Sept. 21, 1954

A. V. L. C. DEBRIE

2,689,729

FILM-FEEDING DEVICE

Filed May 19, 1950

3 Sheets-Sheet 1

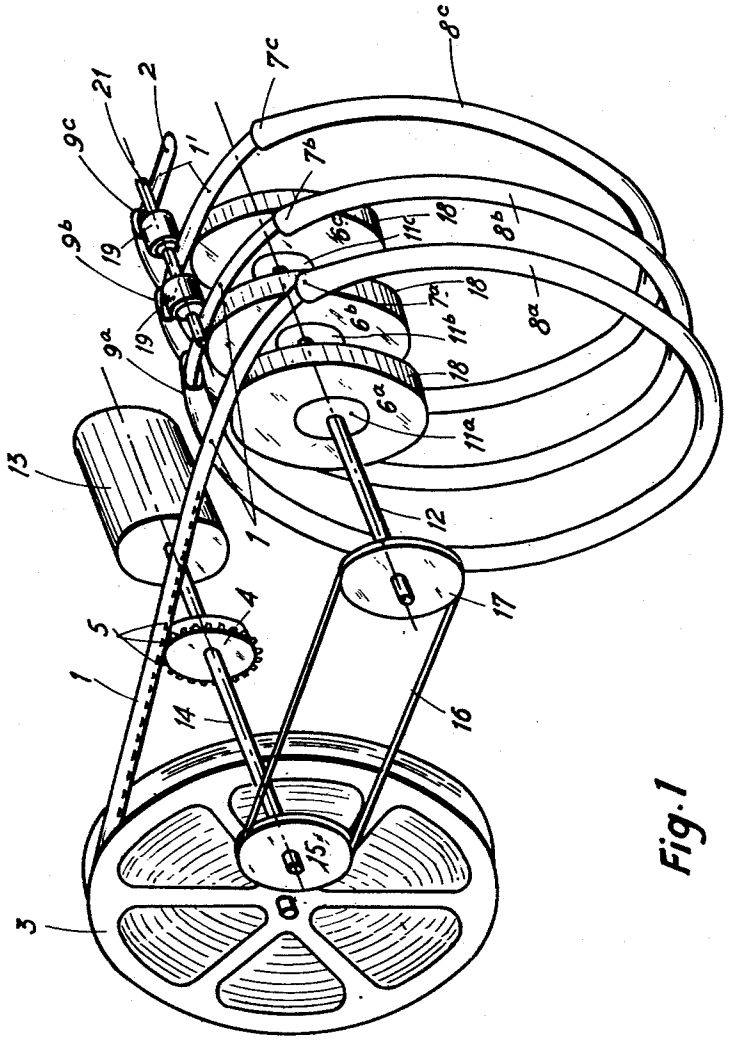


Fig. 1

Inventor
André Victor Léon Clément Debrie
By Mudael & Stone
Attorneys

Sept. 21, 1954 A. V. L. C. DEBRIE 2,689,729

FILM-FEEDING DEVICE

Filed May 19, 1950 3 Sheets-Sheet 2

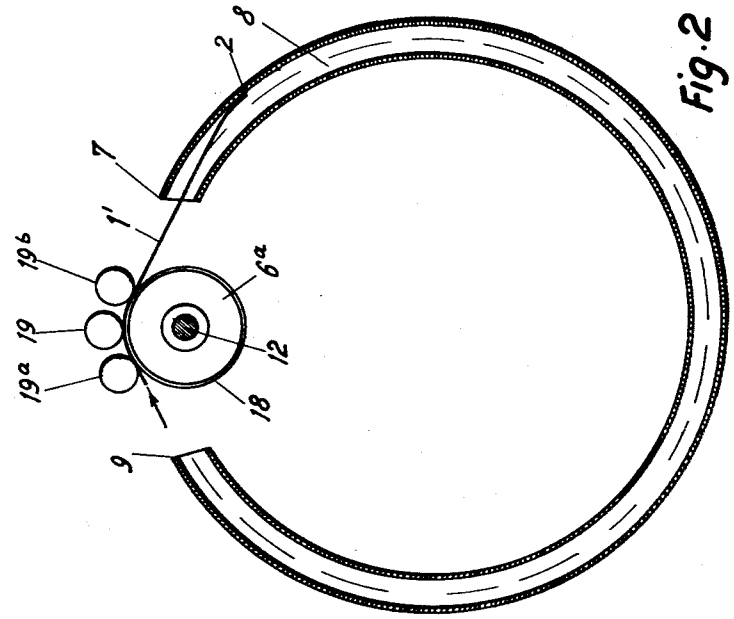


Fig. 2

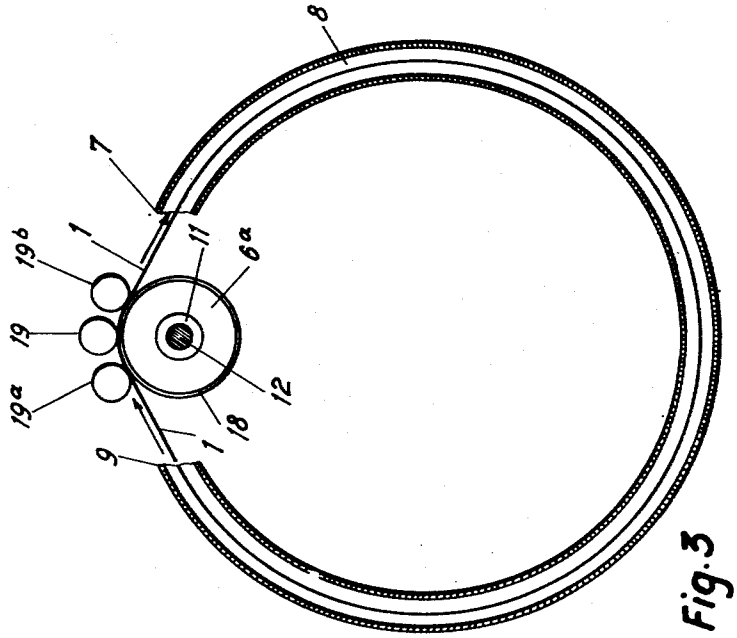


Fig. 3

Inventor
André Victor Léon Clement Debrie
By Michael Stone
Attorney

Sept. 21, 1954 A. V. L. C. DEBRIE 2,689,729

FILM-FEEDING DEVICE

Filed May 19, 1950 3 Sheets-Sheet 3

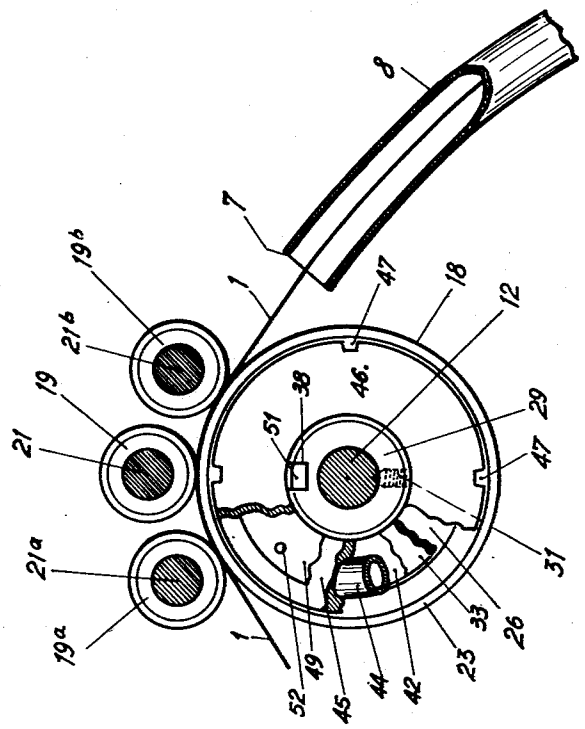


Fig. 5

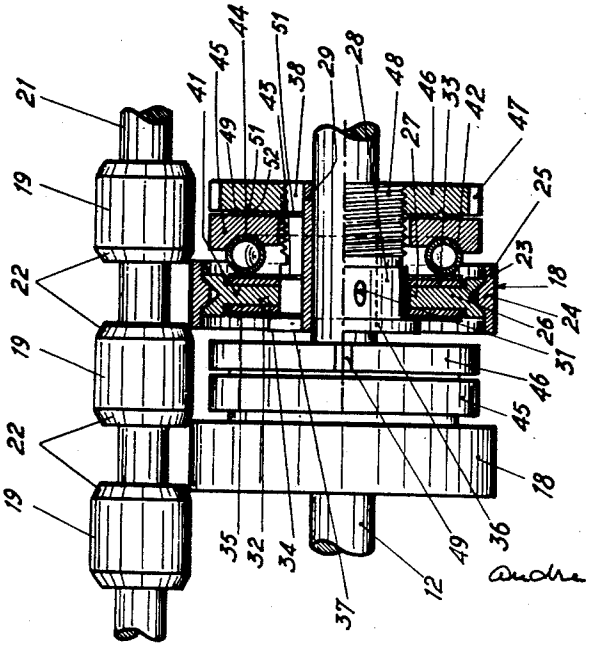


Fig. 4

Inventor
André Vida Léon Clément
Debrie
By Marshall & Yates
Atty

Patented Sept. 21, 1954

2,689,729

UNITED STATES PATENT OFFICE

2,689,729

FILM-FEEDING DEVICE

André Victor Leon Clement Debrie, Paris, France

Application May 19, 1950, Serial No. 162,893

Claims priority, application France
February 20, 1950

4 Claims. (Cl. 271—2.3)

1

This invention relates to film-feeding devices and more particularly to a device of this kind for feeding cinematographic or other films wherein the film, while being so guided as to form a plurality of loops arranged serially for example as a helix, is passed on a series of feeding drums mounted on a common shaft, each turn of the helix passing on one of these drums.

This device is particularly adapted for automatically loading and driving the film in developing machines wherein the film is treated in passages forming helical loops through which the treating liquids or drying air are circulated, these passages being either formed of tubular windings or turns having their top portions interrupted, or in a block and also interrupted at their top portions, the arrangement being such that the outlet aperture of one passage faces the inlet aperture of the next passage, a driving drum being disposed in the vertical plane of these two apertures.

In the known devices all the driving drums rotate at exactly the same speed as the shaft which carries them and advantage is taken of the inequalities of driving action caused by variations in the diameters of the drums both on introducing the film and during the treatment thereof. The film is introduced dry, then it is wetted and subsequently dried, whereby elements such as length, frictional engagement with the drums, etc. are somewhat modified.

Thus, in hitherto known devices the film is introduced into each turn formed by the preceding drum. As the film end is free, the film tends to bear outward in the passage and apply its emulsified side on the guiding walls. Therefore, the braking effect on the film is increased and the latter may pack itself and become scratched or otherwise deteriorated in the passage.

The device used for causing the variable adherence of the film on the driving drums are delicate in operation and any slippage of the film on these drums is likely to deteriorate it.

These and other drawbacks are obviated with the present invention by the provision of means for automatically taking up the film travel in each turn on passing the initial end of the film into this turn, while avoiding any undue pull on the film and positioning it in an absolutely automatic manner. No special handling or preparation is required except, as in existing devices, that the initial end of the film to be treated is preceded by a non-gelatinous initial film band in order to avoid any over-packing. The length of this initial film band may be reduced to less than two full lengths of a turn, the taking-up by the drive,

2

whereby a pulling action is substituted for the former compression or pushing action exerted on the film, being effected at a great speed as soon as the free end has passed over a drum, which begins with the second drum of the series.

In this device the film is driven through continuous adherence on driving drums mounted on a common shaft but each drum is mounted for free sliding anglar motion on this shaft. When the reaction torque produced by the pull exerted on the film reaches a value corresponding to the adjustment of the friction drive of each drum on the driving shaft, the angular velocity of the drum becomes lower than the angular velocity of the shaft. On the other hand, the film is braked in relation to the first drum whereby the angular velocity of first drum is constantly kept lower than that of the driving shaft.

A device of this kind is illustrated diagrammatically in the accompanying drawings by way of example in view of affording a better understanding of one possible application of the invention to a developing machine of the kind adapted to pass the film through tubular turns cooperating so as to form guide member for the film and circulating passages for the treating fluids.

In the drawings:

Fig. 1 is a diagrammatic fractional perspective view of one embodiment of the invention.

Figs. 2 and 3 are diagrammatical cross-sections along the axes of the turns in which the film is caused to slide loading of the turns by means of the initial film band, Fig. 3 illustrating the film in the suitably stretched condition in which it is brought when driven by two successive drums.

Fig. 4 is an elevational and horizontal cross-sectional view of one possible embodiment of a pair of driving drums with the counter-rollers used for applying the film against the periphery of these drums.

Fig. 5 is an elevational view in cross section of the embodiment of Fig. 4 with portions of certain parts removed to show the arrangement thereof.

In the different figures of the drawing the same reference numbers are used to designate similar parts of the device.

The film 1 to be used with the device according to the invention has attached to its leading end an additional strip or band 1' of nonemulsified film material having its leading end preferably rounded up for facilitating the passage thereof along the tubular turns by exerting a pushing action on the film band. This film 1 is fed from a spool 3 on which it is wound.

For this purpose, the film is driven for example by a toothed film-feeding device 4 having its teeth

in meshing engagement with the perforations both of film 1 and initial band 1' thereof.

This film is brought by guiding means not shown mounted on the casing or structure of the developing machine on the first drum 6a of the machine so as to engage this drum with its non-emulsified side.

This drum 6a corresponds to the inlet aperture 7a of the first tubular turn 8a the outlet aperture 9a of which corresponds to a drum 6b facing the inlet aperture 7b of the next tubular turn 8b and so forth . . . 6c, 6d . . . 7c, 7d . . . 8c, 8d . . .

Drums 6a, 6b . . . 6n are mounted, through the medium of friction devices shown diagrammatically at 11a, 11b, 11c . . . , by a motor 13. The shaft 14 of this motor is operatively connected to the feeding sprocket 4. A driving pulley 15 fixed on this shaft may be operatively connected through a transmission belt 16 to a driven pulley 17 fixed on drum shaft 12.

The radiuses of the various elements 4, 15, 17 and film-driving peripheral portions 18 of the different drums 6a, 6b, . . . are such that the peripheral velocity U of portions 18 of drums 6, when the latter rotate without slippage at the angular speed of shaft 12, is higher than the linear speed u of the film as produced by the driving action of the film-feeding device 4.

The surfaces 18 by which the drums engage the film are so arranged that the film will adhere thereto for instance through application of a pair of marginal film strips against the drum peripheral surfaces by rollers 19 carried by shafts 21 parallel with shaft 12, these rollers being mounted for loose rotation in the machine frame although they are guided as to bear on each edge 18 of the different drums 6.

Fig. 1 shows only one fragmentary portion of shaft 21 carrying a pair of rollers 19.

From the standpoint of the adherence of film 1 alone on surface 18 a single row of rollers 19 would be sufficient. However, as a matter of fact and as shown in Figs. 2, 3 and 5, it is necessary to provide three rows of shafts 21 carrying rollers 19 so that as the leading end 2 of the initial film band 1' continues its travel from the outlet 9 of each tubular turn it is gripped automatically due to its engagement between the corresponding roller 19a and peripheral surface 18. Then it continues its forward movement between roller 19 and surface 18 and leaves the latter where this surface is engaged by the third roller 19b, whereby the tangential direction followed by the film will bring it without any additional guiding action or means into the aperture 7 of the next corresponding tubular turn.

The three axes (Fig. 5) 21, 21a and 21b may fall freely by their own weight in guiding means provided in the machine frame, for instance, and rollers 19 will rotate loosely as they are driven by the film which they press on surface 18 through their suitably chamfered outer edges 22 (see Fig. 4).

Theoretically, rollers 19 should rotate freely about their respective shafts 21 so as to avoid any undue slippage of surfaces 22 on the film.

Practically, satisfactory operation may be afforded by the provision of rollers 19 fast with their shafts 21 and acting simultaneously on two successive turns as shown in Fig. 4.

Of course, rotation of their common shaft 21 is constantly kept free and is in accordance with the average speed u of the film which drives this assembly of rollers fast with each other. As a matter of fact the possibly detrimental slipping action derived from the difference between u and U exists only when the machine is loaded with film and appears only on the aforesaid band of non-emulsified film, which is by no means detrimental per se. Slippages due to changes in the film length during the treatment will produce only variations of the order of $u \pm \epsilon$, i. e. very slight ones.

The driving drums 6 on the outer periphery of which the film 1 is caused to adhere are constructed, in the example illustrated, as follows:

A lining of rather soft rubber 23 having the form of a cylindrical ring of substantially the film width is fixed by introducing a central inner rib 24 in the groove 25 of a disc 26 of any suitable material such as molded plastics for instance, having a concentric bore 27 so dimensioned as to rotate freely on the cylindrical portion 28 of a hub 29 fixed coaxially on shaft 12 for example by means of a set screw 31.

The outer rim of a disc 26 is narrower than its rubber lining 23 whereby the protruding edges of its cylindrical outer surface will yield slightly under the edge strips of film 1 when the latter is pressed by the chamfered portions 22 of rollers 19.

By suitably selecting the quality and grade of the rubber lining a perfect adherence of film 1 on the driving surface 18 will be obtained.

Frictional driving of 18, mounted on 26, through shaft 12 and hub 29 fast therewith occurs as follows:

A felt-ring 32, 33 is applied on either sides of disc 26. Thus, felt-ring 32 is pressed between side 34 of disc 26 and a washer 35, for instance of stainless steel, threaded on 28 and bearing on a flange 36 which terminates 28 at one end of hub 29. Washer 35 is held against rotation on hub 29 by a stop-pin 37 cut out from its central bore and extending in a longitudinal groove 38 formed in hub 29. On the other side 41 of 26 there is another felt-ring 33 pressed against this side by another washer 42 with stop-pin 43 similar to the aforesaid washer 35 adapted to transmit to the felt-ring and washer assembly, by pressing them against disc 26, the pressure of a spring member, in this case a hollow rubber ring 44 pressed by a plate 45. An adjusting flat nut 46 provided for instance with peripheral notches 47 adapted to receive a convenient wrench, makes it possible by tightening this nut 46, to flatten the rubber ring 44 and press felt-rings 32, 33 between the sides of disc 26 and washers 35, 42 which rotate fast with shaft 12.

In view of preventing nut 46 from unscrewing itself a washer 49 is interposed between plate 45 and nut 46. This washer is provided with a stop-pin 51, similar to washers 35, 42, but so shaped as to act resiliently. It has stamped and pressed projections 52 adapted to penetrate into corresponding holes 53 of nut 46 in order to prevent any untimely rotation thereof.

It is therefore possible to adjust the driving torque of surface 18 adherent to film 1 up to a suitable maximum value.

As the coefficient of friction of felt is practically constant in either wet or dry conditions this adjustment will hold when the machine will be running.

The device described operates as follows:

When the film-pulling initial band 1' engages the periphery 18 of drum 6a it adheres thereto and, as the peripheral speed u of the feeding device 4 is lower than the peripheral velocity U

of drums 6 when the latter are not slipping on their drives 11, this drum 6a is braked and it is only at the linear speed u that 1' is pushed into the first tubular turn 8a (Fig. 2).

Then, this film will take the shape shown and its end will tend to apply itself against the largest diameter of the tube.

When the band end 2 guided by rollers 19 is gripped by and adheres to the next drum 6b, the latter has a peripheral speed $U>u$.

During a short period of time the film fed by 6a at a speed u is pulled by 6h at the speed U at which it is still rotating. But as the film is consequently stretched between 6a and 6b, it will be directed toward the center of the tube in a normal guiding position. A braking effect will result, as the film acts like the rope in a rope brake in which the drum would be held against motion.

This braking effect will induce slippage of drum 6b about its hub 11b and this drum will feed the film into turn 8b at a feeding speed u, the same cycle of phenomena occurring again until the film reaches 6c and so forth until the complete set of drums are fitted with film adhering and passing thereon at the same speed u.

Thus, it will be readily seen that with the device described the positioning and displacement of the film are obtained automatically.

The film, except the leading turn on loading the device, is constantly urged to the center of the tube on the guiding parts through a pull which is always equal to the tension which forces each drum to revolve only at the peripheral speed u instead of U, this speed U being that at which the drums would revolve if they were driven by shaft 12 without any possibility of any slippage.

It will be apparent that even if, for any given reason a local elongation occurred in any one turn, the following drum would slip less on its shaft and, by revolving faster, absorb the slack which, being transmitted from drum to drum, would be therefore absorbed along the entire film length.

On the contrary, a local braking would bring about the braking in series of the next elements, but a slack in the preceding portion would bring about a relaxation transmitted from drum to drum and absorbed as soon as it is produced.

The average running will be constantly and automatically established without permitting the film pull from drum to drum to exceed the tension which causes slippage of the most braked drum.

Separate adjustments of the drums make it possible to set these pulling stresses to a suitable value in accordance with a normal film traction and guiding action.

In the embodiment illustrated by way of example the invention is shown as applied to a developing machine provided with helical film guiding means consisting of circular or substantially circular tube elements.

It will be obviously apparent that this driving system is applicable whatever be the manner in which the turns are guided, provided only that the tightening of a turn by the film pull be limited and forces the film to be braked in each turn by the tension of the out-coming film, the drum positioned before this turn remaining unaffected by this increased tension.

Again, the friction means interposed between the driving shaft and the drums may be modified without departing from the spirit and scope of the invention.

The drum driving means may be completely independent from those of the film feeding device; they may be the same for the complete set of drums or adapted to drive each drum separately.

Furthermore, the positive-drive film-feeding device using a toothed sprocket as described and shown may be replaced by the sole pulling force exerted by the first drum or by other suitable means without departing from the spirit and scope of the invention.

The latter consists essentially in a device for driving the film by means of drums on which the film is caused to adhere, these drums on the contrary being rotated by driving means adapted to slip about their shafts as soon as the film pull reaches a predetermined value, in braking the film before the first drum in order to cause this drum to slip about its shaft while a device brakes the film between two successive drums so as to prevent the pull exerted by the next drum from affecting the former drum, this braking action being produced by increasing the pull between this fixed portion and the next drum through a winding effect or other suitable means.

What I claim is:

1. Apparatus for feeding and treating a film strip, comprising, in combination, a plurality of stationary, substantially circular tubes adapted to contain film treating fluids and being arranged next to each other about a predetermined axis, each of said tubes extending through almost a complete turn of a helix and having an outlet end located opposite an inlet end of the next succeeding tube; a plurality of drums mounted for rotation about an axis parallel to said predetermined axis and respectively being arranged between the opposite outlet and inlet ends of each pair of adjacent tubes with the peripheries of said drums respectively arranged along circular arcs having their centers in said predetermined axis and respectively extending between the opposite outlet and inlet ends of each pair of adjacent tubes so that a film strip guided through the successive tubes and along the peripheries of said drums will not be sharply bent; friction drive means operatively connected to said drums for rotating the same at a substantially constant predetermined peripheral speed when said drums do not slip with respect to said drive means; feeding means located adjacent said drums and tubes for feeding a film strip to the first of said tubes at a constant speed which is less than said peripheral speed of said drums so that the film strip passing through the successive tubes and engaging said drums will frictionally rub against said tubes and will frictionally engage said drums to retard the rotation thereof so that said drums rotate at less than said peripheral speed and slip with respect to said drive means during operation of the apparatus; and pressure means located opposite the periphery of each of said drums for pressing only opposite side edges of a film strip against opposite side edges of said drums.

2. Apparatus for feeding and treating a film strip, comprising, in combination, a plurality of stationary tubes adapted to contain film treating fluids and being arranged next to each other about a predetermined axis, each of said tubes extending through almost a complete turn of a helix and having an outlet end located opposite an inlet end of the next succeeding tube; a plurality of drums mounted for rotation about an axis parallel to said predetermined axis and respectively being arranged between the opposite

outlet and inlet ends of each pair of adjacent tubes with the peripheries of said drums respectively arranged along circular arcs having their centers in said predetermined axis and respectively extending between the opposite outlet and inlet ends of each pair of adjacent tubes so that a film strip guided through the successive tubes and along the peripheries of said drums will not be sharply bent; friction drive means operatively connected to said drums for rotating the same at a substantially constant predetermined peripheral speed when said drums do not slip with respect to said drive means; feeding means located adjacent said drums and tubes for feeding a film strip to the first of said tubes at a constant speed which is less than said peripheral speed of said drums so that the film strip passing through the successive tubes and engaging said drums will frictionally rub against said tubes and will frictionally engage said drums to retard the rotation thereof so that said drums rotate at less than said peripheral speed and slip with respect to said drive means during operation of the apparatus; and pressure means located opposite the periphery of each of said drums for pressing only opposite side edges of a film strip against opposite side edges of said drums, said pressure means being in the form of three pairs of rolls located next to each other about the periphery of each drum with each pair of rolls having a pair of chamfered annular rim portions respectively located opposite the opposite side edges of said drum.

3. Apparatus for feeding and treating a film strip, comprising, in combination, a plurality of stationary tubes adapted to contain film treating fluids and being arranged next to each other about a predetermined axis, each of said tubes extending through almost a complete turn of a helix and having an outlet end located opposite an inlet end of the next succeeding tube; a plurality of drums mounted for rotation about an axis parallel to said predetermined axis and respectively being arranged between the opposite outlet and inlet ends of each pair of adjacent tubes; drive means frictionally driving each of said drums for rotating the same at a substantially constant predetermined peripheral speed when said drums do not slip with respect to said drive means, said drive means including a shaft and for each of said drums a hub fixed to said shaft, passing through said drum and having an end flange located opposite a side surface of said drum, a first washer located next to said flange between the same and said drum and a first felt ring located between said first washer and drum, a second felt ring located about said hub against the opposite side of said drum, a second washer located against said second felt ring, a rubber tube extending about said hub and being located against said second washer, a plate engaging said rubber tube, and a nut threadedly mounted on said hub and pressing against said plate to maintain the latter pressed against said rubber tube and to maintain said rubber tube pressed against said second washer so that said washers and felt rings are urged together with said drum toward said end flange of said hub; feeding means located adjacent said drums and tubes for feeding a film strip to the first of said tubes at a constant speed which is less than said peripheral speed of said drums so that the film strip passing through the successive tubes and engaging said drums will frictionally rub against said tubes and will frictionally engage said drums to retard the rotation thereof so that said drums rotate at less than said peripheral speed and slip with respect to said drive means during operation of the apparatus and pressure means located opposite each of said drums for pressing a part of a film strip against each of said drums so that the film strip cannot slip with respect to said drums.

4. Apparatus for feeding and treating a film strip, comprising, in combination, a plurality of stationary tubes adapted to contain film treating fluids and being arranged next to each other about a predetermined axis, each of said tubes extending through almost a complete turn of a helix and having an outlet end located opposite an inlet end of the next succeeding tube; a plurality of drums mounted for rotation about an axis parallel to said predetermined axis and respectively being arranged between the opposite outlet and inlet ends of each pair of adjacent tubes; drive means frictionally driving each of said drums for rotating the same at a substantially constant predetermined peripheral speed when said drums do not slip with respect to said drive means; feeding means located adjacent said drums and tubes for feeding a film strip to the first of said tubes at a constant speed which is less than said peripheral speed of said drums so that the film strip passing through the successive tubes and engaging said drums will frictionally rub against said tubes and will frictionally engage said drums to retard the rotation thereof so that said drums rotate at less than said peripheral speed and slip with respect to said drive means during operation of the apparatus; and pressure means located opposite each of said drums for pressing a part of a film strip against each of said drums so that the film strip cannot slip with respect to said drums.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
761,943	Brown	June 7, 1904
1,185,260	Stine	May 30, 1916
1,464,471	Getz	Aug. 7, 1923
1,544,931	Patterson	July 7, 1925
1,686,907	Fairall	Oct. 9, 1928
2,027,451	Rooney	Jan. 14, 1936
2,085,188	Gerlach	June 29, 1937
2,135,516	Hurtzthal	Nov. 8, 1938
2,191,850	Debrie	Feb. 27, 1940
2,246,456	Quigley	June 17, 1941
2,488,142	Pratt et al.	Nov. 15, 1949

FOREIGN PATENTS

Number	Country	Date
447,065	Great Britain	May 11, 1936