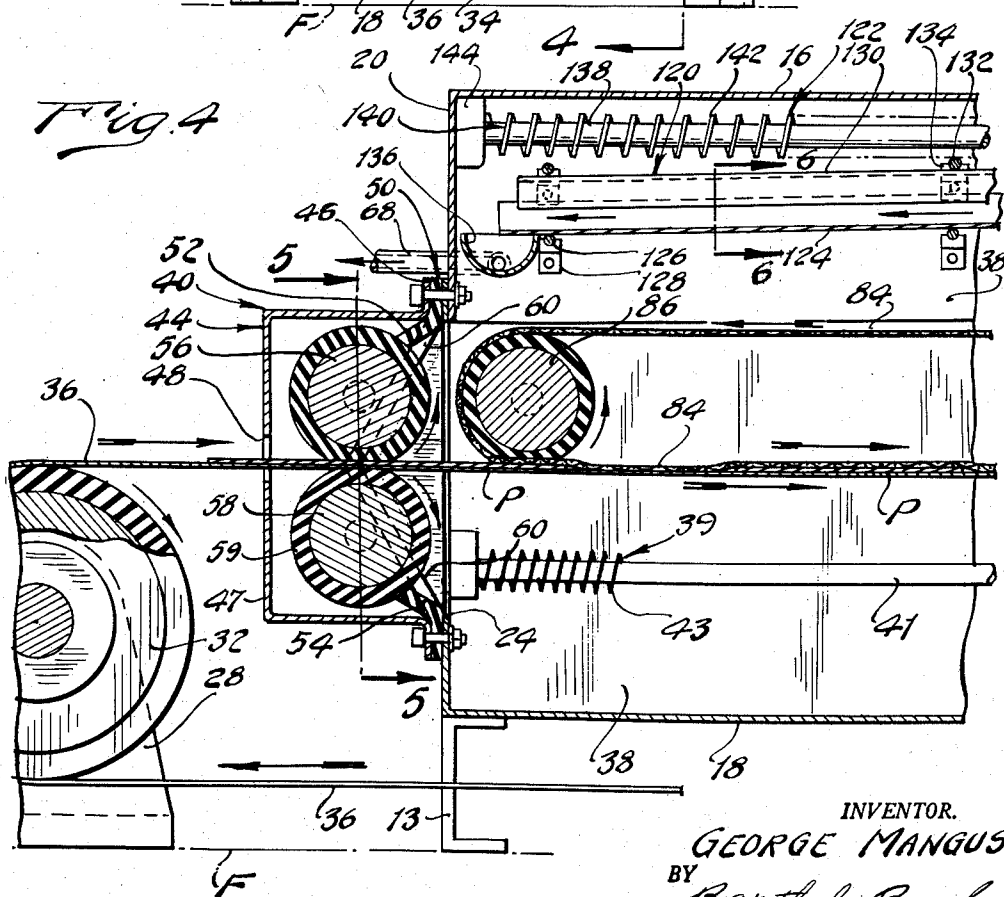


Fig. 4



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HIGH SPEED PHOTOGRAPHIC PRINT DRYING MACHINE

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Filed Sept. 14, 1959, Ser. No. 839,943
14 Claims. (Cl. 34—73)

This invention relates to drying machines and, in particular, to photographic print drying machines.

One object of this invention is to provide a high speed photographic print drying machine which is adapted to remove the water from photographic prints at relatively low temperatures so as to avoid damage to the photographic emulsion which occurs at high temperatures, and at the same time to convey the print through the machine while drying.

Another object is to provide a high speed print drying machine of the foregoing character wherein evaporation of the water from the prints is accelerated by heating the interior chamber of the drying machine while placing it under a vacuum, which greatly lowers the temperature at which water will evaporate.

Another object is to provide a high speed print drying machine of the foregoing character which is especially well adapted for the high speed drying of commercial glossy or other photographic prints such as are used in newspaper photography, and at the same time squeezing the prints while conveying and drying them through the use of a chromium-plated steel or Phosphor bronze belt upon which the print rests, emulsion downward.

Another object is to provide a high speed print drying machine, as set forth in the object immediately preceding, wherein the prints being dried are held down against the steel or bronze belt by a mesh belt of plastic or other suitable material which at the same time releases the water vapor from the print to pass upward and out of the drying chamber.

Another object is to provide a high speed print drying machine of the foregoing character wherein the water vapor is entrapped and carried away by a water removing device located in the upper part of the drying chamber, optionally assisted by a heater located above the water removing device for enhancing circulation of the water vapor upward by convection.

Another object is to provide a high speed print drying machine of the foregoing character wherein the print-conveying belts pass into and out of the drying chamber through rollers with resilient coatings of rubber-like material, so as not only to squeeze out excess water but also to form sealing devices for the entrance and exit openings of the machine.

Another object is to provide a high speed print drying machine of the foregoing character which shall be of limited length and height in order to fit into the available space in photographic process laboratories, such as are used in high speed newspaper publishing, and which is of such elongated shape but small cross-sectional dimensions and height as to be capable of use in or adjacent a photographic dark room or between a pair of adjacent photographic darkrooms.

Other objects and advantages of the invention will become apparent during the course of the following description of the accompanying drawings, wherein:

FIGURE 1 is a central vertical longitudinal section through a high speed photographic print drying machine, according to one form of the invention, taken along the line 1—1 in FIGURE 2, divided into two bracketed sections in order to accommodate the view upon the

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sheet and at the same time show details upon a sufficiently large scale;

FIGURE 2 is a horizontal section taken along the line 2—2 in FIGURE 1, with the central portion of the machine omitted to conserve space;

FIGURE 3 is a vertical cross-section taken along the line 3—3 in FIGURE 1;

FIGURE 4 is an enlarged fragmentary longitudinal vertical section taken along the line 4—4 in FIGURE 3, showing details of the vacuum sealing arrangement at the entrance of the machine;

FIGURE 5 is a cross-section taken along the line 5—5 in FIGURE 4; and

FIGURE 6 is an enlarged fragmentary view of a portion of FIGURE 3, showing the action of the water extractor-collector.

Referring to the drawings in detail, FIGURES 1 and 2 show a high speed photographic print drying machine, generally designated 10, according to one form of the invention as including an elongated box-like substantially air-tight housing, generally designated 12, supported on legs 13 on the floor F. The housing 12 is provided with opposite side walls 14, top and bottom walls 16 and 18 respectively, and entrance and exit end walls 20 and 22 respectively, having entrance and exit openings 24 and 26 respectively. Mounted on the floor F outside the entrance and exit walls 20 and 22 are entrance and exit drum-supporting frames 28 and 30 rotatably supporting resiliently-coated entrance and exit drums 32 and 34 which in turn support an endless chromium-plated steel or Phosphor bronze belt 36. The lower course of the belt 36 passes beneath the housing 12, and the upper course through the entrance opening 24 along the elongated housing chamber 38 and outward through the exit opening 26, and is sealed by similar entrance and exit rotary sealing units, generally designated 40 and 42 respectively. A suitable heater 39 is mounted within the housing 12 below the upper course of the belt 36, the heater shown having spaced elongated insulating rods 41 carrying electrical resistance wire heating coils 43 connected to leads 45 and 47.

Each rotary sealing unit 40 and 42 consists of a box-shaped casing 44 (FIGURES 2, 4 and 5) each having a flanged open side 46 facing its respective opening 24 or 26 and bolted to its respective wall 20 or 22. The outer wall 47 of each casing 40 is provided with an elongated slot 48 (FIGURE 4) through which the upper course of the belt 36 passes. Bolted between the flanged open side 46 at the top and bottom of each casing 40 is the upper and lower horizontal portion of an open-centered border or picture frame-shaped sealing wiper, generally designated 50. The latter has upper and lower inclined sealing wiping portions 52 and 54 engaging the peripheries of resiliently-coated upper and lower sealing rollers 56 and 58 respectively, and has approximately V-shaped roller-end-sealing side portions 60 disposed between the ends of the rollers 56 and 58 and the end walls 62 of the casing 44, the sealing coating 59 being preferably of resilient rubber-like material, such as natural or synthetic rubber or resilient synthetic plastic or other elastomers. The sealing rollers 56 and 58 are journaled at their opposite ends in bearing blocks 64 (FIGURE 2) secured to the opposite end walls 62 of the casing 40. In this manner, the endless steel belt 36 is sealed by the pressure of the resiliently-coated rollers 56 and 58 and these in turn are sealed by the open-centered sealing member 50 so as to exclude the greater portion of the air and permit a vacuum to be built up in the chamber 38 by a conventional vacuum pump. For these reasons, the housing 12 may be regarded as being substantially airtight, even though some leakage would normally be expected.

To build up and maintain this vacuum in the chamber

38, a vacuum pump, generally designated 66, is connected thereto through the downwardly-inclined conduit 68 at the top of the water trap unit 70 of the vacuum pump 66. A water drain pipe 72 containing a check valve 74 leads out of the water trap unit 70 to release water collecting therein but at the same time to prevent the flow of air backward into the water trap unit 70. Water collecting in the lower part of the chamber 38 of the housing 12 is released from time to time through a drain pipe 76 (FIGURE 1) containing a drain valve 78. In order to admit air into the chamber 38 of the housing 12 in controlled amounts and rates, such as for enhancing convection within the chamber 38, the bottom wall 18 of the housing 12 is also provided with air inlet pipes 80, each containing a regulating valve 82.

The wet photographic prints P which are to be dried by the machine 10 and, if glossy prints (as is usual), also to be simultaneously squeegeed, are held down forcibly against the chromium-plated steel belt 36 and at the same time driven in synchronism therewith by an endless mesh belt 84 formed of synthetic plastic or other suitable material and supported on longitudinally-spaced drums or rollers 86 and 88 (FIGURE 2) disposed near the entrance and exit openings 24 and 26 respectively of the casing 12. The rollers 86 and 88 are rotatably supported in bearing blocks 90 which are bolted or otherwise secured to the opposite side walls 14 of the housing 12. One of the rollers 88 is provided with an extension drive shaft 92 carrying a pulley, sprocket or the like 94 which is in turn drivingly connected by a belt or sprocket chain 96 (FIGURE 1) to the output shaft of a reduction gear box 98, the input shaft of which carries a pulley or sprocket 100 driven by a belt or sprocket chain 102 from a double pulley or sprocket 104 on the armature shaft of an electric motor 106. The pulley or sprocket 104 also through a belt or sprocket chain 108 drives a pulley or sprocket 110 on the input shaft of a reduction gear box 112, the output shaft of which carries a pulley or sprocket (not shown) which in turn through a belt or sprocket chain 114 drives a pulley or sprocket 116 drivingly connected to the extension shaft 118 (FIGURE 2) of the exit drum 34. By this mechanism, as previously stated, the upper and lower endless belts 84 and 36 are driven at the same speeds so that the prints P are fed through the machine 10 at a controlled and positively regulated rate.

In order to catch the water from the water vapor rising from the prints P through the open meshes of the mesh belt 84, the housing 12 within the chamber 38 is provided with a water extractor-collector, generally designated 120 mounted near the top wall 16 and separated from it by an optional electric heater, generally designated 122, which is occasionally used for enhancing the flow of convection currents upward so as to increase the speed of disposal of the water vapor from the prints P. The water extractor-collector 120 consists of elongated inclined laterally-spaced lower troughs 124 (FIGURE 3) supported by cross rods 126 between angle brackets 128 secured to the opposite side walls 14 of the housing 12, and inverted upper troughs or deflectors 130 disposed in and above the space between adjacent lower troughs 124 and overlapping their adjacent edges so as to divert rising water vapor downwardly into the lower trough 124. The inverted upper troughs 130 are secured to cross rods 132 which in turn are mounted in brackets 134 secured to the opposite side walls 14 of the housing 12. The troughs 124 and 130 are inclined downwardly from the exit end walls 22 toward the entrance end wall 24 (FIGURE 4) and the lower troughs 124 discharge into an inclined cross trough or manifold trough 136 from the lower end of which the conduit 68 leads downward through the rearward side wall 14 (FIGURE 3) of the water trap unit 70 of the vacuum pump 66. The cross trough 136 is also supported by and between the opposite side walls 14 of the housing 12.

The electric heater 122 is of any suitable type, the type

shown consisting of elongated insulating rods 138 extending longitudinally through the space between the water collector 120 and the top wall 16 of the housing 12. The insulating rods 138 of each heating unit 140 of the electric heater 122 are also provided with a helical coil 142 of electrical resistance heating wire. The opposite ends of each coil 142 are interconnected at junction boxes 144 and 146 and supplied with electric current through current supply lines 148 and 150 leading, for example, to an ordinary 110-volt alternating current supply line.

In the operation of the high speed photographic print drying machine 10 of the invention, the motor 106 is started in operation, causing the chromium-plated steel belt 36 to move in a clockwise direction and the open mesh upper belt 84 to move in a counterclockwise direction, thereby causing the upper course of the lower belt 36 and the lower course of the upper belt 84 to move adjacent one another in the same direction (FIGURES 1 and 4) as indicated by the arrows. At the same time, the contact of the sealing rollers 56 and 58 with the lower belt 36 drives the rollers 56 and 58 in counterclockwise directions respectively (FIGURE 4). The vacuum pump 66 is now started in operation, and, if necessary, the electric heater 122 is energized to accelerate the flow of convection current upward within the chamber 38.

When a sufficiently low vacuum has been obtained within the chamber 38, as indicated by a suitable conventional vacuum gauge (not shown), the operator places the wet prints P, emulsion-down, on the upper course of the chromium-plated steel belt 36 at a location approximately between the entrance drum 32 and the entrance opening 48, whereupon each print is carried through the entrance opening 48 into the entrance sealing unit 40 (FIGURE 4) where the resilient coatings 59 of the upper and lower rollers 56 and 58 squeeze out the superfluous water and pass the print P onward through the entrance opening 24 into the chamber 38. Here the forward or leading edge of the print P is also engaged by the lower course of the upper mesh belt 84, which retains it in position down upon the chromium-plated steel belt 56, assists in feeding it forward through the elongated chamber 38, and guides it outward through the exit opening 26.

As the prints P pass from left to right from the entrance opening 24 to the exit opening 26 of the housing chamber 38, they are subjected to the drying action of the heaters 39 and 122 which, under the vacuum existing in the chamber 38, drives off the water in the form of vapor at a relatively low temperature in the neighborhood of 100° F. or slightly above, depending upon the degree of vacuum obtained in the chamber 38, instead of at the high temperature of 212° F. occurring at sea level atmospheric pressure, which damages the emulsions of the prints being dried. The water vapor expelled from the prints P passes through the interstices or openings between the mesh of the mesh belt 84 and passes upward into the water extractor-collector 120, as shown in FIGURE 6. Here the water vapor condenses into water which flows downward through the lower trough 124, cross trough 136 and conduit 68 into the water trap unit 70 of the vacuum pump 66, which at the same time is withdrawing water vapor from the chamber 38 through the conduit 68. It will be understood, of course, that the sealing arrangement described above is subject to a certain amount of air leakage but this entering air assists in the convection action within the chamber 38 and thus aids in expelling the water vapor from the prints P. The water passes out of the water trap unit 70 through the drain pipe 72 and check valve 74 (FIGURE 1).

When the prints P have reached the end of the lower course of the mesh belt 84, they continue onward and outward through the exit opening 26 and thence through the exit sealing unit 42 into the open air in a dried condition. At the same time, while they have been passing through the chamber 38 upon the chromium-plated steel or Phosphor bronze belt 36, they have undergone the

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squeegee treatment and emerge as dried glossy prints, from the opening 48 in the exit sealing unit 42, which in this instance is an exit opening.

In this manner, the prints P from a single dark room or from two dark rooms side by side can be fed rapidly into one end of the drying machine 10 and are dried and squeegeed in a rapid and efficient manner. The low temperature at which expulsion of the water vapor from the prints occurs protects the emulsion from the otherwise damaging effects of drying at high speed and high temperature, since the vacuum treatment lowers the temperature to about half of the temperature at the boiling point of water at sea level, namely 212° F.

What I claim is:

1. A high speed photographic print drying machine comprising an elongated substantially air-tight housing having an entrance opening and an exit opening spaced apart from one another, an endless print-carrying belt mounted adjacent said housing and having a print-conveying course thereof passing through said openings, an endless perforated print-hold-down belt mounted in said housing with a course thereof disposed adjacent the said print-conveying course of said print-carrying belt for reception of prints between said belts, mechanism for driving said belts along their respective paths with said adjacent courses traveling at substantially equal speeds, means for sealing said print-carrying belt course at said entrance and exit openings against the passage of air therethrough from outside said housing, a water extractor-collector disposed in said housing adapted to collect condensed vapors therein and having a drain conduit extending externally of said housing, a vacuum pump communicating with said drain conduit in air-exhausting relationship therewith, and a heater mounted in said housing for accelerating convection therein.

2. A high speed photographic print drying machine, according to claim 1, wherein said heater is disposed adjacent said print-conveying course of said print-carrying belt.

3. A high speed photographic print drying machine, according to claim 2, wherein said water extractor-collector is disposed in the upper portion of said housing above said belts.

4. A high speed photographic print drying machine, according to claim 1, wherein said sealing means includes opposed resilient rollers disposed adjacent said openings and also includes sealing elements mounted on said housing in yielding sealing engagement with said rollers.

5. A high speed photographic print drying machine, according to claim 4, wherein said sealing elements com-

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prise border members of resilient material mounted adjacent the borders of said openings and extending into said openings into yielding engagement with said rollers.

6. A high speed photographic print drying machine, according to claim 5, wherein said sealing elements also include roller end-sealing portions yieldingly engaging the opposite ends of said rollers.

7. A high speed photographic print drying machine, according to claim 6, wherein said end-sealing portions are bent into approximately V-shaped formation toward the nearest points of approach of said sealing rollers to one another.

8. A high speed photographic print drying machine, according to claim 1, wherein said water extractor-collector includes elongated water troughs extending through said housing and inclined downwardly toward said drain conduit.

9. A high speed photographic print drying machine, according to claim 8, wherein said water troughs are spaced laterally apart from one another and wherein water deflectors are disposed in the spaces between said troughs above said troughs and overlapping the edges of said troughs.

10. A high speed photographic print drying machine, according to claim 8, wherein a manifold trough is disposed transversely of said elongated water troughs and wherein said drain conduit is connected to said manifold trough.

11. A high speed photographic print drying machine, according to claim 1, wherein auxiliary air inlet devices are connected to said housing.

12. A high speed photographic print drying machine, according to claim 1, wherein said print carrying belt has a highly polished surface thereon whereby to squeegee the prints while drying them.

13. A high speed photographic print drying machine, according to claim 1, wherein the lower course of the print carrying belt has a path of travel externally of said housing.

14. A high speed photographic print drying machine, according to claim 13, wherein rotary belt-supporting elements are mounted externally of the housing near the opposite ends thereof adjacent said openings.

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