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K. GALL

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APPARATUS FOR PROCESSING PHOTOGRAPHIC MATERIALS

Filed March 12, 1964

2 Sheets-Sheet 1

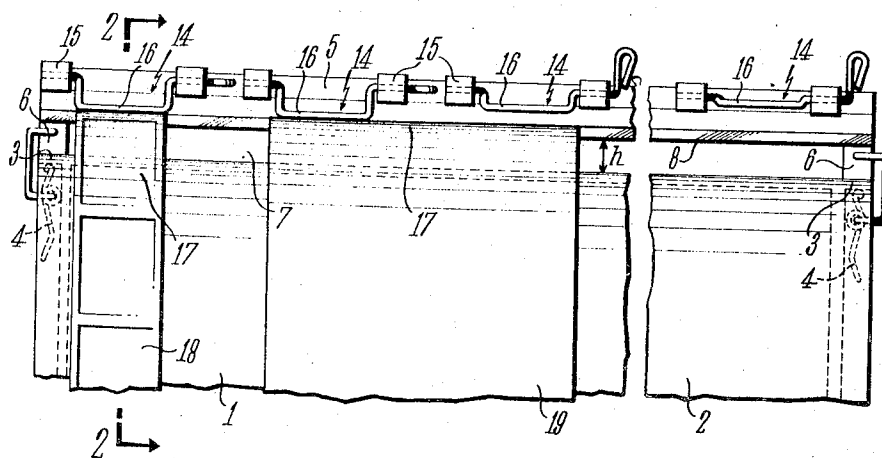


Fig. 1

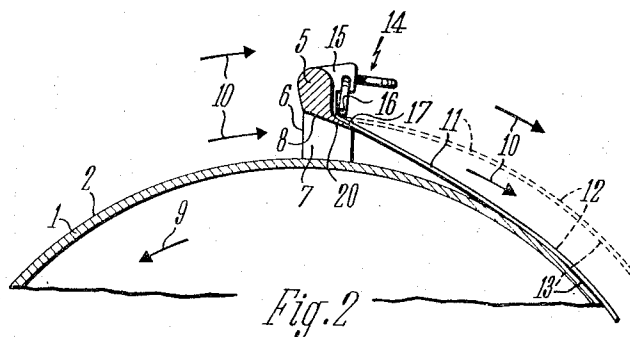


Fig. 2

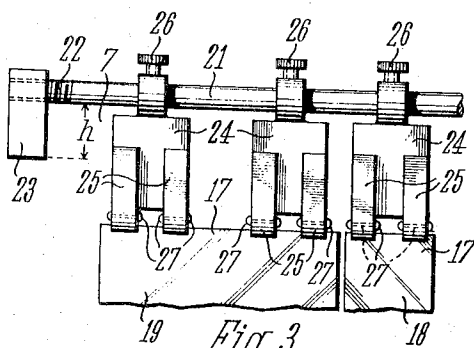


Fig. 3

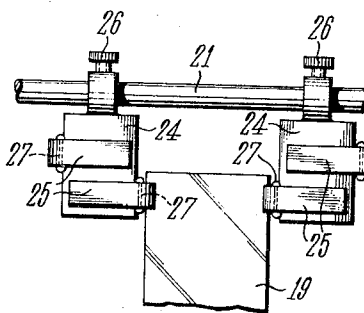


Fig. 4

INVENTOR  
Kurt Gall

BY

Western. Ross & Meser

Feb. 21, 1967

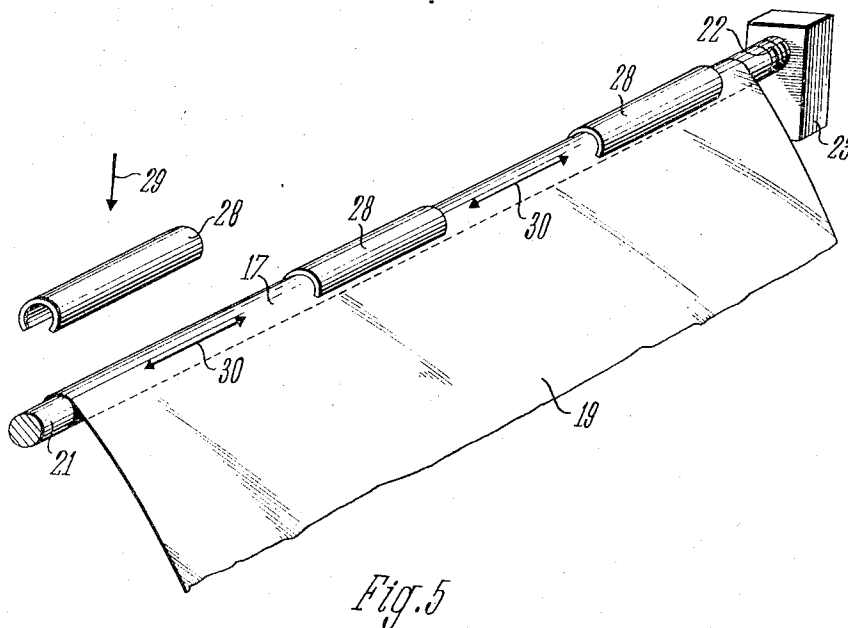
K. GALL

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2 Sheets-Sheet 2



INVENTOR

Kurt Gall

BY

Montern, Ross & Mesferrer

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## APPARATUS FOR PROCESSING PHOTOGRAPHIC MATERIALS

Kurt Gall, Welfenstrasse 22, Stuttgart-Birkach, Germany

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15 Claims. (Cl. 95—93)

The present invention relates to an apparatus for processing exposed photographic materials, such as films or prints, including a container which may be closed light-tight and is adapted to receive a processing liquid, a drum which is continuously rotatable in the container and at least partly immersed in the processing liquid, and at least one bar or rod which is connected to the outer peripheral surface of the drum and adapted to hold the photographic material, i.e. an exposed film or print, so as to pass the same through the processing liquid during the rotation of the drum. More particularly, the present invention relates to improvements in such a holding bar and in the means for attaching the photographic material thereto.

The prior devices of the above-mentioned type were usually provided with one or more holding bars which were secured to the outer surface of the drum and were adapted to clamp the photographic material directly upon this drum surface. This required one end of the photographic material to be slipped or pushed underneath one of the longitudinal edges of the holding bar or underneath a plurality of teeth on this edge. Apart from the fact that this operation was rather difficult, especially with a limp sheet of photographic paper, such a holding bar which pressed the end of the photographic material directly upon the outer surface of the drum had the still greater disadvantage that during the rotation of the drum it deflected the processing liquid in the outward direction away from the drum with the result that only the outer surface of the photographic material came into contact with and was properly acted upon by the processing liquid, while its moist inner surface often became stuck tightly to the outer surface of the drum and was either not treated at all or treated only insufficiently. Moreover, if accidentally an undeveloped film or print was attached to the holding bar so that its sensitive side faced toward the drum rather than outwardly, such a film or print was bound to be ruined in the developing bath.

It is an object of the present invention to provide a holding bar for a photographic processing apparatus of the above-mentioned type which is designated so as to insure that the photographic material which is attached thereto on the outer periphery of the drum will be guided thereby so that also the inner surface of the material will come into proper contact with the respective processing liquid including the washing water and will never stick to the outer surface of the drum.

A feature of the invention for attaining this object consists in providing the holding bar itself with suitable means for removably securing one end of the photographic material thereto.

Another feature of the invention consists in mounting this holding bar on the outer surface of the drum in such a manner as to be spaced from this surface so that a slot is formed between them which preferably extends along the entire length of the holding bar and permits the respective processing liquid including the washing water to pass freely through this slot when the drum is rotated. As soon as the rotation of the drum is started, a part of the processing liquid will then flow through this slot and press against the inner surface

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of the photographic material which is attached at one end to the holding bar and thereby lift the material off the outer surface of the drum. If the drum is completely submerged in the processing liquid, the photographic material will then extend substantially parallel to the peripheral surface of the drum as long as the rotation of the drum continues and the inner surface of the material will never come into contact with the drum. Consequently, both surfaces of the photographic material will be equally treated by the processing liquid.

Another feature of the invention consists in providing the holding bar at least at its two ends thereof with feet whose height determines the width of the slot for the passage of the processing liquid. These feet may be secured to the ends of the holding bar, for example, by being provided with tapped bores into which the threaded ends of the holding bar may be screwed.

A further feature of the invention consists in designing the holding bar so as to make it adjustable to different positions around the periphery of the drum and also removable therefrom whereby any suitable number of such holding bars can be mounted on the drum and photographic materials of different sizes can be connected thereto. An additional feature of the invention therefore consists in the provision of suitable clamping means for quickly connecting the holding bar or bars to the drum or removing them therefrom and for quickly adjusting each of them to any desired position around the periphery of the drum, preferably in a direction substantially parallel to the axis of the drum.

Another preferred feature of the invention consists in making the holding bar of such a shape that the lower surface thereof which is spaced from the outer surface of the drum so as to form the slot for the passage of the processing liquid is downwardly inclined toward the drum, as seen in the direction opposite to the rotation of the drum, whereby the flow area through the slot decreases in the direction of flow of the processing liquid and a nozzle effect is thus produced.

Still another feature of the invention consists in the provision of suitable clamping means for attaching the photographic material to the holding bar. According to one preferred embodiment of the invention, these clamping means are mounted on the upper side of the holding bar and at equal distances from each other and are adapted to be moved independently of each other from their released position to their clamping position and vice versa. They may be of a very inexpensive construction in the form of U-shaped wire clamps which are pivotable about an axis parallel to the axis of rotation of the drum. When one end of the photographic material, for example, an exposed print, is then placed underneath one of those clamps upon the upper side of the holding bar which also extends parallel to the axis of the drum and the clamp is then pivoted to a position slightly beyond its dead-center position, it will clamp the end of the material securely upon the holding bar.

According to another preferred embodiment of the invention, the clamping means are adjustable on the holding bar to different positions in the longitudinal direction thereof and are adapted to be locked in any of these positions to the holding bar which in this case is preferably made of a round cross section. The clamping means are then preferably provided in the form of simple spring clamps similar to clothes pins, each of which is mounted on a support which is adjustable in the longitudinal direction on the holding bar and the two clamping arms of which are pivotable relatively to each other about an axis either parallel or perpendicular to the axis of the drum. Each of these supports preferably carries a pair of these spring clamps which, especially if they extend in the same direction and are pivotable about a com-

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mon horizontal axis, may be spaced at such a distance from each other that the two clamps on one support may be operated either independently of each other or simultaneously with one finger. One pair of these clamps may then be attached to the edge of one sheet of photographic material or to the corresponding edges of two closely adjacent sheets.

If the arms of each spring clip are pivotable about a vertical axis on the support, two such clips on two different supports may be attached to the opposite lateral edges of the photographic sheet near the end thereof. This has the considerable advantage that the spring clips will then be located laterally of the direction of flow of the processing liquid over the photographic material and will thus not impede the flow in this direction. The processing liquid will therefore flow fully uniformly along the outer and inner sides of the material and act equally upon both sides.

Some photographic sheet materials will expand considerably in both the longitudinal and transverse directions when acted upon by the processing liquid. If such a material is clamped tightly at several fixed points along its edge, the transverse expansion of the sheet will result in the formation of undesirable wrinkles therein between the individual clamping points. In order to overcome these difficulties, the invention further provides that the clamping means are made in the form of longitudinally slotted clamping sleeves which have an inner cross-sectional shape in accordance with the shape of the holding bar but an inner width slightly larger than the thickness of the holding bar. These clamping sleeves are snapped over the holding bar upon which the end of a photographic sheet is placed and thereby grip the latter sufficiently so that it will not be pulled off the bar by the drag of the current of processing liquid on this sheet in the direction transverse to the bar, but they surround the holding bar with such a clearance that they are slidable thereon in its longitudinal direction and thus permit the photographic sheet to expand in this direction.

The above and other objects, features and advantages of the invention will become more fully apparent from the following detailed description of several preferred embodiments thereof which is to be read with reference to the accompanying drawing in which:

FIG. 1 shows a side view of a part of a drum and a holding bar thereon to which a photographic film or print is attached;

FIG. 2 shows a cross section which is taken along the line 2—2 of FIG. 1;

FIGS. 3 and 4 show side views of a holding bar, according to a modified embodiment of the invention, with several pairs of spring clamps which are adjustable in the longitudinal direction of the holding bar; while

FIG. 5 shows a perspective view of a holding bar with clamping sleeves according to another embodiment of the invention.

As illustrated in FIGS. 1 and 2, the drum 1 has a hollow cylindrical shape and is rotatable about its longitudinal axis within a container, not shown, which is adapted to receive the respective processing liquid or washing water for treating photographic materials which may consist of photographic films, prints or enlargements. Drum 1 carries one or more holding bars 5 which extend substantially parallel to the axis of the drum and are removably secured to its outer surface 2 by means of a pair of clamps 4 which bear upon the inner surface of the drum at points 3 near the opposite outer edges thereof.

This holding bar 5 is provided on its opposite outer ends with a pair of feet 6 by means of which the holding bar is spaced from the outer surface 2 of the drum in the radial direction of the latter so as to form an intermediate slot 7 of a width  $h$ . As shown particularly in FIG. 2, the lower (i.e. inner) side 8 of the holding bar 5 is inclined toward the outer surface 2 of the drum in the direction opposite to the direction of rotation 9 of the

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drum so that the flow area of slot 7 decreases in the direction of flow 10 of the processing liquid. Thus, the slot 7 produces a nozzle effect and thereby an increase of the velocity of flow of the processing liquid. By virtue of this slot 7 and its particular shape, a part of the processing liquid passes underneath the photographic material 11 which is thereby lifted from its original position is engagement with the outer surface 2 of the drum, as shown in full lines in FIG. 2, to a position substantially parallel to the surface 2, as indicated in dotted lines in FIG. 2. This insures that the outer and inner surfaces 12 and 13 will come equally into contact with and will be acted upon equally by the processing liquid or the washing water. Thus, not only will the film, print or enlargement 11 be equally acted upon at both sides by the developing and fixing solutions, but the hypo will also be washed out completely which is possible only if, e.g. in a print, not only the sensitive emulsion but the paper backing as well is thoroughly washed.

For clamping the photographic material, for example, an exposed print 19 or a film 18, to the holding bar 5, the latter is provided on its upper side with clamping means in the form of a plurality of U-shaped wire clamps 14 which are pivotally mounted in bearing blocks 15 and are each provided with a central part 16 which, when pivoted slightly beyond its dead-center position, is adapted to clamp the end 17 of the film 18 or the print 19 against the upper surface of a longitudinal ledge 20 of the holding bar 5.

A modification of the holding bar and of the clamping means according to the invention is illustrated in FIG. 3. In this case, the holding bar has the shape of a rod 21 of a round cross section and each of its ends is provided with a screw thread 22 which is screwed into a block-shaped foot 23 whose length between its lower end and the rod 21 determines the width  $h$  of the slot 7. Rod 21 carries a plurality of pairs of identical spring clamps 25 connected to a preferably flat supporting member 24 which by means of a bearing member is adjustable along the rod 21 to different positions in which it may be secured to rod 21 by a setscrew 26. Although the two arms of each spring clamp 25 may be pivotable relatively to each other on the end of the supporting member 24 about an axis defined by a pin 27 which extends parallel to the axis of rod 21 and thus also parallel to the axis of rotation of drum 1, one of the arms may be integral with and project from the supporting member 24, while only the other arm is pivotable about the pin 27. The two spring clamps 25 on each supporting member 24 are preferably spaced at such a distance from each other that both of them together may be used for clamping the end 17 of a film 18. This distance may be so short that the upper ends of the two pivotable arms on the same side of the two clamps 25 on one supporting member as shown in FIG. 3 may be depressed simultaneously with one or two fingers to open these clamps. If, however, a print 19 of a greater width is to be clamped, two or more pairs of clamps 25 may be used. Of course, the two clamps 25 on one supporting member 24 may also be used to clamp the edges of two closely adjacent films or prints.

FIG. 4 illustrates a modification of the spring clamps according to FIG. 3. In this case, each clamp is mounted on its supporting member 24 so as to be pivotable about an axis defined by a pin 27 which extends perpendicularly to the axis of rod 21 and to the axis of rotation of drum 1. In order to make the supporting members 24 as narrow as possible, the two spring clamps 25 on each supporting member are preferably disposed one above the other. Two adjacent supporting members 24 are then adjusted on the rod 21 to such a distance from each other that the two corresponding spring clamps 25 thereon will grip the lateral edges of the photographic material 19 near its end. This embodiment of the invention has the advantage that, since the spring clamps 25 are located laterally of the photographic material 19 to be treated, these clamps do not impede the flow of the processing

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liquid in the longitudinal direction of the material and the processing liquid can therefore pass very evenly and equally on both sides along the photographic material 19.

FIG. 5 finally illustrates another modification of the holding bar and the clamping means thereon. This holding bar again preferably consists of a rod 21 of a round cross section, while the clamping means consist of slotted elongated sleeves 28 of a resilient material which are adapted to be snapped over the rod 21 and the end 17 of a larger print or enlargement 19 thereon in the direction shown by the arrow 29. These clamping sleeves 28 have an inner diameter slightly larger than the diameter of the rod 21 so as to grip the end 17 of the print 19 sufficiently to prevent them from being pulled off the rod 21 by the drag on the print produced by the flow of processing liquid, but this grip of the clamping sleeves 28 on the end 17 of the print 19 is still so loose that the print can slide in the axial direction (arrows 30) along the rod 21. This is important especially when processing a large sheet of photographic paper which, when moistened, expands in its longitudinal and transverse directions. When such a sheet is clamped tightly at several points, very undesirable wrinkles will form therein. These wrinkles will, however, be suppressed if the sheet can expand transversely by being able to slide relatively to its clamping means 21 and 28.

All of the embodiments of the holding bar according to the invention including the different clamping means as previously described may be employed individually or together or in different combinations of the parts thereof, as well as in any desired number, on the drum 1. While the holding bar 5 according to FIGS. 1 and 2 is especially suitable for films and photographic papers of a size of approximately 5 x 7" up to 20 x 24", the holding bar 21 according to FIG. 3 is suitable especially for paper sizes of less than 5 x 7". The holding bar 21 with the transversely extending spring clamps 25 as shown in FIG. 4 is, however, preferred especially when a particularly sensitive developing process is to be carried out which requires a very even flow of the processing liquid. Finally, the holding bar 21 with its clamping sleeves 28 according to FIG. 5 is suitable especially for clamping the ends of very large paper sizes of more than 20 x 24" where the loss of the edge portion 17 because of insufficient treatment is of no importance.

If the holding bars 5 or 21 are mounted so closely adjacent to each other on the drum 1 that the individual films or sheets of paper overlap each other somewhat like roof shingles, it is possible to attach to the drum 1, and to process simultaneously, three or more times the number of such films or sheets that can be processed if they are attached to the holding bars peripherally behind and spaced from each other. In order to insure that the individual films or prints on the peripherally separated holding bars will be sufficiently spaced from each other so that a flow of processing liquid will at all times pass along both sides of all films or prints and the latter will never adhere to each other, the successive holding bars may be spaced at increasing distances from the outer surface 2 of the drum 1 so that the width  $h$  of the slot 7 between each succeeding holding bar and the outer surface 2 will be slightly greater than that of the slot 7 on the preceding bar.

Although my invention has been illustrated and described with reference to preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, I claim:

1. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously in one direction therein, and mechanism for connecting

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said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one bar, support means for securing said bar to said drum adjacent the outer peripheral surface of said drum and substantially parallel to the axis of said drum, said bar having an inner edge portion radially spaced from said outer surface and forming therewith a continuous slot for the passage of said processing liquid therethrough during the rotation of said drum, and gripper means disposed near the ends of said slot for removably connecting said photographic sheet material to said bar.

2. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously in one direction therein, and mechanism for connecting said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one bar, support means for fixedly securing said bar to said drum at a predetermined distance from the outer peripheral surface of said drum and substantially parallel to the axis of said drum, said bar having an inner edge radially spaced from said outer surface and forming therewith a continuous slot extending substantially along the entire length of said bar for the passage of said processing liquid therethrough during the rotation of said drum, and gripper means distributed over substantially the entire length of said slot for removably connecting said photographic sheet material to said bar.

3. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously and unidirectionally therein, and mechanism for connecting said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one bar and extending along the outer peripheral surface of said drum and substantially parallel to the axis of said drum, said bar having an inner edge radially spaced from said outer surface and forming therewith a continuous slot extending substantially along the entire length of said bar for the passage of said processing liquid therethrough during the rotation of said drum, spacing means engaging the outer ends of said bar and rising from said outer surface for supporting said bar and maintaining the width of said slot, and a gripper means distributed over substantially the entire length of said slot for removably connecting said photographic sheet material to said bar.

4. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously therein, and mechanism for connecting said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one bar connected to said drum and extending along the outer peripheral surface of said drum and substantially parallel to the axis of said drum, said bar having an inner edge radially spaced from said outer surface and forming therewith a slot extending substantially along the entire length of said bar for the passage of said processing liquid therethrough during the rotation of said drum, spacing means engaging the outer ends of said bar and rising from said outer surface for supporting said bar and maintaining the width of said slot, and gripper means for removably connecting said photographic sheet material to said bar, said spacing means including a pair of members threadedly secured to said outer end of said bar and resting on said outer surface adjacent opposite peripheral edges of said drum.

5. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously

in one direction therein, and mechanism for connecting said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one bar, support means for securing said bar to said drum adjacent the outer peripheral surface of said drum and substantially parallel to the axis of said drum, said bar having an inner edge portion radially spaced from said outer surface and forming therewith a slot for the passage of said processing liquid therethrough during the rotation of said drum, and gripper means for removably connecting said photographic sheet material to said bar, said support means including clamping means for removably securing said bar to said drum and for permitting said bar to be mounted in different positions around the periphery of said drum.

6. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously in one direction therein, and mechanism for connecting said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one bar, support means for securing said bar to said drum adjacent the outer peripheral surface of said drum and substantially parallel to the axis of said drum, said bar having an inner edge portion radially spaced from said outer surface and forming therewith a slot for the passage of said processing liquid therethrough during the rotation of said drum, and gripper means for removably connecting said photographic sheet material to said bar, said inner edge portion forming a surface which is inclined toward said outer surface of said drum so that said slot decreases in width in the direction opposite to the direction of rotation of said drum.

7. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously in one direction therein, and mechanism for connecting said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one bar, support means for securing said bar to said drum adjacent the outer peripheral surface of said drum and substantially parallel to the axis of said drum, said bar having an inner edge portion radially spaced from said outer surface and forming therewith a slot for the passage of said processing liquid therethrough during the rotation of said drum, and gripper means for removably connecting said photographic sheet to said bar, said gripper means including a plurality of clamping members equispaced from one another along said bar.

8. An apparatus as defined in claim 7, wherein said clamping members are movable independently of each other from a released position to a clamping position and vice versa.

9. An apparatus as defined in claim 8 wherein each of said clamping members comprises a substantially crank-shaped clamp having two arms rotatably mounted on said bar so as to be pivotable about an axis extending parallel to the axis of said drum, the central part of said clamp between said arms being adapted in said clamping position to clamp one end of said photographic sheet material against said bar.

10. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously in one direction therein, and mechanism for connecting said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one rod, support means for securing said rod to said drum adjacent the outer peripheral surface of said drum and

substantially parallel to the axis of said drum, said rod having an inner edge portion radially spaced from said outer surface and forming therewith a slot for the passage of said processing liquid therethrough during the rotation of said drum, and gripper means for removably connecting said photographic sheet to said rod, said gripper means comprising a plurality of clamping members slidable longitudinally along said rod and locking means for individually securing each of said clamping members to said rod.

11. An apparatus as defined in claim 10 wherein each of said clamping members comprises a supporting member slidably mounted at one end on said rod and carrying said locking means, and at least two spring clamps on said supporting member extending substantially parallel to and spaced from each other, each of said spring clamps having a pair of arms movable relatively to each other from a gripping position to a releasing position and being adapted in said gripping position resiliently to grip one end of said photographic sheet material between them.

12. An apparatus as defined in claim 11 wherein the arms of said spring clamps on each supporting member are pivotable about a common axis extending parallel to the axis of said drum.

13. An apparatus as defined in claim 11 wherein the arms of each of said spring clamps on each supporting member are pivotable about an axis extending perpendicularly to the axis of said drum.

14. An apparatus as defined in claim 13 wherein each supporting member carries two of said spring clamps extending in opposite directions to each other for gripping a lateral edge of one photographic sheet at one side of said supporting member and a lateral edge of another photographic sheet at the opposite side of said supporting member.

15. An apparatus for processing exposed photographic sheet material such as films or prints, comprising a container adapted to receive a processing liquid, a drum immersed into said liquid and adapted to rotate continuously in one direction therein, and mechanism for connecting said photographic material to said drum for treatment by said processing liquid; said mechanism comprising at least one rod, support means for securing said rod to said drum adjacent the outer peripheral surface of said drum and substantially parallel to the axis of said drum, said rod having an inner edge portion radially spaced from said outer surface and forming therewith a slot for the passage of said processing liquid therethrough during the rotation of said drum, and gripper means for removably connecting said photographic sheet to said rod, said gripper means comprising a plurality of slotted resilient elongated sleeves adapted to be snapped over said rod at different parts thereof so as to grip the end of a photographic sheet on said bar sufficiently to prevent it from being pulled off by the drag exerted thereon by the flow of processing liquid upon rotation of said drum, each of said slotted sleeves having an inner width slightly greater than the thickness of said rod so as to permit said sheet to move in the axial direction of and relatively to said rod and said sleeves so as to be able to expand in said direction without wrinkling between adjacent sleeves.

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JOHN M. HORAN, *Primary Examiner*.

C. B. PRICE, *Assistant Examiner*.