

March 20, 1973

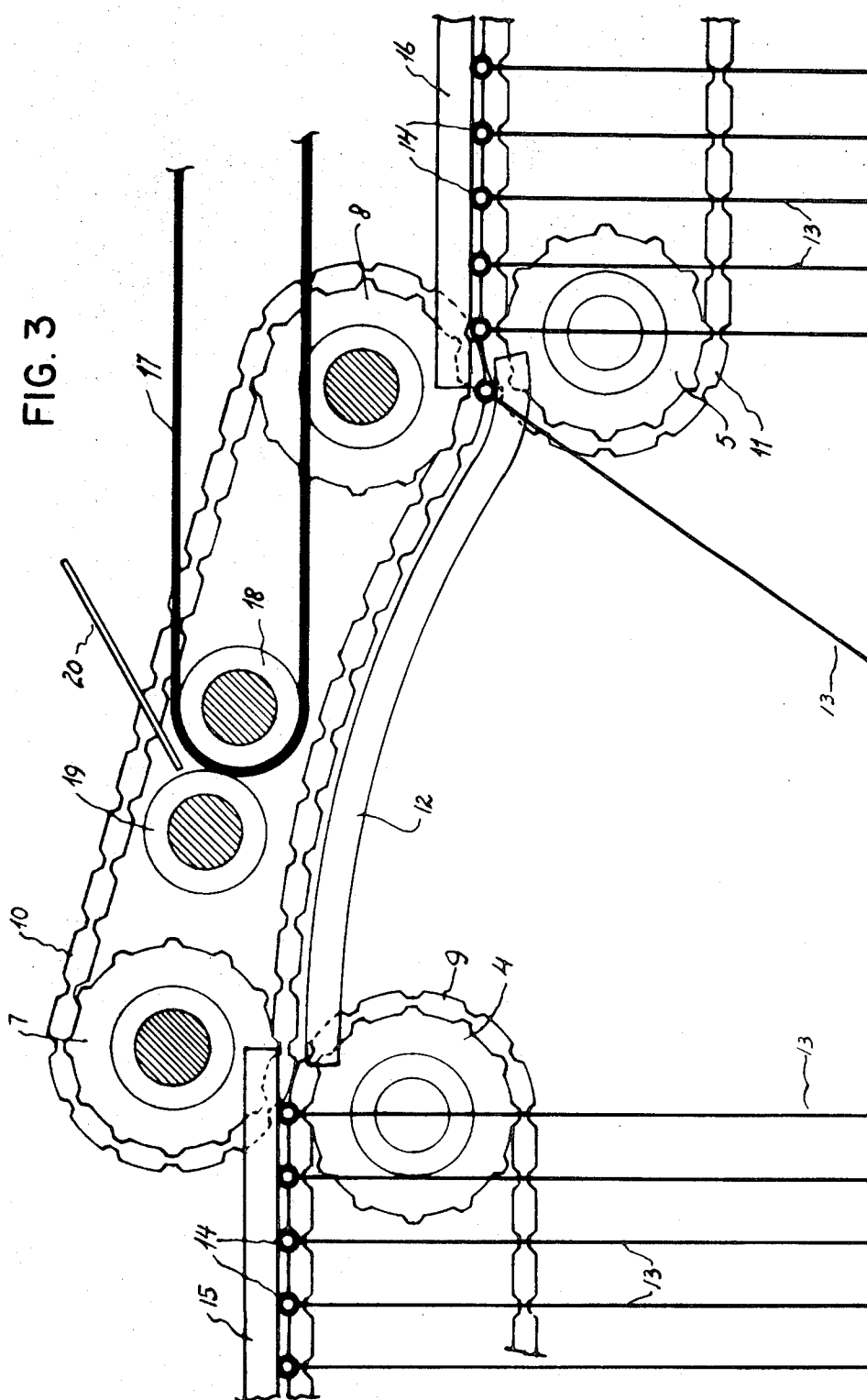
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APPARATUS FOR COLLATING SHEETS

Filed Aug. 16, 1971

3 Sheets-Sheet 2



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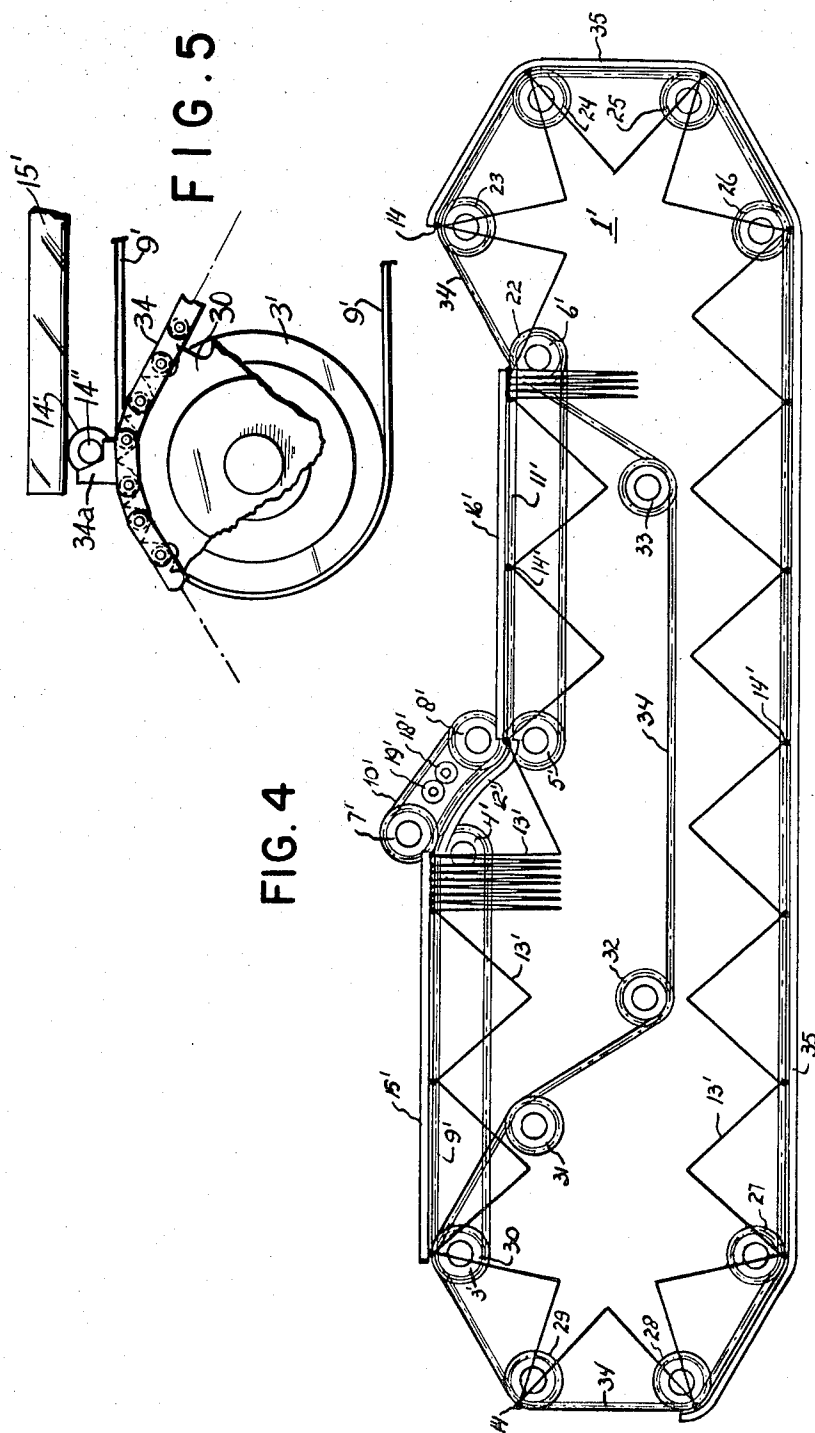
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APPARATUS FOR COLLATING SHEETS

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12 Claims

ABSTRACT OF THE DISCLOSURE

A simple apparatus for collating sheets such as copies being fed from an office copying machine makes use of a series of compartments having the form of suspended file folders mutually joined together, as provided for example by a cardboard band folded in zig-tag form. The folders are suspended by elements secured to upper edges or upper folds thereof and supported on a conveyor extending from either side of the sheet feed path, and are opened successively across that path by means which transfer the suspending elements successively to a conveyor supporting them at the other side of the feed path. The support conveyors and the transfer means may each comprise a flight of a system of notched belts. One of the support conveyors is disposed at a lower level than the other so that a certain panel of each opened folder will lie oblique to the other panel thereof, causing all sheets in the folder to rest against the oblique panel.

The present invention relates to apparatus for collating sheets such, for example, as copies of documents being delivered from a photocopying or other copying machine.

A known apparatus for such purposes makes use of a rotating drum having a circumferential series of collator compartments each of which comprises a partition, or sheet supporting member, that can swing relative to another wall thereof so as to open the compartment as it is moved through a sheet feed path and to keep it closed in other parts of its path of rotation. See United States Pat. 3,096,089.

Another known type of sheet collator makes use of stationary collating compartments to which the sheets are carried by a belt conveyor system provided with reversible flaps which deliver the sheets to the desired compartments. See, for example, United States Pat. No. 2,661,209.

While these known devices generally are reliable in operation, they are rather complicated in construction and they require relatively large amounts of floor space. Consequently, they are used principally for collating sheets delivered from the larger, higher speed automatic copying machines such as are used, e.g., in commercial reproduction shops and large photo-printing rooms.

In recent times, copying machines of relatively small capacity—the so-called office printers—have become more and more automated. For instance, many machines of this character are already provided with counting devices which enable a preset number of copies to be made automatically from an original that is fed only once.

It is obvious that an apparatus suitable for collating the sets of sheets delivered from such machines would also be particularly advantageous, but in order to serve this need effectively the collating apparatus must be relatively inexpensive and relatively simple in construction and operation.

The object of the present invention is to provide a collating apparatus meeting these requirements.

According to the invention, use is made of collator compartments having the form of suspended file folders each of which comprises confronting flaps, or panels, joined together at their lower edges and respectively having

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means on their upper edges for suspending the folder in working position; and the folders are arranged one adjacent to another with the respective adjacent panels of adjacent folders hinged together at their upper edges. Separate folder support means are provided to extend respectively in a substantial horizontal direction from opposite sides of a sheet feed station which is constituted by suitable means for delivering sheets to be collated in a substantially downwardly directed feed path. Each of the said folder support means is engageable with the suspending means on the upper edges of the folders so as to support a substantially horizontally extending array of the folders in suspension therefrom in substantially closed condition; and folder transporting means are provided which include means operable to transfer the said suspending means individually, one after another, from either one to the other of the support means and thus to open in succession across the feed path the folders of an array thereof suspended from either of the support means. The distance of travel of one of the suspending means away from another during transfer thereof across the feed path is considerably greater than the distance between these means in array on the support means, and thus a folder related to each suspending means so transferred is opened to receive a sheet being delivered in the feed path.

The collator compartments, or suspended file folders, may be formed from a single band, or web, of suitably stiff yet foldable sheet material, such as cardboard, by folding it in zig-zag form so that the folds along one side of the band will constitute the bottoms of compartments hinged together by, and suspended from elements such as suspension rods secured to, the folds along the opposite side of the band. Thus, a quite simple and inexpensive folder structure can be used for the collection and sorting of sheets according to the invention.

The apparatus preferably is so constituted that the folder support means at one side of the feed path is disposed at a level substantially lower than that of the folder support means at the other side of the feed path. This causes each suspended file folder when disposed across the feed path to be opened asymmetrically relative to the vertical, with a certain panel thereof lying oblique to the other panel thereof, so that the sheets fed successively into the same folder will lay themselves continually against the same, oblique panel thereof.

Each of the said folder support means is advantageously constituted by a movable flight of a belt or chain conveyor system. The said transfer means may also comprise a movable flight of a belt or chain conveyor system. Thus, three such conveyor systems may be employed, to provide synchronous transporting of the folders successively from one side to the other side of the feed path, in which case the apparatus includes means for driving the several conveyor systems synchronously and in the same direction but with the middle system, that of the transfer means, operating at a substantially higher transporting speed than the two outer systems.

The conveyor systems are preferably driven intermittently, as is conventional for sheet collating devices, in such manner that in each interval between their steps of movement only one of the suspended file folders is held in open position across the feed path.

The conveyor systems may be varied widely in construction, but it is a further attribute of the invention that relatively simple and inexpensive notched belts may be employed, which have protruding portions, or teeth, alternating with notches adapted to receive, hold in place and carry forward the respective suspending means, such as parts of suspension rods, secured to the upper edges or hinges of the file folders.

Other objects, features and advantages of the invention will be apparent from the following detailed description

and the accompanying drawings of illustrative embodiments thereof.

In the drawings:

FIG. 1 is a schematic longitudinal section of an apparatus embodying the invention;

FIG. 2 is a vertical cross-section along the line II—II of FIG. 1;

FIG. 3 shows on an enlarged scale a principal portion of the apparatus of FIGS. 1 and 2;

FIG. 4 is a schematic longitudinal section of another embodiment of the invention; and

FIG. 5 is a schematic view on an enlarged scale of a hook element of a chain conveyor employed in the embodiment of FIG. 4.

The apparatus shown in FIGS. 1, 2 and 3 comprises spaced-apart upright frame plates 1 and 2 having bearings thereon which rotatably support a number of shafts fitted with respective pairs of toothed wheels, or sprockets, 3, 4, 5, 6, 7 and 8. Pairs of notched endless belts 9, 10 and 11 are trained upon and extend between the wheels 3-4, 7-8 and 5-6, respectively. A major part of the lower flight of the belts 10 extends along and rests on upwardly curved guide rails 12.

The sheet sorting compartments C of the apparatus are formed by folded sheets 13, made from cardboard or folders employed in filing cabinets and the like. The upper edge of each panel of each folder 13 is provided with a suspension rod 14 the ends of which protrude beyond the ends of the folder panel and engage in notches, i.e., between the teeth, of the belts of one of the belt pairs 9, 10 or 11. In the form shown, the desired number of folders 13 is obtained from a single band of cardboard or like material by having it folded suitably in zig-zag manner. Thus, the adjacent flaps or panels of adjacent folders are hinged together by the folds at their upper edges, and a single suspension rod 14 suffices for each of those folds.

Some or all of the suspension rods 14 may be supported in notches of the upper flights of the belts 9 and held in place by guide rails 15. Alternatively, they may be supported in notches of the upper flights of the belts 11 and held in place by guide rails 16. The ends of at least one of the rods may be engaged in notches of the lower flights of the belts 10 and supported on the upper edges of the curved guide rails 12.

The sheets to be sorted, which typically are copies being delivered from a photo-copying machine, are fed to the collating apparatus by any suitable means, such as a conveyor belt 17, rollers 18 and 19 and a guide plate 20. Plate 20 may be connected to the collating apparatus, but may also form part of a copying machine used in combination with this apparatus.

During the collation of the fed sheets, the belts 9, 10 and 11 are driven intermittently either in one direction or in the other. The belts 9 and 11 are driven in such manner that in each step of their movement they travel through the distance between the centers of two of the notches therein. The belt 10 is driven in such manner that in each step of its movement it travels through a distance equal to the length of the path along the guide rails 12 between the locations where notches of the belts 9 and 11 will deliver the ends of a rod 14 to and from those rails.

The mechanism for driving the belts can be provided in various ways evident to skilled persons. For example, power from a continuously rotating motor can be transmitted to the shaft of wheels 7 to drive the belts 10 via a one revolution clutch and transmission gears, and to the shafts of wheels 4 and 5 to drive the belts 9 and 11 via the same clutch and a star wheel mechanism. In the usual manner for collating devices of this type, signals for energizing the clutch and for determining the direction of the driving action can be derived from a copy-counting mechanism of the copying machine.

By the step-by-step movements of the three systems of conveyor belts, the folders 13 which form the sorting compartments C are carried progressively from one folder supporting station of the machine to the other. When a rod 14 being supported on the belts 9 in one direction of the conveyor movement, or being supported on the belts 11 in the other direction thereof, reaches the rails 12, the rod is engaged at its ends in notches of the belts 10 and then is moved by those belts along the guide rails 12 up to the location where the ends of the rod engage in notches of the belts 11, or of the belts 9, as the case may be. Due to the distance of travel between the outer systems of belts, a folder 13 having its panel edge rods 14 positioned under the rollers 18 and 19 forms a widely open sorting compartment C', thus enabling a sheet delivered into it to be received easily even if the sheet is not entirely flat but somewhat curled.

Since the belts 11 are disposed at a lower level than the belts 9, as indicated in FIGS. 1 and 3, each folder when positioned across the path where the sheets are deposited is always opened in such a way that one of its panels hangs oblique to the other which is more nearly vertical. Thus, sheets already present in the folder will always lie against the same, oblique wall thereof and another sheet entering the folder will take its proper place therein, assuring a proper sequence of collation.

After the copies have been deposited and collated in the folders 13, they can be removed from the folders via a large opening 1a provided in frame plate 1 (FIG. 1). The walls of the folders, or sorting compartments, are provided with cut-away portions which form recesses 21 to facilitate the grasping and removal of the collections of sheets gathered in them.

The invention may be embodied in various designs and forms of apparatus differing from the embodiment shown in the figures. For instance, ball chains or roller chains fitted with special notched links can be used instead of notched rubber or elastomer belts. Also, the suspension rods 14 need not be located in successive notches; two or more protrusions or teeth may be arranged between two rods.

Plain belts can also be used, but in such case the suspension rods hung from them may sometimes be pushed out of alignment. Grippers for the rod ends or large wheels having peripheral recesses can also be used for transporting the rods 14. When the sheet delivery time and the intervals between the delivery of copies are sufficiently uniform and synchronized with the movement of the suspended file folders, the belts can even be kept in continuous motion.

In the use of the embodiment of the invention according to FIG. 1, it sometimes is necessary, after a set of sheets has been collated in and removed from the sorting compartments, to return some or all of the empty compartments to a starting position, or folder supporting station, at one and the same side of the feed station in order to have a sufficient number of compartments available there for collating a subsequent set of sheets.

In many cases, this repositioning of the compartments need not be objectionable, because it can be effected quite easily. Where the copying machines are very fast in operation, however, the short waiting period that occurs each time it is required may still be annoying.

According to a further feature of the invention, the needs for interruption of the feeding of sheets into the apparatus can be reduced and operations improved by the provision of an apparatus in which all the suspended file folders are joined together at the upper edges of adjacent panels thereof so as to form an endless system of suspended file folders. Thus, after the collation of one set of sheets, the compartments required for collating another set can be brought to the desired starting position without being passed back through the feed station.

An embodiment of the invention utilizing this feature of construction is illustrated schematically in FIG. 4,

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In this figure, elements which correspond in function to elements of the apparatus of FIGS. 1-3 are designated by corresponding but primed reference numerals. Thus there is a series of collator folders 13' which are mutually joined together by folds at the locations of suspensions rods 14' but in this embodiment the folders form an endless series of sorting compartments.

The frame plates, such as plate 1', of the apparatus of FIG. 4 are elongated in the directions of travel of the conveyors 9', 10' and 11' and are fitted with a number of additional shafts, rotatable in bearings, which carry pairs of sprockets 23 through 29 and 31 through 33. Two endless chains 34 are trained upon and extend between these sprockets and sprockets 22 and 30 which are mounted on the same shafts as sprockets 6' and 3' corresponding in function to the previously mentioned toothed wheels 6 and 3.

Different from the situation in the embodiment according to FIGS. 1-3 the belts 9' and 11' are only notched at the sides contacting the wheels 3-6; their surfaces contacting the rods 14' are plain.

Fixed to the chains 34 are a number of hooks, one of which is shown schematically at 34a, FIG. 5, for holding the end portions, or journals 14," of the suspension rods 14' in position on these chains. In order to prevent the rod ends from falling out of the hooks at the lower side of the apparatus, two guide rails 35 are mounted outside and beneath the chains 34.

During a collating cycle the belts 10' are moved stepwise; in each step a rod 14' will be delivered from the belts 9' to the belts 11' or vice versa. At the same time the belts 9' and 11' move continuously in one direction or the other. Due to this continuous movement the file folders 13' will tend to heap up at the ends of the belts 9' and 11' respectively. As during this time the chains 34 do not move, some folders will be spread out more or less as is illustrated in FIG. 4.

If at the end of a collating cycle all the folders which are in use, are filled with copies and have reached the vicinity of the wheels 6', the collated sheets can be removed and after removal of the collated sheets the chains 34 can be started. Successively the suspension rods 14' then come within the range of movement of the hooks 34a being passed by the chains over the sprockets 22. The hooks lift each rod from the belts 11' and move it progressively in a circuitous path into engagement with the belts 9', via the sprockets 22 to 30 inclusive.

As the rods 14' pass over the sprockets 30 they fall successively from the hooks of the chains 34 on the belts 9', so that the folders suspended from them are again positioned for use in a new collating cycle.

Preferably the chains are driven at a much higher speed than the belts 9' and 11'. The new collation cycle can be started then already before all the folders to be used have reached their position on the belts 9'.

What is claimed is:

1. Apparatus for collating sheets such as copies of documents, comprising a plurality of collator compartments having substantially the form of suspended file folders, each of which comprises confronting panels joined together at their lower edges and respectively having means on their upper edges for suspending the folder in working position, said folders being arranged one adjacent to and another with their respective adjacent panels hinged together at the upper edges thereof, means for delivering sheets to be collated successively in a substantially downwardly directed feed path, separate folder support means respectively extending from opposite sides of said feed path and each engageable with said suspending means to support a substantially horizontally extending array of said folders in suspension therefrom in substantially closed condition, and folder transporting means including means operable to transfer said suspending means one after another from either one to the other

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of said support means and thus to open in succession across said feed path said folders of an array thereof suspended from either of said support means.

2. Apparatus according to claim 1, one of said support means being disposed at a substantially lower level than the other so that a certain panel of each said folder opened across said feed path will lie oblique to the other panel thereof.

3. Apparatus according to claim 1, said compartments being constituted by a band of sheet material folded in zig-zag form, the folds along one side of said band constituting the bottoms of said compartments and the folds along the opposite side thereof hinging said compartments together and respectively having said suspending means secured thereto.

4. Apparatus according to claim 1, each said folder support means comprising a movable flight of a belt or chain conveyor system, said transporting means further including means for driving said conveyor flights in synchronism with and in the same direction as said transfer means but at a substantially lower transporting speed than that of said transfer means.

5. Apparatus according to claim 4, said driving means being operative to move said conveyor flights and said transfer means intermittently so that in each interval between their movements one of said folders is held open across said feed path.

6. Apparatus according to claim 1, said suspending means comprising rods respectively secured to and along and having ends protruding laterally from the upper edges of said panels or the hinges of the upper edges of said adjacent panels, each said support means comprising an upper flight of substantially parallel notched conveyor belts having upwardly open notches therein to receive and support said protruding rod ends.

7. Apparatus according to claim 6, each said support means further comprising guide rails positioned over and along said belts in said upper flight so as to hold said rod ends in place in notches of said belts.

8. Apparatus according to claim 6, said transfer means comprising guide rails extending between the said support means in position to support and guide the ends of any one of said rods during transfer thereof from said belt flight of one to said belt flight of the other of said support means, and further comprising substantially parallel notched conveyor belts having a lower flight thereof positioned over and along said guide rails and presenting downwardly open notches adapted to receive the ends of said rod and carry them along said rails during such transfer.

9. Apparatus according to claim 8, said transporting means further including means for intermittently driving the said belt flights synchronously and in the same direction but with the speed of said upper flights substantially lower than the speed of said lower flight and with the latter speed sufficiently great that during each step of the driving action said lower flight will carry one of said rods through the entire distance between said upper flights.

10. Apparatus according to claim 8, said upper flight of one of said support means being disposed at a substantially lower level than said upper flight of the other of said support means, so that a certain panel of each said folder opened across said feed path will lie oblique to the other panel thereof, said guide rails and said lower belt flight defining an arcuate path for the movement of each said rod between said support means.

11. Apparatus according to claim 1, the upper edges of the panels of each of said folders being hinged respectively to the upper edges of adjacent panels of two others of said folders, said folders thus constituting an endless series of suspended collator compartments.

12. Apparatus according to claim 11, and conveyor means coacting with said suspending means for conveying empty folders of said series from one to the other

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of said support means through a circuitous path disposed away from said feed path.

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