Aug. 20, 1935. G. J. GAGE 2,011,576

METHOD OF PROCESSING MOTION PICTURE FILMS

Filed March 3, 1932 3 Sheets-Sheet 1

FIG. 1

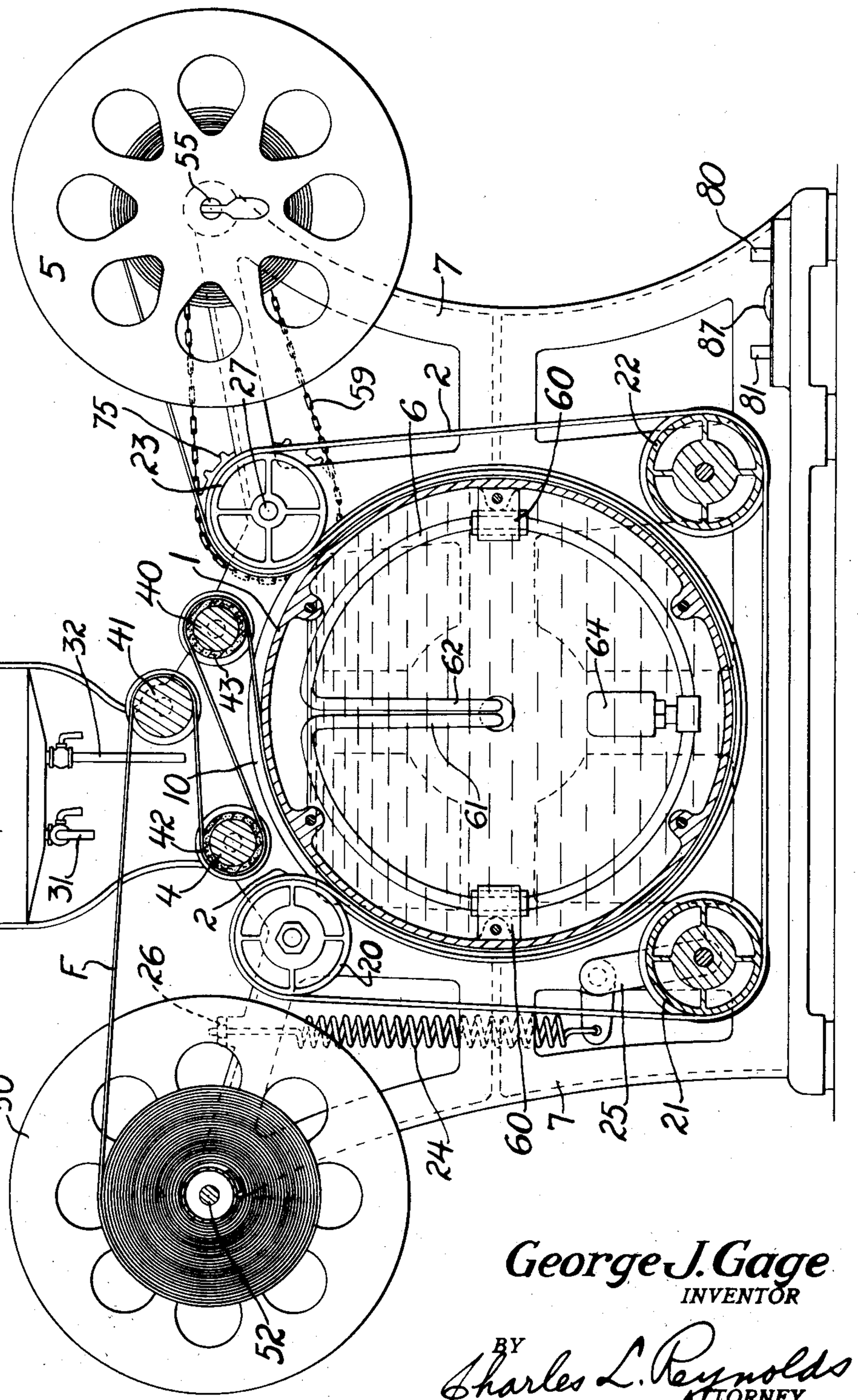

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FIG. 2

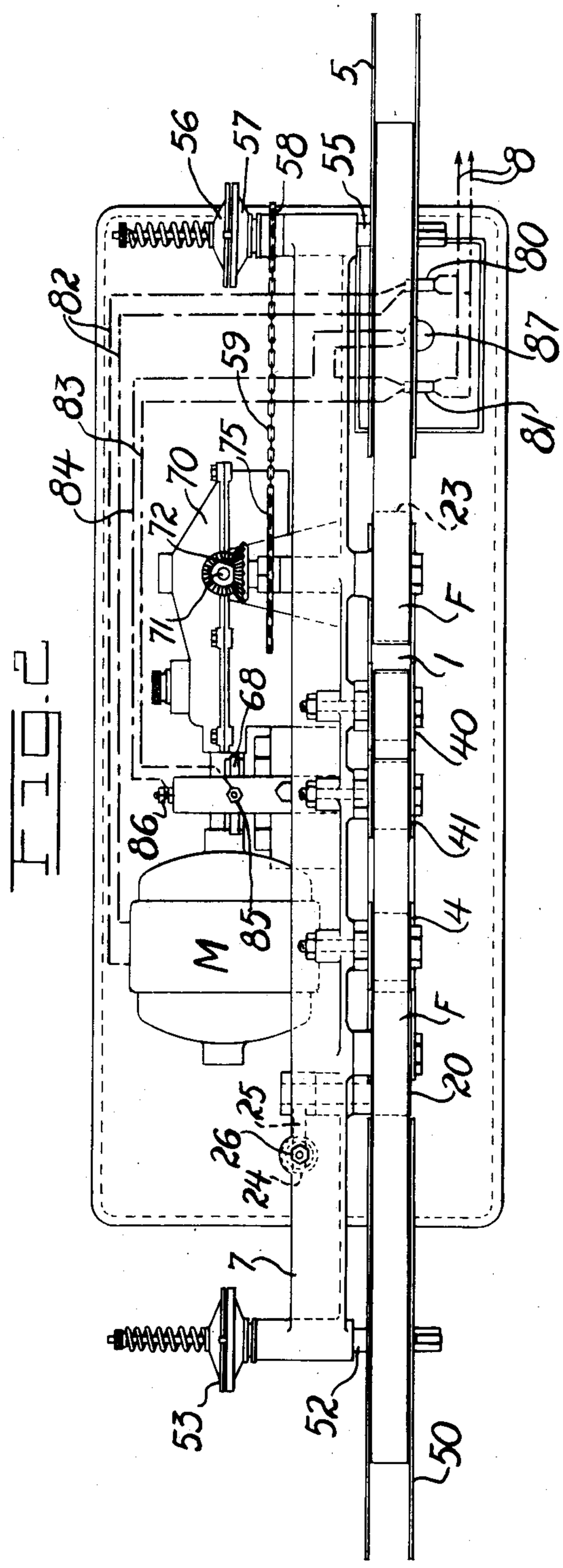

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FIG. 4

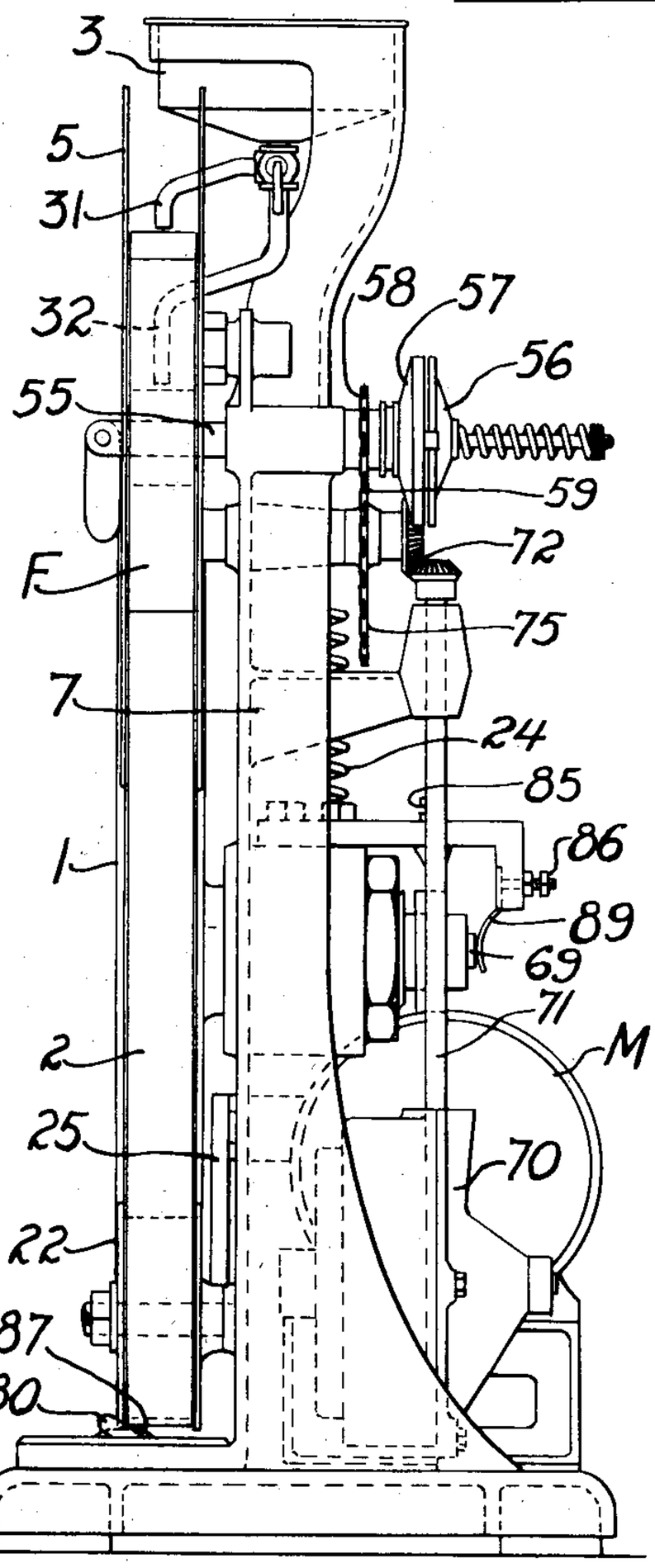
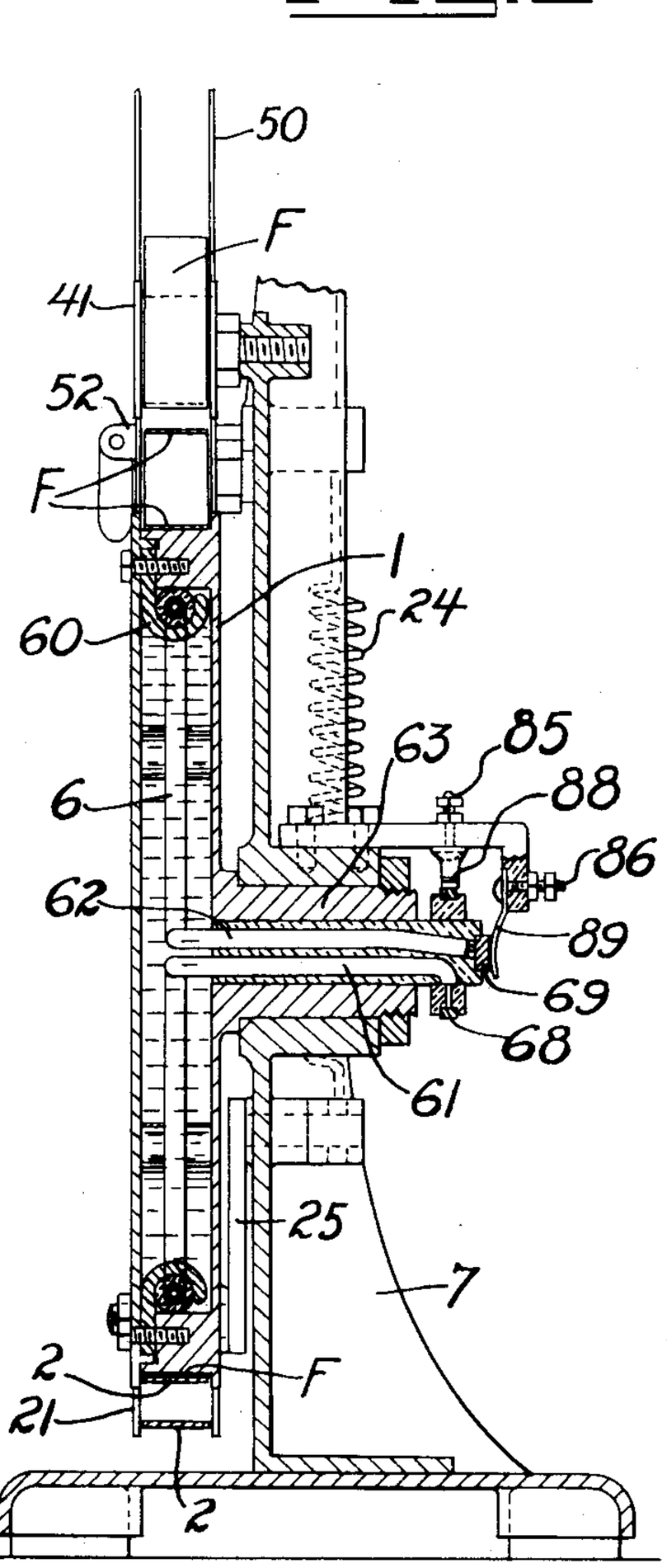


FIG. 3



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2,011,576

METHOD OF PROCESSING MOTION PICTURE FILMS

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Application March 3, 1932, Serial No. 596,564

15 Claims. (Cl. 18—56)

This invention relates to a method of processing printed motion picture film.

When an exposed light-sensitive material is placed in a developer, the chlorine or bromine is taken away from the silver, and the black metallic silver which remains behind forms the image. This image is made up of grains, because the original emulsion contains the silver bromide in the form of microscopic crystals, and when the bromide is taken away from each of these, the crystal breaks up and a tiny coke-like mass of metallic silver remains behind in exactly the same position as the bromide crystal from which it was formed, so that, whereas the original emulsion consisted of microscopic crystalline grains of the sensitive silver salt, the final image consists of equally microscopic grains of black metallic silver. Chemically, this removal of the bromide from the metallic silver is known as "reduction". A motion picture film being no different from any other photographic material with respect to the chemical structure of the image after the reduction process, it will be appreciated that the aforestated microscopic grains of black metallic silver combine to form at the emulsion side of the film a large number of infinitesimal voids. I have discovered that these voids are sooner or later filled up with wax, machine oil and dust, and in the ordinary movement of the film through a projecting machine, the particles of matter contained therein are, by the heat of the projection arcs, converted into hard bits of carbon. In time, these bits of carbon work loose from the voids and come to rest at some place in the projector, where they contact with the emulsion of the film, injuring both the sound track and the images. The co-efficient of expansion of celluloid being different from that of the emulsion of the film, it follows that as little friction as possible should be placed on the film in its movement through the projector, as otherwise the tensile strain placed on the celluloid tends to cause same to creep away from the emulsion. This frictional resistance upon the film and the tendency of the celluloid to move relatively to the emulsion soon fracture the emulsion, generally at the sound track and at various places in the frames of the film.

I have discovered that by properly processing printed film the objections otherwise resulting, such as those above stated, can be entirely eliminated. Proper processing of the film includes a step of making plane or substantially smooth the black metallic silver surfaces on the emulsion of the film. Broadly, this is the purpose of my invention.

Both new and old film have been successfully treated to close the surface voids in the metallic silver of the emulsion and to make the surfaces plane or smooth. By new film, I refer to film that has never been run through a projector as distinguished from film that has been run many times and has about outlived its usefulness. In order, however, to bring back to old film many of the qualities which it originally possessed, such as a high degree of flexibility, in order that the film may be looped readily without resulting in fracturing the emulsion, and to clean the film and correct discoloration thereof, and also to lubricate the film to further insure its free passage through the projector, I preferably make use of a cleansing, discoloration-correcting and lubricating solution such as is described in my abandoned application Serial No. 534,219, filed May 1, 1931. In order that those skilled in the art may fully and satisfactorily practice the method herein claimed, the solution referred to is described herein as made up of the following parts, to wit:

Chloroform	18 fluid ounces.
Carbon tetrachloride	110 fluid ounces.
White petroleum	5 drams.
Paraffin wax	4 drams.
Victoria blue	2 or more ounces.

This fluid has a very low temperature drop and has no damaging effect, chemically or mechanically, upon the emulsion or the celluloid of the film.

In the above statement of my invention, I have referred to the existence of carbon deposits in the surface voids of old or used film. Now, it obviously follows from what has been said that when processing old film strips the surface of the emulsion should be first cleaned and treated with the aforementioned solution and all hard foreign particles removed therefrom, after which the loosened particles and dirt should be thoroughly collected in order that the film may be perfectly clean before it is permitted to undergo its final treatment to make smooth the surface of the metallic silver.

An important object, therefore, is to provide a method of processing printed motion picture film which will not alter the intended or necessary positions of the images and will so prepare the emulsion side of the film that much of the friction heretofore caused by the unevenness in the surface thereof will be eliminated, thus enabling the film to be drawn freely through the projector. By eliminating the cause of the friction, the tensile

strains on the emulsion are removed and it is possible to maintain considerably better association of the pictures with the optical system of the projector and insure better and clearer projection of the pictures and to retain the sound tract more correctly co-ordinated with the light cell of the sound circuit and the sound tract made clear so as to allow more faithful reproduction of sound.

My present invention comprises the novel method herein disclosed and claimed, and as will be more particularly defined by the claims which terminate the same.

In the accompanying drawings I have shown a typical form of apparatus for carrying out my method.

Figure 1 illustrates my mechanism in elevation, the film guiding and engaging members being shown in section for better illustration.

Figure 2 is a general plan view of the machine.

Figure 3 is a vertical axial section through the drum forming part of the machine.

Figure 4 is an end elevation of the machine.

Essentially my method consists in passing the film strip F between two smooth surfaces pressed together uniformly over a considerable area,—that is to say, throughout a considerable length of the film strip—advancing the film strip and the smooth surfaces, uniformly pressed together throughout their contact area, simultaneously at identical rates of speed, whereby a continued pressure effect is obtained equal throughout all portions of that part of the film strip which is between the contacting surfaces, ultimately leading the film strip out after it has been pressed between the two surfaces for a period of time. In order to accomplish all the ends in view, as heretofore outlined, the method preferably includes the step of supplying a liquid, such as that disclosed in my aforementioned abandoned application, to the surfaces of the film prior to its entering the pressure area. It is also preferred to apply heat to the film when in the pressure area, especially when such a liquid is employed. Thus the contact zone becomes also a heated zone.

I prefer that the temperature of the film be raised and maintained within this heated zone at perhaps 190° Fahrenheit or higher—up to about 210° F. The temperature in the heated zone determines, to some extent, the time during which it remains in this zone, or vice versa. Especially when the liquid substance mentioned is employed, I have found that the film may be properly processed by continuing it into the contact and pressure zone for from two to three seconds traveling at a rate of about 90 feet a minute, with the temperature between the limits mentioned above. If the film is processed at higher speeds, the temperature may be increased considerably over the maximum named, hence I do not wish to be understood as naming 210° F. as a critical or maximum temperature, nor as limting the process to such a temperature factor. This is merely the temperature which experience has demonstrated to be a safe temperature, operating at the speed given, and without provision for cooling the film or preventing access of air thereto.

A mechanism for carrying out this processing of the film conveniently comprises a hollow drum 1 of sufficient peripheral extent to give contact through the period and at the speed mentioned, or an equivalent contact at some different speed. An endless belt 2 is wrapped partly about the periphery of the drum. This belt may be of various materials. I have found flexible brass to be most suitable. It is of about the width of a strip of film, and the drum preferably is flanged, as indicated at 10, whereby the film F is exactly positioned between the belt and the periphery of the drum. Thus it may not move laterally. The belt is guided by guide rollers 20, 21, 22 and 23. One of these—for instance, the roller 23—may be a drive roller connected to a suitable source of power such as the motor M, and another pulley—for instance, the pulley 21—may be connected with a tightening means such as the tension spring 24 and bell crank lever 25, so that an amount of tension, determined by the adjusting nut 26 used in connection with the spring, may be applied to the belt such as to cause the proper amount of pressure to be applied to the periphery of the drum.

For convenience in applying liquid from the tank 3 to the surfaces of the film, and to spread the liquid, I provide guide rollers 4, 40 and 41 about which the film strip passes and whereby its direction is reversed. In passing from the wind-off reel 50, the film passes first about the roller 41, and in this run one surface may be coated by liquid from the discharge spout 31 depending from the bottom of the tank 3. Its direction is then reversed between the rollers 41 and 4, and liquid from a second discharge spout 32 coats this surface. The liquid upon the surface first coated is spread by the roller 4 about which it passes, and excess liquid, dirt upon the surface, such as dust, carbonized matter, machine oil, and the like, all loosened and carried by the excess liquid, comes off on the soft felt or cloth surface of the roller 4, this soft surface being indicated at 42. Similarly, the roller 40 has a surface of like character, indicated at 43, which acts upon the opposite face of the film.

The several rollers and the reel 50, together with the wind-on or receiving reel 5, are in alignment with the drum 1 and with the belt 2, and properly guide the film strip into position between the belt and the periphery of the drum, and when it reaches the pulley 23, the film strip passes directly about this pulley and upon the wind-on reel 5.

The drum, as has been stated, is preferably heated, and to heat it I may employ an electric heating element 6 supported within and insulated from brackets 60 inside and preferably close to the periphery of the drum, the heat from this heating element being transmitted to a liquid such as oil, filling the interior of the drum. Insulated leads 61 and 62 through the trunnion 63 of the drum permit the transmission to the heating element of electric current, while a thermostat 64, connected in circuit with the heating element and in communication with the liquid to be affected by its heat, controls the temperature of the drum.

The various parts heretofore described are suitably supported upon a frame 7. The motor M drives the pulley 23 through such means as reduction gearing contained within the gear box 70, the vertical shaft 71, and the pair of bevel gears 72, one of which is connected to the shaft 27 which supports the pulley 23. Thus the belt 2 is driven, and by its bearing upon the drum 1, it causes the latter to rotate at precisely the same speed.

To rotate the wind-on reel 5 it is supported upon a spindle 55 carrying a clutch element 56 with which is lightly engaged a clutch element 57 rotatable with a sprocket wheel 58, over which runs a chain 59. This chain is driven from a sprocket wheel 75 upon the shaft 27, and because

of the clutch connection at 56, 57, the reel 5 is driven always at a speed sufficient to take up the film as it leaves the pulley 23 and the drum 1. The reel 50 is supported upon a spindle 52, and a clutch device 53 exerts sufficient drag on the rotation of this reel to prevent it overrunning at the usual operating speeds of the machine

Current is supplied from mains 8 through switches 80 and 81. From the switch 80 leads 82 extend to the motor M. From the switch 81 leads 83 and 84 extend to binding posts 85 and 86, respectively, one of these leads including a warning light 87 which indicates when the current is passing through these leads. Associated with the terminal posts 85 and 86 are brushes 88 and 89, respectively, the one contacting with a ring 68 connected to the lead 61 and the other contacting with a disk 69 connected to the lead 62, and thus current is supplied to the heating element 6 while the drum 1 supporting the same is rotating.

Such details may be varied to suit the desire or convenience of the designer, the important principles of the machine being embodied in the two smooth surfaces which press together uniformly over a considerable area, represented by the periphery of the drum 1 and the belt 2, and which receive between them the film strip so that as it travels along it is subjected to pressure and to heat supplied while in the pressure zone. Pressure and heat, thus applied to the film, flatten the silver deposit on the emulsion while the latter is slightly soft, so as to greatly, if not entirely, close the voids in the cellular structure of the silver.

What I claim as my invention is:

1. The method of processing motion picture films comprising the continuous passage of the film through a zone wherein heat and pressure are applied thereto simultaneously and equally, over a considerable length of the film.

2. The method of processing motion picture films comprising the continuous feeding of the film into and through a heated zone of considerable length maintained at a temperature of about 190° F., and at a rate to pass from said zone in a few seconds, and applying to the film during its passage through such zone pressure substantially equalized throughout.

3. The method of processing motion picture film which comprises the application to the film's surface of a substance having lubricating qualities, and the subsequent application of pressure to the film to distribute the substance uniformly thereon.

4. A method of acting upon the metallic silver image formed in the emulsion of a printed photographic film to make substantially plane the exposed side of the emulsion, comprising simultaneously applying heat and surface pressure to a predetermined length of film to slightly soften and flatten the emulsion, while retaining the length against longitudinal and transverse movement, and progressively acting on like lengths of the film as preceding lengths thereof are released from such conditions and while preventing relative movement between the length being acted on and the surface pressure media.

5. The method of processing printed motion pitcure film comprising removing foreign matter from the surface of the emulsion thereof, then applying uniform surface pressure to the film throughout a predetermined length thereof to thereby flatten the silver deposit and reduce the depth of the voids contained therein.

6. The step in the method of reducing the depth of the voids in the metallic silver on the emulsion of a printed photographic film, comprising applying uniform pressure to the surface of the film throughout a predetermined length thereof, while preventing relative movement between the film and the surface pressure media.

7. The steps in the method of reducing the depth of the voids in the metallic silver on the emulsion of a printed photographic film, comprising pressing the surface of the film while holding the film against movement relatively to the surface pressure media and while heating the film to maintain the emulsion in a uniformly soft state until the pressure is released.

8. The method of making substantially plane the surface of the metallic silver on the emulsion of printed photographic film comprising interposing a predetermined length of the film between co-operable movably supported pressure surfaces within a zone in which the length being acted upon is maintained at a relatively fixed, emulsion-softening temperature, and moving the pressure surfaces and said length at identical rates of speed and while acting upon the surfaces to maintain uniform pressure thereof against the opposite sides of the length, then leading the length from between the surfaces and from said zone.

9. The method of processing printed motion picture film comprising cleaning the film of foreign matter, interposing same between movably supported pressure surfaces within a zone in which the film is heated to slightly soften the emulsion and moving the pressure surfaces and the film at identical rates of speed while maintaining pressure of the surfaces against opposite sides of the film which is equal throughout the portion thereof being acted upon.

10. The method of processing printed motion picture film comprising cleansing and lubricating the film, then interposing same between co-operable movably supported pressures surfaces, within a zone in which the film is heated to slightly soften the emulsion, moving the pressure surfaces and the film at identical rates of speed while maintaining uniform pressure of the surfaces against opposite sides of the film, whereby to flatten the exposed surface of the emulsion, then leading the film from between the surfaces and from said zone.

11. The method of processing printed motion picture film comprising treating the film to cleanse, lubricate and correct discoloration thereof, heating the film to slightly soften the emulsion; and advancing and maintaining surface pressure against the film for a predetermined period of time while the emulsion is soft.

12. The method of processing printed motion picture film comprising interposing a length of a continuous strip of film between co-operable movably supported pressure surfaces, moving the surfaces and the strip at identical rates of speed while establishing and maintaining uniform pressure of the surfaces against opposite sides of the length being acted upon, then releasing the length from between the surfaces at the expiration of a predetermined period of time.

13. The method of processing printed motion picture films comprising cleansing the film and applying a lubricating substance thereto, and applying to a predetermined area thereof heat to slightly soften and pressure to flatten the emulsion.

14. The method of processing clean printed

motion picture film which comprises the application of a fluid light-filtering substance thereto, and the uniform application of surface pressure to the film to cause equal distribution of the substance over the surface of the film.

15. The method of processing printed motion picture film to correct discoloration thereof which comprises cleansing the film to remove foreign deposits and viscous substances therefrom, then uniformly spreading a fluid light-filtering substance over one side of the film.

GEORGE J. GAGE.