Nov. 24, 1936. A. L. V. C. DEBRIE 2,061,552

DEVELOPING MACHINE

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FIG. 1

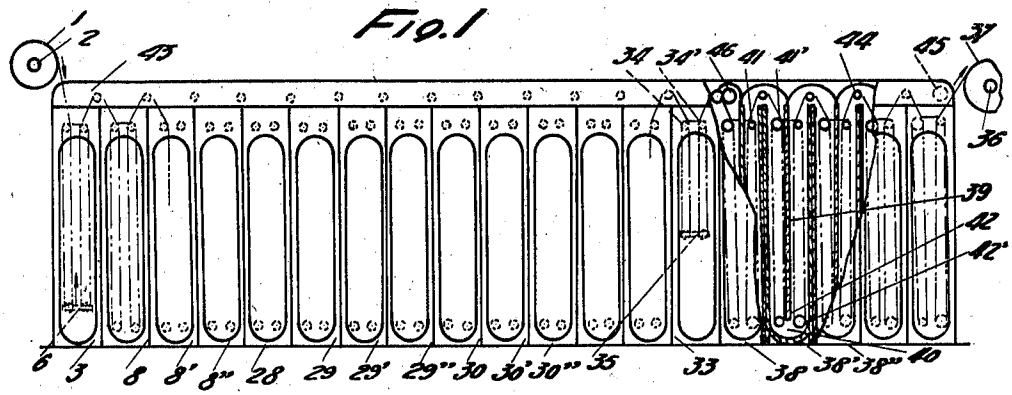
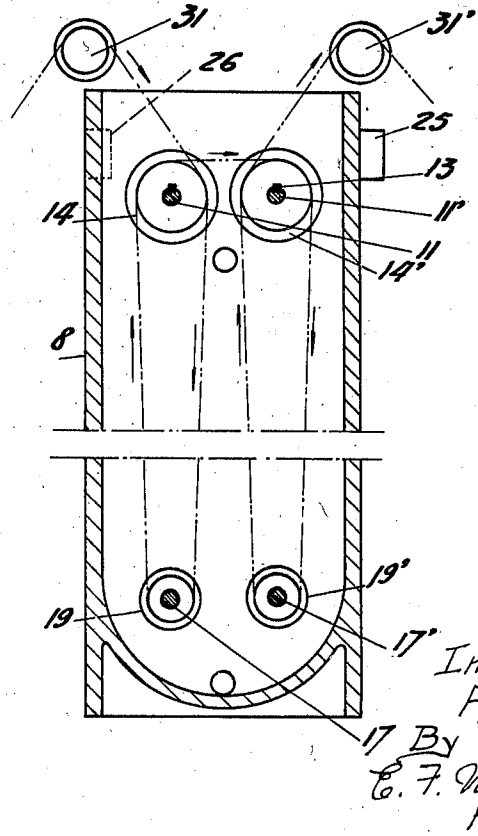


FIG. 2



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FIG. 3

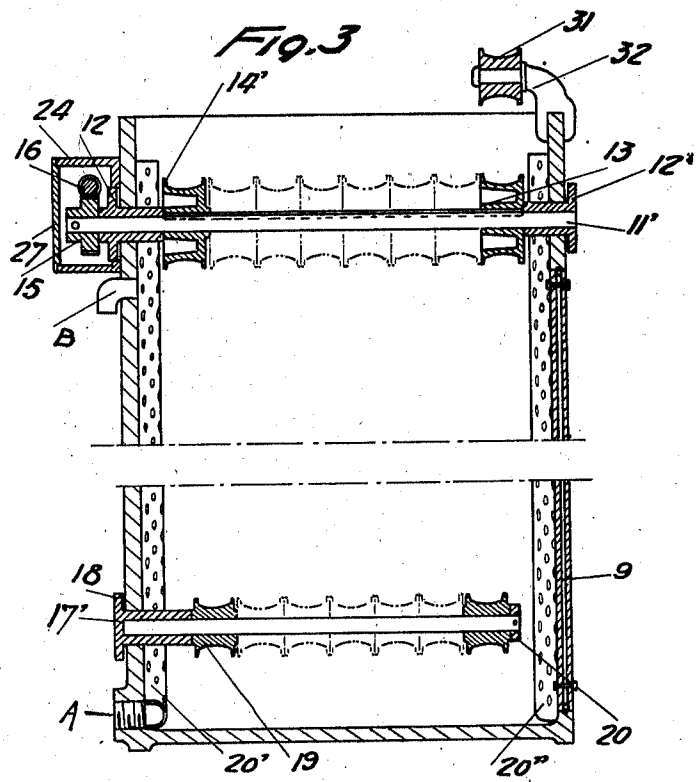
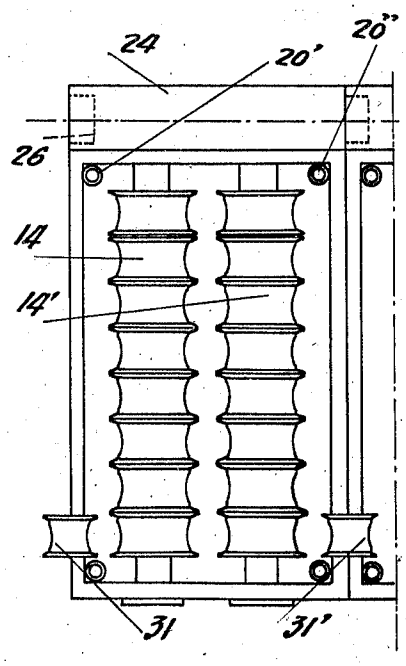


FIG. 4



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Fig. 5

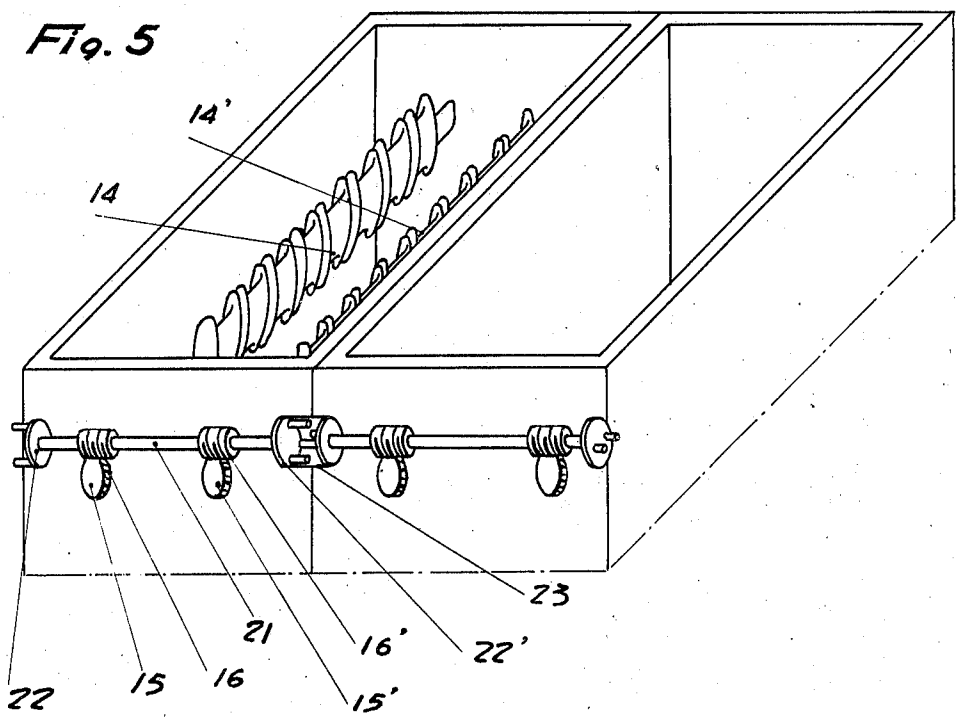
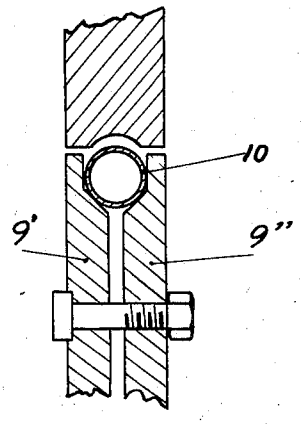


Fig. 6



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DEVELOPING MACHINE

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Fig. 7

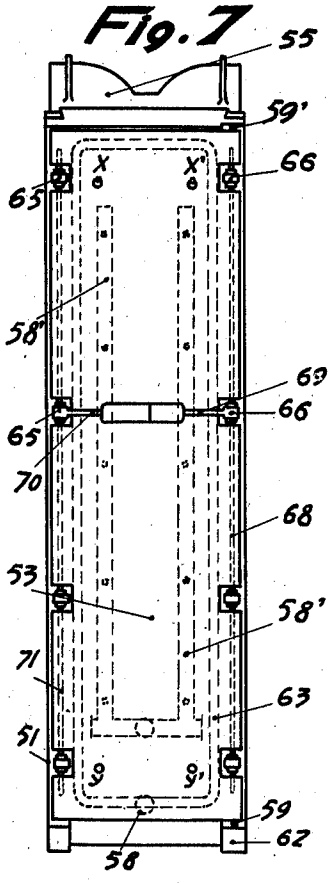


Fig. 8

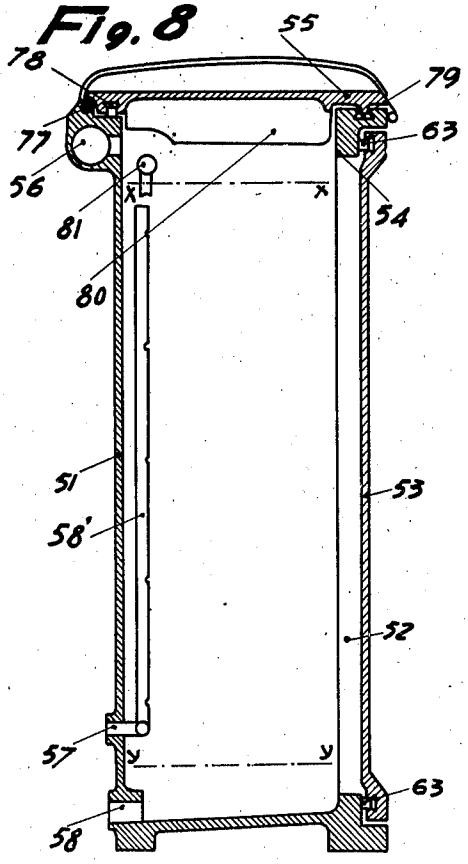
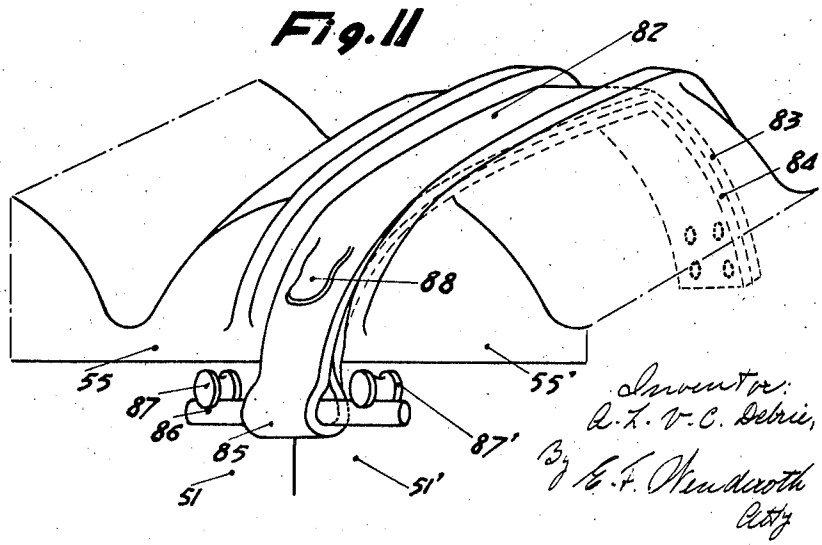


Fig. 11



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Fig. 9

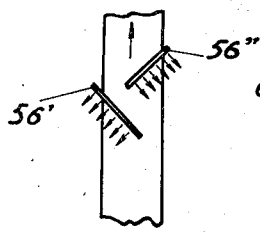


Fig. 10

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UNITED STATES PATENT OFFICE

2,061,552

DEVELOPING MACHINE

André Léon Victor Clément Debrie, Paris, France

Application March 20, 1935, Serial No. 12,102
In France March 26, 1934

18 Claims. (Cl. 95—94)

My invention has for its object an apparatus for developing kinematographic films which is of particularly simple design, easy mounting and high efficiency. It allows the omission of any differentiation between the successive vats composing it whereby the apparatus may be formed of a series of independent interchangeable vats provided each with a loading and cleaning preferably one-part door, said vats being indifferently adapted for use for developing, washing, fixing, drying or for containing the stoppage-compensating means provided in case the film cannot progress any more at one end of its path. The very simple film driving means carried by each vat is adapted for instantaneous connection with the corresponding means in the adjacent vat whereby it is possible to modify at will and without any mechanical complication, the number of vats and their utilization. At the same time I do away with all toothed driving drums or sprocket wheels which I replace to advantage by smooth drums of sufficient diameter to act through mere adherence.

The apparatus according to my invention may include numerous further novel and advantageous arrangements which will be described hereinafter with greater detail: such arrangements comprise inter alia a provision for removing in the manner of the usual provisions the drawbacks resulting from the stoppage of the progress of the film at one end of the apparatus, said provision being particularly intended for making up for the effects of the changing of the take-up reel by allowing at the moment considered the continuation of the progress of the film through the temporary extension of the length thereof afforded by the provision.

I have shown by way of example in accompanying drawings a form of execution of the apparatus according to my invention.

Fig. 1 is a general elevational view thereof,

Figs. 2, 3, 4 show an interchangeable vat in longitudinal cross-sectional and plan views,

Fig. 5 is a part perspective view of two adjacent vats with their film-driving means and the control thereof,

Fig. 6 is a view at a larger scale of the door of the vat,

Fig. 7 is a lateral view of a modified vat seen sideways,

Fig. 8 is a cross-sectional view of the latter vat, the section being made through a plane perpendicular to the plane of Fig. 7,

Fig. 9 is a diagrammatical figure illustrating the manner of blowing air into the vat for removing the water after each treatment,

Fig. 10 shows the locking means for the door and Fig. 11 the manner of securing the cover of the vat of Figs. 7 and 8.

The apparatus the whole of which is shown in Fig. 1 is constituted by a plurality of similar narrow vats preferably of moulded material arranged with the longest sides of two adjacent vats in contact. The vat shown at 3 contains the first film provision, those at 8, 8', 8'' contain the developer, those at 28 . . . the water, those at 29, 29', 29'' . . . the fixing liquid, those at 30, 30', 30'' . . . serve for washing, the vat at 33 contains the second film provision and the vats 38, 38', 38'' . . . serve for drying, these latter replacing the usual kiln. Obviously the number and use of the different vats may vary at will according to the conditions of operation. The vats are closed by a cover 45 composed of interchangeable elements. The film, advancing at variable speed through the successive vats in which the path assigned to it is submitted to no modification except in the vats containing the film provision, winds off the feed reel 1 frictionally mounted on its axis 2 and enters the film-provision vat 3 and thence it passes into the following vats. All the vats have two upper horizontal transverse axes 11, 11' rotatably carried through one or both ends in the small or lateral sides of the vat and carrying smooth drums 14, 14' the diameter of which is sufficient to ensure the frictional drive of the film passing over them. The vats also comprise, except the film-provision vats, two lower horizontal transverse axes 17, 17' which are only secured to one small side of the vat through the sleeve 18 so as to leave a certain play between the other small side of the vat and the stop ring 20 fitted on their free ends. These lower axes also carry smooth flanged drums 19, 19' mounted loose on said axes and serving only for unwinding purposes. The diameter of these drums may thus be smaller than that of the upper drums, whereby the film portions passing from an upper drum to a lower drum are constrained to lie obliquely with reference to the moving liquid. The number of drums on a lower axis is smaller by one with reference to the number of corresponding drums 14, 14' keyed through the key 13 to an upper axis 11 or 11'. These upper axes are rotatably mounted in the journals 12, 12' secured in the wall of the vat and their rotation which provides that of the drums 14, 14' is ensured by the pinions 15 keyed to the different upper axes

on the outside of the vat, preferably on the side carrying the sleeves 18 carrying the lower axes.

These pinions 15 are driven by the worms 16 on the stub shaft 21 carried in the example shown on the outside of the vat considered in parallelism with the axis of the vat directed longitudinally of the apparatus. This stub shaft carries at each end a driving plate 22 or 22' adapted to engage when the adjacent vat is in place, the corresponding plate 22' or 22 of the latter, a driving joint or packing 23 being provided between the two plates. A casing 24 contains these different driving parts 15, 16, 21, 22, 22', 23 outside the vat and has a cylindrical or the like extension 25 at one end and at the other a recess 26 adapted to house the extension 25 of the casing on the adjacent vat. The casing is closed sideways by a door 27. It is aparent that such successive and automatic connections between the adjacent vats through parts such as 25—26 on one hand and 22, 22' on the other provides both the assembly of the vats and the connection and centering of the different stub shafts 16, the rotation of which provides the general rotation of the driving drums 14, 14'.

Each vat carries also on the side opposite the casing 24 two pulleys 31, 31' mounted on squares 32 above the upper edge of the vat underneath the cover thereof, said pulleys serving as a guide for the film between the vat considered and the adjacent vat nearest the pulley.

In the small side of each vat opposite the casing 24 there is also provided in front of the free ends of the lower axes an opening closed by a door 9, the opening of which allows the cleaning of the vat and the mounting of the film on the lower drums. Watertightness is obtained advantageously by means of a solid rubber packing or a small diameter air-chamber 10 inserted at the grooved periphery of the two superposed parts 9, 9'' forming the door. Once the latter is in place, it is sufficient to fasten for instance by bolting, the assembly of parts 9', 9'' so as to make the solid rubber or air chamber 10 act as a watertight packing between the door and the edge of the opening receiving it (Fig. 6).

The winding of the film over the different drums forms a large number of loops which increase considerably the path of the film and consequently the efficiency of the apparatus. This winding is performed as follows: after opening the doors 9 for allowing the passage of the loops over the free ends of the lower axes, I cause the film coming from the pulley 31 to pass over the upper drum 14 on the adjacent upper axis which is nearest the corresponding small side of the vat. The film is then passed round the lower drum 19 which is almost directly underneath this first drum, and then over the upper drum 14 adjacent said first drum. It is then passed downwards round the lower drum 19 adjacent to the first lower drum and so on until the film has passed over all the higher and lower drums on the axes to one side of the vat. From the last upper drum 14, the film is passed over the last upper drum 14' of the upper axis 17' from which it passes downward round the underlying last drum 19' of the lower axis 17' and so on until it reaches the first upper drum 14' facing the upper drum 14 over which the winding in the vat has begun, the film passing then-after out of the vat on to the pulley 31'. Obviously, there exist disconnecting means allowing, through an action on the key 13 by means of a nut, flywheel or the like, the upper drums to be disconnected with reference to their shaft or axis during the above-described operation.

The admission of the bath into each vat is effected through a pump forcing the liquid into the lower part A of the vat through a series of tubes 20', 20'' arranged in the corners of the vat; these tubes are provided with a large number of perforations through which the liquid escapes, which ensures the proper commingling of the bath and regulates its activity; the outlet of the liquid is at B at the upper part of the bath. Only the vats 3 and 33 containing a provision of film length differ from the others inasmuch as the lower stationary axes 17, 17' are replaced by an equivalent system of suspended drums forming a pulley block 6 allowing a modification in the total length of the film in the apparatus at the moment of a stoppage at the corresponding end of the apparatus. In the case of the entrance film provision 3, the weight of the pulley block with its fittings is greater than the braking force due to the friction of the feed drum 1 on its spindle. Consequently during normal operation this block 6 remains during operation at the lower part of the vat. When the feed reel is stopped during the time required for the insertion of a fresh film length and its connection with the length still under development, the pulley block 6 rises up to about the middle of the height of the vat under the action of the traction exerted by the film ahead which continues advancing through the apparatus, which compensates thus the action of the stoppage of the film at the entrance of the apparatus. As soon as the feed reel is again operative, the pulley block 6 sinks under the action of its weight so as to restore the original length of the film provision and the normal tension of the film entering the apparatus.

On the contrary the provision 33 disposed ahead of the drying vats becomes operative when the part of the film wound over the take-up reel 37 frictionally mounted on its axis 36 is removed. During the replacement of a full reel by an empty one and the starting of operation with the latter, there is a stoppage at the exit from the apparatus and the film contained in the drying vat ceases progressing, the drums in these latter vats being all mounted loose on their spindles as described hereinafter. On the contrary the film continues advancing in the vats preceding the provision vat 33. Consequently the pulley block 35 in the provision vat 33 the weight of which is smaller than the force of traction due to the normal progression of the film and which, in contradistinction with the pulley block for the usual film provision at the entrance, remains normally at the upper part of the vat, sinks down to the middle of the height of the latter under the action of the progress of the film to the rear of it. Reversely when normal progress is resumed, the pulley block 36 rises under the action of the tension of the film ahead and the provision returns to its normal state. This provision vat before the drying vats may comprise water removing means for the celluloid support side of the film.

After developing, washing, and passing through the provision vat, the film passes through the vats 38, 38', 38'' used for drying. A partition 39 divides each of these vats into two compartments and leaves at its lower end a free space 40 for the passage of the drying air and of the film. This ensures a restriction for the air passage in front of the film which increases substantially the efficiency of the drying system. In contra-

distinction with the developing, washing and fixing vats, the upper drums in the case considered where the outlet provision vat **33** is disposed in front of the drying vats, are not keyed to their spindles **11**, **11'**. In this case it is possible to arrange the large diameter drums no longer exclusively on the upper spindle but in alternation for instance on the upper spindles **11** and on the lower spindles **17'** while the small diameter drums are set over the spindles **11'** and **17** of the same vat. Under such conditions it is possible to make the film pass from the entrance spindles on to the outlet spindles after passing under the partition **39**, the film strips remaining always, by reason of the arrangement of the rollers, oblique with reference to the direction of the air threads entering through **45** against the direction of progress of the film and passing out through **48**. The elementary covers **43** corresponding to the drying vats form incurved sheaths **44** covering the upper part of two adjacent half vats of two successive drying vats, a special part being of course used for covering the first half-vat in the drying section. I may also provide a speedometer giving out in the usual manner the time of development, said speedometer being controlled by the general control motor.

In the modification of Figs. 7 and 8 the vat **51**, which is of an acid-proof material, has on one of its small sides, i. e. side which does not come into contact with the adjacent vat, a loading aperture **52** extending in the case shown throughout the area of the side considered. A door **53** which is made of the same material as the vat itself closes said aperture.

The aperture **52** is bounded at its upper part by a stay **54'** with a rabbet, said stay being cast in one with the vat of the upper edge of which it forms an extension above the door. This stay carries the edge of the cover **55** also of the same material as the vat. The four roller spindles XX'—YY' are carried by the vat side opposed to the door side. A channel **56** serving for the distribution of compressed air is provided at the upper part of the small side of the vat opposed to the door and to the stay **54**. This distributor channel feeds nozzles such as those shown apart in Fig. 9 at **56**, **56''** which open in front of the film elements passing out of the vat on the door side whereby the entrained liquid drops are removed by the blast of air from the film passing out of a developing, fixing or washing bath in the vat. The blowing on the film is effected from the middle towards its edges as illustrated in Fig. 9 and as disclosed in Phillipe's U. S. specification 1,748,188.

The apertures **57** and **58** provided in the same side as the distributor channel **56** serve for the admission and removal of the developing, fixing and washing liquids in the vats, said liquids being forced through **57** into the vertical aspersion tubes **58'**, **58''** arranged inside the vat on the side opposed to the door. The aspersion of these liquids is effected between the opposite sides of the supporting surfaces of the film loops passing from the lower rollers of one of the spindles Y or Y' on to the upper rollers of the corresponding spindles X or X'. I obtain thus a perfect and speedy stirring of the liquids which ensures a perfect regularity of development or fixation and a better washing for a smaller consumption of water. The door **53** is carried at its upper and lower ends through the alined pivots **59**, **59'** (Figs. 7, 10) slidingly held in horizontally elongated holes such as **60** provided in a small plate **61** secured to a projection **62** on the vat **51**. A packing **63** of yielding material is fitted round the periphery of the door. The bolting of the door against the aperture **52** which also ensures the desired crushing of the packing, is performed along two vertical edges of the door through the agency of a series of elements **65** or **66** distributed over the height of the door in a manner such as will absorb in a uniform manner the pressure of the inner liquid. The lower elements **65** or **66** are therefore closer to one another than the upper elements and consequently the packing **63** is applied against the body of the vat through fastening means compensating at all points the variable pressure of the liquid. The elements **65** or **66** comprise primarily a strap such as **65** secured to the edge of the vat facing the door and engaging the hooks **64**, **64'** (Fig. 10) rigidly secured to the door. The fastening of these hooks in the strap **65** is effected through the eccentrics **67** which are rotatable round a common rod **68** which may end with the above mentioned pivots **59**, **59'**. The common control of the eccentrics on one side of the door is effected by levers **69** (or **70** on the opposite side of the door) secured through pins to the eccentrics **67** and their control rod **68** (or **71** for the opposite side of the door). Thus the motion given to the levers **69** is transmitted to the eccenters **67** for providing the secure application of the packing **63**. The unbolting is obtained through the reverse displacement of the levers which disengage the corresponding straps **15** from their hooks **64**, **64'**. The uniform crushing of the packing **53** to either side of the door is rendered possible by the transversal shifting of the hinge line **59**, **59'** allowed by the above described play of the pivots in the elongated holes **60**.

In order to prevent any untimely operation of the levers **69** and **70**, the opposite levers lying at the same lever are secured together when desired in the following manner; on one or more levers **69** there is secured through a pin a sleeve **72** provided with a male threaded part **73** while on the corresponding lever **70** there is mounted loose a sleeve **74** the longitudinal path of which is bounded by the stop rings **75**, **76** secured through pins to the lever **70**. This sleeve **74** is provided with a female threaded part adapted to be screwed over the threaded male part of the sleeve **72** whereby the whole arrangement of levers **69**, **70** may be locked and consequently the door completely bolted.

As the vats are interchangeable, they must be light-tight when used in the developing section and they must retain the air pressure required in the drying section. They may be provided to this end at their upper end with a cover **75** hinged at **77** and bearing on the upper edge of the vat against which it crushes the packings **78** and **79**. To the mean part of the cover, considered in the transverse direction of Fig. 7, there is secured an air deflector or membrane **80** recessed so as to afford means for the passage of the transverse shaft **81** controlling the driving spindles XX' of the film. It should be noted that this control, originally provided on the outside of the vat is thus brought advantageously inside same.

The covers are applied on their vats as shown in Fig. 11. They cannot overlap from one vat to the other as they are to open independently one from the other. Consequently there is provided a belt **82** which ensures the closing of the adjacent halves of the covers of two adjacent vats, by providing the joint between said covers.

This belt, of rubber for instance, has an inner layer **83** which is less hard than the outer layer **84**. This belt is hooked at each end over the small sides of each of the corresponding vats by means of a loop formed by the outer layer of the belt and through which a spindle **86** is inserted. This spindle is held by two stops carried by the corresponding side of each of the adjacent vats respectively. In order to further the securing of the belt, a tongue **88** is secured to the outer layer **83**. The tractional stress exerted for applying said layer **83**, at the moment of hooking the belt under its stops has for its result the crushing of the layer **84** which forms a joint by reason of its higher elasticity.

It is apparent that the machine according to my invention which is formed of standard elements the type of which may obviously be modified at will, may be adapted to all requirements as to place and working by modifying the number, the intended use and certain secondary arrangements of the vats.

What I claim is:

1. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluidtightly closing the aperture in each vat and horizontal spindles for driving and winding the films through each vat.

2. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluidtightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, rollers carried by said spindles for driving and winding the films through the vat and control means for the driving rollers.

3. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluid tightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, rollers carried by said spindles for driving and winding the film through the vat and control means for the driving rollers adapted to engage in an immediate manner with the control means of the adjacent vats.

4. In a machine as claimed in claim 1, the arrangement of frictionally acting film-feeding and film take-up reels at either end of the machine.

5. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluidtightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, rollers carried by said spindles for driving and winding the films through the vat and control means for the driving rollers including a horizontal shaft rotatably carried in parallelism with a small side of the vat, worms engaged by same carried by the upper horizontal spindles and driving plates on the horizontal shaft to operatively engage in an immediate manner the corresponding plate of the adjacent vat.

6. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluidtightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, rollers carried by said spindles for driving and winding the film through the vat, control means for the driving rollers adapted to engage in an immediate manner with the control means of the adjacent vats, and a pulley block in the first vat used over which block a film length is adapted to be wound and the weight of which is slightly greater than the frictional effort produced by the feed reel.

7. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluidtightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, rollers carried by said spindles for driving and winding the film through the vat, control means for the driving rollers adapted to engage in an immediate manner with the control means of the adjacent vats, and a pulley block provided in one of the vats following those used for developing, washing and fixing over which block a length of film is wound for carrying said block the weight of which is slightly less than the frictional stress exerted by the take-up reel.

8. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluidtightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, the upper spindles being rotatable and the lower stationary spindles terminating short of the door, rollers keyed to the upper axes, rollers mounted loosely on the lower axes and means for driving the upper axes.

9. In a machine as claimed in claim 1 two superposed plates forming the door with a groove at their common periphery, a yielding packing in said groove engaging the edge of the vat aperture and means for fastening the two plates together.

10. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluidtightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, rollers carried by said spindles for driving and winding the films through the vat, control means for the driving rollers including a horizontal shaft rotatably carried in parallelism with a small side of the vat, worms engaged by same carried by the upper horizontal spindles and driving plates on the horizontal shaft to operatively engage in an immediate manner the corresponding plate of the adjacent vat and interengaging casings on the outside of the different vats containing the said control means.

11. In a machine as claimed in claim 1, a pulley carried by each vat above its upper edge at each side thereof for unwinding the film as it enters and passes out of the vat.

12. In a machine as claimed in claim 1 perforated tubes in the angles of the vats through which the baths may be forced into the vats.

13. In a machine as claimed in claim 1, a horizontal channel provided along one upper edge of each vat, and nozzles communicating therewith adapted to blow air from the middle towards the edge of the films passing out of the vat.

14. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluidtightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, rollers carried by said spindles for driving and winding the films through the vat, control means for the driving rollers and means for forcing liquid under pressure between the opposed sides of the film loops formed between corresponding upper and lower rollers.

15. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each on one of its small sides with a loading and cleaning aperture, a door for fluid tightly closing the aperture in each vat, two pairs of horizontal spindles secured respectively to the top and bottom of each vat and lying parallel to its long sides, rollers carried by said spindles for driving and winding the films through the vat and control means for the driving rollers including a horizontal shaft rotatably carried in parallelism with a small side of the vat and arranged inside said vat, worms engaged by same carried by the upper horizontal spindles and driving plates on the horizontal shaft to engage in an immediate manner the corresponding plate of the adjacent vat.

16. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each throughout the area of one of its small sides with a loading and cleaning aperture, a stay above the aperture closing the upper end of the aperture, a door for fluidtightly closing the aperture in each vat, a packing between the door and the edge of the opening, horizontal guideways for the door on the vat, a series of locking means arranged along both vertical edges of the door adapted to compress said packing when operative, means for controlling the locking means on both sides of the door and horizontal axes for winding the films through each vat.

17. A film developing machine comprising a series of interchangeable vats adapted to be arranged in contact with one another through their long sides and provided each throughout the area of one of its small sides with a loading and cleaning aperture, a stay above the aperture closing the upper end of the aperture, a door for fluidtightly closing the aperture in each vat, a packing between the door and the edge of the opening, guideways for the door on the vat, a series of locking means arranged along both vertical edges of the door adapted to compress said packing when operative, a vertical shaft on either side of the door, eccentrically mounted levers rigid therewith and controlling the corresponding locking means, means for bolting together an eccentric lever on one side of the door with an eccentric lever on the other.

18. In a machine as claimed in claim 1, covers adapted to close each vat and belts adapted to be secured to two adjacent vats for forcing the adjacent half covers on the two adjacent vats to bear in an airtight manner thereon.

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