

March 25, 1952

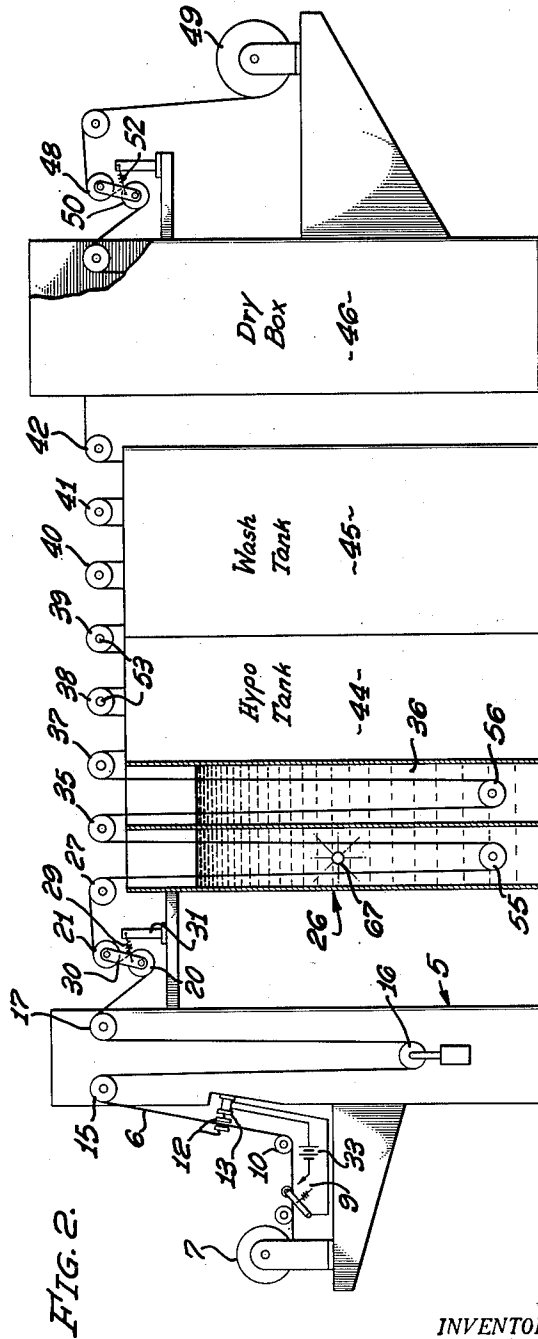
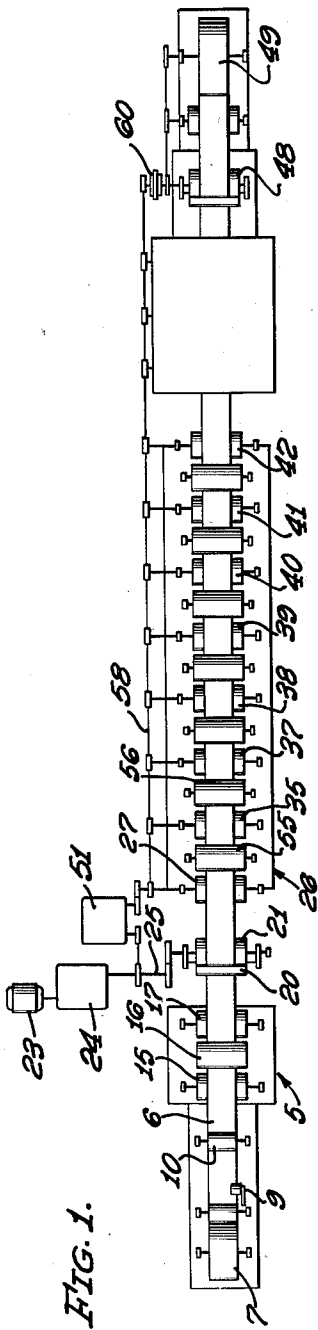
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2,590,699

DRIVE FOR PHOTOGRAPHIC MATERIAL

Filed Oct. 20, 1947

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

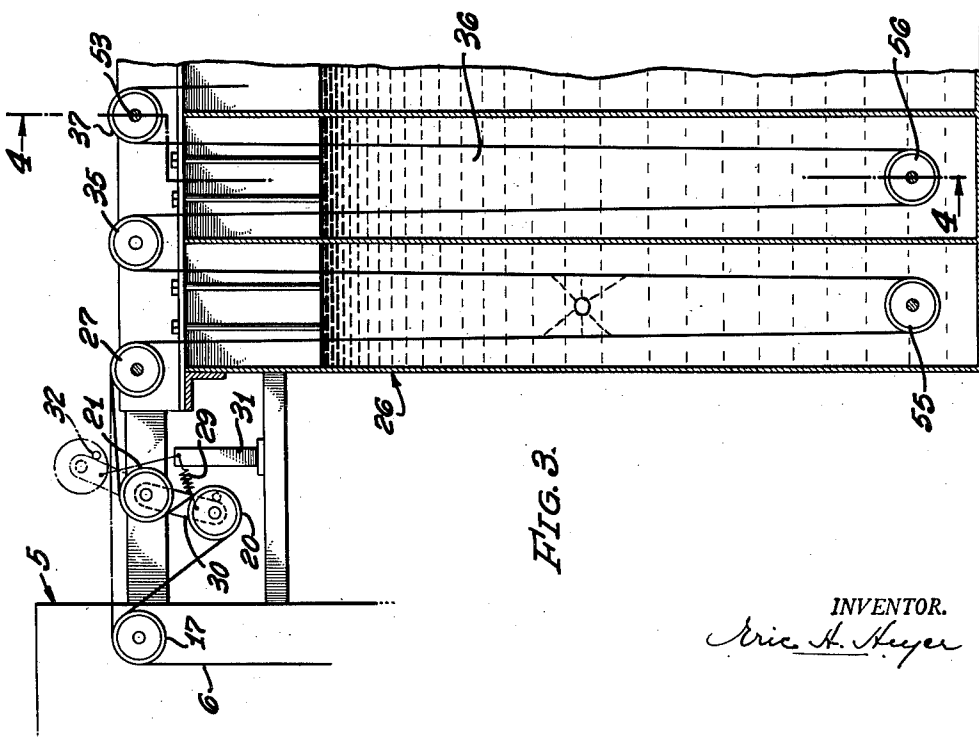


FIG. 3.

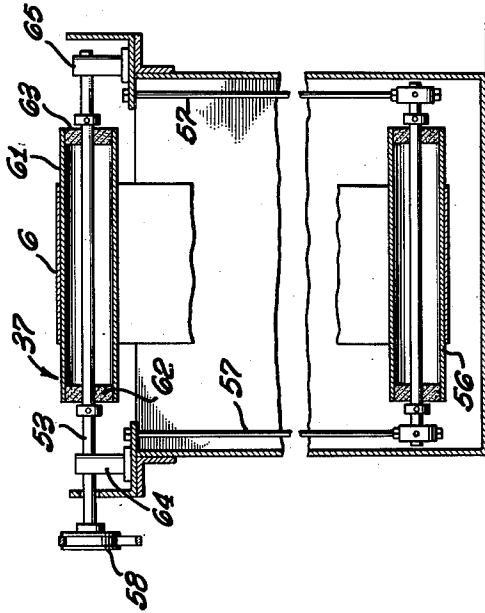


FIG. 4.

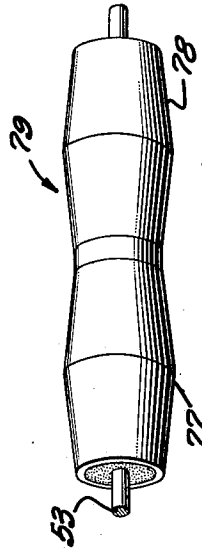


FIG. 5.

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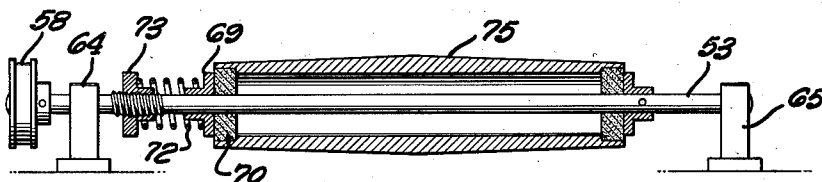


FIG. 6.

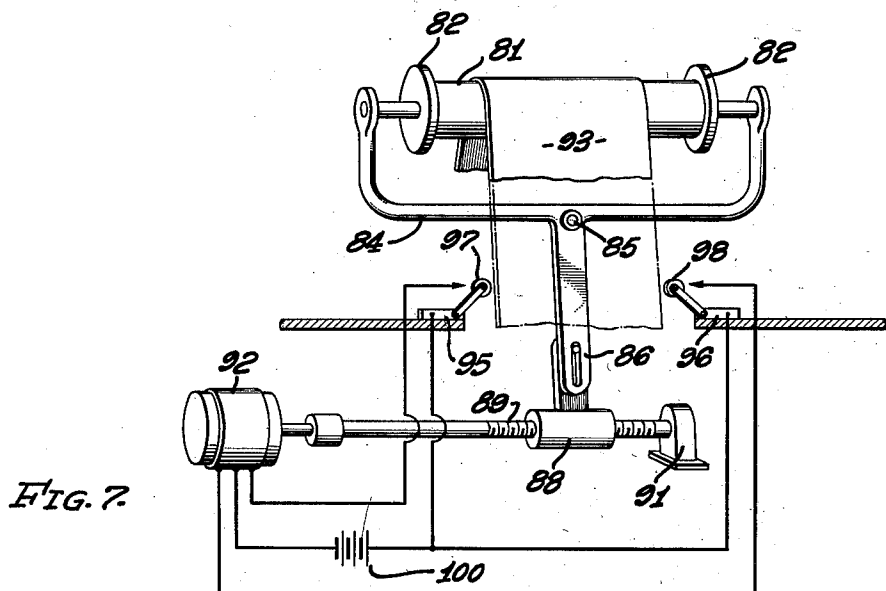


FIG. 7.

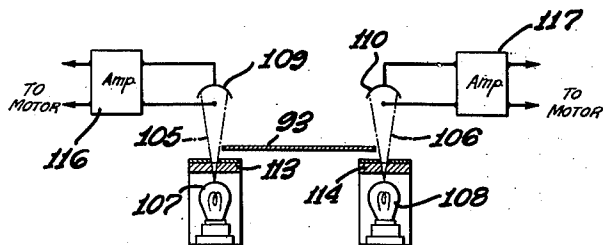


FIG. 8.

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UNITED STATES PATENT OFFICE

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DRIVE FOR PHOTOGRAPHIC MATERIAL

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8 Claims. (Cl. 271—2.3)

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This invention relates to film developing apparatus, and particularly to a driving system for advancing film strips through the series of solutions and fluids required to develop, fix, wash, and dry the film.

The continuous developing of motion picture film through a series of developing, fixing, and washing tanks and drying cabinets is well-known. It is also well-known that raw film stock, when immersed in the different solutions, expands or stretches, while it contracts or shrinks during the drying process. These facts necessitate a film advancing medium which compensates for these variations in film length during the developing and drying treatment of the film, while providing proper and equalized tension throughout the film length. In color photography, where the number of process steps is many times that for black and white film, the film drive is particularly important to obtain the correct timing of each step.

This problem has been solved by others in various ways, an on and off frictional drive being disclosed in United States Patent No. 2,146,170 of February 7, 1939. The majority of prior developing machines are adapted to motion picture film having sprocket holes for metering the film, the constant width of the film permitting standard guide and drive rollers to be used. The present invention is suitable for any width film material with or without sprocket holes, such as roll films, amateur prints and paper, etc., and provides substantially equal tension in all film loops, regardless of changes in length, while automatically guiding the film strip, regardless of its width. The invention makes possible the continuous development of emulsions on paper strips which have very low tensile strength. The simultaneous developing of two or more film strips side by side is also possible, a film end safety grip being provided together with a safety release feed.

The principal object of the invention, therefore, is to facilitate the developing of photosensitive emulsions in strip form.

Another object of the invention is to provide an improved feed or advancing mechanism for photographic film or print stock.

A further object of the invention is to provide an improved film strip drive in which substantially uniform tension is obtained along the length of the film throughout the developing process.

A still further object of the invention is to provide a metering drive with safety feed release and film end grip.

A still further object of the invention is to provide an automatic film roller guide for film or print strips without edge contact of the strips with a guiding means.

Although the novel features which are believed to be characteristic of this invention will be pointed out with particularity in the appended claims, the manner of its organization and the

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mode of its operation will be better understood by referring to the following description read in conjunction with the accompanying drawings, forming a part hereof, in which:

5 Fig. 1 is a plan view of the general arrangement of the film drive embodying the invention.

Fig. 2 is an elevational view of the film drive shown in Fig. 1.

10 Fig. 3 is an enlarged, elevational view of the metering and safety release features used in the film drive of the invention.

Fig. 4 is a cross-sectional view of one of the drive rollers of the invention taken along the line 4—4 of Fig. 3.

15 Fig. 5 is a perspective view of a multiple strip drive roller usable in the invention.

Fig. 6 is a cross-sectional view of a modification of a drive roller of the invention.

20 Fig. 7 is a combination diagrammatic and perspective view of an automatic guide roller for the film strips, and

Fig. 8 is a partial view of a modification of the control portion of the guide roller system of Fig. 7.

25 Referring now to the drawings, in which the same numerals identify like elements, an accumulator cabinet 5 receives a film strip 6 from a roll 7, after passing through a switch 9 normally held open by the film, a roller 10, through the jaws 12 of a solenoid 13, and over a roller 15. The film then passes around weighted roller 16 and over roller 17 to the metering and safety release rollers 20 and 21. In Fig. 1, the metering roller 21 is shown driven from a motor 23 through a variable speed reducer box 24, and then through any suitable positive drive 25 such as shafts and gears, chains and sprockets, or belts and pulleys. The speed of roller 21 is adjustable by box 24 to permit any desired amount of film or print stock to be fed to the developing tank 26 over roller 27 in any given period of time depending upon the type of emulsion being processed, the type of developer being used, and the temperature of the developer. Since the roller 20 provides a tight wrap over roller 21 which is solidly fastened to its drive shaft, by the tension of a spring 29 connected to roller arm 30 and anchor support 31, accurate metering of the film fed to the developer is obtained.

30 The arrangement of rollers 20 and 21 also provides a safety release for the film drive in the event of a loop loss in the accumulator. This is accomplished by having the arm 30 rotatable on the axis of roller 21 and the tension of spring 29 such that before the tensile strength of the film strip is exceeded, the arm 30 is rotated against the spring tension to a stop position shown by the dotted lines (see Fig. 3) where the roller 20 is again held in release position by the spring 29 against a stop 32. Now, since the surface of roller 21 is below the straight line path between the surfaces of rollers 17 and 27, which the film strip

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occupies, the film ceases to be fed into tank 26 even though roller 21 continues to rotate. The subsequent rollers of the developing machine are not sufficiently positively driven to pull the film into tank 26.

Before continuing the film drive, reference is made to the operation of the film end grip 12—13. When the end of the film passes switch 9, permitting it to close, energy is supplied to solenoid 13 from any suitable source of supply such as a battery 33, which closes jaws 12 and holds the end of the film stationary. This operation may also energize a signal so that an operator may be apprised of the fact that the end of the film roll is reached, and he can attach the end of new film roll thereto or a leader, the time for this operation being provided by the film loop in the accumulator 5.

After development in tank 26, the film passes over roller 35 to a short stop tank 36, and then over rollers 37—42 through a hypo tank 44, a wash tank 45, to a dry box or cabinet 46. The film strip then passes over roller 48 to a take-up reel 49. The film is wrapped around roller 48 by an idler roller 50 tensioned by a spring 52 similarly to the arrangement of roller 20—21, the rollers 48—50 compensating for momentary increases in film tension due to dry box contraction. It is to be understood that other developing steps may be used with the same strip drive, since the film expands and contracts in length as it passes through the liquids and dry air, the rollers 35 and 37—42 being driven in a novel manner. First, a positive drive is provided between speed control box 24 and a second speed control box 51, which provides a predetermined constant speed for the shafts 53 of the above-mentioned rollers. The rollers at the bottom of the tank such as 55 and 56 are idler rollers and not driven in any manner, they being supported on rods 57, as shown in Fig. 4.

The shafts 53 of each of the top rollers are driven through belts, chains, or shafts as shown diagrammatically at 50, while the roller 48 may have a clutch release 60 to stop the film during the exchange of take-up reels. The clutch 60 also provides for more positive drive for the roller 48, the roller 50 providing the necessary safety factor in view of the more positive drive. In Fig. 4, the roller 37 is shown as a cylinder 61, preferably slightly crowned (see Fig. 6), and having end bearing discs 62 and 63. These discs are of any oil-less bearing material such as "Parock," which is a rubber graphite composition containing approximately eighty percent graphite. Another suitable material is "Grafitar," a carbon and graphite composition. These materials are not affected by developing solutions, require no oil, and have substantially the same coefficient of friction whether running in liquids or dry. Now, to provide a predetermined and uniform tension on the film from roller 21 to roller 48, the shafts 53 of the top rollers are driven at substantially twice the rotational speed required to pass the film through the tanks. This shaft speed is controlled by control box 51 in relation to the speed of metering roller 21. The shafts 53, of course, rotate on standard bearings 64 and 65 in which each is mounted. If too great a tension is placed in the film at double shaft speed, the speed may be decreased by adjusting box 51, while it is increased in case the expansion of the film is greater than the double speed can accommodate. The frictional pull between the shafts 53 and the bearing material of

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the discs 62 is substantially a constant at any certain shaft speed, the discs having bearing surfaces of a predetermined area to maintain this constant frictional drive. For instance, since each drive roller takes care of the frictional loss in the idler roller, such as 55 or 56, just ahead of it, there is no accumulation or building up of tension in the film strip at any point in the film path through the developing process. Where contraction occurs, the drive shafts handling this portion of the film strip may be rotated slower than the other shafts handling the expanding portions of the strip to compensate for shrinkage and contraction of the film. This is accomplished by varying the pulley or gear sizes of the respective drive shafts.

Referring to Fig. 2, a jet or high velocity spray nozzle 67 is illustrated, this nozzle adding turbulence to the developer to provide better chemical action between the developer and emulsions. However, these devices increase the solution drag on the film, and tend to increase the film loop, and a greater driving tension or force is, therefore, required than that provided simply by the friction between shafts 53 and discs 62—63, which is sufficient for normally agitated solutions and to overcome the friction of the lower idler rollers such as 55 and 56. To add the desired amount of frictional drive where spray nozzles are used, the end clutch shown in Fig. 6 is used, wherein a non-corrosive metal or plastic disc 69 is pressed against a graphite bushing or disc 70, similarly to discs 62—63 of Fig. 4, by a spring 72 having one end abutting a flange 73 threadedly adjustable on the shaft 53. The flange 73 may not necessarily be threaded, but may be slidable on shaft 53 to the desired position and locked with a set screw to the shaft. By this arrangement, however, certain rollers such as 35, 40, and 42 may be more strongly driven than the other rollers to provide the proper advancement of the film strip.

In Fig. 6, it is noted that the surface of roller 75 is slightly crowned, and by utilizing this principle, a film strip will remain centralized on the roller. Rollers with two or more crowns, as shown at 77 and 78 on roller 79 in Fig. 5 may advance a plurality of film strips simultaneously through the developing machine while maintaining each film or paper strip in its respective path. To obtain more positive strip guiding which may be necessary where wet film strips of paper bases are driven over smooth rollers, the devices of Figs. 7 and 8 have been provided.

Referring now to Figs. 7 and 8, an idler roller 81, which may be cylindrical if desired, or slightly crowned, has safety flanges 82 at the ends thereof. This roller may also be a drive roller by connecting a flexible shaft thereto. The roller 81 is sufficiently long to accommodate the widest film or paper strip to be developed. This roller is mounted on a yoke 84 pivoted at 85 and having its end 86 attached to a nut 88 threaded on a screw shaft 89. The shaft 89 has one end mounted for rotation in a bearing 91 and the other end attached to the shaft of a reversible motor 92. On each side of a film strip 93 are adjustable micro switches 95 and 96 having their rollers 97 and 98 positioned slightly away from the edge of the strip 93 when the strip is properly centered on the roller 81. The switches 95 and 96 are adjustable to accommodate the width of the film strip being processed. Now, should the strip 93 move to one side or the other on the roller, due to such reasons as unequal contractions or

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expansions of the film, one of the switches 95 or 96 will be closed, which will energize the motor 92 from a suitable power source 100 to tilt the axis of the roller 81 in a direction to cause the film to return to its centralized position. The three conductor energizing system for the motor will drive the nut 88 in the proper direction in accordance with whichever energizing switch is closed by the strip 93.

As mentioned above, this developing apparatus drive is also suitable for paper photographic stock which, when wet, has little stiffness, rigidity, or tensile strength compared with film having a nitrate and acetate base. To permit such paper strips to be guided on rollers 81, the photoelectric cell control arrangement shown in Fig. 8 has been provided. The strip 93 now has its edges adjacent and between two light beams 105 and 106 projected by lamps 107 and 108, respectively, toward photocells 109 and 110. To protect the undeveloped or partially developed emulsion, the lamps 107 and 108 may be infrared or enclosed visible light lamps with filters 113 and 114 with a cut-off frequency beyond the sensitiveness of the emulsion being developed. Now, when the strip 93 moves off position intercepting one or the other of beams 105 or 160, the resulting electrical pulse is amplified in respective amplifier 116 or 117 which is transmitted to the control circuit of motor 92 to drive it in a direction to return the strip to its proper position on roller 81. By equipping several of the series of driving rollers 27, 35, and 37 to 42 or idler rollers 15 or 17 with guiding mechanisms, as shown in Figs. 7 and 8, perfect guiding of various width film or paper stock may be safely obtained, while being advanced through the necessary series of developing tanks and cabinets for any type of emulsion. As mentioned above, the drive rollers would be driven with flexible shafts.

I claim:

1. A drive mechanism for a developing machine to advance photographic material comprising a support, a plurality of driving rollers on said support, a plurality of intermediate idler rollers on said support, a roller for determining the rate of feed of a film into said machine, a roller swingable about the axis of said feed roller, said photographic material passing around said swingable roller and then reversely around said feed roller, resilient means associated with said swingable roller for exerting a predetermined tension in said photographic material as said material passes around said swingable roller, a greater tension than said predetermined tension in said material swinging said swingable roller about said feed roller to a position to disengage said photographic material from said feed roller, and means for driving said driving rollers to maintain a substantially uniform tension in said film between said rollers.

2. A photographic stock developing machine drive comprising a roll of photographic stock, a loop switch positioned adjacent said roll and adapted to close when the end of said roll passes said switch, a stock grip controlled by said switch, a positively driven feed roller for determining the speed of advancement of said stock into said machine, said stock being wrapped around a substantial portion of the surface of said feed roller, means for decreasing the amount of wrap of said stock around said feed roller to release said stock from said feed roller when said stock grip is actuated, and a plurality of drive

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rollers for said stock, said drive rollers being frictionally overdriven.

3. A photographic stock developing machine in accordance with claim 2, in which means are provided for guiding said stock over said drive rollers, said means including a mount for said rollers, means for tilting said mount to tilt the axis of said rollers, and means actuated by the stock for controlling the tilting of said mount.

4. A photographic stock developing machine in accordance with claim 3, in which said last mentioned means include switches actuated by the movement of said stock from a predetermined position on said rollers.

5. A drive for photographic strip material comprising a frame, a strip supply reel, a positively driven metering roller for taking said strip from said reel and feeding said strip at a uniform rate, a plurality of rollers for advancing said strip after leaving said metering roller, means for frictionally driving certain of said plurality of rollers at different speeds to maintain substantially uniform tension in said strip, and a spring tensioned roller for wrapping said strip around a substantial portion of said metering roller, a predetermined overtension in said strip reducing the amount of wrap of said strip around said roller to release said strip from said spring tensioned and metering rollers.

6. A drive in accordance with claim 5, in which a strip clamp and a switch are provided between said reel and said metering roller, the passage of the end of said strip past said switch actuating said clamp to grip said strip.

7. A film feed drive comprising a feed roller having an axis of rotation, a photographic material wrapped around a substantial portion of said roller, a bracket swingable about said axis, a roller mounted on said bracket, said photographic material passing around said swingable roller and then reversely around said feed roller, and resilient means attached to said bracket for exerting a predetermined tension in said material, an increase in said tension swinging said swingable roller about said axis of said feed roller to a position to disengage said material from said feed roller.

8. A film feed drive in accordance with claim 7, in which a photographic material stop grip is provided prior to said rollers, together with means for actuating said grip when the tension in said material is reduced below a predetermined amount.

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