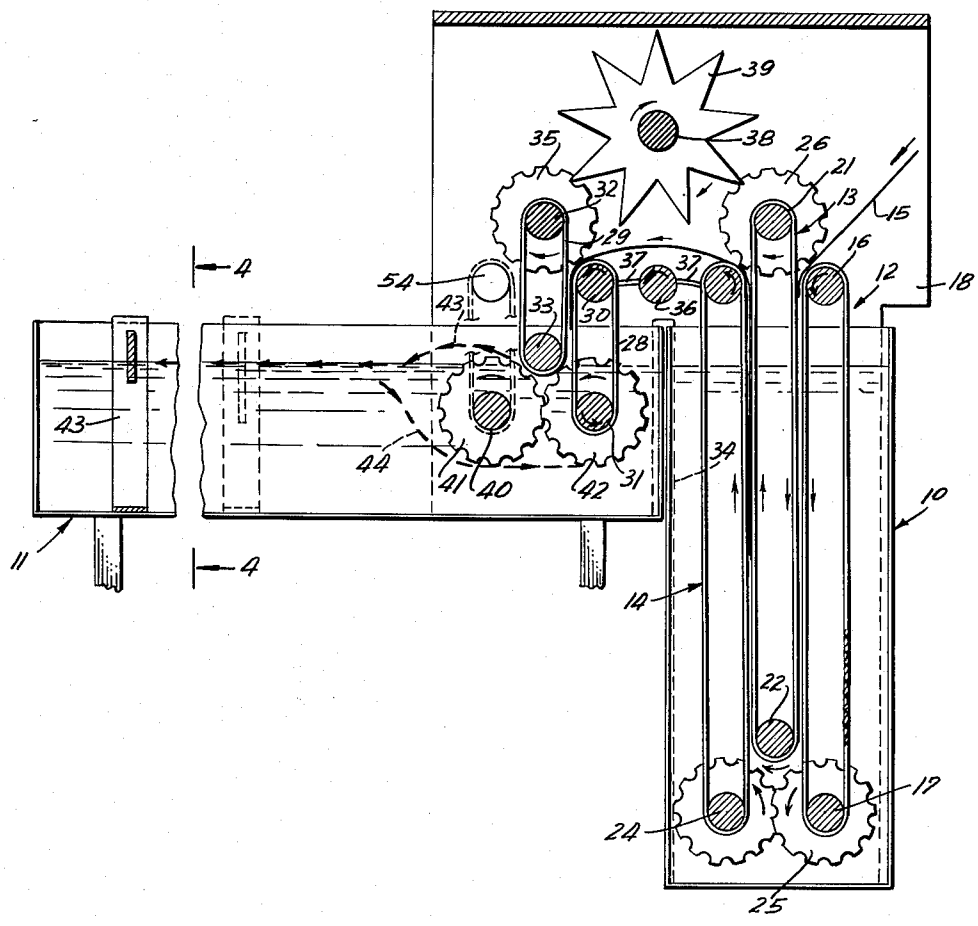
April 4, 1961 E. DUTCH 2,977,868

APPARATUS FOR PROCESSING SHEETS SUCH AS PHOTOCOPIES AND THE LIKE

Filed Oct. 16, 1957 3 Sheets-Sheet 1

FIG. 1



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APPARATUS FOR PROCESSING SHEETS SUCH AS PHOTOCOPIES AND THE LIKE

Filed Oct. 16, 1957 3 Sheets-Sheet 2

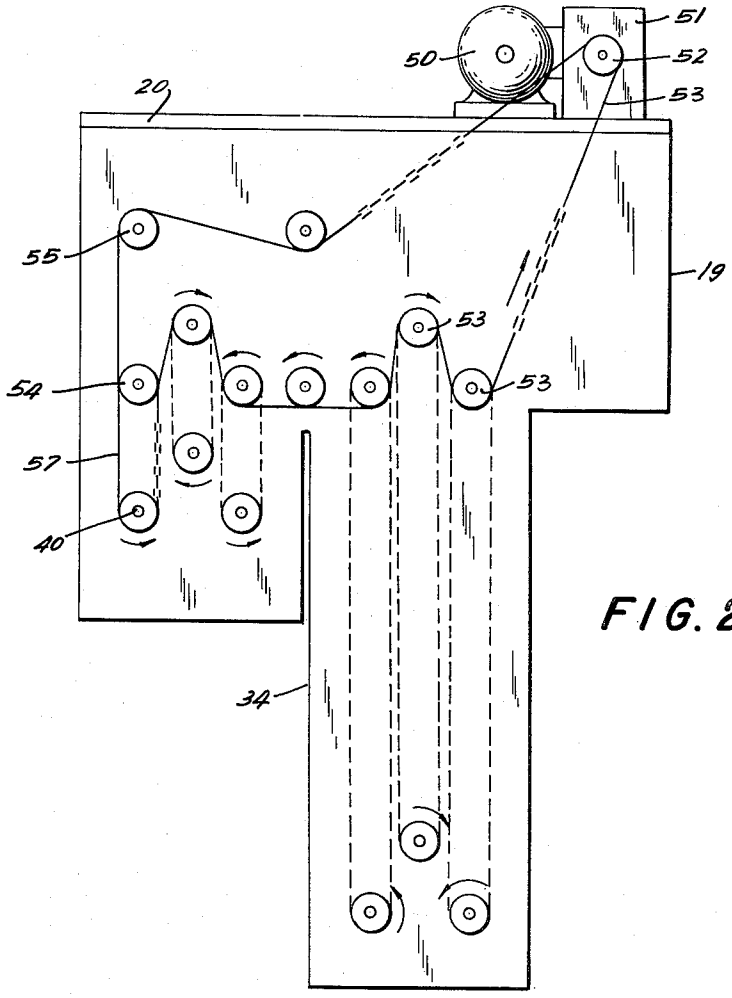


FIG. 2

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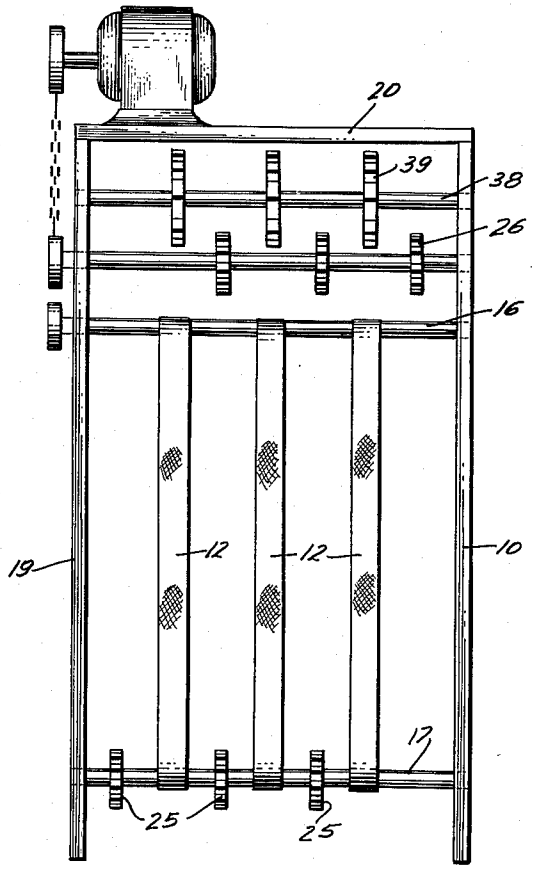
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APPARATUS FOR PROCESSING SHEETS SUCH AS PHOTOCOPIES AND THE LIKE

Filed Oct. 16, 1957

3 Sheets-Sheet 3

FIG. 3



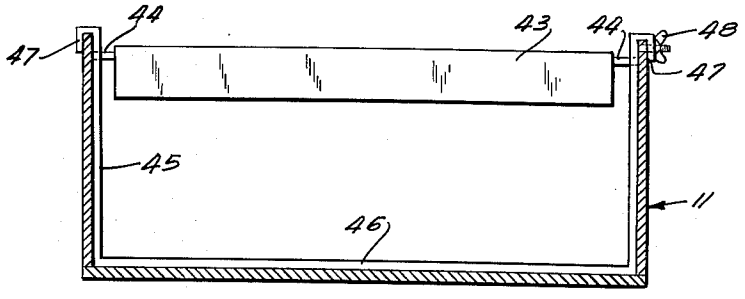


FIG. 4

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2,977,868

APPARATUS FOR PROCESSING SHEETS SUCH AS PHOTOCOPIES AND THE LIKE

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Filed Oct. 16, 1957, Ser. No. 690,536

5 Claims. (Cl. 95—94)

The present invention relates to apparatus for processing sheets such as photocopies.

At the present time apparatus of this type used, for example, for the development of photocopies is very elaborate and expensive, so that it is not always feasible for those who contemplate a relatively small use of such machines to purchase the latter. Furthermore, the machines have a tendency to overdevelop certain portions of the photocopies.

One of the objects of the present invention is to provide a processing apparatus of the above type which will have a greatly reduced tendency to overdevelop the photocopies or the like.

Another object of the present invention is to provide a relatively simple semi-automatic processing apparatus which is small enough and inexpensive enough to warrant the purchase of such machines by those who contemplate only relatively small use of the machines.

A further object of the present invention is to provide a processing machine which is capable of transporting sheets such as photocopies horizontally in a treating solution as well as vertically.

An additional object of the present invention is to provide a processing machine of the above type which is capable of automatically maintaining sheets submerged in stacked condition in a treating solution until the sheets are removed from the treating solution by the operator.

Still another object of the present invention is to provide an apparatus of the above type which is capable of being adjusted to sheets of different lengths.

A still further object of the present invention is to provide a processing apparatus capable of compensating for slight variations in the lengths of sheets.

With the above objects in view, the present invention includes in an apparatus for processing sheets such as photocopies or the like, a first tank adapted to contain a first treating solution and a first conveyor means for successively conveying sheets to be treated first downwardly into and then upwardly out of the first treating solution. A second tank is adapted to contain a second treating solution and is located adjacent the first tank, and this second tank carries or has extending into its interior a second conveyor means which receives the sheets from the first conveyor means and which introduces the sheets into the second treating solution in the second tank. Located in this second tank is a means which receives the sheets from the second conveyor means, which submerges the sheets in the solution in the second tank, and which maintains the sheets in stacked condition submerged in the solution while additional sheets are being added to the stack until the operator removes the stack of sheets from the solution in the second tank.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a sectional side elevational view of one possible apparatus constructed according to the present invention;

Fig. 2 is a side elevational view of the conveyor assembly of the present invention, Fig. 2 showing in particular the drive for the several conveyor components;

Fig. 3 shows the structure of Fig. 2 as seen from the right side of Fig. 2; and

Fig. 4 is a sectional elevational view taken along line 4—4 of Fig. 1 in the direction of the arrows and showing the details of a stop means according to the present invention.

Referring to Fig. 1 of the drawings, there is illustrated therein a vertical tank **10** adapted to contain a first treating solution in the form of a photographic developer solution. The expression "vertical tank" is intended to mean a tank which has considerable depth as compared to its length. A second tank **11** is located next to the first tank **10**, and this second tank is a horizontal tank in the sense that it is relatively shallow and quite long in relation to its depth, and the horizontal tank **11** is adapted to contain a second treating solution in the form of a hypo solution.

A first conveyor means extends into the first tank **10** for conveying sheets downwardly into and upwardly out of the solution in the tank **10**, and this first conveyor means is of the three belt type in that it includes the three sets of endless belts **12**, **13**, and **14** indicated in Fig. 1. The three belt type of conveyor means is driven in such a way that the adjacent vertical runs of the belts **12** and **13** move downwardly, as indicated by the arrows in Fig. 1, while the adjacent vertical runs of the belts **13** and **14** move upwardly, and thus a sheet **15**, such as a photocopy or the like, which is engaged between the belts **12** and **13** at the adjacent vertical runs thereof will be moved by the conveyor means downwardly into the developer solution, and the sheet when it is engaged between the adjacent runs of the belts **13** and **14** will be moved upwardly out of the solution.

The details of the conveyor means are illustrated in Figs. 3 and 2. Thus, there are a plurality of belts **12** which are in the form of loosely woven bands of a material which is incapable of reacting with the developer solution, and because of the loose weave of these bands the solution is capable of passing freely through the bands to work on the sheets. The bands **12**, of which there may be any desired number, are carried by a pair of shafts **16** and **17**, and these shafts are supported for rotation about their axes by a pair of side frame members **18** and **19** in the form of rigid plates interconnected at their top edges by a top plate **20**. The shafts **16** and **17** are driven by a drive means described below so that they rotate in a counterclockwise direction, as viewed in Fig. 1, the drive actually being transmitted to the shaft **16** and the shaft **17** rotating due to the frictional engagement with the belts **12**.

The belts **13** which are equal in number to the belts **12** and which are aligned therewith are carried by a pair of shafts **21** and **22** which are horizontal and which are respectively located at higher elevations than the shafts **16** and **17**, respectively, as is evident from Fig. 1. The shaft **21** is driven so that it turns in a clockwise direction. The belts **14** are equal in number to the belts **13** and are aligned therewith and these belts are carried by a pair of shafts **23** and **24** supported for rotation about their axes by the side frame members **18** and **19**, and the upper shaft **23** is driven so that it rotates in a counterclockwise direction, as viewed in Fig. 1. The lower shafts **17** and **24** each fixedly carry a plurality of serrated discs **25**, and any desired number of these discs may be

located on each of the shafts 17 and 24. These discs on one of the shafts are staggered with respect to the discs on the other of the shafts, and the discs overlap each other, as is indicated in Fig. 1. The sheets to be treated may be inserted manually into the top nip between the belts 12 and 13, or, if desired, an inclined plate may extend between the frame members 18 and 19 to guide the sheets to the nip between the belts 12 and 13. Of course, the belts 13 and 14 are made of the same material as the belts 12.

The leading edge of each sheet which is moved downwardly by the cooperating runs of the belts 12 and 13 is engaged by the rotating peripheries of the right serrated discs 25 of Fig. 1 and is urged by these discs 25 to the left discs 25 which in turn guide these leading edges of the sheets into the nip between the upwardly moving adjacent runs of the belts 13 and 14, and in this way each sheet is guided to the belts 13 and 14 to be moved by the latter upwardly out of the developer solution. The shaft 21 carries a plurality of serrated discs 26 similar to the serrated discs 25, and these discs turn with the shaft 21 in a clockwise direction, as viewed in Fig. 1. Thus, these serrated discs 26 guide the sheets into the nip between the belts 12 and 13, and also they cooperate with the belts 13 and 14 to engage the leading edges of the upwardly moving sheets as they come out of the solution and to urge the sheets to the left, as indicated in Fig. 1.

A two-belt type of conveyor means is carried by the frame members 18 and 19 and extend into the hypo tank 11 for receiving the sheets from the conveyor means 12—14 and for introducing the sheets into the hypo solution in the tank 11. This two-belt conveyor means includes the belts 28 and 29. These belts are driven so that their adjacent runs move downwardly, as indicated by the arrows in Fig. 1, and thus when the leading edge of each sheet is engaged in the nip between the belts 28 and 29 the latter convey the belts into the hypo solution. The belts 28 and 29 may be made of the same material as the belts 12 and are constructed in the same way except that they are shorter. The plurality of belts 28, of which there may be any desired number, are carried by the shafts 30 and 31 which are supported for rotation about their axes by the side frame members 18 and 19, and the upper shaft 30 is driven in a counterclockwise direction, as viewed in Fig. 18, so that the left run of the belts 28 move downwardly. The belts 29 which are equal in number to the belts 28 and which are aligned therewith are carried by a pair of horizontal shafts 32 and 33, and the upper shaft 32 is driven in a clockwise direction. The side frame members 18 and 19 are formed with upwardly extending slits 34 into which the adjacent end walls of the tanks 10 and 11 extend, as indicated in Fig. 1, so that in this way the side members 18 and 19 straddle the pair of tanks and are capable of positioning the pair of conveyor means in the tanks.

The upper shaft 32 carries a series of serrated discs 35 which engage the edges of the sheets coming from the three-belt type conveyor means 12—14 and guides these leading edges into the nip between the belts 28 and 29. Also, the plates 18 and 19 rotatably support a shaft 36 between the shafts 23 and 30 and at the same elevation as the shafts, so that if a particularly limp sheet tends to move downwardly between the shafts 23 and 30, the leading edge thereof will be engaged by the shaft 36 and guided toward the shaft 30. Suitable grids 37 in the form of perforated plates or the like may be positioned between and closely adjacent to the shafts 23, 36 and 30, as indicated in Fig. 1, these grids 37 being carried by and extending between the plates 18 and 19, so that these grids will prevent the sheets from moving downwardly into the spaces between the shafts 23, 36, and 30.

In accordance with the present invention, at the part of the conveyor structure which is located over the shaft 36, which is to say over the place where the tanks are located next to each other, the plates 18 and 19 turnably support a shaft 38 which carries a plurality of star wheels 39, and the shaft 38 is driven in a clockwise direction. Any number of star wheels may be distributed along the shaft 38 for rotation therewith, and these star wheels will engage the sheets and direct them to the serrated discs 35. Because the star wheels 39 have only a substantially point contact with the sheets, any developer solution which happens to be on the star wheels will engage the sheets at only an extremely small area and will have very little influence on the sheets, so that with this arrangement there will be practically no overdevelopment of the sheets. It will be noted from Fig. 1 that the star wheels 39 overlap both the serrated discs 26 and the serrated discs 35, and of course the star wheels 39 are staggered with respect to these discs.

In accordance with the present invention the hypo tank 11 has located in its interior a means which receives the sheets from the two-belt conveyor means 28, 29, which moves the sheets horizontally along the surface of the hypo solution in the tank 11, and which then submerges the sheets and maintains them in submerged stacked condition in the hypo solution until the operator removes the sheets from the hypo solution. This means includes a shaft 40 supported for rotation about its axis by the side frame members 18 and 19. Of course, these side frame members are located in the tanks 10 and 11 closely adjacent to the side walls thereof so that the shaft 40 extends almost all the way across the interior of the tank 11. The shaft 40 is driven in a counterclockwise direction, as viewed in Fig. 1, and it carries a plurality of serrated discs 41 which are staggered with respect to the serrated discs 42 which are carried by the shaft 31. These serrated discs 42 direct the leading edges of the sheets from the nip between the belts 28 and 29 to the serrated discs 41 which thus engage the sheets and move them in the direction of the curved line 43 shown in Fig. 1 onto the surface of the hypo solution. The level of the hypo solution is such that the upper peripheral portions of the discs 41 extend above the surface of the solution. Thus, as the sheets successively emerge from the conveyor means 28, 29 they are horizontally transported by the discs 41 to the left, as viewed in Fig. 1, along the surface of the solution in the hypo tank 11.

A stop means is located in the tank 11 to engage the leading edge of each sheet before the trailing edge thereof moves beyond the discs 41 and while this trailing edge is in engagement with the discs 41. This stop means is in the form of a bar 43. As may be seen from Fig. 4 the bar 43 is carried by a pair of pins 44 extending from its end walls and these pins 44 extend into aligned openings formed in the side portions 45 of a support bar 46 which has a horizontal portion extending along the bottom of the tank and the side portions 45 extending upwardly along the inner side surfaces of the tank, respectively. The side portions 45 terminate in downwardly extending portions 47 which straddle the upper side edges of the tank 11, and one or both of these portions 47 may be provided with a wing screw 48 which may be turned against a side wall of the tank 11 so as to fix the stop means in the tank at an adjusted distance from the discs 41. In this way the distance between the stop means and the discs 41 may be set for sheets of different lengths. At the same time, due to the pivotal support of the bar 43, this bar is capable of swinging freely, and therefore it is able to automatically and yieldably compensate for slight variations in the lengths of the successive sheets.

As the sheets move horizontally along the surface of the hypo solution, their leading edges finally abut against the stop bar 43 while their trailing edges are still in engagement with the serrated discs 41, and of course this operation takes place successively for each sheet. At this moment the trailing edge is engaged by the serrations of the discs 41 and the latter now submerge the sheet at its

trailing edge so that the sheet then has the position indicated by the curved line 44 in Fig. 1. The continued rotation of the serrated discs 41 in a counterclockwise direction, as viewed in Fig. 1, causes these discs to engage the sheets at their submerged trailing portions and at their top faces so as to transport the sheets to the right, as viewed in Fig. 1, away from the stop bar 43 until the right end edges of the sheets, as viewed in Fig. 1, engage the right end wall of the tank 11, as viewed in Fig. 1. Thus, the rotating discs 41 continuously urge the sheets to the right and maintain them submerged. After one sheet has been treated in this way the next sheet will simply slide along the top face of the already submerged sheet, and in this way a series of sheets will be maintained submerged in stacked condition within the hypo solution. The right end wall of the tank 11, as viewed in Fig. 1, thus forms a means located in the path of movement of the sheets away from the stop bar for maintaining the sheets in stacked condition submerged within the solution until the sheets are removed from the tank by the operator. After the trailing portion of the sheets are submerged by the disc 41 the remainder of the sheets move under the surface of the liquid, and the operator need only remove the sheets when the height of the stack of sheets approaches the distance between the bottom wall of the tank 11 and the discs 41.

The drive for the several shafts is shown most clearly in Fig. 2. The top wall 20 of the supporting frame carries a driving motor 50 which through a suitable gear reduction 51 drives a sprocket wheel 52, and the latter sprocket wheel drives a chain 53. This chain 53 extends about a series of sprocket wheels 54 located on the shafts 16, 21, 23, 36, 37, 32, and 54. In addition the chain extends around an idler shaft 55, on a sprocket wheel carried by this shaft. From the sprocket wheel on the shaft 55 the chain passes beneath a sprocket wheel on the shaft 38 and then goes back to the sprocket wheel 52. Thus, all of the shafts are driven in the direction described above. The shaft 54 carries a second sprocket wheel which drives a second chain 57, and this chain engages a sprocket wheel 58 on the shaft 40 at the exterior of the side frame member 19, so that the shaft 40 is driven in this way.

Thus, it will be seen that with the above structure there is provided a semi-automatic apparatus of relatively simple inexpensive construction which is capable of efficiently processing sheets such as photocopies or the like.

It should be noted that it is important that the liquid level in the hypo tank 11 be maintained at such an elevation that, on the one hand, the upper peripheral portions of the serrated discs 41 extend outwardly and upwardly beyond the level of the liquid, and on the other hand the lower portion of the shaft 33 should be submerged in the liquid and should extend beneath this liquid level.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of sheet processing apparatus differing from the types described above.

While the invention has been illustrated and described as embodied in photocopy processing apparatus, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In an apparatus for processing sheets such as photocopies or the like, in combination, a tank adapted to contain a treating solution; a shaft extending horizontally across the interior of said tank and supported by said tank for rotation about its axis; a plurality of serrated discs carried by said shaft for rotation therewith and having upper peripheral portions extending above the surface of a treating solution in said tank; drive means operatively connected with said shaft for rotating the latter so that said discs will move sheets delivered thereto successively along the surface of the treating solution in a direction away from said discs; stop means carried by said tank for engaging the leading edge of each sheet before the trailing edge thereof leaves and moves beyond said discs, so that the latter engage said trailing edge of each sheet and submerge the trailing edge of each sheet and then move each sheet in the reverse direction away from said stop means and into the solution.

2. In an apparatus for treating sheets such as photocopies and the like, in combination, a tank adapted to contain a treating solution; a shaft extending horizontally across said tank and supported for rotation about its axis by said tank; a plurality of serrated discs carried by said shaft for rotation therewith and having upper peripheral portions extending above the level of the treating solution in said tank, so that sheets delivered to said serrated discs during rotation of said shaft and discs will be moved by said serrated discs along the surface of the solution in said tank; a stop bar extending across said tank and spaced from said upper peripheral portions of said discs by a distance approximately equal to the length of the sheets so that the leading edges of the sheets engage said stop bar while the trailing edges thereof are still in engagement with said discs, so that the latter move the sheets at the trailing edges thereof first beneath the surface of the solution and then away from the stop bar.

3. In an apparatus for treating sheets such as photocopies and the like, in combination, a tank adapted to contain a treating solution; a shaft extending horizontally across said tank and supported for rotation about its axis by said tank; a plurality of serrated discs carried by said shaft for rotation therewith and having upper peripheral portions extending above the level of the treating solution in said tank, so that sheets delivered to said serrated discs during rotation of said shaft and discs will be moved by said serrated discs along the surface of the solution in said tank; a stop bar extending across said tank and spaced from said upper peripheral portions of said discs by a distance approximately equal to the length of the sheets so that the leading edges of the sheets engage said stop bar while the trailing edges thereof are still in engagement with said discs, so that the latter move the sheets at the trailing edges thereof first beneath the surface of the solution and then away from the stop bar means located in the path of movement of the sheets away from said stop bar for maintaining the sheets in stacked condition submerged within the solution until the sheets are removed from the tank by the operator; and means for adjusting the position of said stop bar in said tank to accommodate sheets of different lengths.

4. In an apparatus for treating sheets such as photocopies and the like, in combination, a tank adapted to contain a treating solution; a shaft extending horizontally across said tank and supported for rotation about its axis by said tank; a plurality of serrated discs carried by said shaft for rotation therewith and having upper peripheral portions extending above the level of the treating solution in said tank, so that sheets delivered to said serrated discs during rotation of said shaft and discs will be moved by said serrated discs along the surface of the solution in said tank; a stop bar extending across said tank and spaced from said upper peripheral portions of said discs

by a distance approximately equal to the length of the sheets so that the leading edges of the sheets engage said stop bar while the trailing edges thereof are still in engagement with said discs, so that the latter move the sheets at the trailing edges thereof first beneath the surface of the solution and then away from the stop bar means located in the path of movement of the sheets away from said stop bar for maintaining the sheets in stacked condition submerged within the solution until the sheets are removed from the tank by the operator; and means supporting said stop bar for yieldable movement to compensate for variations in the lengths of successive sheets.

5. In an apparatus for treating sheets such as photocopies and the like, in combination, a tank adapted to contain a treating solution; a shaft extending horizontally across said tank and supported for rotation about its axis by said tank; a plurality of serrated discs carried by said shaft for rotation therewith and having upper peripheral portions extending above the level of the treating solution in said tank, so that sheets delivered to said serrated discs during rotation of said shaft and discs will be moved by said serrated discs along the surface of the solution in said tank; a stop bar extending across said tank and spaced from said upper peripheral portions of said discs by a distance approximately equal to the length of the sheets so that the leading edges of the sheets engage said stop bar while the trailing edges thereof

are still in engagement with said discs, so that the latter move the sheets at the trailing edges thereof first beneath the surface of the solution and then away from the stop bar means located in the path of movement of the sheets away from said stop bar for maintaining the sheets in stacked condition submerged within the solution until the sheets are removed from the tank by the operator; and means supporting said bar for free swinging movement about an axis parallel to said bar so that said bar is capable of swinging to yieldably compensate for variations in the lengths of successive sheets.

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