Sept. 6, 1960 K. HUBER 2,951,700

MATERIAL HANDLING APPARATUS

Filed April 10, 1956 2 Sheets-Sheet 1

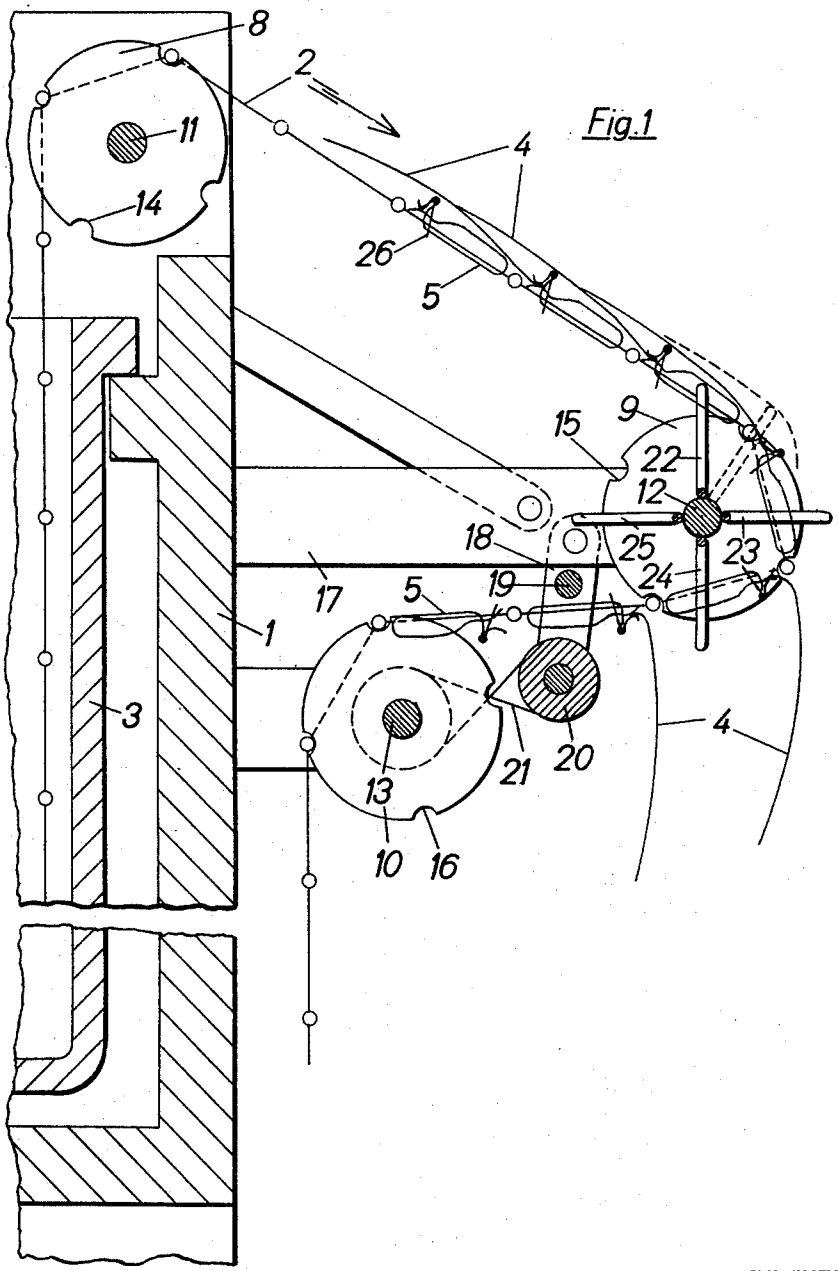


Fig.1

INVENTOR.
Karl HUBER

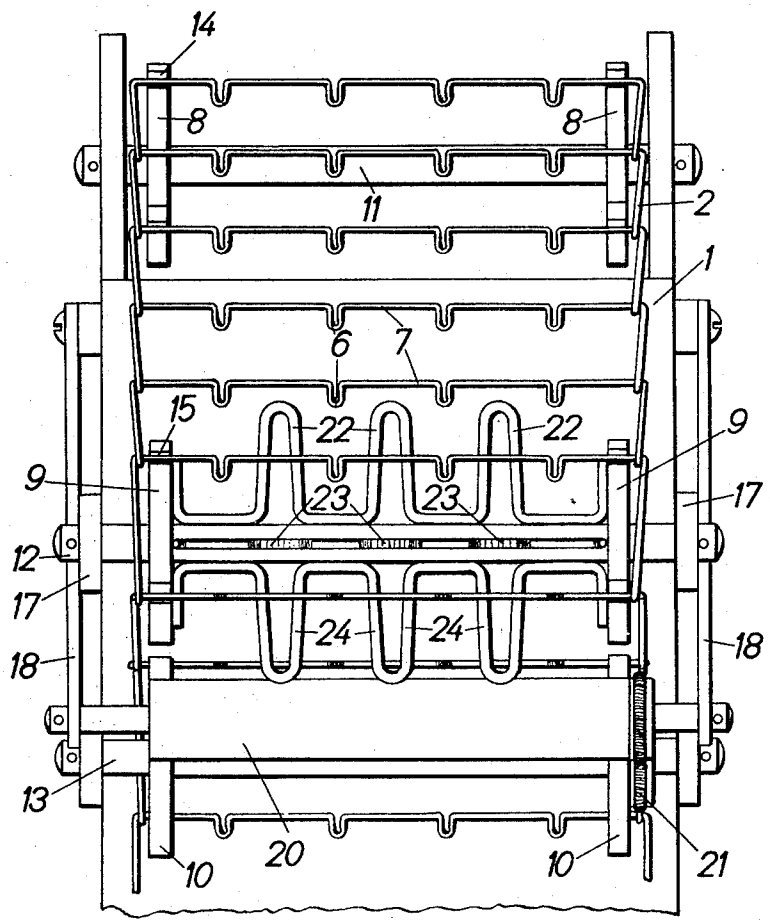
BY:
Michael S. Striker
agt.

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MATERIAL HANDLING APPARATUS

Filed April 10, 1956 2 Sheets-Sheet 2

Fig. 2



INVENTOR.
Karl HUBER

BY:
Michael S. Striker
agt.

United States Patent Office

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MATERIAL HANDLING APPARATUS

Karl Huber, Munich, Germany, assignor to Agfa Camera-Werk Aktiengesellschaft, Munich, Germany

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9 Claims. (Cl. 271—79)

The present invention relates to a material handling apparatus.

More particularly, the present invention relates to an apparatus which is adapted to handle such materials as sheets of paper for passing the latter through several treatment baths as in the case of a machine for developing photographic film, for example.

With material handling apparatus of the above type the sheets which are treated are located as close to each other as possible in order to treat the greatest number of sheets in the shortest possible time and thus have the greatest possible output from the machine. Thus, the sheets which are to be treated are located so close to each other that they overlap and contact each other, and at a certain stage of the material handling process the sheets are to be removed from the means which transport them through the several treating baths or the like. Inasmuch as the sheets are damp as they leave the baths and overlap and contact each other, they tend to cling to each other and thus difficulty arises in reliably placing the sheets in a hanging position where they may be conventiently removed from the apparatus. When the sheets fail to hang separately from the means which transports the sheets, then faulty operation results, often necessitating stopping of the machine so that continuous operation is interrupted, and in the case of photographic film some of the film may be spoiled.

One of the objects of the present invention is to provide a material handling apparatus of the above type with a means which will guarantee that sheets of the above type will not cling to each other and will be separated from each other so that they can hang properly from the means which transports the sheets so that the latter can be reliably removed from the material handling apparatus.

Another object of the present invention is to provide a means for separating sheets in the manner described above which requires no independent drive means for actuating the same.

A further object of the present invention is to provide a sheet separating means of the above type which may be conveniently incorporated into existing material handling apparatus of conventional construction.

An additional object of the present invention is to provide structure capable of accomplishing the above objects and characterized by extreme simplicity and ruggedness as well as reliability in operation.

With the above objects in view the present invention mainly consists of a material handling apparatus which includes an elongated chain having a plurality of interconnected links. A plurality of roller means cooperate with the chain for transporting the latter in a first direction along its given path toward an upper portion of one of the roller means, then around this one roller means, and then in a second direction along the given path away from a lower portion of this one roller means. A plurality of carrier means are carried by the chain for carrying a plurality of sheets in a position overlapping and contacting each other and located over the chain as the latter moves in the first direction toward the said one roller means and in a position hanging downwardly from the chain as the latter moves in the said second direction away from a lower portion of the said one roller means. Cooperating with this one roller means is a means for raising the successive sheets away from the chain and separating the contacting overlapping sheets from each other as the sheets move with the chain toward and around the said one roller means, so that in this way the sheets will reliably hang from the chain as the latter moves in the said second direction even though the sheets are damp and cling to each other as they move with the chain in the said first direction toward the said one roller means.

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 partly sectional, fragmentary, side elevational view of a structure according to the present invention; and

Fig. 2 is an end view of the structure of Fig. 1 as seen from the right side of Fig. 1, the sheets of paper and the elements which carry the same being omitted from Fig. 2 for the sake of clarity.

Referring now to the drawings, it will be seen that the structure of the invention includes a support means 1 in the form of a suitable frame which carries all of the structure of the invention. A transport means in the form of a chain 2 is provided for transporting the sheets of paper 4 which are to be treated through a series of baths of which only the last bath 3 is indicated in Fig. 1. The structure with which the invention is used corresponds in principle to the structure shown in British Patent No. 736,179, which shows a series of baths and which shows and endless element for transporting the material to be treated. Thus, the chain 2 is an endless chain which is guided by suitable rollers through a series of baths in which the sheets of paper 4 are treated, and after passing through the baths the transport means carries the sheets to a position where they are acted on by the structure of the present invention.

The sheets of paper 4 are carried by a plurality of carrier means 5 in the form of clips, and the structure of the carrier means 5 forms no part of the present invention so that these elements are shown only diagrammatically in a single line representation in Fig. 1 of the drawings. These elements 5 which carry the sheets may have the structure shown in Figs. 5–8 of British Patent No. 736,179. Each of the carrier means 5 includes a lever 26 which serves to nip the papers so as to clamp the latter releasably to the carrier means.

The chain 2 is composed of a series of pivotally interconnected links each of which has an elongated portion 7 extending across the chain, as is evident from Fig. 2, and each of these elongated portions 7 is formed with a plurality of U-shaped portions 6 to which the plurality of carrier means 5 are respectively connected, so that a plurality of carrier means are distributed along each elongated portion 7 of each link of the endless chain 2.

A plurality of roller means form part of the transport means and cooperate with the chain 2 for transporting the latter during part of its movement in a first direction along a given path, this first direction being indicated by the arrow at the upper portion of Fig. 1. The plurality of roller means are carried by the support means 1 for rotation about a plurality of parallel axes. Thus, one of these roller means is constituted by the shaft 11 which is carried by the support means 1 for rotation about its

axis and which has fixed thereto a pair of circular flanges 8. The second of the roller means shown in the drawings is constituted by the shaft 12 which is supported for rotation about its axis by the arms 17 of the support means 1, the pair of circular flanges 9 being fixed to the shaft 12 for rotation therewith to constitute part of the second roller means. The third roller means is formed by the shaft 13 which is also supported for rotation about its axis by the support means 1 and a pair of circular flanges 10 which are fixed to the shaft 13 for rotation therewith. Each of the flanges 8—10 is formed in its periphery with a plurality of recesses uniformly distributed about the axis of the shaft carrying each flange. Thus, the flanges 8 are formed with a plurality of recesses 14 at their peripheries, respectively, and in the example shown in the drawings there are four recesses 14 on each flange 8 angularly spaced from each other by 90°. In the same way the flanges 9 are formed with recesses 15 and the flanges 10 are formed with recesses 16, each flange having the recesses thereof uniformly distributed about the axis of the shaft carrying each flange. The recesses of the pairs of flanges of each roller means are in alignment with each other, and furthermore the flanges of the several roller means are located at the same distances from each other, as is evident from Fig. 2. The angular distance between each pair of successive recesses formed in the peripheries of the flanges is equal to the distances between the successive elongated portions 7 of the links of the chain 2, so that these elongated portions 7 successively enter the recesses at the peripheries of the flanges. Thus, when the above described roller means rotate in clockwise directions, respectively, as viewed in Fig. 1, they will move the endless chain 2 with the upper portion of the chain 2 which leaves the roller means 8, 11 moving in the above mentioned first direction along a given path toward an upper portion of the roller means 9, 12, then around this roller means, and then in a second direction away from a lower portion of the roller means 9, 12 to the roller means 10, 13 from where the chain moves to a position where it is charged with a fresh load of papers to be treated, the chain moving continuously through the bath and along the above described path. The above described roller means are driven so as to rotate in a clockwise direction, as viewed in Fig. 1, by any suitable drive means not forming part of the present invention and not shown in the drawings. For example, one of the roller means may be driven and the remaining roller means may be turned by the chain 2 itself.

The structure shown in the drawings also includes a removing means for removing the sheets 4 which hang from the chain 2, as shown at the lower right portion of Fig. 1, from the chain 2. This removing means includes a pair of arms which respectively are connected to and extend downwardly from the arms 17 and which carry between themselves the rod 19, the pair of arms 18 which carry the rod 19 being shown in Fig. 2. The arms 18 also turnably support a stripper roller 20 for rotation about its axis, and this stripper roller 20 is driven in a counterclockwise direction, as viewed in Fig. 1, by a pulley belt 21 in the form of a crossed endless coil spring driven by the roller means 10, 13 as by passing about a pulley connected to the shaft 13 and then being crossed and passing about a portion of the roller 20, as is evident from Figs. 1 and 2. The rod 19 is located in the path of movement of the levers 26 of the carrier means 5, and as these levers successively contact the rods 19 the levers 26 are turned to a position where they release the sheets 4. Beacuse these sheets 4 may still be damp, they tend to cling to the carrier means 5, and the stripper roller 20 reliably removes the sheets 4 from the carrier means 5 so that the sheets 4 are reliably moved from the material handling apparatus in this way.

As the sheets 4 move out of the bath 3 and in a first direction along the path of movement of the chain toward the roller means 9, 12, these sheets 4 are located over the chain 2 in a position overlapping and contacting each other, as indicated in Fig. 1. For proper operation, the sheets 4 should hang separately from the chain as these sheets 4 approach the removing means 18, 21, as is indicated in Fig. 1. However, because the sheets 4 are still damp, they tend to cling to each other, and it is not feasible to space the successive sheets 4 from each other by a distance which will prevent them from overlapping and contacting each other, because the result would be a reduction in output. If the sheets 4 cling to each other and do not hang separately from the chain as they approach the roller means 20, then faulty operation results often requiring interruption of the continuous operation of the machine, and furthermore in the case of photographic film the film can become spoiled.

In accordance with the present invention a means is provided for guaranteeing that the sheets 4 will be separated from each other so that they will reliably hang in the manner desired from the chain as they approach the removing means 18, 21. The means for separating the sheets 4 from each other, in accordance with the present invention, takes the form of a plurality of elongated wires 22, 23, 24, and 25. Each of these elongated wires has a plurality of spaced portions extending along and fixed to the outer surface of the shaft 12 as by being welded thereto. Between the portions of each of these wires which are fixed to the shaft 12, each wire has an elongated substantially U-shaped portion extending radially from the shaft 12, and these elongated U-shaped portions form separator elements for separating the successive sheets 4 from each other as they move around the roller means 9, 12. As is evident from Fig. 1, the elongated U-shaped portions of the wires 22—25 extend radially from the shaft 12 and outwardly beyond the flanges 9. Moreover, the wires 22—25 are respectively arranged substantially midway between the recesses 15 at the peripheries of the flanges 9. Furthermore, as is evident from Fig. 2, the successive U-shaped portions of each wire are staggered with respect to the portions 6 of the links 7 which are connected to the carrier means 5. In this way, as the sheets 4 move in the direction of the arrow shown in the upper portion of Fig. 1 toward an upper portion of the roller means 9, 12 the successive U-shaped portions of the wires 22—25 will move into and out of the spaces defined between the successive links of the chain 2 and when the successive wires have the dotted line position indicated in Fig. 1 they will have engaged and raised the sheet which they contact upwardly from the chain and out of contact with the next sheet so that when the chain moves around the roller means 9, 12 the sheets which may still be damp and tend to cling to each other will reliably hang separately from the chain. Thus, the U-shaped portions of the wires 22—25 form a plurality of separator elements arranged in groups which are distributed about the axis of the roller means 9, 12 extending radially from this axis beyond the flanges 9 of the roller means and angularly spaced from each other in such a way that they coincide with the spaces between the links and move into and out of these spaces to reliably separate the successive sheets 4 from each other. Because the elongated separator elements are staggered with respect to the carrier means 5, they do not engage or in any way interfere with these carrier means and move into the spaces between the group of carrier means which is carried by each elongated portion 7 of each link. It will be noted that each group of separator elements is arranged in a row extending axially along the shaft 12. Of course, instead of forming the elongated separator elements from U-shaped portions of a wire, it is possible to use separate rods or the like which are fixed to and extend radially from the shaft 12 at the positions where the U-shaped portions of the wires 22—25 are located. As is evident from Fig. 2, these wires in addition to having axially extending portions fixed to the outer surface of the shaft 12, have radially extending end portions respectively fixed to the inner faces of the flanges 9, as by being welded thereto.

It will be noted that with the above described structure of the invention the structure for separating the successive sheets from each other requires no separate drive means and simply turns together with the roller means **9, 12** without moving with respect to the latter. Thus, there are no moving parts involved in the structure of the invention which are likely to become worn out or which are likely to have undesirable play. Furthermore, it is an extremely simple matter to incorporate the above described wires **22—25** into an existing machine having rollers of the above type, so that there is no problem in accommodating any known structures with the structure of the invention.

It will be understood that instead of arranging the plurality of wires **22—25** on the shaft **12**, said wires may be fixed directly to the flanges **9** without being fixed to the shaft **12**. Furthermore, instead of arranging the wires **22—25** on the roller means **9, 12**, said wires may be arranged on an additional shaft rotating under the action of separate drive means and located adjacent another part of the path of the chain **2**, for example over a part of said path between the roller means **9, 12** and the removing means **18, 21**. In that case (not shown in the drawings) the sheets **4**—if they do not hang separately from the chain after having passed the roller means **9, 12**—will be pushed downwardly by the U-shaped portions of the wires **22—25** so that the successive sheets will be separated from each other and brought into the hanging position.

Furthermore, 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 material handling apparatus, differing from the types described above.

While the invention has been illustrated and described as embodied in sheet separating structure for a material handling 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 a material handling apparatus, in combination, elongated transport means for transporting a plurality of sheets along a predetermined path with said sheets spaced from each other along and hanging down from said transport means while the latter transports said sheets along at least a part of said path, said transport means including a series of elongated elements extending transversely of said path and defining a plurality of spaces between themselves; and separator means located adjacent said part of said path for automatic movement to and from a position extending through said spaces as they move successively past said separator means, the latter engaging sheets carried by said transport means to separate the sheets from each other in the event that they are damp and cling to each other so as to guarantee that the sheets will hang separately from each other during movement along said part of said path.

2. In a material handling apparatus, in combination, elongated transport means for transporting a plurality of sheets along a predetermined path with said sheets spaced from each other along and hanging down from said transport means while the latter transports said sheets along at least a part of said path, said transport means including a series of linked elongated elements extending transversely of said path and defining a plurality of spaces between themselves; and separator means located

adjacent said part of said path for automatic movement to and from a position extending through said spaces as they move successively past said separator means, the latter engaging sheets carried by said transport means to separate the sheets from each other in the event that they are damp and cling to each other so as to guarantee that the sheets will hang separately from each other during movement along said part of said path.

3. In a material handling apparatus, in combination, an elongated chain composed of a series of interconnected links defining successive spaces therebetween; a plurality of roller means spaced from each other and cooperating with said chain for guiding the latter in a first direction along a given path to an upper portion of one of said roller means, then around to a lower portion of said one roller means, and then in a second direction along said path away from said one roller means; carrier means carried by said chain for carrying a plurality of overlapping contacting sheets in a position located over said chain as the latter moves in said first direction toward said one roller means and in a position extending downwardly from said chain as the latter moves in said second direction away from said one roller means; and separating means connected to said one roller means for turning movement therewith and moving into and out of the successive spaces defined by said links for raising the successive sheets upwardly from said chain as the latter approaches and moves around said one roller means to separate said overlapping contacting sheets from each other so that they will hang downwardly from said chain and be separated from each other as said chain moves in said second direction along said path even if said sheets are damp and tend to cling to each other.

4. In a material handling apparatus, in combination, an elongated chain composed of a series of interconnected links defining spaces therebetween; a plurality of roller means spaced from each other and cooperating with said chain for guiding the latter in a first direction along a given path to an upper portion of one of said roller means, then around said roller means, and then in a second direction along said path away from said roller means; carrier means carried by said chain for carrying a plurality of sheets which overlap and contact each other in a position over said chain as the latter moves in said first direction along said path and in a position hanging downwardly from said chain as the latter moves in said second direction along said path; and a plurality of elongated elements connected to said one roller means for rotation therewith, distributed about the axis thereof, and extending radially beyond said one roller means, said elongated elements respectively having positions on said one roller means which coincide with said spaces between said links as said chain moves around said one roller means so that said elongated elements move successively into and out of said spaces to raise the successive sheets away from each other as said chain moves around said one roller means to guarantee that said sheets hang properly from said chain as the latter moves in said second direction along said path even if said sheets are damp and cling to each other as the move with said chain in said first direction along said path.

5. In a material handling apparatus, in combination, an elongated chain composed of a plurality of interconnected links which define spaces therebetween, each of said links having an elongated portion extending across said chain; a plurality of roller means spaced from each other and cooperating with said chain for guiding the latter in a first direction along a given path toward an upper portion of one of said roller means, then around said roller means, and then in a second direction along said path extending from a lower portion of said one roller means; a plurality of carrier means connected to and distributed along each elongated portion of each link for carrying a plurality of sheets which overlap and

contact each other and which are located over said chain as the latter moves in said first direction along said path, said sheets hanging downwardly from said chain as the latter moves in said second direction along said path; and a plurality of elongated separator elements connected to said one roller means for rotation therewith, extending radially with respect to the axis of said one roller means beyond the latter, and arranged in a plurality of groups which are angularly spaced from each other by angular distances equal to the angular distances between the spaces between said links as the latter move around said one roller means and in positions coinciding with said spaces, the separator elements in each group being arranged in a row extending axially across said one roller means and the separator elements of each group being staggered with respect to the plurality of carrier means connected to each elongated portion of each link, so that said separator elements move into and out of said spaces to contact the successive sheets as they approach said one roller means and raise the successive sheets to separate the latter from each other so that they will hang downwardly from said chain as the latter moves in said second direction along said path even if said sheets are damp and cling to each other as they move with said chain in said first direction along said path.

6. In a material handling apparatus, in combination, an elongated chain composed of a plurality of interconnected links which define spaces therebetween, each of said links having an elongated portion extending across said chain; a plurality of roller means spaced from each other and cooperating with said chain for guiding the latter in a first direction along a given path toward an upper portion of one of said roller means, then around said roller means, and then in a second direction along said path extending from a lower portion of said one roller means; a plurality of carrier means connected to and distributed along each elongated portion of each link for carrying a plurality of sheets which overlap and contact each other and which are located over said chain as the latter moves in said first direction along said path, said sheets hanging downwardly from said chain as the latter moves in said second direction along said path; and a plurality of elongated separator elements connected to said one roller means for rotation therewith, extending radially with respect to the axis of said one roller means beyond the latter, and arranged in a plurality of groups which are angularly spaced from each other by angular distances equal to the angular distances between the spaces between said links as the latter move around said one roller means and in positions coinciding with said spaces, the separator elements in each group being arranged in a row extending axially across said one roller means and the separator elements of each group being staggered with respect to the plurality of carrier means connected to each elongated portion of each link, so that said separator elements move into and out of said spaces to contact the successive sheets as they approach said one roller means and raise the successive sheets to separate the latter from each other so that they will hang downwardly from said chain as the latter moves in said second direction along said path even if said sheets are damp and cling to each other as they move with said chain in said first direction along said path, each group of separator elements being in the form of a single wire having a plurality of spaced portions substantially parallel to the axis of said one roller means and fixed to the latter and having between said spaced portions elongated substantially U-shaped portions extending radially from the axis of said one roller means.

7. In a material handling apparatus, in combination, support means; a plurality of parallel shafts spaced from each other and carried for rotation about their axes, respectively, by said support means; a pair of flanges spaced from each other and fixed to each shaft for rotation therewith, each of said flanges having an outer peripheral portion formed with a plurality of recesses distributed uniformly about the axis of each shaft and located at given angular distances from each other; an elongated chain composed of a plurality of interconnected links each of which has an elongated portion extending across said chain, said elongated portions of said links being spaced from each other by distances equal to the distances between successive recesses at said peripheral portion of each flange and said elongated portions of said links moving successively into successive recesses of said flanges so that when said shafts and flanges rotate they cooperate with said chain to guide the latter, said shafts and flanges respectively forming a plurality of roller means and said chain moving toward an upper portion of one of said roller means in one direction, then around said one roller means, and then in a second direction away from a lower portion of said one roller means; a plurality of carrier means respectively carried by said elongated portions of said links for carrying a plurality of sheets in a position overlapping and contacting each other as said chain moves toward said one roller means and in a position hanging down from said chain as the latter moves in said second direction away from said one roller means; and a plurality of elongated separator elements fixed to the shaft of said one roller means, extending radially therefrom, being angularly spaced from each other by the same angular distances as the recesses of the flanges of said one roller means, and being respectively located substantially midway between said recesses, said elongated separator elements extending radially beyond said flanges so that they move successively into the successive spaces between said links as the latter move around said one roller means to raise said sheets from each other so as to guarantee that the latter hang from said chain as the latter moves in said second direction even if said sheets are damp and tend to cling to each other as they move with said chain in said first direction.

8. In a material handling apparatus, in combination, support means; a plurality of parallel shafts spaced from each other and carried for rotation about their axes, respectively, by said support means; a pair of flanges spaced from each other and fixed to each shaft for rotation therewith, each of said flanges having an outer peripheral portion formed with a plurality of recesses distributed uniformly about the axis of each shaft and located at given angular distances from each other; an elongated chain composed of a plurality of interconnected links each of which has an elongated portion extending across said chain, said elongated portions of said links being spaced from each other by distances equal to the distances between successive recesses at said peripheral portion of each flange and said elongated portions of said links moving successively into successive recesses of said flanges so that when said shafts and flanges rotate they cooperate with said chain to guide the latter, said shafts and flanges respectively forming a plurality of roller means and said chain moving toward an upper portion of one of said roller means in one direction, then around said one roller means, and then in a second direction away from a lower portion of said one roller means; a plurality of carrier means respectively carried by said elongated portions of said links for carrying a plurality of sheets in a position overlapping and contacting each other as said chain moves toward said one roller means and in a position hanging down from said chain as the latter moves in said second direction away from said one roller means; a plurality of elongated separator elements fixed to the shaft of said one roller means, extending radially therefrom, being angularly spaced from each other by the same angular distances as the recesses of the flanges of said one roller means, and being respectively located substantially midway between said recesses, said elongated separator elements extending radially beyond said flanges

so that they move successively into the successive spaces between said links as the latter move around said one roller means to raise said sheets from each other so as to guarantee that the latter hang from said chain as the latter moves in said second direction even if said sheets are damp and tend to cling to each other as they move with said chain in said first direction; and removing means located adjacent said chain at a portion of the latter moving in said second direction for removing the hanging sheets from said carrier means.

9. In a material handling apparatus, in combination, a plurality of roller means each of which includes a shaft and a pair of flanges spaced along and connected to said shaft and each having a peripheral portion formed with a plurality of recesses spaced uniformly about the axis of said shaft at predetermined angular distances from each other; support means supporting said shafts at positions spaced from each other for respective rotation about axes coinciding with the axes of said shafts, respectively, and being parallel to each other; an elongated chain composed of a plurality of interconnected links each of which has an elongated portion extending across said chain, said elongated portions being spaced from each other by distances equal to the distances between successive recesses of said flanges and successively entering said recesses so that the rotation of said plurality of roller means guides said chain along a given path, said path having a first portion which extends in a first direction toward one of said roller means, then passing around said one roller means, and then extending in a second direction away from a lower portion of said one roller means; a plurality of carrier means connected to each elongated portion of each link and distributed along the same for carrying a plurality of sheets in a position

located over said chain and contacting and overlapping each other as said chain moves in said first direction along said path and in a position hanging downwardly from said chain as the latter moves in said second direction along said path; and a plurality of elongated wires fixed to and distributed about the shaft of said one roller means and each having spaced portions extending parallel to and engaging said shaft of said one roller means and having substantially U-shaped portions extending radially from said shaft beyond said flanges fixed thereto so that a row of U-shaped portions of each wire extend radially beyond the flanges of said one roller means, said wires being angularly spaced from each other by distances equal to the angular distances between successive recesses of said flanges and being located substantially midway between successive recesses, and said U-shaped portions of each wire being staggered with respect to said carrier means so that said U-shaped portions of said wires successively move into and out of the spaces between said links to engage and raise the papers carried by said chain upwardly from the latter as said chain approaches said one roller means to guarantee that said papers hang separately from said chain as the latter moves in said second direction even if said papers are damp and cling to each other as they move with said chain in said first direction.

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