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[54] **APPARATUS FOR PROCESSING PHOTOGRAPHIC SHEET MATERIAL**

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[51] **Int. Cl.** **G03d 3/08**

[58] **Field of Search** ..... 95/89 R, 94 R, 96, 97, 95/98; 354/297, 319, 324, 331

[56] **References Cited**

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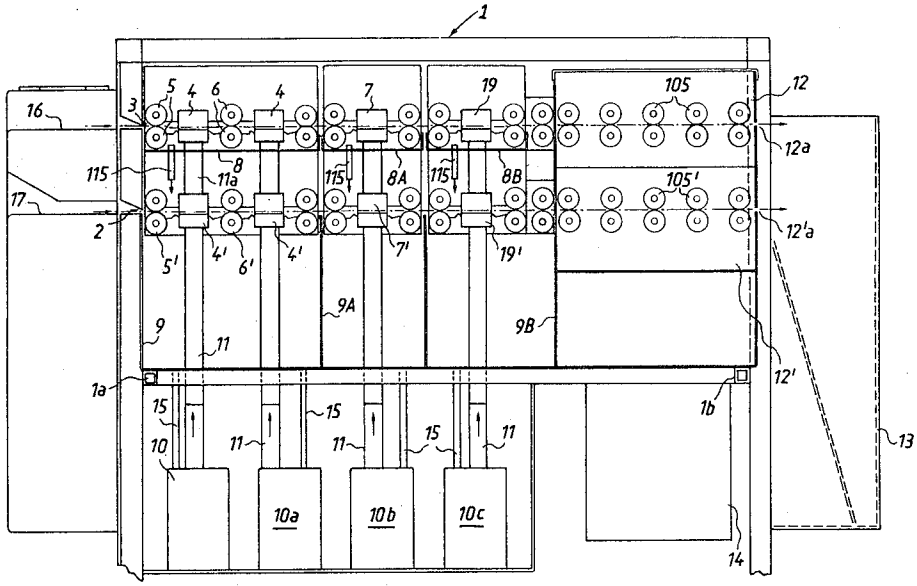
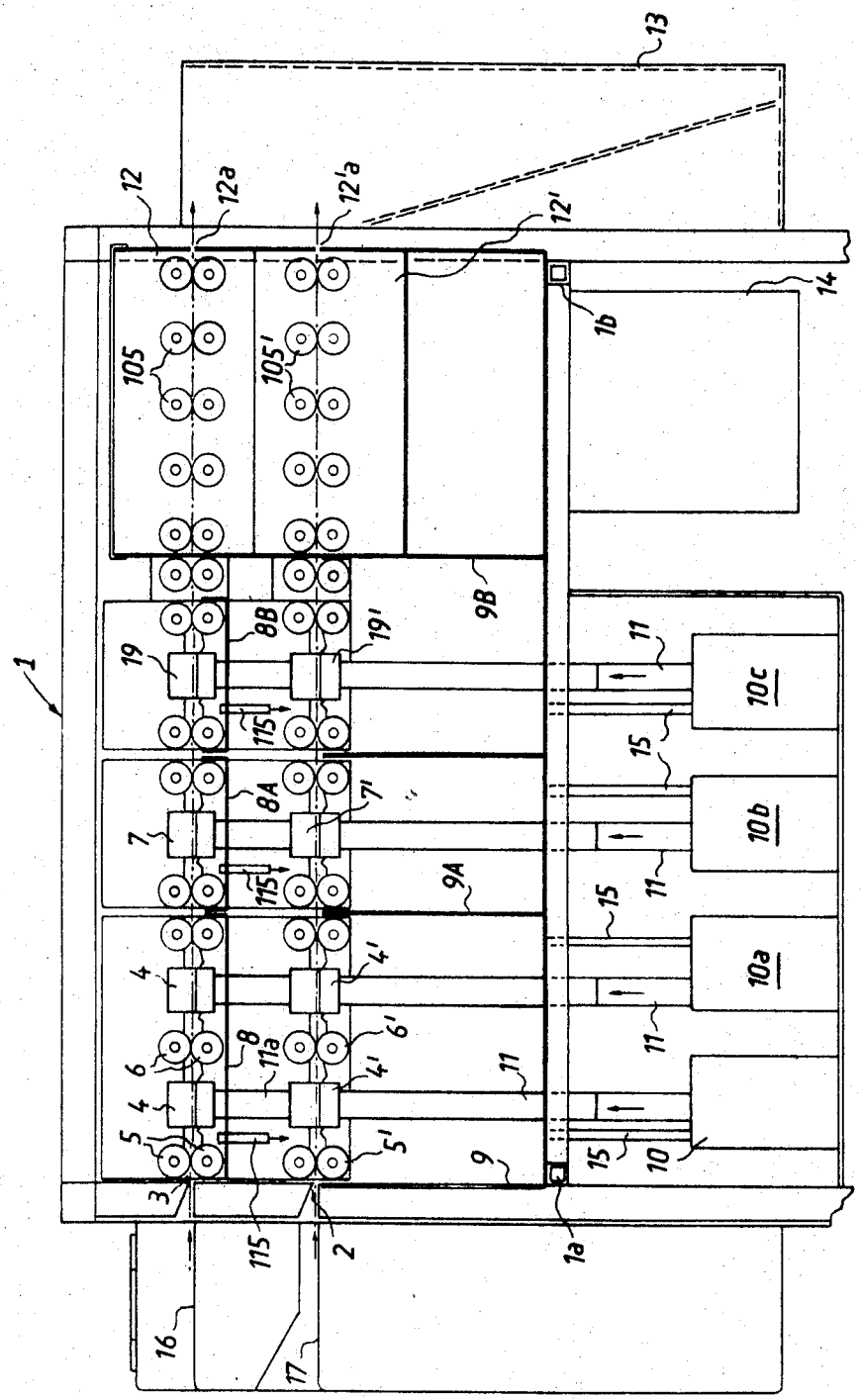
[57] **ABSTRACT**

Apparatus for simultaneous treatment of two series of successive sheets of photographic material has a frame for two rows of developing, fixing and rinsing chambers and a dryer behind each rinsing chamber. Each chamber of one row is located above a corresponding chamber of the other row and the frame supports discrete pumps for developing, fixing and rinsing liquids whereby each pump supplies liquid to a chamber of each row. The dryers receive heated air from a common blower and the dried sheets are caused to accumulate in a common container. Each chamber is disposed between two pairs of advancing rolls which transport the sheets of the respective series through successive chambers and the corresponding dryer. A tank is disposed below each chamber and the liquid which overflows from an upper tank enters the respective lower tank which is connected with the inlet of the corresponding pump.

13 Claims, 1 Drawing Figure

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12a
12'a
12'
14
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105
105'
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8B
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7'
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10b
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APPARATUS FOR PROCESSING PHOTOGRAPHIC SHEET MATERIAL

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for processing photographic sheet material, and more particularly to improvements in apparatus for wet treatment and drying of sheets or webs consisting of or carrying layers of photosensitive material.

It is already known to convey photographic sheet material along a substantially horizontal path and to subject the travelling material to one or more wet and/or dry treatments. Such apparatus are in use for treatment of X-ray films, especially for development and drying of X-ray films. The advantages of such apparatus include their simplicity, low cost, ruggedness, and a minimum of maintenance and repair. As a rule, the sheets are conveyed along a predetermined path by advancing rolls which are installed upstream and downstream of each processing station (e.g., a series of stations each of which contains a supply of processing liquid). The length of discrete stations, as considered in the direction of lengthwise movement of the sheets, is determined by the minimum length of sheets which are to undergo treatment in such apparatus. This determines the speed at which the sheets can be transported along the predetermined path since the time for development cannot be reduced beyond a certain minimum value. Thus, the capacity of such apparatus is rather limited, especially if the apparatus are to be capable of treating relatively long as well as relatively short sheets.

SUMMARY OF THE INVENTION

An object of the invention is to provide a novel and improved apparatus which can be used for processing sheets of photographic material and exhibits all advantages of conventional apparatus but is capable of processing sheets of a rate which is a multiple of the rate of processing in conventional apparatus.

Another object of the invention is to provide an apparatus which, in spite of its high output, does not require more floor space than heretofore known apparatus.

A further object of the invention is to provide a processing apparatus wherein certain components or aggregates can perform all such functions which they perform in conventional apparatus plus one or more additional functions without any appreciable increase in initial or maintenance cost and/or energy requirements.

An additional object of the invention is to provide an apparatus which is capable of subjecting a plurality of sheets of photographic material to simultaneous treatment at each of a plurality of processing stations.

Still another object of the invention is to provide a processing apparatus which can use conventional parts, which can be readily assembled or taken apart with little loss in time, which can be operated at full capacity or at a fraction of maximum capacity and which, when operated at full capacity, is more economical than heretofore known apparatus.

The invention is embodied in an apparatus for processing photographic sheet material, particularly, for developing, fixing, rinsing and drying sheets of X-ray film. The apparatus comprises a plurality of processing units (e.g., two units) disposed at different levels in a frame or an analogous support and each comprising discrete sets of driven rolls or analogous advancing

means operable to advance a series of sheets along a separate path and at least one processing device (such as a dryer or a chamber for discharging a liquid processing fluid against one or both sides of successive sheets) arranged to subject the sheets in the respective path to the action of a fluid, and a pump, blower or an analogous common source of fluid for the one device of each processing unit.

The paths along which the sheets advance are preferably horizontal or nearly horizontal and the advancing means preferably comprises pairs of advancing rolls disposed in front of and behind each processing device, as considered in the direction of transport of sheets along the respective paths.

Each processing unit preferably includes one or more tanks which are disposed below and serve to collect fluid issuing from the respective processing devices. The fluid (such as a developing, fixing or rinsing liquid) which accumulates in an upper tank overflows into the tank therebelow, and the latter is connected with the respective source (e.g., a pump) which supplies fluid to the processing devices in each of the processing units. For example, the apparatus may include two processing units each of which includes two developing devices in the form of chambers having nozzles for directing developing liquid against both sides of successive sheets in the respective path, a fixing device which may be similar to a developing device, a rinsing device which may be similar to a developing or fixing device, and a dryer which is located past the respective rinsing device.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE is a schematic partly elevational and partly sectional view of an apparatus which embodies one form of the invention and which is designed for simultaneous processing of two series of sheets of photographic material.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawing shows an apparatus for simultaneous processing of two series of sheets of photographic material, e.g., sheets of X-ray film. The apparatus comprises a skeleton frame or support **1** which is preferably assembled of hollow steel tubes having a polygonal (e.g., square) profile as shown at **1***a* and **1***b*. The tubes can be welded or otherwise rigidly secured to each other. The frame **1** surrounds a housing or casing having upper and lower sections or stories. The lower storey or stories include a regenerating unit, containers or tanks for storage of processing liquids, a blower **14** which serves as a source of supply of a heated gaseous drying fluid and/or others.

The upper part of the housing in the frame **1** carries two discrete processing units which define two parallel horizontal paths **2** and **3** for the transport of two series of sheets through several processing stations. The first station of the upper unit receives a first processing or

treating device or chamber 4 which is preferably constructed in a manner as disclosed in patent No. 3,693,528. A similar device or chamber 4 is provided at the second station of the upper unit, and this second chamber 4 is followed by a processing device or chamber 7 at a third processing station. The chambers 4 are designed to subject the sheets to the action of a developing liquid and the sheets passing through the chamber 7 are subjected to the action of a fixing liquid. A processing device 19 is provided behind the chamber 7 and this processing device is followed by a drying device or chamber 12. The device 19 discharges one or more streams of a rinsing liquid against one or both sides of sheets in the path 3.

The first chamber 4 is flanked by pairs of advancing rolls 5 and 6, and the rolls 6 simultaneously serve to advance successive sheets which travel along the path 3 into the second chamber 4. The distance between the advancing rolls 5, 6 which are disposed in front of and behind a chamber 4, 7 or 19 does not exceed the length of the shortest sheet which is to be treated in the apparatus. If the apparatus comprises a single fixing chamber 7 and two developing chambers 4, the time allotted for development of successive sheets is twice the time which is allotted for the fixing of developed sheets.

The chambers 4 are located at a level above an intercepting receptacle or tank 8 which serves to collect developing fluid issuing from the chambers 4 thereabove. Each chamber 4 is located at a level above a similar chamber 4' which forms part of the lower processing unit and discharges developing liquid into a tank 9. The depth of the lower tank 9 greatly exceeds the depth of the tank 8 so that the tank 9 can store a supply of developing fluid which is being circulated by a pump 10 or 10a located in the lower part of the housing within the frame 1. The lower tank 9 has an overflow opening connected to a pipe 15 which supplies developing liquid to the foremost chambers 4 and 4'. The outlet of the pump 10 supplies developing fluid to the foremost chambers 4, 4' through a riser 11. A pipe 115 connects the overflow opening of the upper tank 8 with the lower tank 9. The pipe 115 is spaced apart from the chamber 4' as considered in or counter to the direction of transport of sheets along the path 2 or 3, i.e., the pipe 115 is located outside of the outline of the foremost chamber 4 or the chamber 4' below the foremost chamber 4. The chambers 4 and 4', 7 and 7' or 19 or 19' are preferably of identical design so that they can be interchanged at will. The arrangement is preferably such that the chambers 4, 7 and 19 and the associated advancing rolls 5, 6 are removably mounted in guides or platens carried by the upper tank 8, 8A (below the chamber 7) or 8B (below the chamber 19), and that the chambers 4', 7', 19' and the associated advancing rolls 5', 6' are removably mounted in guides or platens carried by the lower tank 9, 9A or 9B. Thus, each of the chambers 4, 4' can be lifted off the respective tank 8 or 9 by moving it upwardly, as viewed in the drawing. The same applies for the chambers 7, 7' and 19, 19'. The riser 11 for the foremost chambers 4 and 4' is sealingly connected with the foremost chambers 4, 4' in such a way that each of these chambers can be moved upwardly. It is also possible to make the upper portion 11*a* of the foremost riser 11 rigid with the foremost chamber 4 so that the portion 11*a* is lifted off the tank 8 together with the respective chamber 4. The lower end of the riser portion 11*a* is then sealingly but movably fitted into the chamber 4' therebelow or is sealingly but separably connected with the upper end of the main part of the foremost riser 11. Still further, it is possible to rigidly connect the portion 11*a* to the tank 8 and to slidably mount the foremost chamber 4 on the portion 11*a*. In such apparatus, the tank 8 can be removed upon removal of the upper chambers 4 and the corresponding advancing rolls 5 and 6 so that the attendants can gain access to the chambers 4'. The drying devices or dryers 12, 12' of the upper and lower processing units may be constructed and assembled in a manner as disclosed by U.S. Pat. No. 3,726,023.The upper dryer 12 receives sheets issuing from the rinsing chamber 19, and the lower dryer 12' receives sheets issuing from the lower rinsing chamber 19'. The developed, fixed, rinsed and dried sheets issue from the discharge openings 12*a*, 12'*a* of the dryers 12, 12' and descend into a suitable collecting container 13. The aforementioned blower 14 is shown as being mounted in the frame 1 at a level below the lower dryer 12' and serves to supply the dryers 12, 12' a suitable gaseous drying medium, such as heated air. The discharge end of the blower 14 is connected with suitable conduits (not specifically shown) which supply heated drying medium to the dryers 12 and 12'. The blower 14 and/or the dryers 12, 12' are equipped with temperature regulating means of conventional design (not specifically shown) to insure that the temperature of the drying medium invariably remains within a desirable optimum range.

The construction of the superimposed fixing chambers 7 and 7' and rinsing chambers 19, 19' is preferably identical with or analogous to that of the developing chambers 4, 4'. The pumps 10*a*, 10*b*, 10*c* are adjacent to the pump 10 and serve to feed developing, fixing and rinsing liquid into the chambers 4, 4', 7, 7' and 19, 19' thereabove.

The means for transporting the sheets through the dryers 12, 12' comprises pairs of advancing rolls 105 and 105'.

The tanks 9A and 9B are respectively accessible upon removal of the parts 5, 6, 7, 8A and 5, 6, 19, 8B thereabove.

The operation:

The sheets which are to be treated at the upper level can be placed seriatim onto a supporting platform or guide 16 and fed lengthwise so as to enter the nip of the leftmost advancing rolls 5. From there on, the sheets advance automatically along the path 3 by passing through the two chambers 4, thereupon through the chamber 7, through the chamber 19 and upper dryer 12, and into the container 13 via discharge opening 12*a*. A second set of sheets can be treated simultaneously by placing such sheets seriatim onto a platform or guide 17 and moving them forwardly into the nip of the leftmost advancing rolls 5'. Such sheets then advance along the path 2 at the lower level and pass through successive chambers 4', through the chamber 7', thereupon through the chamber 19' and dryer 12', and descend into the container 13 by passing through the discharge opening 12'*a*. The sheets which are being advanced along the path 2 may but need not have the same size as the sheets advancing along the path 3. The speed of the upper advancing rolls 5, 6 may but need not necessarily equal the speed of the lower advancing rolls 5', 6'. If the speed of the rolls 5, 6 is identical with that of the rolls 5', 6', and if the dimensions of sheets

which are fed into the path **3** equal the dimensions of sheets fed into the path **2**, the capacity of the improved apparatus is exactly double the capacity of an apparatus having only two chambers **4**, a fixing chamber **7** a rinsing chamber **19**, and a dryer **12**. The outlay for doubling the capacity of conventional apparatus is only a small fraction of the outlay for the purchase of two conventional apparatus. This is due to the fact that the apparatus of the present invention can employ a single pump **10** for the two foremost chambers **4, 4'**, a single pump **10***a* for the next-following chambers **4, 4'**, a single pump **10***b* for the fixing chambers **7, 7'**, a single pump **10**c for the rinsing chambers **19, 19'** and a single blower **14** for the dryers **12, 12'**. It is even possible to construct the apparatus for simultaneous processing of three or more series of sheets, e.g., to provide a third processing unit above the path **3** or below the path **2**.

The only difference between the pumps **10–10***c* and blower **14** on the one hand and the pumps and blower means used in conventional apparatus is that the parts **10-10**a and **14** are designed to insure a satisfactory supply of liquid and gaseous processing fluids to all of the respective groups of processing devices.

It is clear that the improved apparatus further comprises suitable means for conditioning the respective fluids, such as means for maintaining the temperature of the developing, fixing and/or rinsing liquid within an optimum range, means for regulating the rate at which the liquid entering a chamber **4, 4', 7, 7', 19, 19'** is being discharged against the respective side or sides of a sheet, means for regulating the rate of delivery of the pump **10, 10***a*, **10***b* and/or **10***c*, means for synchronizing the speed of advancing rolls with the output of the pumps, and/or others. It is further clear that each tank **8** and/or **9** may comprise two separable or discrete tanks, one for each of the chambers **4** and **4'**, and/or that the upper unit may define a path (**3**) which need not be exactly parallel to the path (**2**) defined by the lower unit.

An important advantage of the improved apparatus is not that its capacity is a multiple of the capacity of a conventional apparatus but that the floor space taken up by the frame **1** need not exceed that which is taken up by an apparatus of conventional design.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which farily constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and ranage of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In an apparatus for processing photographic sheet material, a combination comprising a support; a plurality of processing units disposed in said support at different levels and each comprising discrete advancing means operable to advance a series of sheets along a separate path and at least one processing device arranged to subject the sheets in the respective path to the action of a liquid, said units including an upper unit and a lower unit; a common source of liquid for said one device of each of said units, said source including a pump; a first tank which is disposed below and collects liquid issuing from the one processing device forming part of said upper unit; a second tank which is disposed below and collects fluid issuing from the one processing device forming part of said lower unit; and means for connecting one of said tanks with said pump.

2. A combination as defined in claim **1**, wherein the number of said units is two.

3. A combination as defined in claim **1**, further comprising a common collecting container for sheets leaving said separate paths.

4. A combination as defined in claim **1**, wherein said source is located in said support at a level below said devices.

5. A combination as defined in claim **1**, further comprising means for guiding sheets into the respective paths.

6. A combination as defined in claim **1**, wherein said paths are substantially horizontal and said advancing means comprise pairs of advancing rolls disposed in front of and behind each of said devices, as considered in the direction of transport of sheets along the respective paths.

7. A combination as defined in claim **1**, wherein said processing devices are disposed directly one above the other and are removable from said support one after the other by moving said devices upwardly and starting with the processing device at the uppermost level.

8. A combination as defined in claim **1**, wherein each of said units further comprises a dryer and further comprising a common source of heated gaseous fluid for said dryers.

9. A combination as defined in claim **1**, wherein each of said units comprises a plurality of first processing devices, including said one device, wherein the sheets are contacted by liquid and a second processing device wherein the sheets are contacted by a gas, said source including a plurality of discrete groups each arranged to supply liquid to a single first processing device of each of said units and a blower arranged to supply gas to all of said second processing devices, said pump forming part of one of said groups.

10. A combination as defined in claim **9**, wherein said first devices of each of said units include at least one chamber wherein the sheets are contacted by a developing liquid, a chamber wherein the sheets are contacted by a fixing liquid subsequent to treatment with developing liquid, and at least one chamber wherein the sheets are contacted by a rinsing liquid subsequent to treatment with fixing liquid.

11. A combination as defined in claim **10**, wherein each of said second devices is a dryer and said dryers are located past said chambers for rinsing liquid, as considered in the direction of transport of sheets along the respective paths.

12. In an apparatus for processing photographic sheet material, a combination comprising a support; a plurality of processing units disposed in said support at different levels and each comprising discrete advancing means operable to advance a series of sheets along a separate path and at least one processing device arranged to subject the sheets in the respective path to the action of a liquid, said units including an upper unit and a lower unit and each of said units further including a tank disposed below and arranged to collect liquid issuing from the respective device; a common source of liquid for said one device of each of said units; and means for conveying liquid from the tank of said upper unit into the tank of said lower unit.

13. A combination as defined in claim **12**, wherein said one device of said upper unit is located directly above said one device of said lower unit, and said liquid conveying means is located without the outline of said one device in said lower unit.

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