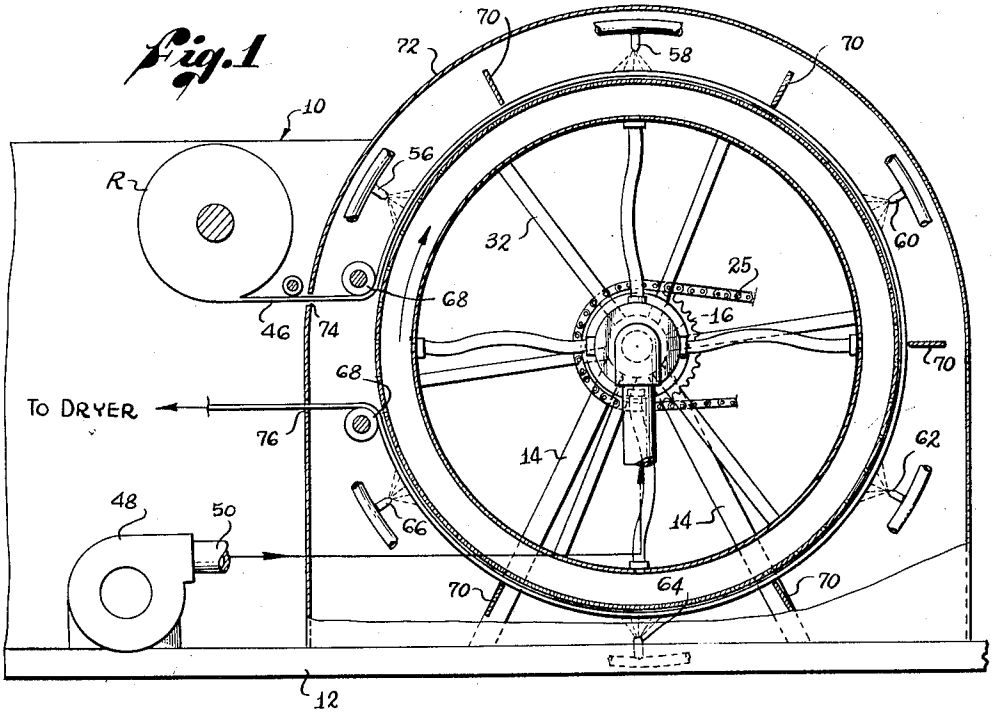
Jan. 5, 1960 C. J. WILLIAMS 2,919,706

AIR CUSHION FOR PHOTOGRAPHIC PROCESSING MACHINE

Filed July 12, 1957

Fig. 1



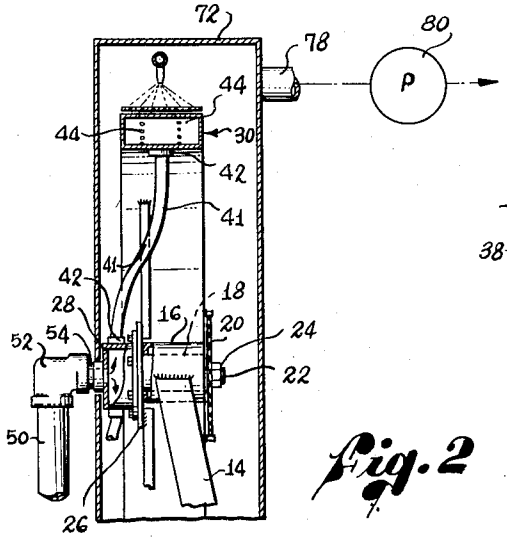
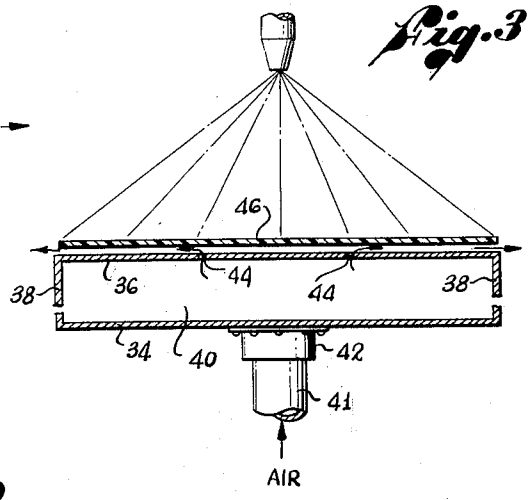


Fig. 2

Fig. 3



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AIR CUSHION FOR PHOTOGRAPHIC PROCESSING MACHINE

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4 Claims. (Cl. 134—122)

This invention relates generally to photographic processing apparatus, and more particularly to improvements in photographic processing machines of the type disclosed in co-pending application, Serial No. 627,302, filed December 10, 1956, and entitled "Processing Machine for Sensitized Paper and the like," now Patent No. 2,861,508.

The photographic processing machine disclosed in the above-mentioned co-pending application comprises, briefly, one or more rotary drums about the periphery of which are located a series of nozzles for directing sprays of photographic processing solutions toward the surface of the drums. These nozzles are arranged in a plurality of circumferentially-spaced treatment zones, the sprays in the successive zones in the direction of rotation of a drum comprising, respectively, a developing spray, a rinse spray, a fixing spray, a rinse spray, a salt spray, and a wash spray.

Located in a final treatment zone of the drum, in the case of a machine utilizing only a single drum or extending peripherally about the second drum, in the case of a machine utilizing a pair of drums, for example, is a curved impingement drier for directing jets of warm air toward the surface of the drum.

One disclosed use of this photographic processing machine is the processing of exposed, sensitized photographic paper, which may comprise, for instance, an oscillograph record. Other uses of the machine are, of course, possible, such as developing motion picture film or ordinary photographic prints.

In the illustrative use of the machine for developing sensitized, photographic paper, the latter is trained about the drum or drums of the machine, so as to move through the treatment zones in successive fashion. During its passage through these zones, the paper is developed, washed, fixed, rinsed, and finally dried. Preferably, the solutions are heated to accelerate the chemical reactions which occur between the emulsion of the paper and the solution sprays, as the paper is fed through the successive treatment zones.

The primary purpose in designing a photographic processing machine of the type disclosed in the aforementioned co-pending application is to enable the processing of relatively large quantities of photographic material, such as oscillograph records, in a relatively brief period of time. As discussed more fully in the aforementioned copending application, in prior photographic processing machines, the photographic material being treated was passed through a series of solution tanks or baths in such a manner that the photographic material was entirely emersed in the various solutions. As a result, both sides of the material were wetted by the solutions.

When processing certain photographic material, such as strips of sensitized paper comprising oscillograph records, for example, the uncoated paper back of the strip became thoroughly saturated with the various solutions. Necessarily, therefore, the paper had to be subjected to thorough and prolonged washing, rinsing and drying steps to thoroughly remove the various processing solutions from the fibers of the paper, and to finally dry the paper. Such prolonged rinsing, washing and drying steps, of course, required either that the photographic material be processed at a relatively slow rate, or that the processing machine be extremely large and space consuming to permit increased processing rates.

This disadvantage of existing photographic processing machines was avoided in the apparatus of the aforementioned co-pending application by embodying means on the drums of the apparatus for preventing the wetting of the fibrous back of the sensitized paper. Thus, during passage of the paper through the sprays in the treatment zones, only the emulsion side of the paper became wet. The emulsion is, of course, relatively impervious to liquid and thus may be relatively quickly washed, rinsed and dried with a substantial reduction in the total time required for processing and drying of the paper.

In the preferred form of the prior photographic processing apparatus, for example, the cylindrical surface of the drum was formed from screen mesh of relatively fine gauge. The spaced point contact established between the cylindrical surface of the drum and the fibrous back of the paper by the use of this screen mesh was found to effectively minimize or substantially eliminate capillary action between the paper and drum and thereby to preclude the seppage of moisture to the uncoated underside of the paper. Alternative means for maintaining the uncoated back of the paper dry in this prior apparatus comprised, for example, circumferential ribs on the drum or sealing bands which firmly pressed the edges of the paper against the drums, thereby preventing seepage of the processing solutions to the underside of the paper.

A broad object of this invention is the provision of rotary drum type photographic processing apparatus of the character described which embodies new and improved means for preventing a seepage of photographic processing solutions to the underside of the photographic material being treated.

A more specific object of the invention is the provision of photographic processing apparatus of the character described wherein pressurized air is introduced between the photographic material being treated and the peripheral surface of the drum, so that the material is, in effect, supported on an air cushion during its passage about the drum, and the entrance of the photographic processing solutions between the material and drum is effectively prevented by the outward flow of air forming the cushion.

Another object of the invention is the provision of photographic processing apparatus of the character described which is especially suited to the processing of strips of sensitized photographic paper and the like.

A further object of the invention is the provision of photographic processing apparatus of the character described which is relatively simple in construction, inexpensive to manufacture, exceedingly effective to accomplish retention of the underside of the material being treated in a dry state during passage through the solution sprays of the apparatus, and which is otherwise especially well suited to its intended function.

Other objects, advantages and features of the invention will become apparent as the description proceeds.

Briefly, the foregoing and other objects are achieved in the illustrative embodiment of the invention, comprising a machine for processing a strip of sensitized photographic paper, such as an oscillograph record, by the provision of a rotary drum about which the paper to be processed is adapted to be trained. Located in a series of circumferentially spaced treatment zones about the drum are a plurality of nozzles for directing sprays of a dif-

ferent photographic processing solution toward the drum.

The drum comprises a hollow annular casing defined by radialy spaced, inner and outer cylindrical walls and annular end walls. During its passage about the drum, the uncoated fibrous back of the paper being treated is located proximate to the outer cylindrical wall of the drum.

The apparatus comprises a blower for producing a continuous flow of air, under slight pressure, into the hollow annular chamber defined by the casing. This air flow occurs through a swivel coupling at the hub of the drum and thence outwardly to the casing through radially extending conduits opening into the chamber.

Formed in the outer cylindrical wall of the drum are two circumferentially extending rows of perforations spaced axially of the drum. The air in the chamber flows outwardly through these holes to the underside of the paper being treated and thence outwardly toward the edges of the paper. This air forms a cushion, in effect, which supports the paper in slightly spaced relation to the drum and effectively prevents the seepage of the processing solutions between the paper and the drum. The fibers of paper are thereby maintained in a relatively dry condition during passage through the several solution sprays so as to enable a substantial reduction in the washing, rinsing and drying times required. The illustrative paper processing machine is, therefore, capable of developing, fixing, washing and drying a continuously moving strip of sensitized paper which is travelling, for example, on the order of 100 feet per minute.

The invention may be best understood by reference to the following detailed description thereof, taken in connection with the annexed drawings, wherein:

Figure 1 is a diagrammatic view in side elevation of the present photographic processing machine;

Figure 2 is a section taken along line 2—2 of Figure 1; and

Figure 3 is an enlarged section taken along line 3—3 of Figure 1.

Referring now to these drawings, the illustrative paper processing machine will be seen to comprise a stationary framework 10, including a base 12. Rising from and rigidly fixed to the base 12 of the frame are a pair of convergent frame members 14 which are welded, or otherwise rigidly secured to a sleeve bearing 16 arranged with its axis horizontal.

Journalled in sleeve bearing 16 is a stub shaft 18, the right-hand end of whch, as viewed in Figure 2, fixedly mounts a sprocket 20. To this end, the right-hand end of the stub shaft 18 may be formed with a reduced, threaded extension 22 to which sprocket 20 is suitably keyed, the sprocket being retained in position on the stub shaft by means of the lock nut 24. A drive chain 25, trained, about the sprocket 20, is driven by a motor, not shown, for rotating the shaft 18 in a clockwise direction, as viewed in Figure 1.

Formed on the left-hand end of the stub shaft 16, as viewed in Figure 2, is a radial flange 26. Firmly bolted to flange 26 in concentric alignment with the stub shaft 16 is a hollow, cylindrical air manifold 28.

Indicated at 30 is the drum of the present paper processing machine which is rigidly supported on the flange 26 of the stub shaft 16 by means of the series of radial spokes 32 which are welded or otherwise firmly secured at their inner ends to the flange 26 and at their outer ends to the drum 30. As shown most clearly in Figures 2 and 3, the drum 30 is of hollow annular construction and defined by an inner cylindrical wall 34, an outer cylindrical wall 36, and annular end walls 38.

The annular chamber 40 within the drum 30 communicates with the interior of the air manifold 28 through a series of conduits 41. As shown in the drawings, these conduits are provided at opposite ends with couplings 42 to accommodate attachment of their opposite ends to

the inner cylindrical wall 34 of the drum 30, and the cylindrical wall of the manifold 28.

Formed in the outer cylindrical wall 36 of the drum 30 are two rows of relatively small openings 44 which extend circumferentially about the drum. As may be seen most clearly in Figure 3, the spacing between the rows of perforations is substantially equal to the spacing between each row of perforations and its adjacent end of the drum.

During operation of the machine, as will presently be described, air under slight pressure is introduced into the manifold 28 and thence flows radially outwardly through the several conduits 41 into the drum chamber 40. The air is exhausted from the chamber 40 through the perforations 44 to the underside of the paper 46 being processed and thence flows outwardly between such paper and the outer cylindrical wall 36 of the drum to the outer edges of the paper, as indicated by the arrows in Figure 3.

As will presently be more fully described, the paper 46 is thereby, in effect, supported on an air cushion so as to not bear directly on the drum 30. The tendency for capillary action to occur between the drum and paper is thereby substantially reduced or entirely eliminated. The outward flow of air toward the edges of the paper 46, moreover, effectively prevents the seepage of the processing solutions to the uncaoted underside of the paper.

Air for this purpose is received from a blower 48 mounted on the framework 10. Air flows from the blower 48 through a conduit 50 to a swivel coupling 52. Journalled in this swivel coupling is a hollow cylindrical shaft extension 54 on the manifold 28. This shaft extension communicates the interior of the swivel coupling 52 to the interior of the manifold to accommodate the flow of air from the pump 48 into the manifold and thence to the drum chamber 40, as mentioned above. This swivel coupling 52 may be of any conventional design and embodies suitable sealing means for preventing the leakage of air between the stationary parts of the coupling and the hollow shaft 54 which rotates with the drum.

Circumferentially spaced about the drum 30 are a series of stationary spray nozzles 56 through 66. As described more fully in the aforementioned co-pending application, these nozzles 56 through 66 are connected, via the piping, partially illustrated in Figure 1, to pressurize sources (not shown) of a developing solution, a wash solution, a fixing solution, a wash solution, a salt solution, and a wash solution, respectively. These nozzles are arranged to direct sprays of the respective solutions toward the surface of the drum 30, as shown in the drawings.

The paper 46 to be processed is trained about the drum 30 and suitable guide rollers 68, the drum being rotated and the paper being fed in the directions indicated by the arrows in Figure 1 during operation of the apparatus. The sprays from the various nozzles 56 through 66 are confined to their respective zones of the drum by means of stationary partitions or squeegees 70 in the same manner as described in the aforementioned co-pending application.

It will be apparent, of course, that since the web of paper 46 is supported on an air cushion rather than on the drum 30 directly, feeding of the paper through the machine cannot be accomplished by rotation of the drum alone. In practice, the paper, after passing through a suitable drier, not shown in the drawings, will preferably pass to a take-up roll. This roll is driven in a direction to pull the paper 46 through the machine, in the direction shown, and to wind the paper on the take-up roll.

Where the web of paper 46 to be processed is relatively long, it will generally be wound in a roll, indicated at R in Figure 1. This roll R will be suitably journalled on the frame 10 of the machine so as to accommodate

unwinding of the web of paper 46 from the roll as the paper feeds through the machine.

In some cases, the photographic processing solutions discharged through the spray nozzles 56—66 may be heated to accelerate the chemical reactions which occur during the photographic developing process. Such heated solutions evolve considerable vapors. For this reason, drum 30 has been shown as being enclosed with a housing 72. This housing is provided with entrance and exit slots 74 and 76, respectively, for the web of paper 46, as shown in Figure 1. Any vapors which are evolved from heated solutions discharged through the spray nozzles 56 through 66 are, therefore, effectively contained by the housing 72.

Communicating to the interior of the housing 72 is a conduit 78 which connects to a pump 80. This pump has an exhaust to atmosphere. During operation of the machine, the pump 80 is operated to continuously withdraw evolved vapors from the housing 72 and exhaust the same to atmosphere. Operation of the pump 80, of course, results in a reduction of the pressure within the housing 72. This, in effect, increases the pressure differential between the chamber 40 within the drum 30 and the interior of the housing 72. This increased pressure differential, obviously, permits a desired rate of air flow through the openings 44 in the drum 30 with a pump 48 of reduced size.

Operation of the present paper processing machine is believed to be obvious in the light of the foregoing description. Thus, drum 30 is rotated in the direction indicated, and the web of paper 46, which is trained about the drum, is fed through the several spray zones of the nozzles 56 through 66 by paper feed means, not illustrated. During passage of the paper through the spray zones, the emulsion is subjected to the several solution sprays issuing from the nozzles. The emulsion is thereby developed, fixed and rinsed during brief travel of the paper about the drum.

The flow of air from the chamber 40 within the drum 30 through the apertures 44 to the underside of the paper 46 and thence to the outer edges of the same provides an air cushion between the paper and the drum, as shown in Figure 3, which, in effect, supports the paper in spaced relationship to the drum. Spacing between the paper and the drum has been exaggerated in Figure 3 for the sake of clarity. Any tendency for capillary action to occur between the paper and the drum, which would cause seepage of the processing solutions to the underside of the paper, is thereby effectively reduced or substantially eliminated.

Moreover, the outward flow of air from the perforations 44 to the outer edges of the paper 46 establishes, in effect, a continuous pressure barrier which precludes the flow of the processing solutions to the underside of the paper. As shown in Figure 3, the nozzles 56 through 66 are arranged generally centrally of the edges of the paper so that the spray issuing from such nozzles is directed away from the underside of the paper at the edges of the latter. This, of course, prevents the direct flow of solution to the underside of the paper.

This paper supporting air cushion and pressure barrier has been found to effectively retain the uncoated back of the paper 46 in an almost entirely dry condition. The fibers of the paper 46, therefore, are not wetted by the processing solutions. The solutions may, therefore, be rapidly washed and rinsed from the paper 46 so as to enable feeding of the paper through the machine at an extremely high rate of speed. The emulsion side of the paper, of course, is wetted by the solutions. The emulsion layer of the paper, however, is relatively impervious to the solutions so that the latter may be rapidly removed from the emulsion side during passage of the paper through the wash and rinse zones of the drum.

Moreover, since the fibers of the paper are retained in a relatively dry state, the paper may be rapidly dried by passage through an impingement drier such as disclosed in the aforementioned co-pending application. It will be clear, therefore, that the concepts and features hereinbefore disclosed enable the production of a photographic processing machine which is capable of developing, fixing, rinsing and drying photographic material at an extremely high rate of speed.

It has been found that two rows of the openings 44, located so as to be positioned substantially equal distances inwardly of the side edges of the web 46, are desirable since the tendency then is for the air issuing from the holes of each row to flow toward its adjacent edge of the web. Both side edges of the paper are thereby effectively retained out of contact with the drum, and wetting of the back of the paper is effectively avoided.

While a single row of holes might be employed, it was found that if one side edge of the web was wetted slightly and contacted the drum, that edge would adhere to the drum causing the air flow, in that portion of the web, to occur only toward the opposite side edge of the web. This, of course, resulted in further seepage of solution to the back of the paper in that portion of the web.

With two rows of holes, however, the air discharged through the holes in one row tends to "buck" the air issuing through the other row of holes. The air discharged from each row of holes is, therefore, forced to occur toward its adjacent side edge of the web. Retention of both side edges of the web out of contact with the drum and in a dry state is thereby assured. Obviously, of course, other arrangements of the holes 44 may be effective for this purpose. Also, various means, other than that disclosed, may be used for introducing air under pressure to the underside of the web.

While the illustrative embodiment of this invention has dealt with a machine for processing so-called sensitized paper, such as oscillograph records, it will be apparent that the principles of the invention may be embodied in machines for handling other types of sensitized, photographic material. Accordingly, the invention should not be thought of as limited to a paper processing machine as disclosed herein for illustrative purposes, but only by the scope and spirit of the following claims.

I claim:

1. In apparatus for treating one side only of a moving web of material with a liquid, a rotary drum about which said web is adapted to be trained with the other side of the web proximate to the cylindrical surface of the drum, the drum rotating with the moving web, stationary nozzle means for discharging a spray of said liquid toward the cylindrical surface of the drum whereby said spray will impinge only said one side of the web as the latter moves through the spray, the drum having at least one row of circumferentially spaced openings in the cylindrical surface thereof, an air manifold on the axis of the drum, air conduit means communicating said manifold and openings, a source of pressurized air, and conduit means including a swivel coupling communicating said source and manifold whereby air under pressure may be delivered to said openings, the air discharging through said openings between the web and drum and flowing outwardly toward the side edges of the web to prevent the seepage of said liquid between the web and drum whereby said web is supported on a thin cushion of air in spaced relation to the drum and capillary action between the drum and web is substantially reduced.

2. The subject matter of claim 1 wherein said drum is defined by spaced, radially inner and outer cylindrical walls and annular end walls to define an annular chamber in the drum comprising said first-mentioned conduit means, said openings being formed in said outer cylindrical wall and communicating to said annular chamber, and said first-mentioned conduit means further compris-

ing conduit means communicating said manifold and annular chamber.

3. In apparatus for treating one side only of a moving web of material with liquids, the combination of a hollow rotary drum about which said web is adapted to be trained with the other side of the web proximate to the cylindrical surface of the drum, nozzle means about the drum for discharging liquid sprays toward the cylindrical surface of the drum, the drum having two rows only of circumferentially spaced openings in the cylindrical surface thereof, the spacings between said rows and between each row and the adjacent end of the drum being approximately equal, a source of pressurized air, and conduit means communicating said source and the interior of said drum whereby air under pressure may be delivered to said openings, the air discharging through said openings between the drum and a web trained about the drum and flowing outwardly toward the side edges of the web to prevent the seepage of said liquid between the web and drum whereby said web is supported on a thin cushion of air in spaced relation to the drum and capillary action between the drum and web is substantially reduced.

4. In apparatus for treating one side only of a moving web of material with liquids, the combination comprising a hollow rotary drum about which said web is adapted to be trained with the other side of the web proximate

to the cylindrical surface of the drum, stationary nozzle means for discharging liquid sprays toward the cylindrical surface of the drum, the drum having at least one row of circumferentially spaced openings in the cylindrical surface thereof, a source of pressurized air, conduit means communicating said source and the interior of the drum whereby air under pressure may be delivered to said openings, the air discharging through said openings between the drum and a web trained about the drum and flowing outwardly toward the side edges of the web to prevent the seepage of said liquid between the web and drum whereby said web is supported on a thin cushion of air in spaced relation to the drum and capillary action between the drum and web is substantially reduced, a relatively closed casing enclosing said drum, means for evacuating the interior of said casing to induce the flow of said air through said openings, and the wall of said casing having a pair of narrow slots through which a web may pass into and out of said casing.

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