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PHOTOGRAPHIC MATERIAL PROCESSING APPARATUS

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2 Sheets-Sheet 1

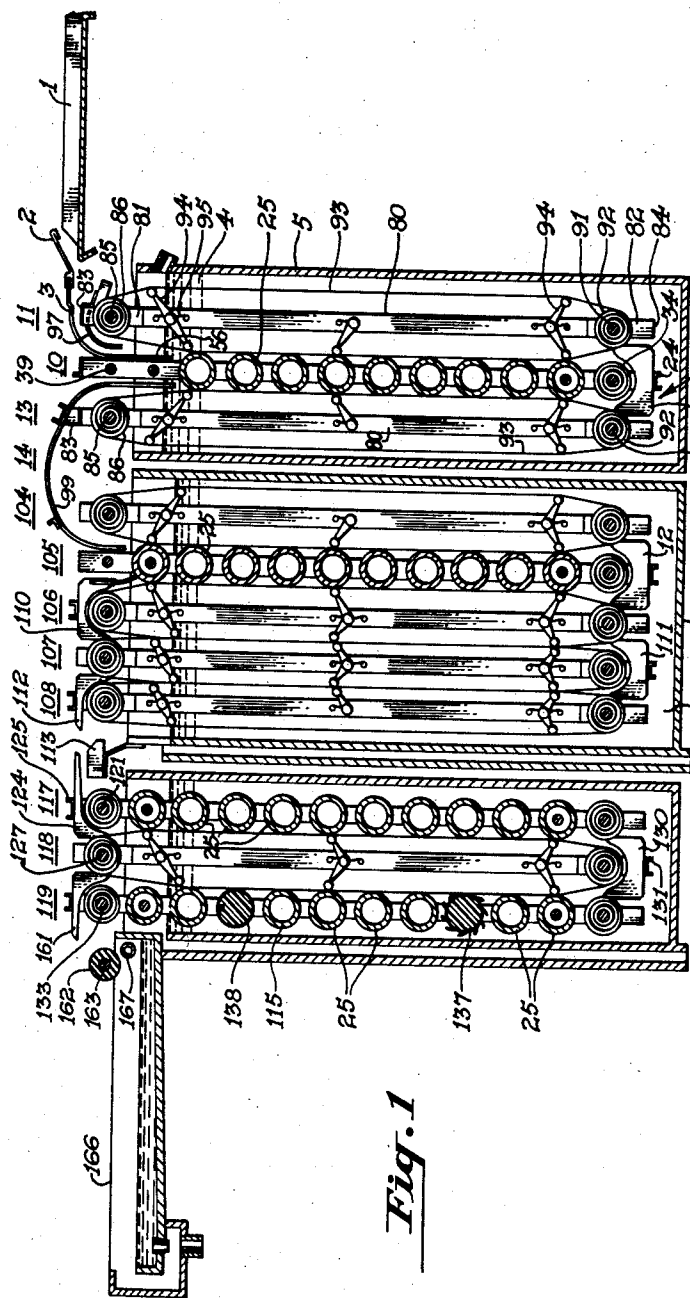


Fig. 1

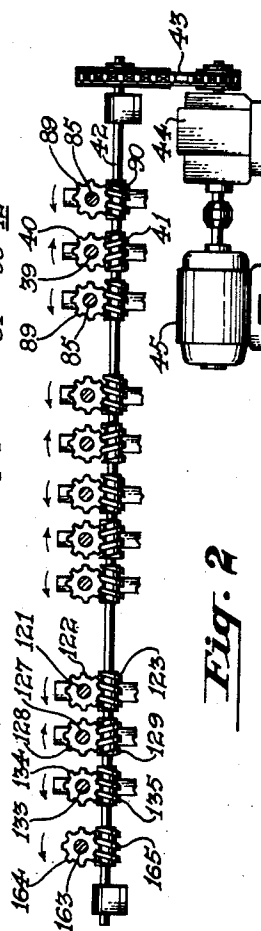


Fig. 2

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PHOTOGRAPHIC MATERIAL PROCESSING APPARATUS

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5 Claims. (Cl. 95—94)

This invention relates to improvements in photographic processing systems, and, particularly, to improvements in conveyor systems for advancing photographic material through photographic processing fluids.

Heretofore a variety of processing machines have been proposed for the automatic processing of photographic film and/or paper. In a typical example of such a prior art device a plurality of endless-belt-carrying frames are immersed in a tank of photographic treating fluid and are arranged to convey the film or paper through the fluid during a predetermined processing cycle in order to complete the developing, fixing, or other treating steps that are to be effected. Specifically, in this arrangement, each of the frames is provided with a plurality of endless belts arranged to move the material through the processing fluid in the tank and means for alternately guiding the material to be processed progressively between successive pairs of the frames, and also includes tension rollers adapted to hold the endless belts on one frame in frictional contact with the endless belts on the adjacent frame, whereby the material to be treated is conveyed by the belts into and out of the processing fluid in the tank.

Arrangements of the sort described above are in wide commercial use and are particularly advantageous for processing photocopy material. However, when the same equipment is used for the processing of graphic arts materials such as film base or translucent paper base material for use in photolithographic processes, it is found to produce unsatisfactory results on occasion. Specifically, it is found that the belts employed for conveying the material through the processing tank occasionally leave marks on the material that cannot be readily eliminated by convenient darkroom techniques, and tend to render the material unfit for its intended use after development. Inasmuch as a substantial amount of make-up work is usually involved in preparing such graphic arts material, it is not feasible to risk the uncertainty of unsatisfactory development. Therefore, it is customary throughout the industry to process such material by hand, thereby materially increasing the labor costs involved.

Inasmuch as equipment constructed in accordance with the abovementioned concept is illustrative of most existing automatic photographic processing apparatus, a brief comparison of the application of such equipment in the photocopy field with its applications in the graphic arts field is of interest in explaining the problems involved. For example, in processing photocopy material, it is required, in the first instance, to develop a relatively thin layer of emulsion on an opaque paper backing by means of a comparatively fast acting developer of the M-Q type so that a great deal of latitude is available in the processing technique. As a result, under reasonably well-controlled processing conditions it is possible consistently to obtain good results using the equipment of the prior art. Occasionally, if temperature conditions are not held within reasonable limits or if the developing agent is approaching exhaustion, it is noted that either light or dark streaks may occur on the processed material in

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positions that correspond to the belt positions of the prior art equipment.

When light streaks occur, they are probably the result of underdevelopment caused by a physical blocking of the developer from the surface of the photocopy emulsion by the belts; whereas, the dark streaks are probably the result of overdevelopment that apparently is caused by or results from oxidation products that adhere to the belts and tend to accelerate developing action in localized areas. In either event, it is found that the defect can be cured by increasing the developer concentration or by increasing developer temperature. In either case developing action is accelerated or increased to produce maximum gamma throughout the photocopy material so that the defects are not apparent in the finished copy. Inasmuch as copy of this type is viewed only by reflected light, such defects would be noticeable only to a highly skilled observer.

On the other hand, when equipment of this type is used for processing graphic arts material having a relatively thicker emulsion on a translucent film or paper backing it is frequently observed that the finished copy has streaks in positions corresponding to those of the belts. Invariably this type of work requires clean, clear, white areas and dense black areas with a minimum of gradations between the white and black areas. Thus, it is not generally practical to overdevelop this material in order to eliminate defects because such materials are employed only in conjunction with transmitted light so that the defects are not obliterated or concealed as in the case of viewing photocopy material by reflected light. Furthermore, in the case of halftone reproductions, it has been noted that uneven dot formations may be found in areas in which the belts are in contact with the emulsion side of the material. A further problem is that with graphic arts materials a caustic high-contrast developer is generally employed so that any attempt to overdevelop to obtain maximum gamma in exposed areas of the film usually results in unwanted gradations of density in other areas of the film, as well as the belt pattern marks.

Although the specific causes for such streaking of graphic arts material are not adequately understood, it is believed that one cause may be pressure sensitization of the emulsion as it is gripped between belts on adjacent frames of the processing equipment. This phenomenon is well known in connection with certain photographic materials wherein it is found that the application of pressure to an emulsion, either before or during development, may result in a non-uniform development of the areas to which pressure was applied. The end result is accentuated in the above-mentioned type of equipment because the negative material is usually held between the belts for a period of from 1 to 2¼ minutes to complete the developing cycle generally required for paper base or film base negatives, as compared with the 30- to 40-second developing cycle that is required for photocopy material. A further cause of streaking may be the fact that the belts of most commercial types of equipment tend to drag developing fluid out of the tank and press it into contact with portions of the emulsion side of the negative material before the surrounding portions are immersed in the developing fluid. As a result, developing action proceeds for a longer period in the areas contacted by a belt than in those in which there is no belt in contact with the emulsion. Even though this period may be relatively short compared to the overall developing time, it is found to have an undesirable effect on the negative material. Finally, oxidation products of the developing agent are found to adhere to the belts and are believed, under certain conditions, to cause an alteration of development in areas where the belt is in contact with the emulsion.

An improved type of photographic processing apparatus

for eliminating or, at least, minimizing the effects of problems of the type described above is disclosed in copending application S.N. 530,872, filed in the names of Glen C. Bull et al. on August 26, 1955, wherein a conveyor unit comprising three mutually coating sections are arranged to convey photographic material through a processing fluid. Specifically, the conveyor unit comprises a central section having a plurality of endless belts and two outer sections each comprising a plurality of vertically-aligned horizontal rollers that cooperate with the endless belts of the central section and serve frictionally to grip the photographic material and pass it through the processing fluid. The endless belts of the central section and the rollers of each of the outer sections are driven at constant peripheral speed and in such direction that the rolls of one roller unit cooperate with the portions of the endless belts on one side of the central section to advance the photographic material downwardly into a processing fluid, and the rolls of the other roller unit cooperate with the portions of the belts on the other side of the central section to advance the film upwardly and out of the processing fluid. Suitable guides are included to direct the photographic material into the processing fluid and then between the rolls of the first roller unit and the belts of the central section, and deflecting means are provided to pass the photographic material to a position to be engaged by the second set of horizontal rollers and the central endless belt section after it has been advanced to the end of the travel permitted by the first set of horizontal rollers and the central belt section. As the photographic material emerges from the processing fluid at the end of its period of engagement with the endless belts and the second set of rolls, it is engaged by suitable guides that direct it preferably through a pair of squeegee rolls to remove excess developing material and then pass it to a second processing tank or tray.

In the arrangement shown in the copending application, the photographic material is fed into the processing tank in a position to engage its emulsion side with the rollers of both roller sections and, since the upper roll of the first roller section is beneath the level of the processing fluid, the processing fluid cannot contact the emulsion side until the material is actually passed beneath the level of the fluid in the processing tank. In addition, this arrangement provides constant agitation of the developer over the emulsion surface throughout the period of passage of the material through the conveyor system. Furthermore, all possibility of air bubbles adhering to the surface of the emulsion is eliminated and uniform development is obtained over the entire surface of the photographic material.

The photographic processing apparatus disclosed in the above-cited copending application has proven particularly useful for its intended purpose and is currently in commercial use. However, further experience with this type of system has shown that with certain modifications it can conveniently be adapted for the complete developing, fixing and washing of photographic material in a manner to provide more positive feeding of the material whereby the time periods during which the material is immersed in any processing fluid can be more accurately controlled and whereby more complete cleaning of the material can be effected during processing. Briefly, it has been found that a reversal of the arrangement of the roller and belt sections of the conveyor system of the above-cited copending application results in more positive feeding of the photographic material. In addition, it has been found that the endless belts of the reference apparatus, when maintained constantly against the surface of the base material of the photographic material, tend to prevent a thorough processing of the antihalation coating that is usually applied to such base material. This antihalation coating usually includes a dye material to prevent fogging of the emulsion during exposure and such dye material is usually dispersed in a gelatin layer adherent to the base

material. The gelatin layer itself usually serves the purpose of preventing or minimizing curling of the photographic material after it is processed.

The principal object of the present invention is to improve the construction and utility of photographic material processing systems. A further object is to provide a processing system construction whereby substantially positive feeding of photographic material through developing, fixing and washing baths is obtained. A further object is to improve the construction of photographic material conveyor systems for use in automatic photographic processing machines. A further object is to provide an improved photographic material conveyor system wherein the emulsion side of the photographic material is contacted only by smooth-surfaced rollers during developing and fixing steps and wherein the base side of the photographic material is contacted by smooth-surfaced rollers during the washing step. A further object is to improve the construction of photographic material conveyor systems to obtain uniform developing and washing action over the entire surface of the photographic material. A further object of the invention is to provide a more efficient and economical construction for photographic material processing systems.

These and other objects of the invention are attained by means of an improved photographic material conveyor construction wherein mutually coating roller sections and endless belt sections are arranged to convey photographic material successively through developing, fixing and washing tanks. Specifically, the developing tank conveyor system comprises two outer sections, each having a plurality of endless belts, and one inner section comprising a plurality of vertically aligned, horizontal rollers that cooperate with the endless belts of the outer sections and serve frictionally to grip the photographic material and pass it through the developing fluid. The endless belts of the outer sections and the rollers of the inner sections are driven at constant peripheral speed and in such direction that the belts of one belt section cooperate with portions of the rollers on one side of the central roller section to advance the photographic material downwardly into the developing fluid, and the belts of the other belt section cooperate with portions of the rollers on the other side of the roller section to advance the film upwardly and out of the developing fluid. Suitable guides are provided to direct the photographic material into the developing fluid and then between the belts of the first belt section and the rollers of the roller section, and deflecting means are provided to pass the photographic material to a position to be engaged by the second belt section and the central roller section after it has been advanced to the end of travel permitted by the first belt section.

As the photographic material emerges from the developing fluid it is engaged by suitable guides that direct it into a similar conveyor system contained in a fixing tank. Preferably, the conveyor system of the fixing tank includes coating belt and roller sections substantially identical to those employed in the developing tank and two additional belt sections, whereby the photographic material is conveyed through the fixing fluid for a time period substantially equivalent to twice the time period in which the material is immersed in the developing tank.

Upon leaving the fixing tank the material is conveyed to a wash tank wherein it is handled by a modified arrangement of belt and roller sections of the type disclosed in the above-cited copending application. Specifically, this system includes a central section having a plurality of endless belts and two outer sections, each comprising a plurality of vertically aligned, horizontal rollers that cooperate with the endless belts of the central section. By this means, the photographic material, which is now thoroughly developed and fixed, is effectively reversed with reference to the surfaces of the belt and roller sections, i.e., the base surface of the material, which

previously had been engaged exclusively by the endless belts of the developing and fixing sections, is now engaged exclusively by roller sections whereby a thorough rinsing of the base surface is obtained. In addition, scrubbing rollers are inserted in at least one of the roller sections of the wash tank conveyor system whereby more effective cleaning of the base surface of the photographic material is obtained.

A preferred form of the invention is shown in the accompanying drawings, in which:

Fig. 1 is a schematic sectional view of the invention embodied in an automatic photographic material processing system;

Fig. 2 is a schematic side elevation of the drive mechanism for the processing apparatus of Fig. 1;

Fig. 3 is an isometric view of the conveyor system roller section construction;

Fig. 4 is an isometric view of a roller section embodying scrubbing rolls, as employed in the wash tank portion of the system;

Fig. 5 is a sectional elevation of a portion of a material transporting roller, together with its supporting and driving means;

Figs. 6 and 7 are sectional views of the scrubbing rolls, taken along the lines 6—6 and 7—7, respectively, of Fig. 4; and

Fig. 8 is a sectional elevation of the drive mechanism for rotating the scrubbing rolls.

Referring to the drawings, Fig. 1 illustrates a conveyor system embodying the invention as applied in a photographic material processing system of a type with which it is primarily intended for use. The photographic material, which may be in roll form or in sheets or strips, is first exposed in conventional manner in a camera and is then positioned on a feed table 1 on which it may be temporarily stored with its emulsion side up in readiness for passage through the processing system. In the arrangement shown, the photographic material may be advanced by hand or mechanically against a deflecting plate 2 that is supported on a plurality of guide wires 3 whereby it is directed downwardly into a developing fluid 4 contained in a developing tank 5. As the leading edge of the photographic material is advanced, it is guided between a roller section 10 and an endless belt section 11, the respective rollers and belts of which are rotated in such direction as to continue urging the material downwardly and through the developing fluid. As the leading edge of the material reaches the end of its travel between roller section 10 and endless belt section 11 it is deflected by a known form of guide assembly 12, which may be of the type disclosed in Garraway reissue patent, No. 22,654, reissued July 3, 1945, whereby it is turned through an arc of 180° and then directed upwardly to be engaged by the other side of roller section 10 and a second belt section 13. The material is thereby moved upwardly until its leading edge is deflected by a guide member assembly 14 that directs it into a tank of fixing solution.

Specifically, roller section 10 of the system (see also Fig. 3) is an adaptation of the roller section disclosed in the above-cited copending application, and includes a frame formed of a pair of vertical channel members 20 that are connected at their upper ends to substantially rectangular nylon blocks 21 which in turn are connected together by an upper frame member 22, on which curved guide wires 3 are mounted. The lower ends of channel members 20 are connected by a frame member 24, and the entire frame is suitably spaced and secured by tie rods 23. All of the several frame members thus far mentioned, as well as the remaining elements used in this mechanism, are formed of stainless steel or other non-corrosive material that will not be affected by the particular processing fluids with which the conveyor system is to be used.

Supported between channel members 20 are a plu-

rality of vertically-aligned, horizontally-arranged roller assemblies 25 (see also Fig. 5), each of which comprises a length of Plexiglas or similar type of plastic tubing 26 having nylon inserts 27 and 27a pressed into opposite ends thereof to prevent the entrance of processing fluid into the tubing. Each insert 27 is provided with a reduced shaft-like shoulder 28 on which a driving sprocket 50 is mounted, as described below. The outer end of each insert 27 and 27a is provided with a bottomed bore to receive the end of a pintle member 29 that is secured by a suitable screw 30 in its associated channel member 20 and thereby serves as a bearing to permit the rotation of the roller assemblies. The upper roller assembly 25 of section 10 is arranged at a position such that it is immersed in the developing fluid at least to the level of its axis of rotation when the section is installed in the developing tank. The lowermost roller assembly of section 10, designated by reference character 34, consists of a stainless steel shaft 31 that is journaled at its ends in suitable bearings on channel members 20, and is provided with a plurality of spaced nylon rollers 32, each of which is fixed on shaft 31.

For positioning roller section 10 against lateral movement in developing tank 5, the inner surfaces of the side walls of the tank are provided with vertically arranged channel members (not shown) having inwardly extending flanges that form guides for the vertical channel members 20 of the section. For supporting the section in the tank, an extension plate 35 is secured to each side of the developing tank and is provided with a plurality of saddle-shaped cutouts 36 along its upper edge. These cutouts engage circular bosses 37 formed on the outward faces of nylon blocks 21 on the upper ends of channel members 20 and thereby serve to suspend the entire roller section 10 within the walls of the tank, and maintain lower frame member 24 out of contact with the bottom of the tank. By this arrangement, roller section 10 may readily be removed from the tank for service or adjustment independently of the remainder of the system.

In order to rotate each of the roller assemblies 25 of frame section 10, there is provided a laterally extending drive shaft 39 (see Figs. 1, 2, and 3) that is journaled in upper nylon blocks 21 and extends outwardly on one end and is provided with a worm gear 40 fixed thereto that is driven by a worm 41 on an exterior shaft 42 which, in turn, is driven by a motor 45 through chain drive 43 and a speed changing mechanism 44 whereby the rate of advance of the photographic material may be adjusted, at will. Fixed on drive shaft 39, just inside of channel member 20, is a sprocket 48 that engages a sprocket chain 49 which, in turn, engages sprockets 50 fixed on shaft extensions 28 of nylon inserts 27 in the roller assemblies 25, as well as a similar sprocket (not shown) fixed on lowermost roller shaft 31. As shown in the drawings, worm gear 40 and worm 41 are arranged to drive each of the roller assemblies in a clockwise direction. A channel-like chain guide member 52 is secured on the inner face of channel member 20 to maintain chain 49 in engagement with sprockets 50.

To assist in guiding the photographic material downwardly after it passes deflecting member 3, section 10 is provided with a plurality of guide wires 56 that are fixed on frame member 22 and extend downwardly to a point at which they are substantially tangential to the surface of the upper roller assembly 25. In practice, since the upper roller is substantially immersed in developing fluid, the lower ends of the guide wires extend slightly into the fluid. As thus arranged, guide wires 56 prevent contact between uppermost roller assembly 25 and any part of the photographic material until the leading edge thereof is immersed in the developing fluid, whereby uniform wetting of the material is insured.

The endless belt sections 11 and 13 (see Fig. 1) of the developer conveyor system are mounted in develop-

ing tank 5 in the same manner as roller section 10 and are adaptations of the endless belt sections disclosed in the above-mentioned Garraway reissue patent, No. 22,654. Each section includes a frame construction similar to that used with the roller section, above described. Specifically, this frame comprises vertical channel members 80 that have nylon blocks 81, 82 at their upper and lower ends which serve to support upper and lower frame member 83, 84, respectively. Journalled in nylon blocks 81 is a drive shaft 85 (see also Fig. 2) of a roller assembly 86 that is similar in construction to roller assembly 34 of roller section 10 and is provided with a plurality of spaced nylon rollers fixed thereon. Shaft 85 is provided at its outer end with a worm gear 89 that cooperates with a worm 90 on drive shaft 42 whereby, in the embodiment shown, roller assembly 86 is rotated in a counterclockwise direction. Journalled in suitable bearings in nylon blocks 82 is a shaft 91 of a roller assembly 92 that includes a plurality of nylon rollers that are spaced in the same relationship as those on roller assembly 86.

Extending around corresponding pairs of the nylon rollers on roller assemblies 86 and 92 of each belt section 11 and 13 are a plurality of endless belts 93 that are preferably formed of a non-corroding material such as woven glass or Saran webbing, although any comparable type of material may be employed. These belts are of such length that they engage their respective rolls somewhat loosely, whereby the respective belt portions on either side of the frame may be extended slightly, by suitable tensioning means, to engage tangentially with the faces of roller assemblies 25 on adjacent roller section 10. For this purpose a plurality of bail members 94, each comprising a pair of arms and a connecting rod are pivotally mounted between channel members 80. Each bail member 94 is resiliently urged outwardly by a suitable coil spring 95 that has one end anchored on channel member 80 and its other bearing against the arm of the bail member. By this arrangement endless belts 93 of each belt section are extended outwardly to engage each of the roller assemblies 25 on adjoining roller section 10 whereby, when photographic material is inserted therebetween, it is lightly, frictionally gripped between the endless belt portions of the outer sections cooperating with the rollers of the roller section. Obviously, the pressure exerted by belts 93 may be varied at will by proper selection of springs 95 on bail members 94.

To complete the photographic material guide partially formed by guide wires 56 on roller section 10, corresponding guide wires 97 are mounted on upper frame member 83 of endless belt section 11. Preferably, guide wires 97 are formed to prevent contact between the incoming photographic material and the belts 93 of belt section 11 until the material is immersed in the developing fluid.

In order to guide the photographic material from engagement with the belts of belt section 11 into engagement with those of belt section 13, a deflecting guide assembly 12 comprising a plurality of deflecting guide members 98 (see also Fig. 3) is secured on lower frame member 24 of roller section 10. Guides 98 are spaced between adjacent pairs of rollers 32 comprising roller assembly 34 and are formed with upwardly extending end portions that extend into the spaces formed between the nylon rollers on the adjacent roller assemblies 92 of belt sections 11 and 13. Each of the guide members 98 is provided with flared leading and trailing edges and a curved portion having a radius slightly greater than that of the nylon rolls comprising roller assembly 34. By this means, the leading edge of the photographic material, after leaving the lowermost roller assembly 25 of section 10 and while the remainder of the sheet is still frictionally driven by the other rollers of this section and belts 93 of belt section 11, is deflected around rollers 32

and then upwardly into engagement with belts 93 of belt section 13 and the portions of the roller assemblies 25 with which they cooperate.

In order to guide the photographic material as it leaves developing tanks 5, a deflecting guide assembly 14 comprising a plurality of V-shaped guide members 99 is secured to upper frame member 83 of belt section 13. Guide members 99 are preferably formed of relatively heavy gauge wires that are spaced across the width of the conveyor system and are provided with downwardly extending portions that extend almost into contact with the upper roller assembly 25 of roller section 10 to intercept the leading edge of the upwardly moving photographic material. By this arrangement, the material is deflected through an angle of approximately 180° to roll it outwardly over the top of belt assembly 13 and into engagement with the conveyor system in the adjacent fixing tank.

Inasmuch as the fixing step in most graphic arts processing techniques requires substantially twice the time period as the developing step, the conveyor system disclosed is arranged to retain the photographic material approximately twice as long as it was retained in developing fluid 4. To this end, the fixing tank 101 which is substantially filled with a suitable fixing fluid 102 is provided with five conveyor sections, whereby the photographic material is twice immersed in the fixing fluid and drawn downwardly to the bottom of the tank and then out of the fluid again before the fixing cycle is completed.

Inasmuch as the gelatin emulsion on the photographic material remains quite soft after the developing step, it is essential that the photographic material be handled with the same degree of care during the first portion of the fixing step as it was throughout the developing step. To effect this result, the first three sections of the fixing tank conveyor system comprise a belt section 104, a roller section 105, and another belt section 106 which are substantially identical in construction and arrangement to the corresponding sections 11, 10, and 13, respectively, of the developing tank. By this arrangement, photographic material that is deflected into the fixing tank via guide wires 99 is passed between belt section 104 and roller section 105 with its emulsion side in contact with the roller assemblies 25 of the roller section. As before, when the photographic material reaches the lowermost end of its path of travel in contact with the endless belts of section 104, it is deflected through 180° by a guide assembly 12 mounted on the lower end of roller section 105. The material is thereby passed upwardly by contact between the belts of section 106 and the rollers of section 105 and its emulsion side is maintained in contact with the roller assemblies.

By the time the photographic material is processed to this extent, the fixing solution is usually effective to harden the gelatin emulsion sufficiently to resist damage by slight abrasion. Therefore, it is possible to arrange two coating belt sections 107 and 108 to operate in conjunction with belt section 106 to complete the passage of the photographic material through the fixing tank. Each of the belt sections 107 and 108 is substantially identical in function and manner of operation to those previously described and, therefore, need not be described in detail. A deflecting guide assembly 110 supported on the upper frame member of belt section 106 serves to deflect the photographic material downwardly and pass it between the cooperating belts of sections 106 and 107. At the end of its downward travel the material is again deflected through 180° by a guide assembly 111 that is supported on the lower frame member of belt section 107, whereby the material is passed upwardly by the cooperation of the belts of sections 107 and 108. At the end of its upward travel, the photographic material is deflected through 90° by a guide assembly 112 mounted on the upper frame member of belt assembly 108, whereby the

material is directed over a guide bar 113 and into engagement with the conveyor system of the wash tank.

In the wash tank, as pointed out above, it is desired that the agitating action previously applied to the emulsion side of the film by the roller sections 10 and 105, respectively, of tanks 4 and 101, be also applied to the back of the photographic material in order that all of the dye material comprising the antihalation coating be removed therefrom. Since it is impractical to turn the film over for passage through a conveyor unit such as disclosed in connection with developer tank 4, it is preferred to achieve the same end result by equipping the wash tank in an adaptation of the manner disclosed in the above-cited copending application. Basically, this arrangement comprises two outer roller sections positioned in coacting relation with an inner belt section. In addition, at least one of the roller sections is preferably provided with specially constructed agitating or scrubbing rolls whereby the effectiveness of the washing action is substantially enhanced.

Specifically, the conveyor system of the wash tank 115 includes a first roller section 117, an intermediate belt section 118, and a second roller section 119 that are supported and arranged in coacting relationship substantially in the manner described above. Roller section 117 is provided with a plurality of vertically aligned, horizontally arranged roller assemblies 25, as shown in Fig. 3, that are driven by a similar chain and sprocket arrangement via shaft 121, worm wheel 122, and worm 123, which is fixed on shaft 42. A guide assembly 124, comprising a plurality of spaced guide members mounted on the upper frame member 125 is effective to deflect photographic material that is passed from the fixing section of the system downwardly into the wash tank and into engagement with roller assemblies 25 of roller section 117. Belt section 118 is similar in construction and arrangement to the belt sections previously described and is driven via shaft 127, worm wheel 128 and worm 129 from shaft 42. A guide assembly 130 mounted on the lower frame member 131 of the belt assembly is effective to deflect the photographic material upwardly after it is passed to its lowermost position under the control of roller assembly 117.

The second roller section 119 of the wash tank conveyor system comprises an array of vertically aligned, horizontally arranged roller assemblies 25 that are similar in general construction to roller section 117, and are driven via a shaft 133, worm wheel 134, and worm 135 from shaft 42. However, in place of two of the roller assemblies, as arranged on the above-described roller sections, section 119 is provided with two wiping or scrubbing roll assemblies 137 and 138 for effecting an increased scrubbing action on the base surface of the photographic material being processed.

Lower scrubbing roll assembly 137 includes a solid plastic roll member 140, preferably formed of nylon, that is provided with a reduced shoulder portion 141 at one end thereof that extends through the opening formed by the driving chain for the roller assemblies 25 and substantially abuts the inner face of channel member 20. Shoulder portion 141 is provided with a bottomed bore that is engaged by a pintle secured by a screw in channel member 20, in the same manner as for the other roller assemblies, whereby scrubbing roll assembly 119 is mounted for rotational movement. The opposite end of roll 140 is also provided with a reduced shoulder portion 142 (see Fig. 8) that is similarly provided with a bottomed bore to receive a pintle member 143 that is secured in channel member 20 by a screw 144. In order to rotate scrubbing assembly 117, a pinion 145 is fixed on its shoulder portion 142 and is driven through an idler gear 146 which, in turn, is driven from a pinion 147 that is fixed on a reduced shoulder portion of the insert 27a of the adjacent lower roller assembly 25. Pinions 147 and 145 are selected preferably so that scrubbing roller

assembly 137 is driven at approximately twice the peripheral speed of roller assemblies 25.

To obtain the desired scrubbing action of the film base material, scrubbing roll assembly 137 includes a fluted surface covering 150 (see also Fig. 7) that is preferably formed of chamois or felt or some similar soft resilient material. The flutes in the surface covering are formed by raising the surface covering material at spaced intervals and securing it to the surface of roller 140 by means of nylon strips 151 that are held on the roller by screws 152. By this arrangement there is provided a scrubbing roller that moves over the surface of the base material in transit and applies a gentle but effective scrubbing action thereto whereby any material that may have adhered to the surface of the base material is rubbed loose therefrom.

Scrubbing roll assembly 138 is provided effectively to supplement the action of scrubbing roll assembly 137. To this end it comprises a nylon roll 155 that is supported for rotational movement in the same manner as roll 140 and is driven in a similar manner through a pinion 156 fixed on roll 155, idler 157 rotatably mounted on channel 20, and a pinion 158 that is fixed on the adjacent upper roller assembly 25. Roll 155 is provided with a smooth-surfaced felt or chamois covering 159 that is secured to the surface of the roll by having its ends forced into a groove formed in the roll and held therein by a wire 160, as shown in Fig. 6. By this arrangement any material still remaining on the surface of the base material at this point in its progress is further loosened or removed.

As the photographic material is moved upwardly by the roller assemblies of roller section 119, it is deflected by a suitable guide assembly 161 through an angle of approximately 90° and over a rubber covered roller 162 that is fixed on a shaft 163 that is driven through worm wheel 164 and worm 165 by shaft 42. By this means the photographic material is conveyed from the processing tank and deposited in a supplemental wash tank 166 wherein it remains until it is manually removed. As the photographic material passes over roll 163, the base surface thereof is sprayed with streams of water ejected from spaced holes in a high pressure water line 167 to rinse off any residual material that may have been loosened by the action of scrubbing roll assemblies 137 and 138.

By the arrangement thus disclosed there is provided an automatic processing system for photographic material whereby the material may be advanced in timed relation through successive developing, fixing, and washing baths by means of a substantially positively-acting conveyor system in a manner that cannot injure the emulsion surface of the material and which, at the same time, is effective to remove all particles of foreign matter from the material in order to provide a finished and acceptable end product.

Although the apparatus of the invention is intended primarily for use with photographic material of the type employed in lithographic reproductions, it is apparent that it may be applied equally well to the processing of other types of photographic materials, such as photocopy material or photographic prints or films. By inspection, it is apparent that the arrangement described can be used equally well for processing continuous strips of film or individual sheets and, that the size of the sheet that may be processed is determined only by the width of the roller and belt sections employed. Therefore, it is intended that all matter contained in this specification be interpreted in an illustrative sense, and that the invention be limited only as defined in the appended claims.

What is claimed is:

1. A conveyor system for advancing photographic material through a tank of processing fluid including a first roller section having a plurality of vertically aligned horizontally positioned roller assemblies, a second roller section having a plurality of vertically aligned horizontally

positioned rollers, said roller sections being positioned in spaced relation to each other, an endless belt section arranged between said roller sections, said endless belt section including a plurality of vertically disposed endless belts and resilient means for urging said belts into tangential contact with the rollers of each of said roller sections, means for driving the rollers of both roller sections in a common direction and for driving said endless belts in material feeding relationship thereto, and means incorporated in one roller section for scrubbing the surface of the photographic material presented thereto.

2. A conveyor system for advancing photographic material through a tank of processing fluid including a first roller section having a plurality of vertically aligned horizontally positioned roller assemblies, a second roller section having a plurality of vertically aligned horizontally positioned rollers, said roller sections being positioned in spaced relation to each other, an endless belt section arranged between said roller sections, said endless belt section including a plurality of vertically disposed endless belts and resilient means for urging said belts into tangential contact with the rollers of each of said roller sections, means for driving the rollers of both roller sections in a common direction and for driving said endless belts in material feeding relationship thereto, and means incorporated in one roller section for scrubbing the surface of the photographic material presented thereto, said last recited means including a roller having a surface formed of soft resilient material arranged thereon.

3. A conveyor system for advancing photographic material through a tank of processing fluid including a first roller section having a plurality of vertically aligned horizontally positioned roller assemblies, a second roller section having a plurality of vertically aligned horizontally positioned rollers, said roller sections being positioned in spaced relation to each other, an endless belt section arranged between said roller sections, said endless belt section including a plurality of vertically disposed endless belts and resilient means for urging said belts into tangential contact with the rollers of each of said roller sections, means for driving the rollers of both roller sections in a common direction and for driving said endless belts in material feeding relationship thereto, and means incorporated in one roller section for scrubbing the surface of the photographic material presented thereto, said last recited means including a roller having a surface formed of soft resilient material arranged thereon, and means for driving said roller at a surface speed in excess of that of the driving rolls.

4. A conveyor system for advancing photographic material through a tank of processing fluid including a first roller section having a plurality of vertically aligned hori-

zontally positioned roller assemblies, a second roller section having a plurality of vertically aligned horizontally positioned rollers, said roller sections being positioned in spaced relation to each other, an endless belt section arranged between said roller sections, said endless belt section including a plurality of vertically disposed endless belts and resilient means for urging said belts into tangential contact with the rollers of each of said roller sections, means for driving the rollers of both roller sections in a common direction and for driving said endless belts in material feeding relationship thereto, and means incorporated in one roller section for scrubbing the surface of the photographic material presented thereto, said last recited means including a roller having a surface formed of soft resilient material arranged in flutes thereon, and a second roller having a surface covering of soft resilient material arranged in continuously contacting relation with the photographic material.

5. A conveyor system for advancing photographic material through a tank of processing fluid including a first roller section having a plurality of vertically aligned horizontally positioned roller assemblies, a second roller section having a plurality of vertically aligned horizontally positioned rollers, said roller sections being positioned in spaced relation to each other, an endless belt section arranged between said roller sections, said endless belt section including a plurality of vertically disposed endless belts and resilient means for urging said belts into tangential contact with the rollers of each of said roller sections, means for driving the rollers of both roller sections in a common direction and for driving said endless belts in material feeding relationship thereto, and means incorporated in one roller section for scrubbing the surface of the photographic material presented thereto, said last recited means including a roller having a surface formed of soft resilient material arranged in flutes thereon, a second roller having a surface covering of soft resilient material arranged in continuously contacting relation with the photographic material, and means for driving said scrubbing rolls at a surface speed in excess of that of the driving rolls.

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