United States Patent [19]

Horn

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[54] **PHOTOGRAPHIC MATERIAL PROCESSING APPARATUS**

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[73] Assignee: **Eastman Kodak Company**, Rochester, N.Y.

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[52] **U.S. Cl.** **95/93**, 118/426

[51] **Int. Cl.** **G03d 3/06**

[58] **Field of Search** ..... 95/89 R, 89 A, 89 D, 95/90.5, 93, 96; 118/423, 426; 134/69, 79, 149, 159

[56] **References Cited**

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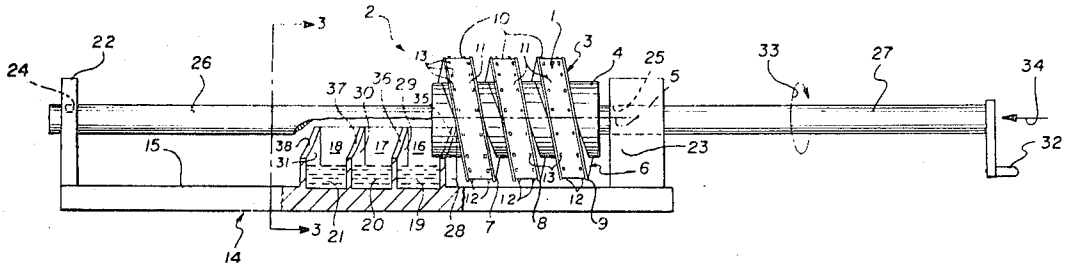
Primary Examiner—Fred L. Braun

Attorney—W. H. J. Kline et al.

[57] **ABSTRACT**

Apparatus for processing photographic material by immersing such material in processing solution, includes a screw member which is provided with a shank having a longitudinally extending axis and with a rib projecting from the shank and helically disposed about the shank axis so as to form a series of uniformly spaced rib convolutions. The rib convolutions are adapted to hold a flexible strip of photographic material in a helical winding. A frame member of the apparatus is provided with a base which supports several processing solution tanks in fixed, aligned relation. The frame member is further provided with other structure which supports the screw member for rotation about the shank axis and for translation in a manner such that the rib convolutions depend into, and move successively through, the tanks. A screw-mating member of the apparatus is located on the frame and adapted to be received between the rib convolutions for effecting translation of the screw upon screw rotation about the shank axis.

7 Claims, 5 Drawing Figures



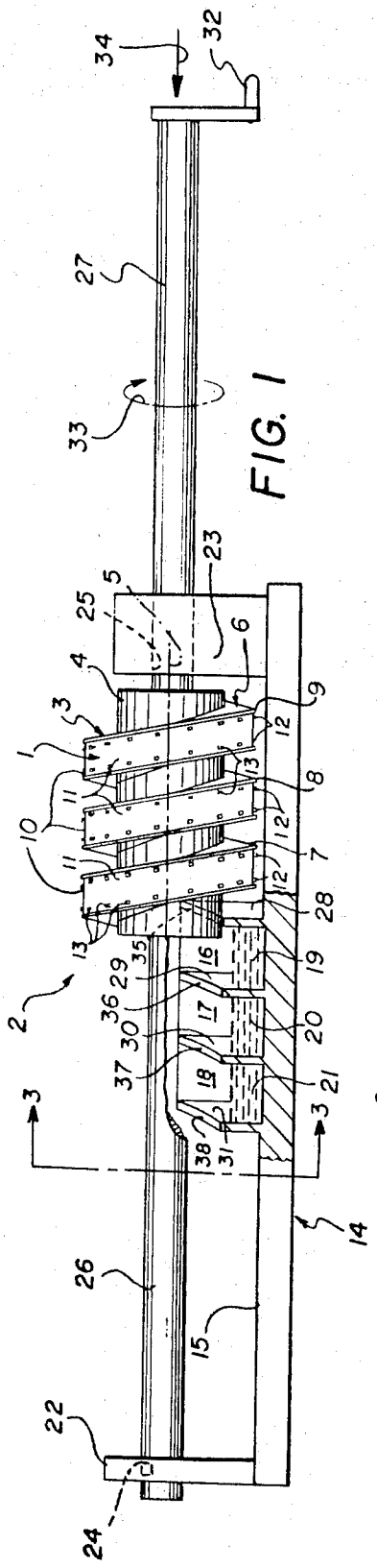


FIG. 1

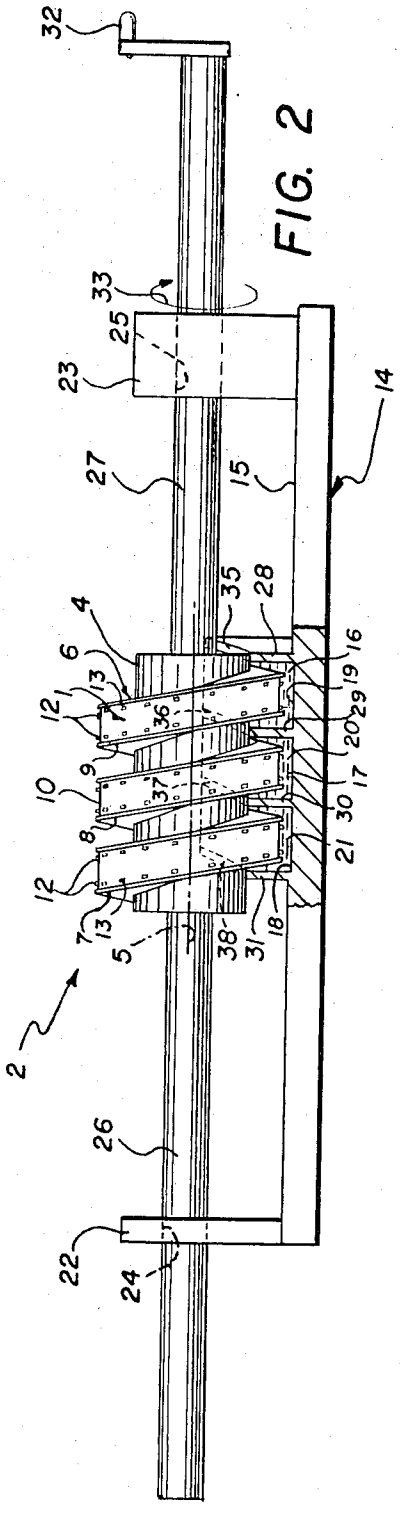


FIG. 2

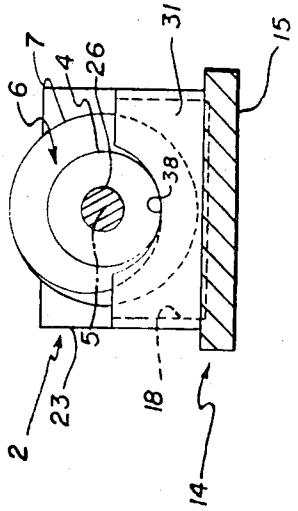


FIG. 3

FIG. 4

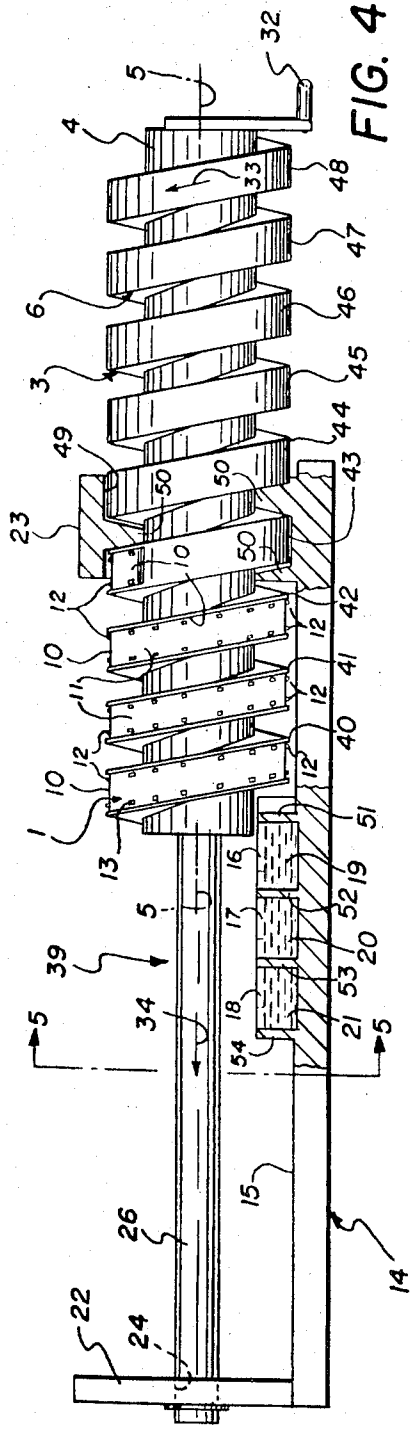

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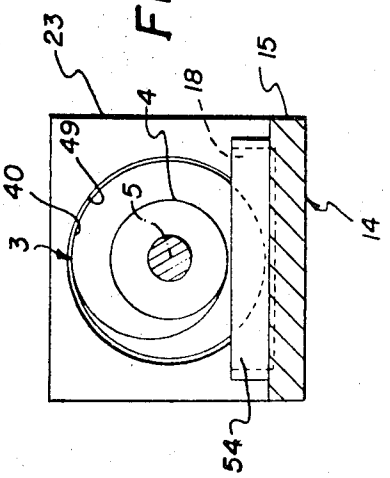
FIG. 5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PHOTOGRAPHIC MATERIAL PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to apparatus for processing strip material by fluid-treating such material and, more particularly, to means by which a flexible strip having a photographic surface is guided and supported during processing treatment by a fluid.

2. Description of the Prior Art

Numerous kinds of apparatus for fluid-treating photographic surfaces have heretofore been devised. Most often, such apparatus is intended to convert the latent image on an exposed photographic surface to a visible image. One well known version of this apparatus, which is adapted for use with film strip material, includes a plurality of tanks each of which contain a different film processing liquid such as a developing solution, a fixing solution and a washing solution. The tanks are disposed in fixed, aligned relation in order that an exposed film strip may be advanced from tank to tank and successively treated by the different processing liquids. To effect such film strip advance the film processing apparatus further includes several groupings of vertically disposed rollers which are respectively immersed in the different processing liquids, within the tanks, for moving the exposed film strip through such liquids. Other rollers are located between the tanks for moving the exposed film strip from tank to tank. Together these rollers define a sinuous film strip advance path which interconnects the tanks. Upon rotationally driving the rollers at the same speed, the exposed film strip will be moved along the sinuous path through the tanks and will be successively immersed in the different processing liquids.

Such film strip processing apparatus, although widely accepted by photofinishers, has several disadvantages. For example one disadvantage is that the rotating rollers (especially if not driven at exactly the same speed) may scratch or mar the emulsion-bearing surface of an exposed film strip moving along the sinuous path. Another disadvantage is that the rotating rollers tend to produce a strain or mechanical load on an exposed film strip moving along the sinuous path, so that such film strip may be caused to separate at splices or joins therein.

One variation of a film strip processing apparatus which appears to avoid the foregoing disadvantages is disclosed in Great Britain Pat. No. 584,556, published Jan. 17, 1947. Briefly stated, this patent discloses an endless band or carrier which is helically disposed about an annular axis and which includes means for securing a film strip along the band length. The several helical convolutions that make up the band respectively depend into different film processing solution tanks. A plurality of drive rollers, in contact with the band, serve to rotate the band convolutions about the annular axis and thereby move such convolutions successively through the different tanks. Thus, when an exposed film strip is secured along the band length and the drive rollers are actuated to rotate the band convolutions, the exposed film strip will be conveyed successively through the different tanks and, in that way, will be subjected to the several stages of processing solution treatment such as developing, fixing and washing.

The film strip processing apparatus disclosed in Great Britain Pat. No. 584,556, while appearing to represent an improvement over previously known devices, has several shortcomings. One such shortcoming is that the endless band, due to the flexing which occurs during rotation about the annular axis, may develop cracks or become separated from the drive rollers. Another shortcoming is that the band may not maintain a constant helical shape after prolonged use and, in such event, the periods for which an exposed film strip is respectively immersed in the different processing liquids may vary from those originally intended and necessary for best processing of such film strip.

SUMMARY OF THE INVENTION

Accordingly, a primary object of the present invention is to provide apparatus for processing strip material by successively exposing such material to a plurality of processing fluids and which is improved so as to avoid the foregoing difficulties existing with respect to those devices previously known.

Another object of the present invention is to provide apparatus for processing photographic strip material by successively immersing such material in a plurality of processing solutions and which is generally free from the possibility of break-down after prolonged use.

A further object of the present invention is to provide photographic processing apparatus, including means by which a flexible strip having a photographic surface is guided and supported during treatment by a processing solution and which substantially minimizes the strain or mechanical load placed on the photographic strip.

In accordance with a preferred embodiment of the present invention there is disclosed, in detail hereinafter, apparatus for processing photographic strip material by successively immersing such material in a plurality of different processing liquids such as a developing solution, a fixing solution and a washing solution. Such apparatus includes a screw member which is provided with a shank having a longitudinally extending axis and with a rib projecting from the shank and helically disposed about the shank axis so as to form a series of uniformly spaced rib convolutions. The rib convolutions are adapted to hold a flexible strip of photographic material in a helical winding. A frame member of the apparatus is provided with a base which supports several processing solution tanks in fixed, aligned relation. The frame member is further provided with other structure which supports the screw member for rotation about the shank axis and for translation in a manner such that the rib convolutions depend into, and move successively through, the tanks. A screw-mating member of the apparatus is located on the frame and adapted to be received between the rib convolutions for effecting translation of the screw upon screw rotation about the shank axis.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-memtioned and other features and objects of the present invention and the manner of obtaining them will become more apparent by reference to the following detailed description of a preferred embodiment of such invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side elevation view, partly in section, of a photographic strip processing apparatus according to a preferred embodiment of the present invention and,

further showing, a film strip supported by such apparatus;

FIG. 2 is a view similar to FIG. 1 illustrating the manner in which the film strip is successively immersed in several different processing solutions;

FIG. 3 is a section view of the photographic strip processing apparatus as viewed along the line 3—3 in FIG. 1;

FIG. 4 is a side elevation view, partly in section, of an alternative embodiment of the photographic strip processing apparatus depicted in FIG. 1; and

FIG. 5 is a section view of such alternative embodiment of the photographic strip processing apparatus, as viewed along the line 5—5 in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and in particular to FIG. 1, there is shown a flexible strip of exposed photographic material 1, such as a 35mm film strip, and a photographic strip processing apparatus which is generally indicated by the reference number 2. The photographic processing apparatus 2, as will be realized from the detailed description which follows hereinafter, is adapted to successively immerse the exposed film strip 1 in several different processing liquids such as developing solution, a fixing solution and a washing solution. Such liquid treatment of the exposed film strip 1 is intended to convert the latent images thereon into visible images, according to film developing practices well known in the photographic art.

As viewed in FIG. 1, the photographic processing apparatus 2 includes a screw member 3 which is provided with a cylindrical shank 4 having a longitudinally extending axis 5 and with a rib 6 or screw thread projecting from the shank. The rib 6 is helically disposed about the shank axis 5 so as to form a series of three uniformly spaced rib convolutions 7, 8 and 9. A channel or track 10, located along the rib convolutions 7–9, is shaped to receive and support the exposed film strip 1 in a helical winding, with an emulsion-bearing face 11 of such wound film strip being spaced from the rib 6 as shown in FIG. 1. To firmly hold the film strip 1 in a helical winding along the channel 10, a plurality of pins (several of which are indicated by the reference number 12) project from the rib convolutions 7–9 and are adapted to respectively extend through a plurality of film strip perforations (several of which are indicated by the reference number 13) to thereby engage such wound film strip. Suitable clips (not shown) or other devices may be used to secure opposite ends of the wound film strip 1 to the rib convolutions 7 and 9.

As further viewed in FIG. 1, a generally U-shaped frame member 14 of the photographic processing apparatus 2 is provided with a horizontal base 15 whitch supports three processing solution tanks or stations 16, 17 and 18 in fixed, aligned relation. Each of the tanks 16–18 is open at the top so that the rib convolutions 7–9 of the screw member 3 can depend into such tanks in the manner shown by FIGS. 2 and 3. To process the exposed film strip 1, the tanks 16-18 respectively contain a developing solution 19, a fixing solution 20 and a washing solution 21. The frame member 14 is further provided with spaced opposed vertical support members 22 and 23 which, as shown in FIG. 1, project from the base 15 and include bearings 24 and 25. Two rod-like arms 26 and 27 of the screw member 3 are fixed to opposite ends of the shank 4 and extend through the bearings 24 and 25, in turn, thus support or mount the screw member 3 for rotation about the shank axis 5 and for translation along such axis so that the rib convolutions 7–9 can be moved into, and successively through, the tanks 16–18 (see FIGS. 1 and 2).

The processing solution tanks 16-18 are partially defined by four parallel spaced walls 28, 29, 30 and 31 which, as viewed in FIG. 1, project vertically from the frame base 15. The tank walls 28–31, in effect, serve as screw-mating members of the photographic processing apparatus 2, in that such walls are adapted to be successively received between the rib convolutions 7–9 for bringing about the translation of the screw member 3 along the shank axis 5 upon screw rotation about such axis (see FIGS. 1 and 2).

In operating the photographic processing apparatus 2, a handle 32, fixed to the screw arm 27, is rotated about the shank axis 5 in a clockwise direction generally indicated by the arrow 33 in FIG. 1. Thus, the screw member 3 will be similarly rotated, and in response thereto, will be translated along the shank axis 5 in a direction generally indicated by the arrow 34 in FIG. 1. Accordingly, as can be appreciated from FIGS. 1 and 2, the rib convolutions 7–9 and the exposed film strip 1 will be moved successively through the developing solution 19, the fixing solution 20 and the washing solution 21 so as to process such film strip. As can be realized from FIGS. 2 and 3, curved edge segments, 35, 36, 37 and 38 respectively of the tank walls 28–31 serve to provide additional vertical support for the shank 4 as the rib convolutions 7–9 and the film strip 1 are moved successively through the processing solution tanks 16–18. After processing of the film strip 1 in the foregoing manner, the film strip can be removed from the rib convolutions 7–9 and then placed in a drying device (now shown). Alternatively, a drying device may be mounted on the frame base 15 at a location to the left of the washing solution tank 18 as viewed in FIG. 2. The rib convolutions 7–9 and the film strip 1 would then be moved into such drying device upon exiting from the washing solution tank 18.

Referring now to FIGS. 4 and 5, there is shown a modified version 39 of the photographic processing apparatus 2 just described. Those elements of the modified apparatus 39, which are identical in function and structure to elements of the first described apparatus 2, are indicated by the same reference numbers. As viewed in FIG. 4, the screw member 3 of the modified apparatus 39 is provided with nine rib convolutions 40, 41, 42, 43, 44, 45, 46, 47 and 48 which are uniformly spaced along the shank 4. Moreover, the vertical support member 23 which projects from the frame base 15 includes an opening 49 through which the screw member 3 extends. An internal screw thread, located in the opening 49, is defined by a projecting helical rib 50. The projecting rib 50 is adapted to be successively received between the rib convolutions 40–48 upon rotation of the screw member 3 about the shank axis 5. Thus, the projecting rib 50, in the modified apparatus 39, serves to effect translation of the screw member 3 along the shank axis 5 upon screw rotation about such axis.

In operating the modified apparatus 39, the handle 32 is rotated in a clockwise direction, generally indicated by the arrow 33 in FIG. 4, so as to similarly rotate

the screw member 3. In response to such rotation, the screw member 3 is translated along the shank axis 5 in a direction generally indicated by the arrow 34, in FIG. 4, and the rib convolutions 40–42 together with the exposed film strip 1 are moved successively through the developing solution 19, the fixing solution 20 and the washing solution 21 to thereby process such film strip. As shown in FIGS. 4 and 5, the processing solution tanks 16–18 are partially defined by tank walls 51, 52, 53 and 54. These tank walls 51–54 differ from the tank walls 28–31, shown in FIGS. 1–3, in that the first mentioned tank walls are not adapted to effect translation of the screw member 3 along the shank axis 5 upon screw rotation about such axis.

Thus, there has been illustrated and described a film strip processing apparatus consisting essentially of two separate components, i.e., the screw member 3 and the frame member 14, the first of which is movable with respect to the other. Such a film processing apparatus has important advantages in that the moving parts thereof are kept to a minimum and very little strain or mechanical load is placed on the exposed film strip 1 while such film strip undergoes liquid-treatment.

It will be appreciated that although such processing apparatus has been described for use with the film strip 1, the processing apparatus can be modified to provide fluid-treatment for other kinds of web material. Moreover, although the processing apparatus has been illustrated with a developing solution tank 16, a fixing solution tank 17 and a washing solution tank 18, the number and contents of these tanks may be varied.

The present invention has been described in detail with particular reference to preferred and alternate embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

I claim:

1. In apparatus for processing strip material by successively exposing such material to a plurality of processing fluids, the combination comprising:

a screw member including:

a. a shank having a longitudinally extending axis;

b. means defining a screw thread helically disposed about said shank axis; and

c. means for supporting strip material on said screw member in a helical winding about said shank axis,

means defining a plurality of processing stations respectively at which strip material supported on said screw member is exposed to a plurality of processing fluids;

means mounting said processing stations and said screw member, for relative rotation therebetween about said shank axis, and for relative movement therebetween along said shank axis in a manner so that such supported strip material is successively received in said processing stations; and

means, cooperating with said screw thread upon said relative rotation between said processing stations and said screw member, for effecting said relative movement between said processing stations and said screw member.

2. In apparatus for processing strip material by successively exposing such material to a plurality of processing fluids, the combination comprising:

a screw member including:

a. a shank having a longitudinally extending axis;

b. a rib projecting from said shank and helically disposed about said shank axis so as to form a series of spaced rib convolutions; and

c. means for supporting strip material on said screw member in a helical winding about said shank axis,

means defining a plurality of processing stations disposed in an aligned arrangement and respectively at which strip material supported on said screw member is exposed to a plurality of processing fluids;

means mounting said processing stations in fixed relation and mounting said screw member for rotation about said shank axis and for translation in a manner so that such supported strip material is successively moved through said processing stations; and

means, adapted to be received between said rib convolutions, for effecting translation of said screw member upon rotation thereof about said shank axis so that such supported strip material is successively moved through said processing stations.

3. In apparatus for processing photographic strip material by successively immersing such material in a plurality of processing solutions, the combination comprising:

a screw member including:

a. a shank having a longitudinally extending axis;

b. a rib projecting from said shank and helically disposed about said shank axis so as to form a series of uniformly spaced rib convolutions; and

c. means located along said rib convolutions for holding photographic strip material in a helical winding about said shank axis,

a plurality of processing solution containers disposed in an aligned arrangement and each having an ingress and egress opening for said rib convolutions;

means supporting said processing solution containers in fixed relation and supporting said screw member for rotation about said shank axis and for translation of said rib convolutions successively through said processing solution containers; and

means located on said supporting means and adapted to be received between said rib convolutions for effecting translation thereof successively through said processing solution containers upon rotation of said screw member about said shank axis.

4. The combination as recited in claim 3 wherein said holding means includes;

means defining a helical channel located along said rib convolutions for receiving photographic strip material.

5. The combination as recited in claim 4 wherein said translation effecting means includes:

means defining an opening in said supporting means for receiving said screw member; and

a helical rib projecting from said opening defining means and adapted to be received between said rib convolutions of said screw member.

6. The combination as recited in claim 3 wherein said translation effecting means includes:

a plurality of wall members respectively projecting from locations interjacent said processing solution containers and adapted to be received between said rib convolutions of said screw member.

7. In apparatus for processing photographic strip material of the kind provided with an emulsion-bearing face, the combination comprising:

a screw member including:

a. a generally cylindrical shank having a longitudinally extending axis;

b. a rib projecting from said shank and helically disposed about said shank axis so as to form a series of uniformly spaced rib convolutions; and

c. means located along said rib convolutions for holding such photographic strip material in a helical winding about said shank axis, with the emulsion-bearing face being spaced from said rib,

a plurality of different processing solution containers disposed in an aligned arrangement and each having an ingress and egress opening for said rib convolutions;

a frame including:

a. a generally horizontal base which supports said different processing solution containers in fixed relation; and

b. several generally vertical support members projecting from said base and respectively having bearings which support said screw member for rotation about said shank axis and for translation in a manner such that said rib convolutions depend into, and more successively through, said different processing solution containers, and

means located on said frame and adapted to be received between said rib convolutions for effecting translation of said screw member upon rotation thereof about said shank axis.

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