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[54] **FILM TURNABOUT SYSTEM**

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[52] **U.S. Cl.** **271/51,** 95/94, 271/80

[51] **Int. Cl.** **B65h 5/06**

[58] **Field of Search** 271/51, 52, 53, 80; 95/96, 95/97, 100, 94

[56] **References Cited**

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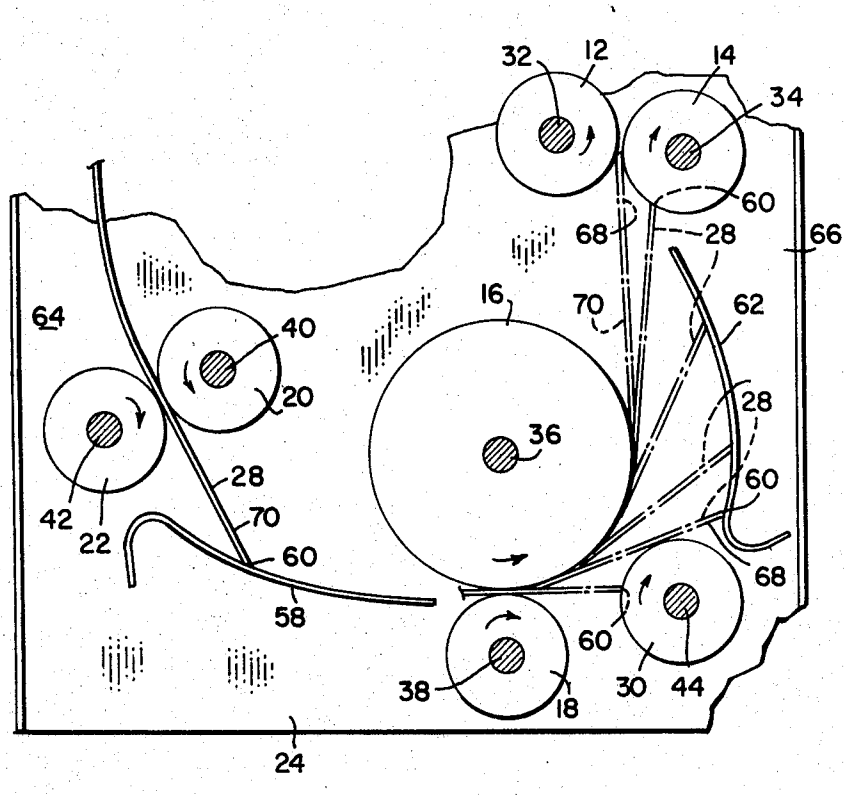
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Assistant Examiner—Bruce H. Stoner, Jr.
Attorney—Karl L. Spivak

[57] **ABSTRACT**

A film turnabout system for conveying X-ray or other film through a processing tank which incorporates a rack assembly having pairs of rollers and discretely positioned film guides which cooperate to drive the film through the processing tank at constant speed without scratching the surface of the film. The device further includes a bottom positioned soft roller which functions at increased rotative speed to direct the film across the bottom of the rack assembly in a minimum of required width and then upwardly through the tank without scratching or other injury.

3 Claims, 4 Drawing Figures



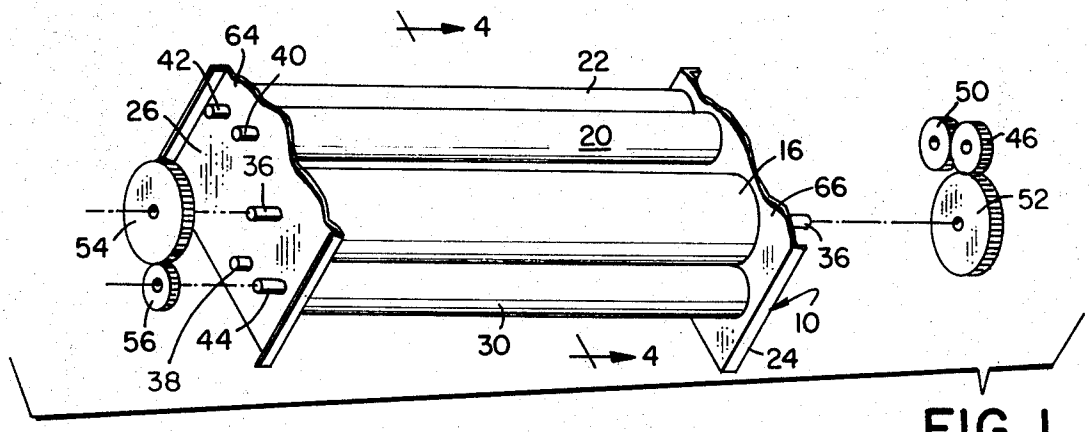


FIG. 1

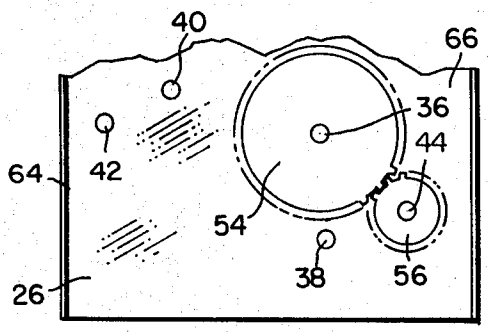


FIG. 2

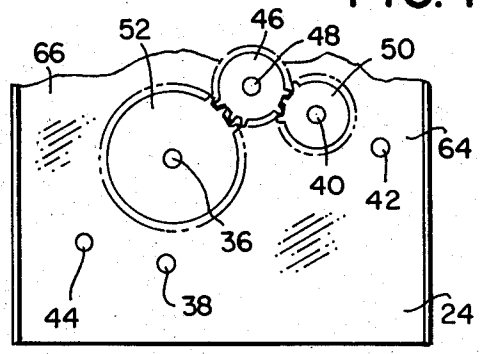


FIG. 3

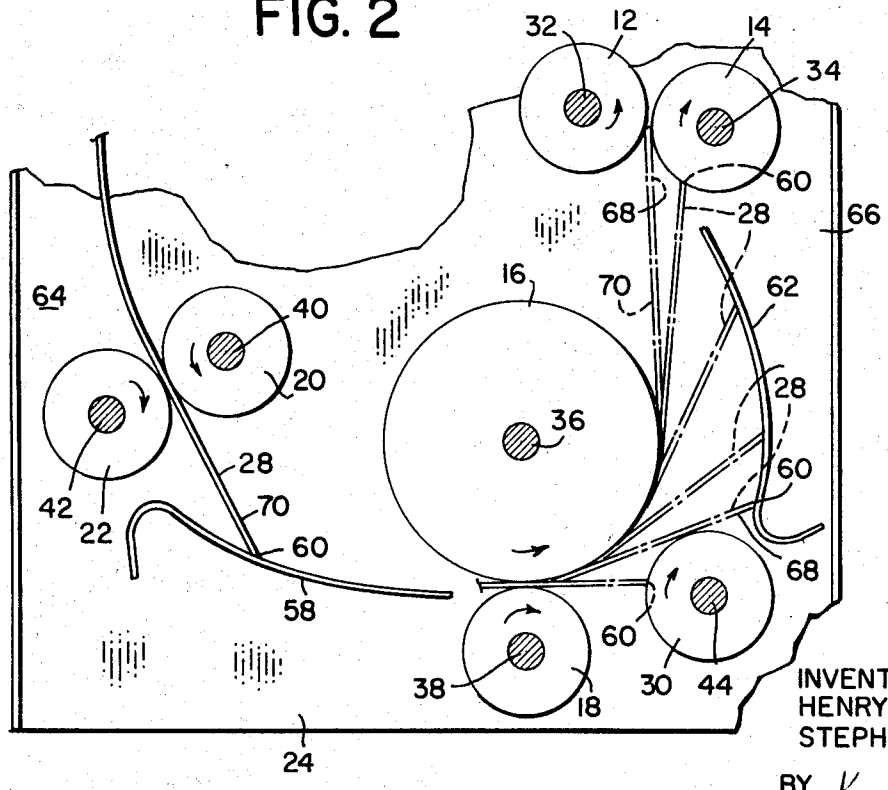


FIG. 4

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FILM TURNABOUT SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates generally to the field of photographic developing equipment, and more particularly, is directed to a film turnabout system for use with automatic film developing equipment.

The use of small, self-contained, automatic film processing equipment has become increasingly more popular for use in hospitals and particularly in the offices of doctors and dentists wherein the necessary extensive floor space and large capital expenditures for darkroom installations are not readily available. The present equipment includes a completely self-contained unit which requires a minimum of floor space. The unit is equipped with all required electrical and plumbing connections, controls and necessary equipment to automatically develop film such as x-ray film in a minimum period of time, with a minimum expenditure in equipment costs. The invention is applicable to all automatic photographic processors such as x-ray, graphic arts, commercial film, etc. The device is useful in the guiding of film anywhere where economy of space and simplicity of construction are desired.

Self-contained, automatic film processing equipment of the type contemplated for use with the instant invention usually includes a plurality of adjacent processing tanks, each of which is equipped with a rack assembly having a plurality of pairs of driving and driven rollers. The rollers contact the film surface to drive the exposed x-ray or other film through various processing tanks which contain the required developers, fixers and washes to positively and automatically develop exposed X-ray or other film in accordance with well-known principles of film developing.

Separate, juxtaposed rack assemblies for the developer tank, the fixer tank and the wash tank have been utilized to feed the exposed x-ray or other film directly through the required tanks in an automatic manner. Such rack assemblies direct the film downwardly into each respective tank and then upwardly through the tank to exit the tank and to introduce the film into the next adjacent tank. Because of the nature of the operation, a substantially 180° bend in the film is imposed at the bottom of each of the film rack assemblies. Inasmuch as it is of utmost importance that the photographically exposed flat surface of the film travel only between the rollers and not contact any other portions of the mechanical equipment, it has been necessary in the past to construct the rack of relatively wide configuration to thereby execute a gradual 180° turn without scratching or other injury to the film. Considering that three or more rack assemblies are required, the prior art racks of which we are familiar have of necessity considerably increased the overall size requirements of the automatic film processing equipment itself. Such racks as have been designed in a narrow configuration have required finely adjusted fixed guides of expensive construction and only limited dependability.

SUMMARY OF THE INVENTION

The present invention relates generally to automatic x-ray or other film processing equipment, and more particularly, is directed to a novel film turnabout system for moving the exposed film through the various development steps within the process equipment without scratching or otherwise damaging the film surface.

The film turnabout system of the present invention directs exposed x-ray or other film downwardly into a processing tank for treatment within the tank. The system incorporates rack assembly means to turn the film through substantially 180° at the bottom of the associated process tank and then to lead the film upwardly for exit at the process tank top.

Cooperating pairs of rollers within a rack assembly direct the film through the processing tank and include a plurality of driven and driving rollers operated through a gear train to propel the film at constant speed. A soft roller positions near the bottom of the rack assembly and is driven through the roller gear train at a greater rotative speed than the other pairs of rollers in the system. The soft roller receives the leading edge of the film and the increased rotative speed facilitates the turning of the film at the bottom of the tank. The increased rotative speed of the soft roller functions to throw the film upwardly, making up for the difference between the linear speed of the body of the film as propelled by the prior rollers and the momentary loss of that speed in the leading edge as it is guided upwardly. The soft roller cooperates with a fixed film guide to direct the film to the next higher cooperating pair of transport rollers in a manner to prevent the flat surfaces of the film from touching any fixed portion of the rack. The film thus travels only through the rollers of the rack assembly and is never exposed to fixed equipment which may scratch or otherwise damage the film surface. By providing the bottom soft roller which operates at increased rotative speed, we have found it possible to minimize the width of the rack so that exposed x-ray or other film may be turned through substantially 180° with a minimum space requirement.

It is therefore an object of the present invention to provide an improved film turnabout system of the type set forth.

IT is another object of the present invention to provide a novel film turnabout system which includes a plurality of pairs of cooperating rollers arranged upon a rack in a manner to direct exposed x-ray or other film downwardly through a processing tank, through a substantially 180° bend and then upwardly to exit from the tank.

It is another object of the present invention to provide a novel film turnabout system which includes a plurality of film directing rollers, all of the rollers operating at the same rotative speed with the exception of one which functions at an increased rotative speed.

It is another object of the present invention to provide a novel film turnabout system for directing x-ray or other film through a processing tank, the system including a plurality of rollers directing the film downwardly and then upwardly through the tank and also includes means to turn the film at the bottom in a minimum space requirement.

It is a further object of the present invention to provide a novel film turnabout system which includes a plurality of cooperating pairs of rollers directing the film downwardly through a processing tank and upwardly to exit the tank, the system further including a bottom positioned soft roller operating at increased

rotative speed to turn the film through substantially 180° in a minimum width requirement.

It is a further object of the present invention to provide a novel film turnabout system which includes roller means directing the film through a processing tank, the said roller means including a lower soft roller functioning at increased rotative speed and which is positioned to direct the film through a 180° turn without scratching or otherwise marring the film surface.

It is another object of the present invention to provide a film turnabout system that is rugged in construction, inexpensive in manufacture and trouble-free in operation.

Other objects and a fuller understanding of the invention will be had by referring to the following description and claims of a preferred embodiment thereof, taken in conjunction with the accompanying drawings, wherein like reference characters refer to similar parts throughout the several views and in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial, perspective view of the bottom portion of a film turnabout system, with the roller driving gears exploded.

FIG. 2 is a partial, side elevational view of the bottom of the film turnabout system of FIG. 1.

FIG. 3 is a partial, side elevational view, similar to FIG. 2, showing the opposite side of the turnabout system.

FIG. 4 is a partial, enlarged, cross sectional view taken along line 4—4 of FIG. 1, looking in the direction of the arrows. The various positions of the leading portion of the film are shown in phantom lines to indicate the location of the leading edge of the film as it travels through the bend at the bottom of the rack assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Although specific terms are used in the following description for the sake of clarity, these terms are intended to refer only to the particular structure of our invention selected for illustration in the drawings and are not intended to define or limit the scope of the invention.

Referring now to the drawings, we show in FIG. 1, the bottom portion of the film transport system which includes a film transport rack assembly **10**. The rack assembly **10** supports a plurality of pairs of film transport rollers **12, 14, 16, 18** and **20, 22** which are rotatively carried between the right and left side plates **24, 26** for film transporting purposes. As best seen in FIG. 4, the film **28** travels downwardly in a substantially vertical path at the rear of the transport rack assembly **10** to the nip of the bottom pair of rear rollers **20, 22**. The film turnabout includes the cooperating pair of rollers **16, 18** and guides **58, 62** and the soft turnabout roller **30** which act to turn the film upwardly at the bottom of the rack assembly. The leading edge **60** of the film **28** is directed to the nip of the forward pair of rollers **12, 14** and then upwardly through other pairs of rollers (not shown) for exit at the top of the film transport rack assembly. The bottom turnaround is accomplished without scratching or otherwise damaging the film surfaces as hereinafter more fully set forth

The film transport rollers **12, 14, 16, 18, 20, 22** and the soft turnaround roller **30** rotate about the respective roller shafts **32, 34, 36, 38, 40, 42, 44** in horizontal, rotative cooperating arrangement. The shafts **32, 34, 36, 38, 40, 42, 44** journal through the right and left rack assembly side plates **24, 26** for rotation within the transport rack assembly in well known manner. The shafts **36, 40** extend through the side plate **24** and the shafts **36, 44** extend through the side plate **26** to provide extension pieces for attachment of the various driving gears for operation of the mechanism.

The power gear **46** rotates about its side plate journalled shaft **48** and receives its power from above through the power driven gear train (not shown) in conventional manner. As best seen in FIG. 3, the power gear **46** meshes with the rear roller gear **50** and the large roller gear **52** which pin or otherwise affix to the respective shafts **40, 36** to simultaneously rotate the shaft affixed rear roller **20** and the large roller **16**. The rear roller **20** in turn drives the rear driven roller **22** through direct rotative contact and the large roller **16** drives its cooperating driven roller **18** through cirect contact for film transporting purposes. The respective driving rollers **20, 16** are fabricated of hard phenolic material for driving purposes and the cooperating driven rollers **22, 18** are fabricated of soft foam rubber in a manner to urge the film forwardly through the rack assembly without scratching or otherwise damaging the sensitized film surface. It will be observed that the photosensitive surface **68** of the film **28** contacts the foam rubber rollers throughout the path of travel. Thus, the rotative urging of the power gear **46** simultaneously drives the cooperating pairs of rollers **20, 22** and **16, 18**. Additional pairs of rollers, for example the rollers **12, 14** may be simultaneously driven in conventional manner by taking the power from the power gear **46** through idlers or otherwise as may be required.

All gears used in the rack assembly **10** are milled or otherwise formed to the same pitch, preferably sixteen pitch, and all small roller shaft affixed gears have the same number of teeth, preferably 16 teeth. Accordingly, all small rollers will rotate at the same rotative speed. The large roller gear **52** is preferably formed with 30 teeth to increase the rotative speed of the soft roller **30**. The large roller shaft **36** extends through the side plate **26** and carries the shaft affixed large gear **54** which preferably is formed with 36 teeth. The large roller gear **54** meshes with the turnaround roller gear **56** to thereby rotate the turnaround roller **30** through power delivered by the power gear **46** across the large roller shaft **36**.

The turnaround roller gear **56** affixes to the turnaround roller shaft **44** and rotates the turnaround roller **30** simultaneously with the operation of the other rollers. The gear **56** is fabricated with 16 teeth, the same as the other small roller gears **46, 50**. It will be noted that the large roller **16** receives its rotative energy through the large roller gear **52** which has 30 teeth. The shaft **36** in turn drives the oppositely positioned large gear **54** which is fabricated with 36 teeth. The 16 tooth turnaround roller gear **56** is thereby urged into a rotative speed that is greater than any of the rollers in the system. Of course, if it is found desirable to increase the rotative speed of the turnaround roller **30** to an even greater extent, this may be done by skilled workers by adjusting gear ratios in well-known manner.

Referring now to FIG. 4, a generally horizontally disposed turning vane **58** positions beneath the rear rollers **20, 22** and transversely extends across the rack assembly **10** for film directing purposes. The turning vane **58** serves to direct the leading edge **60** of the film **28** into a generally horizontal direction to the nip of the corresponding lowest pair of rollers **16, 18**. Similarly, the turning vane **62** positions generally vertically within the rack assembly **10** and transversely extends between the side plates **24, 26** for film directing purposes. The turning vane **62** positions generally forwardly of the large roller **16** and above the turnaround roller **30** to thereby direct the leading edge **60** of the film **28** to the nip of the cooperating pair of upper rollers **12, 14**. The film **28** travels downwardly in a generally vertical path near the rear **64** of the rack assembly **10** and then turns through 180° about the lowest pair of cooperating rollers **16, 18**. The roller **16** is fabricated to an increased diameter to facilitate the bending operation and to remove any tendency of the film to crease, buckle or otherwise permanently deform during the bending operation. The film **28** is then directed generally upwardly in a vertical path near the front **66** of the rack assembly **10** for the exit at the top after treatment within the associated processing tank (not shown). As indicated in phantom lines in FIG. **4**, the rear rollers **20, 22**, the bottom pair of rollers **16, 18** and the upper rollers **12, 14** in cooperation with the turning vanes **58, 62** and the soft turnaround roller **30** precisely position the film **28** at all times during the bottom turn to absolutely prevent scraping, rubbing or scratching of the film photosensitive surface **68** in all positions assumed during the bending operation. The unsensitized film surface **70** contacts the hard phenolic rollers **20, 16** and **12** which cooperate to urge the film **28** through the system without damage. As previously noted, the turnaround roller **30** rotates at a greater speed to facilitate the film turning procedure.

As best observed in FIG. **4**, the leading edge **60** of the film **28** travels generally horizontally as directed by the bottom guide **58**. After passing the lower rollers **16, 18**, the film leading edge **60** abuts the periphery of the turnaround roller **30** above the center line of the turnaround roller shaft **44**. As hereinbefore set forth, the roller **30** is geared to rotate faster than any of the other rollers in the system and thus serves to push the leading edge **60** upwardly. This impetus urges the film **28** to bend upwardly about the large roller **16** to complete the required 180° turn. The leading edge **28** then engages the vertically disposed turning vane **62** and as indicated in phantom lines, the sensitized film surface **68** never is allowed to contact any metallic or other hard surface which may mar or scratch the film. The turning vane **62** directs the film to the nip of the cooperating pair of rollers **12, 14** which serve to drive the film upwardly at constant speed to other roller pairs (not shown) for exit at the top of the rack assembly **10**. The positive, increased, rotative speed of the turnaround roller **30** bends the film **28** upwardly to thereby facilitate a 180° bend in a minimum space requirement.

We claim:

1. In a film turnabout system for carrying film through a processing tank wherein the film has a leading edge, an unsensitized surface and a photosensitive surface, the combination of

A. a film transport, rack assembly including a pair of spaced side plates;

B. rear roller means including at least one pair of cooperating driving and driven rollers rotatively journalled within the said plates,
   1. said rear roller means leading the film downwardly through the rack assembly,
   2. said rear roller means driving and driven rollers rotating at a first speed,
   3. said rear roller means driving and driven rollers each being of a first diameter in cross sectional size,
   4. said driving roller being fabricated of relatively hard material,
   5. said driven rollers being fabricated of soft material, the said photosensitive film surface contacting the driven rollers;

C. bottom turning means receiving the film from the rear roller means and turning the film upwardly,
   1. said bottom turning means including a large driving roller and a cooperating driven roller in tangential contact to define a film driving nip therebetween,
      a. said large driving roller being fabricated of relatively hard material and said driven roller being fabricated of soft material,
      b. said large driving roller having a diameter larger than the said first diameter of the rear roller means,
      c. the said film being carried downwardly through the processing tank by the rear roller means,
      d. the said film turning upwardly through the processing tank by turning about the large driving roller,
   2. said bottom turning means including a turnaround roller rotating at a rotative speed greater than the said first speed,
      a. said turnaround roller being positioned forwardly of the large driving roller to receive the leading edge of the film to turn the leading edge upwardly,
      b. said turnaround roller being fabricated of relatively soft material and having a central axis,
         1. the said central axis being positioned lower in the processing tank than the said film driving nip; and

D forward roller means receiving the film from the bottom turning means and directing the film upwardly through the rack assembly,
   1. said forward roller means rotating at the said first speed.

2. The invention of claim **1** wherein the bottom turning means include a generally horizontally disposed first turning vane positioned rearwardly of the large driving roller, said first turning vane being contacted by the leading edge of the film and being positioned to have no contact with the said photosensitive surface, said first turning vane directing the leading edge of the film to the film driving nip.

3. The invention of claim **2** in a generally vertically disposed second turning vane which is positioned forwardly of the large driving roller, said second turning vane being contacted by the leading edge of the film and being positioned to have no contact with the said photosensitive surface, said second turning vane directing the leading edge of the film upwardly to the forward roller means.

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