

April 1, 1969

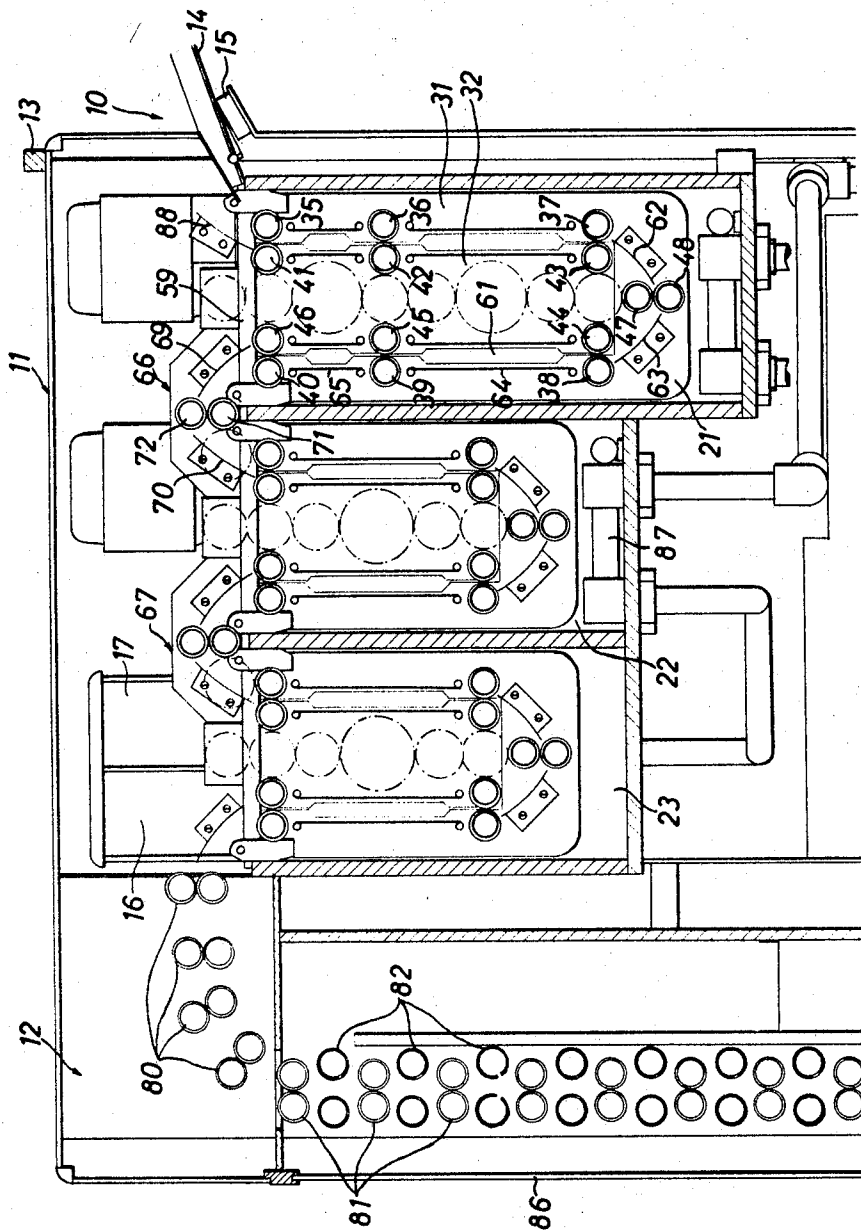
A. P. CAUWE ET AL

3,435,749

PHOTOGRAPHIC MATERIAL PROCESSING APPARATUS

Filed Sept. 17, 1965

Sheet 1 of 3



April 1, 1969

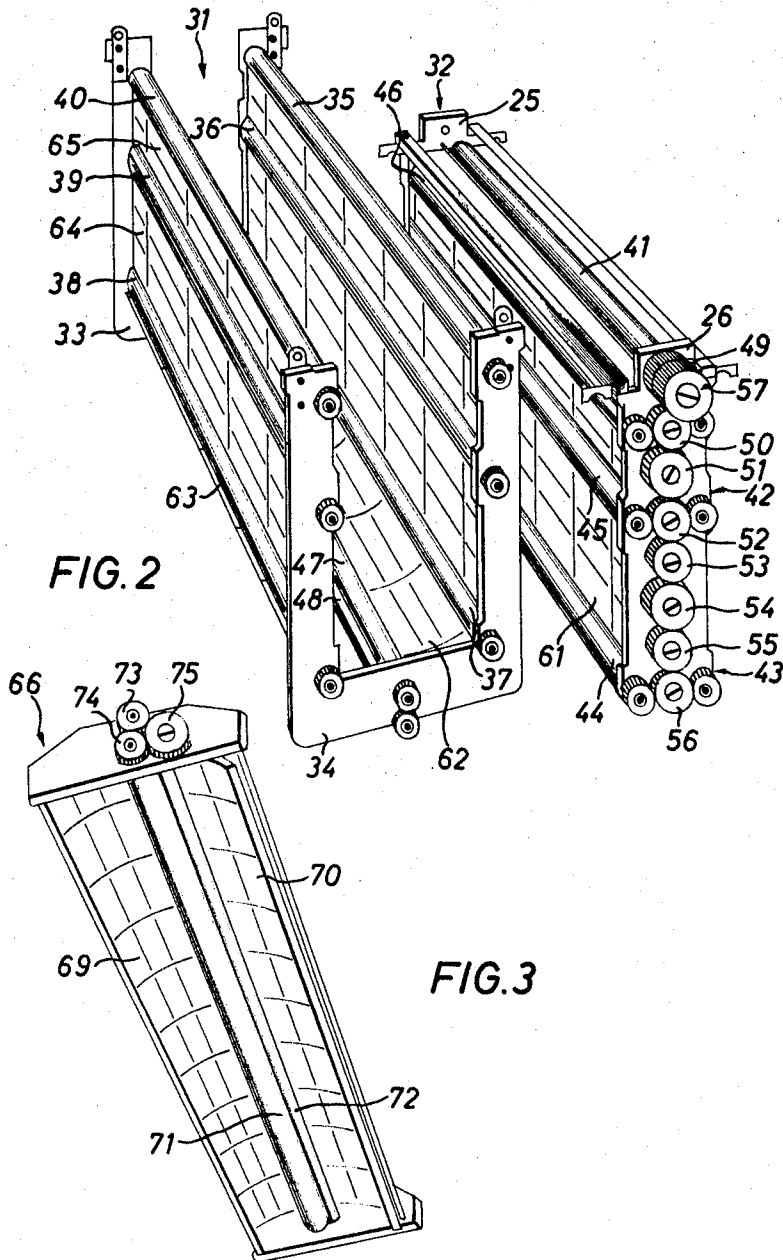
A. P. CAUWE ET AL

3,435,749

PHOTOGRAPHIC MATERIAL PROCESSING APPARATUS

Filed Sept. 17, 1965

Sheet 2 of 3



INVENTORS

ANDRE PAUL CAUWE
LEO PAUL VAN BOUWEL

BY
WATSON, COLE, GRINDLE & WATSON
ATTORNEYS

April 1, 1969

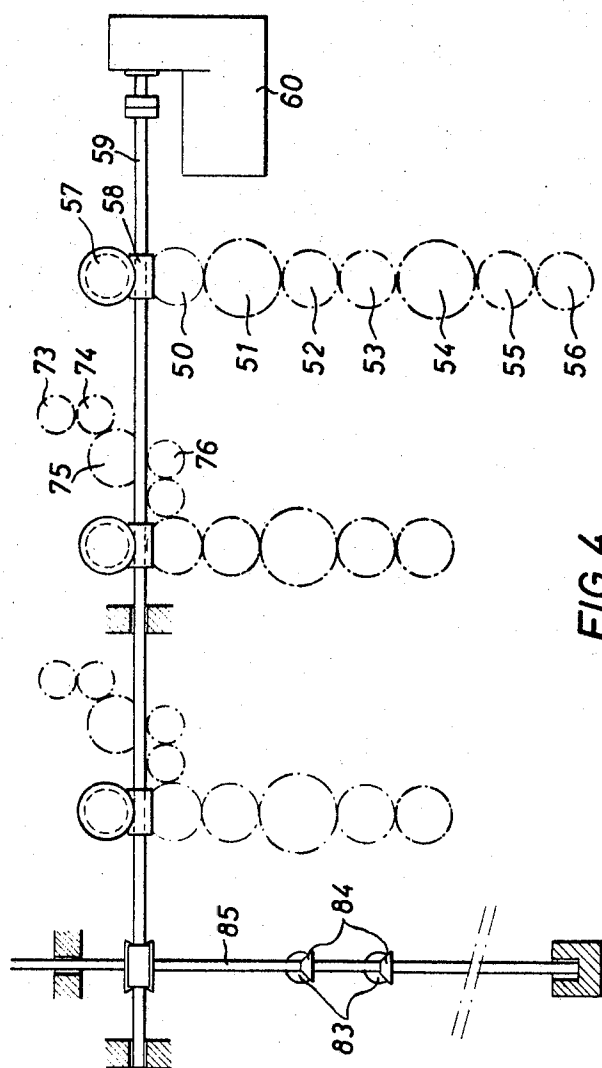
A. P. CAUWE ET AL

3,435,749

PHOTOGRAPHIC MATERIAL PROCESSING APPARATUS

Filed Sept. 17, 1965

Sheet 3 of 3



1

3,435,749

PHOTOGRAPHIC MATERIAL PROCESSING APPARATUS

Andre Paul Cauwe, Bruges, and Leo Paul Van Bouwel, Mortsel-Antwerp, Belgium, assignors to Gevaert-Agfa N.V., Mortsel, Belgium, a Belgian company

Filed Sept. 17, 1965, Ser. No. 488,097

Claims priority, application Great Britain, Sept. 25, 1964, 39,266/64

Int. Cl. C03d 3/12; B65h 17/42, 17/34

U.S. Cl. 95-94

9 Claims

ABSTRACT OF THE DISCLOSURE

A roller arrangement for conveying sheet material in a generally U-shaped path, which is composed of two separable unitary sets of rollers. The outer set has the rollers thereof rotatably held by a supporting frame in two spaced parallel rows while the rollers of the inner set are arranged in at least one row which is adapted to fit in parallel relation between the two outer rows. In working position, the rollers of the two sets form cooperating pairs of rollers defining two spaced apart guide paths forming the legs of the U-shaped path. The inner set includes a frame rotatably supporting the rollers thereof as a unitary assembly for easy bodily displacement outwardly of the outer set. A curved guide plate is located at one end of the two guide paths for directing sheets therebetween to complete the U-shaped path. The rollers are preferably equipped with gear wheels which form part of a unitary intermeshing guide train adapted to be driven by a single driving member when the roller sets are in working position. The guide plate may be constructed integrally with the outer set of rollers. The guiding arrangement may be employed in an apparatus for processing the sheet material through a tank containing suitable processing liquid.

This invention relates to improvements in photographic processing systems and, more particularly, to improvements in conveyor systems for advancing photographic material through photographic processing fluids.

Heretofore a variety of processing apparatus has been proposed for the automatic processing of photographic film and/or paper. In a typical example of such a prior art device, a rack carrying a plurality of pressure roller pairs is immersed in a tank of photographic treating fluid and is arranged to convey the film or paper through the fluid during a predetermined processing cycle in order to complete the developing, fixing or other treating steps that are to be effected.

Arrangements of the sort described are in wide commercial use and in practice perform very well.

They, however, have some drawbacks, the most important of which is the difficulty involved in the cleaning of the racks.

The said operation, which has to be performed weekly and which comprises the thorough rinsing and scouring of the frames and the rollers in order to remove parts of the gelatinous coating of the photographic material, which adhere in the form of spots or strings to the roller peripheries and the inner walls of the frames, is much complicated by the relative inaccessibility of those members.

The present invention provides an apparatus comprising conveying rollers arranged to facilitate their removal from the apparatus and replacement after cleaning.

According to the present invention, processing apparatus suitable for use in processing film sheets is provided comprising a tank, and two roller units each com-

2

prising frames rotatably supporting sheet-conveying rollers and constructed so that they can be separately fitted as units into the tank so that one unit (hereafter called the "inner" unit) lies wholly or partly within the other unit (hereafter called the "outer" unit), the outer unit having rollers disposed in two spaced rows and the inner unit having rollers which lie between and co-operate with the rollers of said spaced rows when such inner unit is in working position, means being provided for driving said rollers and for guiding sheets so that sheets fed between the inner and outer units on one side of the inner unit will be conveyed by the cooperation of the rollers of the two units along that side of said inner unit and subsequently back along the other side of said inner unit.

Apparatus according to the invention may comprise one or more further pairs of roller units, additional to the pair described above, the pairs being arranged for conveying sheets during successive stages of their passage through the tank, and the successive pairs of roller units can be located in distinct compartments of the tank capable of holding processing liquids of different compositions.

The invention is more particularly intended to be applied so that the cooperating rollers serve to convey sheets first downwardly towards the bottom of the tank and then upwardly along substantially vertical paths and to facilitate the description the roller units are hereafter assumed to be constructed and disposed for conveyance of sheets in that matter.

Reversal of the direction of travel of the sheets on reaching the bottom of the units may be achieved by means carried by one or both of the units. For example one or both of the units may carry guide plates for changing the course of the sheets through 180°, e.g., along a semicircular path, and if necessary one or more additional pairs of rollers may be provided at the bottom of the units and carried by one or by both of them for conveying the sheets at this part of their course so that a sheet of which the trailing edge has left the last rollers on its travel down one side of the inner roller unit will continue to be advanced positively even if its leading edge has not reached the lowest rollers on the other side of the inner unit. As an alternative the said sheet reversal may be effected by guides or other means mounted in the tank separately from the said roller units.

According to a preferred feature of the present invention the rollers of the two units carry gear wheels which are located on the outside of their carrying frames and the gear wheels of the different units enter into meshing engagement when the inner unit is moved into working position within the outer unit. A worm gear can be associated with the roller gear train thus formed and this gear train can be driven by a worm shaft mounted in bearings on the tank in such a position that the worm gear meshes with the worm shaft when the units are placed in position in the tank.

Any or each of the rollers of the roller units can be of uniform diameter and extend over the whole or the major part of the width of the units. Alternatively the rollers or any of them can be shaped to make contact with the sheets at spaced positions, or two or more rollers can be mounted side by side for rotation about a common axis at any of the positions on the frames at which conveying rollers are required. In the event that there are separate abreast rollers or rollers shaped to make contact with sheets at spaced side by side positions, sheet guides, e.g., in the form of deflecting wires, filaments or fingers may be mounted so as to intrude between the side by side rollers or roller portions.

A very suitable form of roller for use in apparatus according to the invention is one formed by cladding a

shaft with a suitable material to provide the roller surface or surfaces, leaving the ends of the shaft free for journaling in the frames. The cladding may be a material of resilient nature, e.g., natural rubber, synthetic rubber or the like, or a hard material, e.g., hard poly(vinyl chloride) or hard paper.

Preferably the roller units are made light in weight by using a plastics material or materials for the roller unit frames and plastics material can also be used for gear wheels on the units.

Although in the further description the apparatus will be described in connection with the processing of radiographic film sheets, it is clear that the apparatus according to the invention is as well suited for treating other films such as graphic film for halftone or line reproduction, etc.

The invention includes sheet-conveying means having the features hereinbefore defined.

An embodiment of the invention, selected by way of example, will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a schematic longitudinal, sectional and partial view of an automatic photographic material processing apparatus as an embodiment of the present invention.

FIG. 2 is a perspective lateral view of two insertable roller sections.

FIG. 3 is a perspective view from the underside of a cross-over roller transport section adapted to turn the film through an angle of 180°.

FIG. 4 is a schematic side elevation of the drive mechanism for the processing apparatus of FIG. 1.

As shown in FIG. 1, the apparatus for processing X-ray film comprises a film loading section 10, a wet processing section 11 and a drying section 12. The apparatus is shown only partially, the lower part of it comprising circulation pumps, a heater and a blower for the drying air, being omitted in order to not unnecessarily complicate the drawing. The film loading section 10 is the only portion of the processing apparatus that is situated in the darkroom set off by wall partition 13 and has a support platform 14 upon which the sheet of exposed X-ray film is placed and fed in the direction of the arrow between the entry roller pair 35, 41 of the apparatus. The microswitch 15 which is positioned at the entry of the apparatus and the contact lever of which protrudes through the support plate 14, is actuated by each film sheet which is introduced into the apparatus, and it controls the regeneration of the developing and the fixing solutions of the apparatus by means of the regeneration solutions contained in the small tanks 16 and 17.

As the operation of regenerating the processing solutions is unessential for the understanding of the present apparatus no further details will be given hereinafter in connection with this point. If desired, all details about a suitable regenerating system may be found in the pending United States patent application Ser. No. 419,727, now Patent No. 3,368,472.

The wet processing section 11 is light-tight enclosed, and has three tanks disposed in side-by-side relation, viz., the first tank 21 containing a developer solution, the second tank 22 containing a fixer solution, and the third tank 23 containing water. The developer solution may be of any known type such as the commercially available Gevaert G 125 developer for X-ray film.

The fixing bath is a relatively low pH formula such as the Gevaert G 334 acid fixer for rapid fixing and for hardening to some extent the gelatinous coating of the film. Thereby the tackiness of the film is sufficiently reduced to avoid damaging of the film sheet when it is conveyed between the roller pairs and when it is deflected by the guide plates for returning the direction of travel of the sheets through an angle of 180°.

Each of the tanks 21, 22, 23 of the wet processing section 11 is provided with two roller sections removably insertable in the tank. As the said roller sections are

substantially similar to each other, only the sections inserted in the processing tank 21 will be described hereinafter (FIGS. 2-3).

The conveyor system of tank 12 consists of a first roller section 31 and a second roller section 32. The first section 31 comprises two U-shaped side members 33, 34 which are laterally spaced by rod means (not shown). In said side members are journaled the rollers 35, 36, 37, 38, 39, 40 and the roller pair 47, 48. The second section 32 comprises two I-shaped side members 25, 26 which are similarly laterally spaced and which support the rollers 41, 42, 43, 44, 45 and 46. Each roller of both sections is provided with a shaft extension carrying a gear. The gears of the roller pair 47, 48 of the first section 31 are continuously engaged. The gears of the rollers 35 to 40 and of the rollers 41 to 46 engage each other when the section 32 is inserted in the section 31 as shown in FIG. 1.

The driving of the rollers is performed through the intermediary of a number of gears 49 through 56. Co-axially with the gear 49 is further mounted a worm gear 57 that meshes with a worm 58 when the section 32 is inserted in the apparatus. Said worm 58 is mounted on an exterior horizontally running shaft 59 which is driven by a motor 60 with inbuilt reduction gear (FIG. 4).

Between the different rollers of each section are further provided guide and deflecting plates such as 61 in the roller section 32 and 62, 63, 64 and 65 in the section 31. Said numerals indicate only some of the guide plates which are provided.

The guide plates have the function of preventing the film sheet conveyed by the different roller pairs from diverging from its path. The plates 62, 63 moreover perform the function of turning the film through an angle of 180° so as to direct the film from the lower roller pair 37, 43 through the roller pair 47, 48, to the roller pair 38, 44.

A similar function of turning over the film through 180° is performed by the crossover roller transport sections 66 as represented in FIG. 3, and which are inserted between the successive processing tanks as indicated by 66 and 67 in FIG. 1. A section 66 is composed of two parallel side members spaced by rod means similar to the roller sections 31 and 32. The said side members carry two arcuate guide plates 69, 70 directing at either side to the nip of the roller pair 71, 72. The shaft extremities of the rollers 71, 72 are provided with gears 73, 74 and a gear 75 which is in mesh with the gear 74. When the section 66 is put into place in the apparatus as shown in FIG. 1 the gear 75 engages the gear 76 (see FIG. 4) of the upper roller of the first roller section in the tank 22. The drive of the gear 76 of the roller section in the tank 22 occurs similarly to the drive of the gears of the roller sections 31 and 32 in the tank 21 described hereinbefore.

The exact positioning of the various roller sections and of the crossover roller sections occurs by means of studs and projections which are not referred to, since they are obvious to one skilled in the art and they would only complicate the drawings. The sections are finally provided with hooks or the like in order to facilitate their removal from and their insertion in the apparatus.

The drying section 12 of the apparatus comprises in a known way a number of squeegee roller pairs 80 at the entrance of the drier, drivingly connected together by gears at one end and drivingly connected to the shaft 59 by means of a worm and a worm gear (not shown), a row of vertically aligned horizontally positioned roller pairs 81, and cylindrical air-directing tubes 82. The roller pairs 81 are drivingly connected by means of conical gears 83 which engage corresponding gears 84 on the vertically running shaft 85 as shown in FIG. 4, whereas the shaft 85 itself is driven by the shaft 59 through a worm and worm gear. The air-directing tubes 82 are provided with a longitudinal slit directing towards the film passage; they are closed at one end and they are connected with the

other end to a common conduct which passes through an air heater to a blower. Further details in this respect are omitted because of their minor importance in respect with the invention. It may, however, be interesting to mention that the drying section is provided with a glass panel 86, permitting observation of the interior of the drying section and the arrival of the film sheets.

In the present apparatus the material used for the side members 25, 26 and 33, 34 of the first and second roller sections and for the side members of the crossover roller sections, as well as for the transverse connecting rods, is hard poly(vinyl chloride). The film conveying rollers assemblies were formed by a rod of stainless steel having thinner end portions journaled in suitable bearings in the side members and covered over the remainder of its length with a layer of synthetic rubber of a thickness of 2 mm. The gears which are fitted to the shaft extremities are made of Delrin (trademark for an acetal resin, marketed by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., U.S.A.), whereas the worms and their shafts are made of stainless steel. The rollers of the drying section are covered with a 1 mm. thick layer of hard paper. The fixing solution contained in the tank 22 is kept at a temperature of about 25° C. by means of the conduct of water for the rinsing tank 23, which is passed in the form of a spiral 87 through the tank 22. The solution of the developing tank is thermostatically controlled by means of an electric resistance.

In the present apparatus which is suited for processing film sheets up to a width of 44 cm., the weight of the roller sections of the developing tank amounts to 4.7 kg. for the first and 4.5 kg. for the second roller section, and to 3.4 kg. for the first and 3 kg. for the second roller sections of the fixing and the rinsing tanks. The height of the first roller section of the developing tank amounts to 37 cm.

In the operation of the apparatus, the operator removes in the darkroom an exposed film sheet from its cassette, or the film sheet is automatically removed by a cassette-unloader mechanism. The film sheet is led over the support plate 14 until it becomes deflected by the plate 88 and enters the nip of the entry rollers 35, 41. The lever of microswitch 15 is depressed as long as the film sheet advances over it, and it is the length of film that passed, which will determine the amount of regeneration liquid to be added to the processing solutions.

The film is transported successively through the developer, fixing and rinsing tanks, and then through the squeegee roller pairs 80. The film is then transported vertically through the drying section where the gelatinous coatings of the film are subjected to oppositely disposed symmetrical flows of warm air extending across the entire width of the film. After leaving the drying section the film falls down in a tray at the foot of the apparatus (not shown) where the film is accessible.

What we claim is:

1. In an apparatus for processing sheet material through a tank, an improved guiding arrangement for conveying the sheets in a generally U-shaped path through said tank, said arrangement comprising an outer set of rollers disposed in two spaced apart parallel rows with the rollers in each row extending in spaced generally parallel relation to one another, and frame means for rotatably supporting the rollers of said outer set within said tank; an inner set of rollers comprising at least one row of rollers generally parallel to the rows of said outer set and situated in working position in at least partially telescoping relation between the outer rows, said inner row having the rollers thereof disposed for cooperating relation with the rollers of the outer set to provide cooperating pairs of sheet feed rollers, each such pair including a roller from each roller set, defining two spaced apart guide paths for the sheets, and frame means rotatably supporting the rollers of the

inner set as a unitary assembly whereby said inner set can be bodily displaced outwardly of the outer set; means for driving said rollers; and guide means at one end of the roller sets for directing sheets from one of said guide paths to the other.

2. Apparatus according to claim 1 wherein the outer set comprises substantially U-shaped frame members between which the rollers of that set are rotatable and wherein the inner set comprises frame members which fit between the limbs of said U-shaped frame members of the outer set.

3. The apparatus of claim 1, wherein said guide means comprises a pair of rollers and co-operating arcuate guide plates.

4. Apparatus according to claim 3 wherein said pair of rollers is mounted on the said outer set.

5. The apparatus of claim 1, wherein the rollers of the respective sets carry gear wheels at one end thereof with the gear wheels of at least one set being included in an intermeshing gear train, the gear wheels on the cooperating pairs of rollers intermeshing when the inner set is in working position, whereby all of the rollers can be driven by a common driving member.

6. Apparatus according to claim 5 wherein said gear wheels are located externally of the frames of the roller sets.

7. Apparatus according to claim 5 wherein the inner roller set carries a train of intermeshing gear wheels, including gear wheels fast with the sheet conveying rollers of that set and further gear wheels meshing with such roller gears and with each other, and wherein the outer set carries gear wheels fast with the sheet conveying rollers of that set and located so that they mesh with the roller gear wheels of the inner section when the two sections are in their relative working positions.

8. Apparatus according to any of claim 7 wherein a worm gear is associated with said gear train and a worm shaft is mounted on the tank, the said worm shaft and worm gear being located so that meshing engagement thereof is established by fitting the roller sets in the tank.

9. An improved arrangement for conveying sheet material in a generally U-shaped path, said arrangement comprising an outer set of rollers disposed in two spaced apart parallel rows with the rollers in each row extending in spaced generally parallel relation to one another, and frame means for rotatably supporting the rollers of said outer set; an inner set of rollers comprising at least one row of rollers generally parallel to the rows of said outer set and situated in working position in at least partially telescoping relation between the outer rows, said inner row having the rollers thereof disposed for cooperating relation with the rollers of the outer set to provide cooperating pairs of sheet feed rollers, each such pair including a roller from each roller set, defining two spaced apart guide paths for the sheets, and frame means rotatably supporting the rollers of the inner set as a unitary assembly whereby said inner set can be bodily displaced outwardly of the outer set; means for driving said rollers; and guide means at one end of the roller set for directing sheets from one of said guide paths to the other.

References Cited

UNITED STATES PATENTS

1,656,522	1/1928	Josepho	95—94
2,889,762	6/1959	Taubes	95—94
2,913,973	11/1959	Bull et al.	95—94
2,913,974	11/1959	Sabel et al.	95—94
3,025,779	3/1962	Russell et al.	95—94

NORTON ANSHER, *Primary Examiner.*

F. L. BRAUN, *Assistant Examiner.*

U.S. Cl. X. R.

226—119, 181, 189; 95—89