United States Patent

Turner et al.

[15] **3,669,447**

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[54] SHEET PROPELLING APPARATUS

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[52] **U.S. Cl.** **271/53**, 271/36

[51] **Int. Cl.** **B65h 9/16**

[58] **Field of Search** 271/36, 52, 51, 53, 48, 49, 271/73

[56] **References Cited**

UNITED STATES PATENTS

2,677,542 5/1954 Backhouse et al. ..... 271/53 X

2,165,161 7/1939 Spiess 271/52

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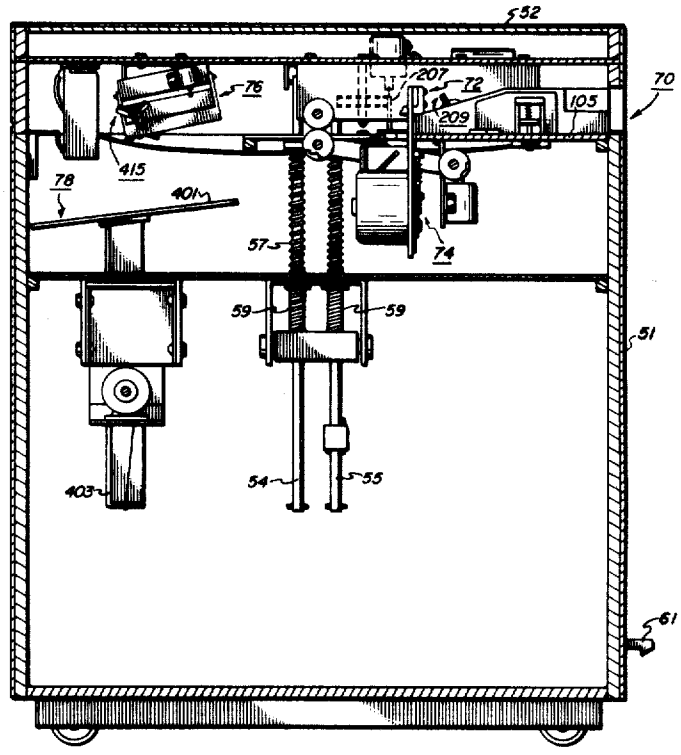
[57] **ABSTRACT**

Sheet propelling apparatus for use with a sheet stacking assembly which includes a shaft member, a hub member affixed thereto, and a plurality of blade members extending from the hub member to contact sheet material fed along a sheet path. The blade members are made from a flexible material of predetermined shape and thickness and formed to make a helix angle with the shaft axis of from about 20° to about 50° to impart one component of thrust on the sheet material at right angles to the sheet path and another component of thrust in the same direction of the sheet path.

8 Claims, 8 Drawing Figures



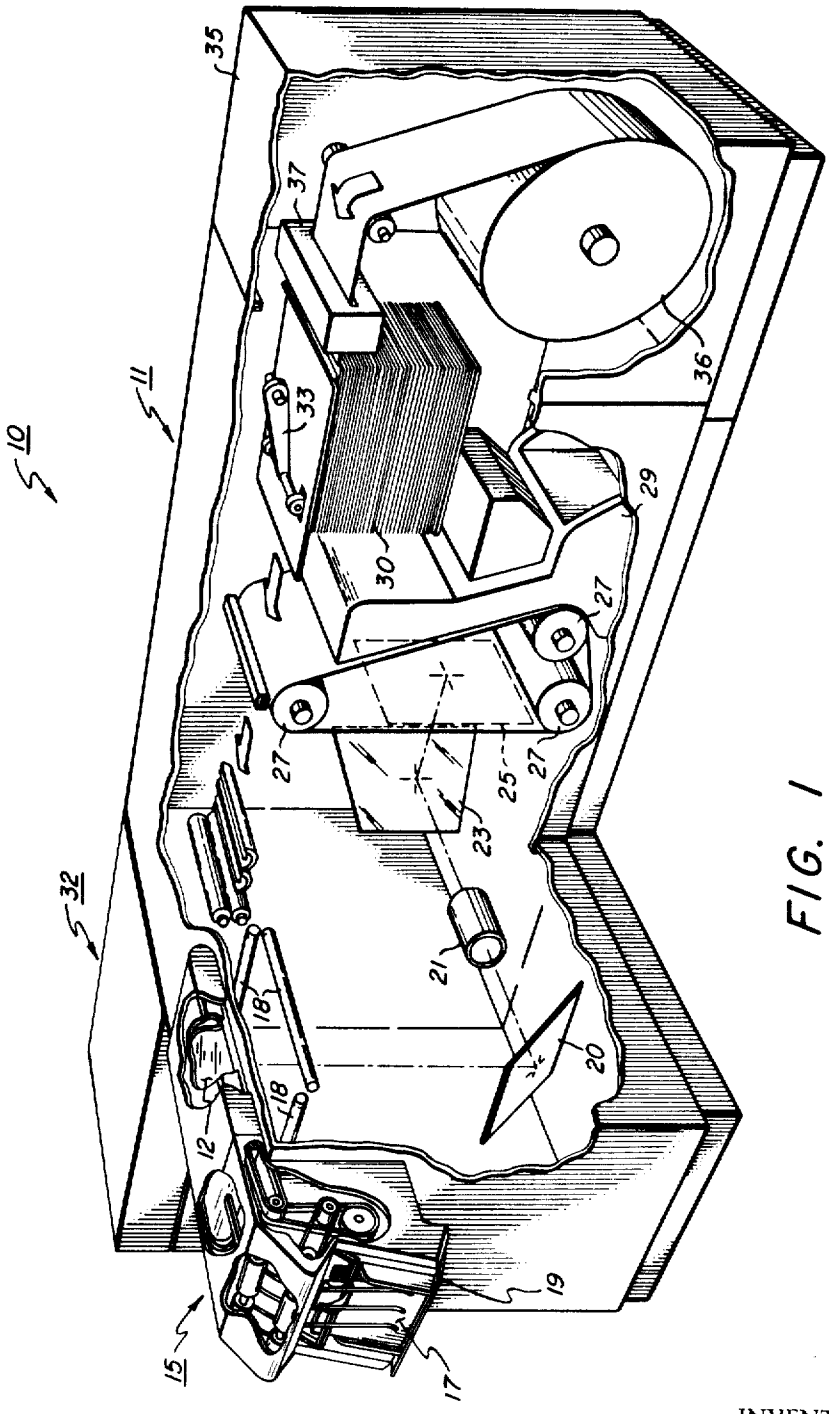


FIG. 1

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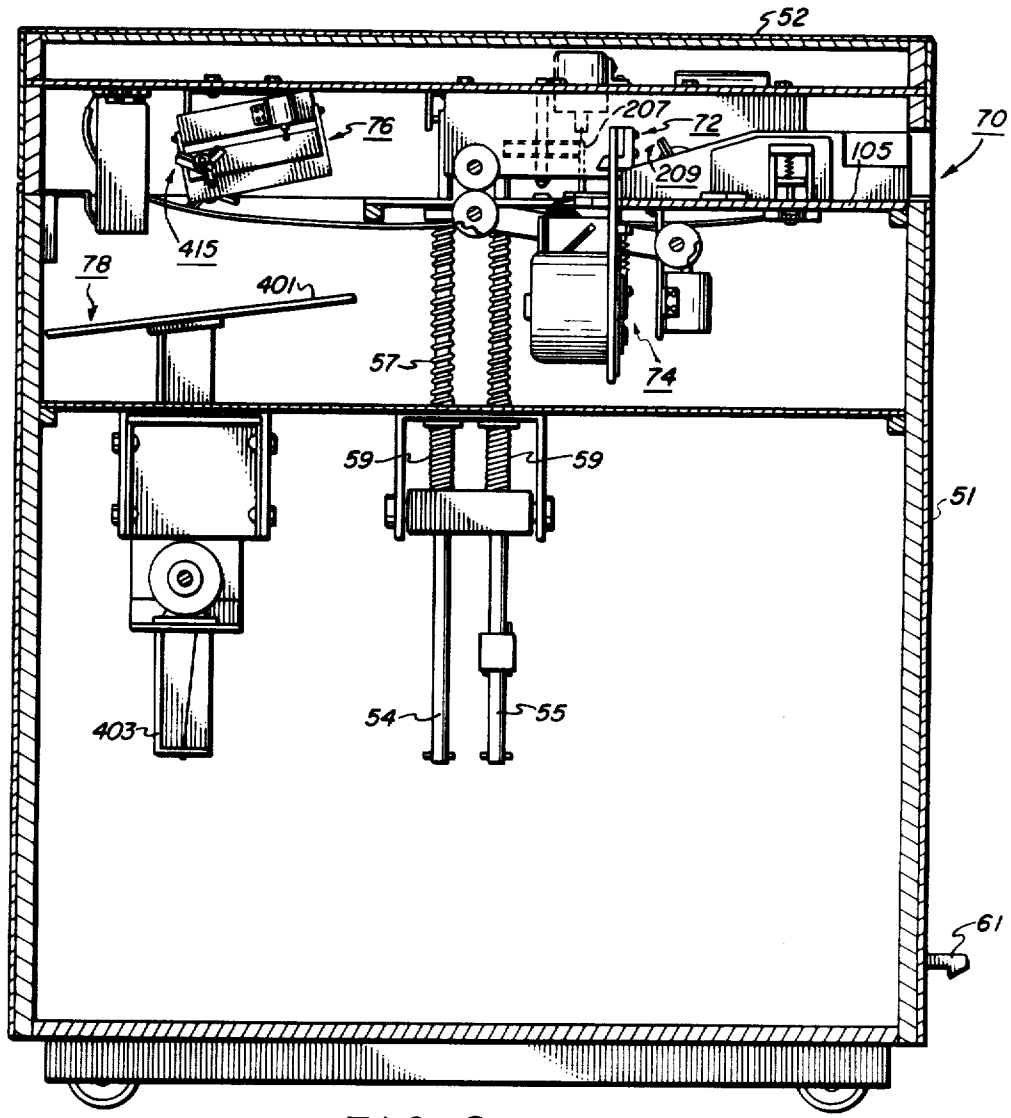

FIG. 2

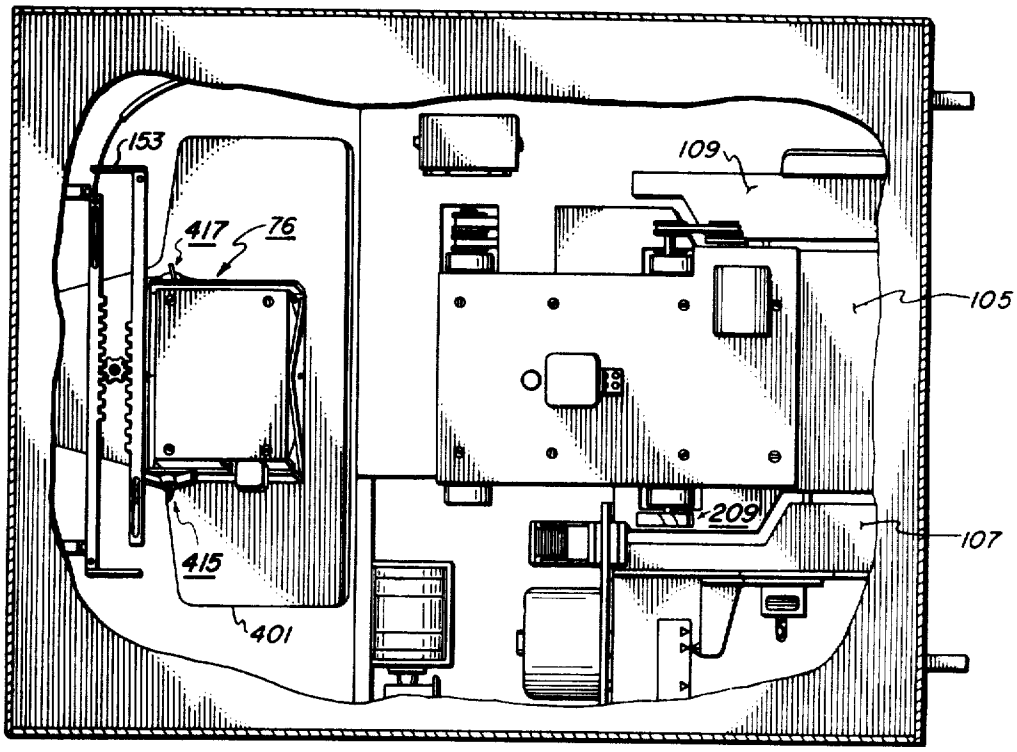

FIG. 3

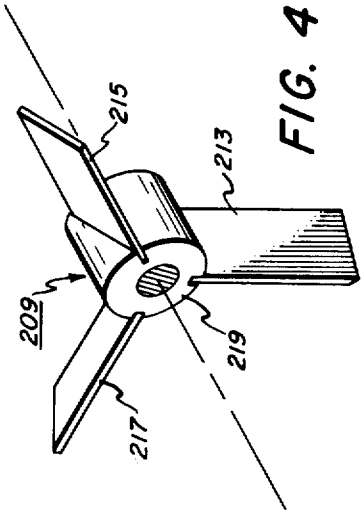

FIG. 4

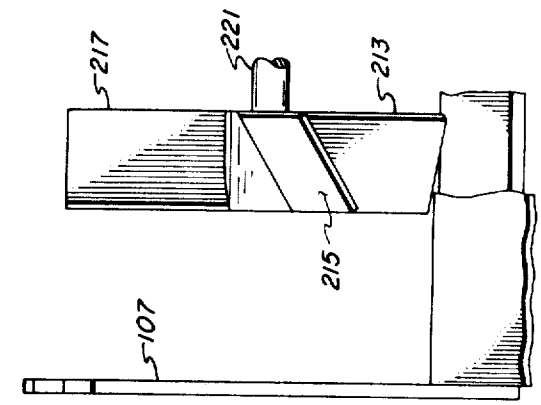

FIG. 4c

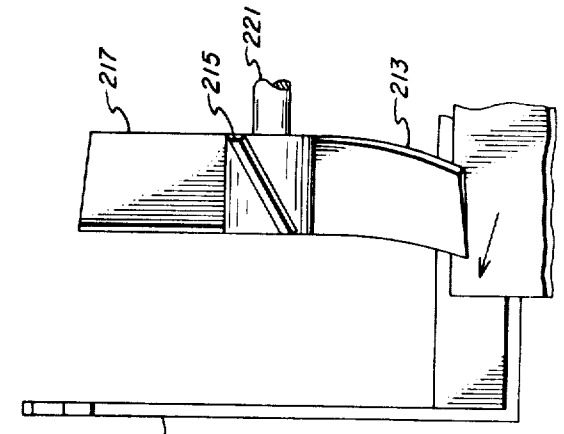

FIG. 4b

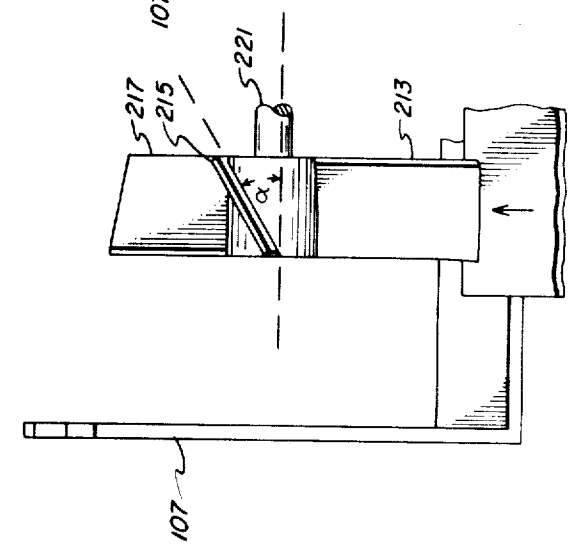

FIG. 4a

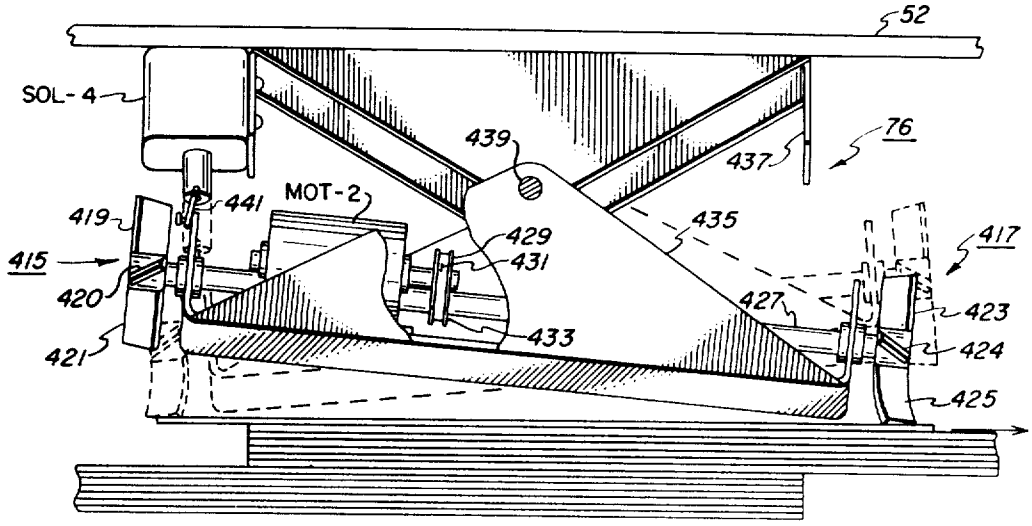
52
SOL-4
439
76
437
441
MOT-2
419
429
435
417
415
431
420
427
423
433
424
421
425

FIG. 5

SHEET PROPELLING APPARATUS

This invention relates to apparatus for propelling sheet material into position for stacking and/or stapling or the like.

As is well known in the art of bookmaking, it is generally necessary to first print or copy sheets and then gather groups of different sheets placed in a definite order referred to as collating. The operation of printing and then assembling sheets into booklets usually requires several steps, the last of which is taking one sheet from each of the stacks and putting these sheets together in the order desired.

Normally the assembling of the sheets into booklets by hand is slow and cumbersome. Also, the number of people necessary is considerable and the likelihood of making a mistake great.

Present devices for mechanically assembling sheets into booklet form have the disadvantage of being prolix and costly and have not been entirely satisfactory.

The present invention enables automatic assembling of sheet material into separate identifiable stacks or booklets which may be fastened into a finished form. To accomplish this, a finishing apparatus accepts copy sheets from a processor and either staples them into booklets or stacks them in separated bundles by the action of a sheet propelling assembly.

It is therefore an object of the present invention to improve the printing of booklets.

It is another object of the present invention to stack collated sets of copy sheets from a processor in a manner more simple and cheaper than heretofore.

It is another object of the present invention to collect copy sheets from a processor into separated identifiable stacks.

It is another object of the present invention to propel sheet material fed along a sheet path in sideways and ahead directions.

It is another object of the present invention to handle stacking and/or stapling sheet material in a manner more expeditious than heretofore.

It is another object of the present invention to provide a sheet paddle assembly which is simple and compact in design.

These objects as well as others will become more apparent upon considering the following description which is to be read in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a copying machine incorporating a finishing apparatus according to the present invention;

FIG. 2 is a side sectional view of the finishing apparatus;

FIG. 3 is a plan view of the finishing apparatus with parts in section to illustrate certain details thereof;

FIG. 4 is an isometric view of a paddle wheel;

FIGS. 4*a–c* illustrate in sequence the action of a rotating paddle wheel on moving sheet material;

FIG. 5 is a side view of the side stacking assembly;

GENERAL

For a general understanding of reproduction apparatus with which the present invention may be incorporated, reference is made to FIG. 1 wherein various components of a typical electrostatic printer system are illustrated. The printer system is of the xerographic type and is generally designated with the reference numeral **10**. As in all xerographic systems, a light image of an original to be reproduced is projected onto the sensitized surface of a xerographic plate to form an electrostatic latent image. Thereafter, the latent image is developed with toner material to form a xerographic powder image corresponding to the latent image on the plate surface. The powder image is then electrostatically transferred to a record material such as a sheet or web of paper or the like to which it may be fused by a fusing device whereby the powder image is caused permanently to adhere to the surface of the record material.

The xerographic processor indicated by the reference numeral **11** is arranged as a self-contained unit having all of its processing stations located in a unitary enclosure or cabinet.

The printer system includes an exposure station at which a light radiation pattern of a document to be reproduced is positioned on a glass platen **12** for projection onto a photoconductive surface in the form of a xerographic belt **13**. The document is transported by a recirculating document feed apparatus **15** from the bottom of a stack **17** on a supply tray **19** to the platen for exposure and then returned to the top of the supply tray on completion of the exposure until the entire stack has been copied at which time the cycle may be repeated as described in copending U.S. application Ser. No. 781,287, filed on Dec. 4, 1968, entitled Document Feed Apparatus and commonly assigned with the present invention.

Imaging light rays from the document as flash illuminated by lamps **18** are projected by a first mirror **20** and a projection lens **21** and another mirror **23** onto the belt **13** at the focal plane for the lens **21** at a position indicated by the dotted line **25**.

As an interface structure and for unobstructive optical projections, the side of the cabinet is formed with an enlarged rectangular opening to permit the projection of image light rays from the lens **21** to the mirror **23**. Similarly, the cabinet supporting the document plane is formed with a corresponding rectangular opening that mates with the opening in the printer cabinet when the two cabinets are operatively joined together for copy/duplicating purposes. Suitable light-type gaskets may be utilized adjacent the exterior of each opening in the cabinets in order to minimize the leakage of unwanted extraneous light.

The xerographic belt **13** is mounted for movement around three parallel arranged rollers **27** suitably mounted in the frame of processor **11**. The belt may be continuously driven by a suitable motor (not shown) and at an appropriate speed corresponding to the discharge responsive the photoconductive material that comprises the belt and the intensity of the imaging light rays from the document. The exposure of the belt to the imaging light rays from the document discharges the photoconductive layer in the area struck by light whereby there remains on the belt an electrostatic latent imaging of figuration corresponding to the light image projected from the document. As the belt continues its movement, the electrostatic latent image passes a developing station at which there is positioned a developer apparatus **29** for developing the electrostatic latent image. After development, the powdered image is moved to an image transfer station whereat record material or sheet of paper just previously separated from a stack of sheets **30** is held against the surface of the belt to receive the developed powder image therefrom. The sheet is moved in synchronism with the movement of the belt during transfer of the developed image. After transfer, the sheet of paper is conveyed to a fusing station where a fuser device **31** is positioned to receive the sheet of paper for fusing the powder thereon. After fusing of the powder image, the sheet is conveyed through an opening in the cabinet to a finishing apparatus **32** for stapling or side stacking in a manner as will be described more fully hereinafter. The sheets are separated from the stack and fed from the top of the stack by means of a separator roll device **33** and timed sequence of the movement of the developed latent images on the belt **13**.

Further details of the processing devices and stations in the printer system are not necessary to understand the principles of the present invention. However, a detailed description of these processing stations and components along with the other structures of the machine printer are disclosed and copending application Ser. Nos. 731,934, filed May 24, 1968, and 756,598, filed Aug. 30, 1968, which are commonly assigned with the present invention.

It will be appreciated that the printer system may be operated in conjunction with a roll converter unit indicated by the reference numeral **35**. The roll converter unit **35** is adapted to convert a relatively large roll of paper **36** into various sizes of sheets of paper by means of a cutter device **37** and a suitable control system (not shown) arranged to control cutting and feeding of the individual sheets into operative

cooperation with the separator roller **26**. It will be appreciated that operative cooperation is assured between the various units operating with the printer system by the physical association of the cabinets for the units and the matching openings which enable full cooperation of the imaging light rays and sheet transport path between the units. In this regard, locking clamps may be provided on all the units for preventing the inadvertent movement of such units during use and interlocks which is an alignment device may be utilized on each unit for ensuring upper alignment and to terminate or suspend operation in the event mis-alignment or separation of the units occur. For facility and needs of operation, each of the units provided with caster wheels and locking brakes thereby aiding in the movement of the units into and out of cooperative engagement.

FINISHING APPARATUS

The finishing apparatus **32** comprises a frame **50** having a main body housing **51** and cover **52** which is connected to the frame by rods **54** and **55** against the action of spring sets **57** and **59** encircling the rods to enable a pop open position of the cover as well as a fully raised position to permit access into housing **51**. Housing **51** has hook members **61** extending from the lower portion to secure the frame to the processor **11** as previously mentioned.

Finishing apparatus **32** includes an input receiving tray assembly **70**, a stapler group **72**, a stapler head assembly **74**, a side stacking assembly **76** and an output receiving tray assembly **78**. Input receiving tray assembly **70** comprises an adjustable input receiving tray **105** which serves to guide the sheet material along a path from the processor into the finishing apparatus. The tray is adjustable for varying paper width which may accept, as for example, 8 ½ × 11 paper up to 9 × –paper.

The staple group assembly **72** comprises a registration gate **207** which stops the forward motion of the sheet material, a paddle wheel **209** which moves the sheet to the forward left-hand corner of the input receiving tray for stapling by stapling head assembly **74** which drives staples into the sheet material positioned on the receiving tray to produce finished booklets. Paper guides **107** and **109** assist in positioning the sheet material coming from the processor and received on the input receiving tray. As the sheet material is received by the receiving tray by virtue of the exit speed of the sheets from the processor, the sheets come into contact with paddle wheel **209**. Paddle wheel **209** comprises three blade members **213**, **215** and **217** which are connected to a hub portion **219** which is received on a shaft member **221**. The blade members are made out of flexible material such as polyurethane and are formed at a helix angle α ranging between about 20° to about 50° and preferably from 25° to 35° along the axis of shaft **221** for a purpose that will become more apparent. The blade members have length to width ratio ranging from about 2:1 to 3:1 and preferably are about one-half inch wide and about 1 ¼ inches to 1 ½ inches long and have a thickness ranging from about 0.050 inch to about 0.100 inch and preferably from about 0.065 inch to about 0.075 inch to obtain proper blade flexing when contact is made with the sheet material at the blade tips. Shaft **221** is driven by a motor **223** through gears **225** and **227** with gear **227** driving a pulley **229** which transmits motion to a pulley **231** mounted on the shaft **221** through an O-ring **233**.

Referring now to FIGS. **4***a*, *b* and *c*, there is shown in sequence the movement imparted to a sheet by the paddle member **209**. The sheet moves initially to the left against paper guide **107** and then forwardly as the paddle member continues to rotate on shaft **221**. The sheet is contacted by the outer tip of the blade **213**. Due to the helix angle of the blade with the shaft axis and the unique shape and thickness of the blade, the blade is caused to flex to the outside or to the left looking at the figures which imparts a force on the sheet to the left carrying the sheet against the paper guide **107**. As the blade member **213** continues to rotate, the outside tip moves out of contact with the sheet and the inner part of the blade is placed in contact with the sheet causing a forward force to be imparted to the sheet in the direction at which the paddle member is being rotated moving the sheet up against a gate member **207**. The inner portion of the paddle member **213** does not flex to the same degree as the outer portion by virtue of the fact that the outer portion commences to return to its original shape after being flexed against the sheet thereby tending to impart a force against further flexing of the blade member in a sideways direction or to the left. As a result, the trailing portion or right-hand portion of the blade member serves to carry the sheet in a forward direction against the gate **207**. Since the blade members **213**, **215** and **217** are continuously acting on sheets, there is a continuous action piling sheets to the left against guide **107** and gate **207** thereby ensuring that sheets received onto the tray are collected in registration for stapling.

Side stacking assembly **76** cooperates with output receiving tray assembly **78** to stack sheets in separately identifiable bundles instead of in stapled booklets at the option of a machine operator. Tray assembly **78** includes a tray **401** positioned at about a 7 ½° angle to the horizontal to facilitate receiving sheets fed along the transport path. Tray **401** is mounted in the frame for sliding movement in a vertical plane on slide shaft **403**. The tray is lowered as the sheets are received to maintain a uniform level with the transport path by an elevator control system described in copending application Ser. No. 70,734 filed Sept. 9, 1970.

Side stacking assembly **76** serves to stack the sheets into shingled or offset bundles on tray **401**. The side stacking assembly comprises a pair of pivotable paddle wheels **415** and **417** which are similar in construction to paddle wheel **209**. Paddle wheel **415** has blade members **419**, **420**, and **421** and paddle wheel **417** comprises blade members **423**, **424**, and **425**. Paddle wheels **415** and **417** are mounted on a shaft **427** which is driven by a motor MOT–2 through the pulley **429** which receives a belt **431** which is wrapped around another pulley **433** mounted on the shaft **427**. In this manner, the paddle wheels **415** and **417** are continuously rotated so that the blade members are advanced into contact with the topmost sheet received on tray **401** such that a sideways and ahead movement is imparted to the sheet as previously described in the case of paddle wheel **209**.

Each of the paddle wheels **415** and **417** may be alternately positioned to contact with the sheets advanced onto the tray depending upon whether the sheets of the topmost bundle are to be stacked on the left of the tray. To accomplish this, the shaft **427** is supported in a frame **435** which is suspended from a similar frame **437** on a pivot pin **439**. Secured on one end of the frame **435** is actuating arm **441** which is connected to a solenoid SOL–4. Upon receiving a signal solenoid SOL–4 actuates arm **441** to cause the frame **435** to pivot on pivot pin **439** so that paddle wheel **417** is in contact with the sheets received onto the tray causing them to be stacked to one side. At the proper interval, solenoid SOL–4 is de-energized which causes frame **435** to pivot due to the weight of motor MOT–2 and paddle wheel **415** to be placed into contact with the oncoming sheets resulting in stacking towards the opposite side. By repeating this sequence, offset stacks or bundles are formed of the sheet material received onto the tray.

What is claimed is:

1. Sheet propelling and registering apparatus comprising

shaft means including a hub portion operative to rotate on an axis extending at right angles to a path along which sheet material is to be fed,

a plurality of flexible blade members having a predetermined shape and thickness extending from said hub portion for rotation therewith and positioned to contact the surface of sheet material fed along the sheet path,

said blade members each forming a helix angle with the axis of from about 20° to about 50° so as to be caused to flex at the leading tip thereof to impart one component of thrust

on the surface of the sheet material at right angles to the sheet path and another component of thrust on the surface of the sheet material in the same direction as the sheet path to effect corner registration of the sheet material.

2. Apparatus according to claim 1 wherein the axis is inclined to an angle relative to the plane of the sheet path.

3. Apparatus according to claim 1 wherein the axis is parallel to the plane of the sheet path.

4. Apparatus according to claim 2 wherein said shaft means includes at least two hub portions each carrying associated blade members.

5. Apparatus according to claim 1 wherein the helix angle formed by said blade members ranges from about 25° to about 35°.

6. Apparatus according to claim 1 wherein said blade members have a length to width ratio ranging from about 2:1 to about 3:1.

7. Apparatus according to claim 6 wherein said blade members have a thickness ranging from about 0.050 inch to about 0.100 inch.

8. Apparatus according to claim 7 wherein the thickness of said blade member ranges from about 0.065 inch to about 0.075 inch.

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