APPARATUS FOR MANIPULATING SHEETS IN COPYING MACHINES

Inventors: Josef Pfeifer, Unterhaching, Günter Abbé, Gilching; Rudolf Eppe, Taufkirchen; Rudiger Ettelbrück, Munich; Günther Schnall, Eching, all of Germany

Assignee: Agfa-Gevaert Aktiengesellschaft, Leverkusen, Germany

Filed: Feb. 21, 1974

Appl. No.: 444,384

Foreign Application Priority Data
Feb. 23, 1973 Germany

U.S. Cl. 271/186; 198/285; 271/187; 271/213

Int. Cl. B65H 29/40

Field of Search 271/186, 187, 80, 65, 66, 271/178, 69, 179, 185, 72, 213; 198/285, 198/245, 257

References Cited
UNITED STATES PATENTS
2,904,334 9/1959 Cundall et al. 271/65

3,075,760 1/1963 Frederick 271/187

FOREIGN PATENTS OR APPLICATIONS
925,871 5/1963 United Kingdom

Primary Examiner—Evan C. Blunk
Assistant Examiner—Bruce H. Stoner, Jr.
Attorney, Agent, or Firm—Michael S. Striker

ABSTRACT

Sheets which issue from the discharge slot of a copying machine with their imprinted sides facing upwardly are inverted prior to descending into a tray. The inverting mechanism employs a wheel having rearwardly inclined blades extending into the path of movement of leaders of successive sheets whereby the leaders rotate the wheel while the trailing ends of the sheets are being advanced by rolls in the housing of the copying machine. This causes a looping of sheets and an automatic inversion as soon as the trailing ends leave the discharge slot. The wheel is braked so that it rotates only while a blade engages with the leader of a sheet. A stop at the lowermost point of the wheel intercepts the leader so that the looping of the sheet becomes more pronounced as the trailing end continues to issue from the slot while the leader bears against the stop.

23 Claims, 4 Drawing Figures
APPARATUS FOR MANIPULATING SHEETS IN COPYING MACHINES

BACKGROUND OF THE INVENTION

The present invention relates to copying machines in general, and more particularly to improvements in apparatus for manipulating sheets in copying machines. Still more particularly, the invention relates to improvements in an apparatus which can be installed in or on a copying machine and serves to transport and guide finished sheet-like copies of paper or the like into a suitable tray or another collecting receptacle.

In presently known copying machines, the finished copies (hereinafter called sheets) issue from the housing in such orientation that their information-bearing sides face upwardly. As a rule, the sheets slide along a suitably inclined guide surface which forms part of or guides the sheets into a tray where the sheets are stacked on top of each other. An advantage of such mode of discharging the sheets is that the operator of the copying machine can observe a sheet while it emerges from the machine and can immediately determine whether or not the reproduction of information is satisfactory. However, such mode of discharging the sheets also exhibits a serious drawback, namely, the sheets in the tray are stacked in reverse order, i.e., the foremost sheet is located at the bottom and the rearmost sheet is located at the top of the stack, and the information-bearing sides of all sheets face upwardly. This renders it necessary to rearrange the sheets so that they follow each other in the same sequence as the originals, e.g., successive pages of a book, successive pages of a legal document or the like. Such rearranging consumes much time, especially if the number of sheets is large.

SUMMARY OF THE INVENTION

An object of the invention is to provide an apparatus which can be built into or attached to a copying machine and is constructed and assembled in such a way that it allows for observation of successive information-bearing sheets of transfer material as they issue from the copying machine but is also capable of stacking the sheets in the same sequence in which the originals to be copied are introduced into the copying machine.

Another object of the invention is to provide an apparatus of the just outlined character which treats the sheets gently, which can manipulate the sheets at the exact rate at which they issue from the copying machine, which need not be provided with a discrete primer mover, and which can be installed in or on existing copying machines.

A further object of the invention is to provide an apparatus which requires no attention on the part of the operator of the copying machine, which comprises a relatively small number of simple parts, which occupies little room in or adjacent to a copying machine, and which can manipulate sheets of any practical size and/or shape.

An additional object of the invention is to provide an apparatus which can be attached to or otherwise coupled with an existing copying machine without necessitating any, or by necessitating only minor, alterations in the construction of the copying machine.

The invention is embodied in a copying machine which comprises means for discharging information-bearing sheets of transfer material so that the information-bearing sides of the sheets face upwardly, means (e.g. a downwardly inclined tray located at a level below the sheet-discharging opening or slot in a wall of the housing of the copying machine) for collecting and stacking the thus discharged sheets, and means for inverting the sheets between the discharging means and the collecting means so that the information-bearing sides of sheets in the collecting means face downwardly.

The discharging means comprises means for advancing successive sheets in a predetermined direction and along a predetermined path, e.g., along a substantially horizontal path, and the inverting means preferably comprises a wheel or an analogous rotary member turnable about an axis which is normal to the direction of movement of sheets and is parallel to the path. The wheel is rotatable in the direction of movement of sheets under the action of advancing means, and the inverting means preferably further comprises a plurality of blades or analogous projections extending outwardly from the periphery of the wheel and counter to the direction of movement of sheets. At least one of these projections extends into the path of movement of a sheet so that it is engaged by the leader of the oncoming sheet and thereby rotates the wheel. As the wheel rotates under the action of the leader of a sheet, and the trailing portion of the same sheet continues to move along the aforementioned path, the sheet is looped around the wheel and is inverted automatically when its trailing portion moves beyond the advancing means. A stop is preferably provided in the path of movement of the leader of a sheet which rotates the wheel so that the looping of the sheet becomes more pronounced when the leader engages the stop while the trailing portion of the same sheet continues to move forwardly.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary perspective view of a copying machine and a perspective view of an apparatus which embodies one form of the invention;

FIG. 2 is an enlarged fragmentary vertical sectional view substantially as seen in the direction of arrows from the line II—II of FIG. 1;

FIG. 3 is a fragmentary transverse vertical sectional view of a modified apparatus; and

FIG. 4 is a sectional view as seen in the direction of arrows from the line IV—IV of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIGS. 1 and 2, there is shown a portion of a copying machine (e.g., a xerographic apparatus) having a housing G including a substantially upright side wall or front wall F having an elongated horizontal slit-shaped discharge opening S for successive information-bearing sheets KT of transfer material. The manner in which the information on an original is reproduced onto one side of a sheet KT in the interior of the housing G forms no part of the present invention;
it suffices to say that the sheet discharging means in the housing G comprises one or more sets of driven advancing rolls W1, W2 (FIG. 2) which transport successive sheets KT in the direction indicated by arrow L so that the sheets KT advance along a substantially horizontal path extending through the discharge opening S and into the range of rearwardly inclined blade-like projections K extending outwardly from the cylindrical peripheral surface of a rotary member here shown as a wheel R. The wheel R is mounted at a level above the rear upper edge of a downwardly inclined sheet-collecting and stacking receptacle or tray A wherein the inverted sheets KT form a stack KTS. The copying machine including the housing G operates in such a way that the information-bearing sides of successive sheets KT which reach the advancing rolls W1, W2 face upwardly, i.e., that successive increments of such information can be observed while a sheet KT emerges from the housing G by passing through the discharge opening S. The function of the inverting means including the projections K and wheel R is to invert successive sheets KT before they descend into the tray A to constitute the uppermost sheets of the stack KTS. Thus, a sheet KT which forms part of the stack KTS has a blank side which faces upwardly and an imprinted or information-bearing side which faces downwardly; therefore, the sheets KT in the tray A are stacked in the same order in which the respective originals are being introduced into the copying machine.

The means for inverting successive sheets KT further comprises a suitably configured guide member FF the rearmost portion of which is a flat plate and is located immediately behind the nip of the advancing rolls W1, W2 so that the leader of a sheet KT which emerges from the discharge opening S begins to slide along the upper side of the guide member FF. The median portion of the guide member FF includes two substantially semicylindrical parts or shells FF1, FF2 which flank the wheel R (see FIG. 2) and whose diameters equal closely approximate the diameter of the peripheral surface of the wheel. It will be noted that the unconcealed blade-like projections K on the wheel R extend outwardly beyond the outer sides of the shells FF1 and FF2. Each of the shells FF1 and FF2 has a substantially semicylindrical (convex) outer surface in register with the peripheral surface of the wheel R. The projections K are substantially tangential to the peripheral surface of the wheel and the maximum width of triangular recesses RE between the peripheral surface of the wheel and the projections K need not exceed the combined thickness of two to five sheets KT.

The rear or outer end portion of each projection K constitutes a relatively sharp edge KS extending in parallelism with the axis of the wheel R. The axis of this wheel is parallel to the path indicated by the arrow L and normal to the direction of lengthwise movement of sheets KT though and beyond the discharge opening S. It will be noted that the uppermost portion of the guide member FF is substantially horizontal and tangential to the peripheral surface of the Wheel R. An abutment or stop FA is provided on the rear portion of the tray A and/or on the shell FF1 and/or FF2 of the guide member FF in the region where the lower portion of the guide member FF extends tangentially from the peripheral surface of the wheel R, i.e., substantially at the 6 o'clock position of the wheel R, as viewed in FIG. 2.

The apparatus further comprises means for braking the wheel R so that the latter preferably rotates only when driven by the leader of a sheet KT which emerges from the discharge opening S. The braking means comprises one or more leaf springs D each of which is anchored in an L-shaped holder H secured to the rear panel FR of a casing CS including the guide member FF. The free end of each leaf spring D bears against a hub Z of the wheel R, and this hub is rotatable on a horizontal shaft O mounted in one or both lateral panels FS of the casing CS. The hub Z may constitute a discrete one-piece or two-piece cylinder which is rigidly or separably connected with and is located in the interior of or adjacent to one or both axial ends of the wheel R. The bias the spring or springs D upon the peripheral surface of the hub Z can be changed by an adjusting screw B which is mounted in the holder H.

The operation is as follows: An information-bearing sheet KT whose leader emerges from the discharge opening S under the action of advancing rolls W1 and W2 (arrow L) is sufficiently stiff to slide along the upper side of the adjacent horizontal portion of the guide member FF and the median portion of such leader enters the recess RE between the nearest projection K and the periphery of the wheel R. As the advancing rolls W1, W2 continue to move the sheet KT forwardly, the sheet begins to rotate the wheel R clockwise, as viewed in FIG. 2, through an angle of approximately 180°, i.e., until the leader reaches the stop or stops FA. Such stage of manipulation of a sheet KT is shown in FIG. 2. Since the information-bearing side of the sheet KT faces upwardly, the attendant is in a position to observe the information and to judge whether or not the sheet is satisfactory; if not, the sheet is simply removed from the position shown in FIG. 2 and dumped into a basket or the like. Also, the attendant then knows that the respective original must be copied again.

The rolls W1, W2 continue to advance the trailing portion of the sheet KT after the leader of such sheet reaches the stop or stops FA whereby the sheet forms a loop around the sheets FF1 and FF2. The size of such loop increases while the trailing portion of the sheet continues to move forwardly (arrow L). Once the trailing portion of the sheet KT advances beyond the nip of the rolls W1, W2, such trailing portion travels along an arc as indicated by arrow T and the sheet descends into the tray A to form the bottom sheet of a developing stack or the topmost sheet of a growing stack KTS. Thus, the imprinted side of each sheet KT in the tray A faces downwardly so that the sheets of the stack are assembled in the same sequence in which the respective originals are introduced into the copying machine. If the copying machine is set to make two or more copies from each original, the stack contains successive groups of identical sheets KT; however, even then, the sorting of sheets forming the stack is more convenient than heretofore because, once the stack is removed from the tray A, the attendant can begin to form discrete sets of sheets by starting at the bottom of the stack rather than at the top.

The bias of the spring or springs D upon the hub or hubs Z of the wheel R is preferably selected in such a way (by the screw or screws B) that the wheel R rotates only as long as it is being pushed by the leader of a sheet KT, i.e., while the leader extends into the recess RE behind one of the projections K and travels toward
the stop or stops FA. Thus, the braking action is sufficiently weak to allow the wheel R to rotate with a minimum of resistance but is strong enough to reduce the likelihood of rotation of the wheel R due to inertia once the leader of a sheet KT reaches the stop or stops FA. It is presently preferred to employ a relatively light weight wheel of low inertia, for example, a hollow drum consisting of a single piece of synthetic plastic material. Such hollow drums can be mass-produced by injection molding or by resorting to another well known plastic-shaping technique.

The width of the projections K, as considered in the axial direction of the wheel R, may be a small fraction of the width of a sheet KT, e.g., about ten percent of the width of a sheet.

A fresh sheet KT may emerge from the discharge opening S to again set the wheel R in rotary motion while the preceding sheet is in the process of turning about its leader (which abuts against the stop or stops FA) and descending into the tray A.

The casing CS including the guide member FF, the rear panel FR and the lateral panels FS can be permanently or detachably secured to the wall F of the housing G. As shown in FIG. 2, the rear panel FR has one or more claw- or hook-shaped extensions FH which can pass through suitable apertures FL in the wall F to maintain the rear side of the panel FR in abutment with or close to the wall F. The casing CS contains the shaft O, the hub or hubs Z, the spring or springs D, the holder H with its bias adjusting screw or screws B, the wheel R with projections K, and the bearing or bearings for the wheel R, the hub or hubs Z and/or shaft O, depending upon whether the wheel R and the hub or hubs Z rotate with or relative to the shaft O. The coupling means FH, FL for the casing CS enables an attendant to rapidly detach the casing CS from the housing G, for example, during shipment of the machine to or from the locale of use, when a repairman wishes to inspect the machine through the discharge opening S, or when the attendant desires to operate the copying machine without automatic inversion of sheets. The copying machine can be furnished with two or more casings CS each of which supports a wheel having a different diameter.

This renders it possible to use a first apparatus when the sheets KT are rather short and another apparatus in connection with relatively long sheets.

It is also within the purview of the invention to use two or more wheels which are coaxial with but spaced apart from each other, and/or to provide the wheel or wheels with blade-like projections which extend rearwardly as shown in FIG. 2 and are curved outwardly so that their convex sides face the periphery of the wheel. This further insures that the leader of a sheet KT can find its way into the recess between the nearest projection and the periphery of the wheel.

It is further clear that the braking means of FIG. 2 constitutes but one of many devices which can be used to prevent unintentional rotation of the wheel and/or to arrest the wheel as soon as the leader of a sheet reaches the stop or stops FA. A modified braking means is shown in FIGS. 3 and 4 wherein all such parts which are identical with or clearly analogous to the corresponding parts shown in FIGS. 1 and 2 are denoted by similar reference characters each followed by a prime. The hub N of the wheel R includes at one end three ring-shaped portions Z1, Z2, Z3 having different outer diameters. The braking means comprises three shoes HS1, HS2, HS3 which can be moved into and from frictional engagement with the respective portions Z1, Z2, Z3 of the hub N. The means for moving the shoes includes a shaft EA carrying three cams N1, N2, N3 which respectively extend into suitably configured cutouts or holes in the corresponding shoes HS1, HS2, HS3. The shaft EA extends laterally from the casing CS and has a knob KB outwardly adjacent to one of the lateral panels FS so that the shaft EA can be rotated by hand whereby the shoe HS1 engages the portion Z1 in a first angular position, the shoe HS2 engages the portion Z2 in a second angular position, and the shoes HS3 engages the portion Z3 in a third angular position of the shaft EA. The knob KB is preferably provided with a pointer (not shown) which moves with respect to a scale at the outer side of the adjacent side panel FS so that the attendant can readily find a desired angular position of the shaft EA and the magnitude of the selected braking action. The braking action of the shoe HS2 upon the portion Z2 is assumed to be more pronounced than the braking action of the shoe HS3 upon the portion Z3 but less pronounced than the braking action of the shoe HS1 upon the portion Z1. Each of the shoes HS1-HS3 has a substantially hemicylindrical braking surface.

The shaft O' for the wheel R' is journaled in two internal partitions P1, P2 of the casing CS'. The hub N is assumed to rotate with the shaft O' and wheel R'. The shoes HS1-HS3 are slideable up and down in vertical ways WS secured to the partition P2.

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 which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In a copying machine, a combination comprising means for discharging information-bearing sheets of transfer material, including means for advancing successive sheets in a predetermined direction and along a predetermined path; means for collecting the thus discharged sheets; means for separating the sheets between said discharging means and said collecting means, including at least one rotary inverting member turnable about an axis which is substantially parallel to said path and substantially normal to said direction, said rotary member being turnable by the leaders of successive sheets which are being advanced along said path; and means for braking said rotary member, including at least one braking member in frictional engagement with a portion of said rotary member and means for adjusting the friction between said braking member and said portion of said rotary member.

2. A combination as defined in claim 1, wherein said rotary member is turnable in said direction and said inverting means further comprises a plurality of projections extending outwardly from said rotary member and substantially counter to said direction, at least one of said projections extending into said path to be engaged by the leader of an incoming sheet.

3. A combination as defined in claim 2, wherein said path is substantially tangential to said rotary member.
4. A combination as defined in claim 3, wherein said inverting means further comprises guide means having a first portion adjacent to said path between said discharging means and said rotary member and an arcuate second portion having a convex outer side and adjacent to at least one axial end of said rotary member.

5. A combination as defined in claim 4, wherein said rotary member has a substantially cylindrical peripheral surface from which said projections extend and said second portion of said guide means has a convex outer surface in at least substantial register with said peripheral surface.

6. A combination as defined in claim 5, wherein said second portion of said guide means extend along an arc of approximately 180°.

7. A combination as defined in claim 3, wherein said inverting means further comprises guide means having a portion adjacent to said path between said discharging means and said rotary member, and stop means located substantially diametrically opposite said portion of said guide means with respect to the axis of said rotary member, said stop means being positioned to intercept the leader of a sheet which engages one of said projections so that the thus intercepted sheet is automatically inverted in response to further movement of its trailing portion along said path.

8. A combination as defined in claim 7, wherein said stop means forms part of said guide means.

9. A combination as defined in claim 7, wherein said portion of said guide means and said stop means are respectively located above and below the axis of said rotary member and said collecting means is adjacent to said stop means.

10. A combination as defined in claim 1 for discharging, collecting and inverting sheets having a predetermined width, as considered transversely of said path, wherein said inverting means further comprises a plurality of projections extending outwardly from said rotary member and at least slightly counter to said direction, the width of said projections, as considered in the axial direction of said rotary member, being a fraction of said predetermined width and at least one said projections extending into said path to be engaged by the leader of an oncoming sheet.

11. A combination as defined in claim 10, wherein the width of said projections is about 10 percent of said predetermined width.

12. A combination as defined in claim 1, wherein said inverting means further comprises a plurality of projections extending outwardly from said rotary member and counter to said direction, at least one of said projections extending into said path to be engaged by the leader of an oncoming sheet whereby the rotary member is rotated in said direction by the thus engaged projection while the trailing portion of the respective sheet continues to advance along said path, each of said projections having a relatively sharp edge portion remote from said rotary member.

13. A combination as defined in claim 1, wherein said inverting means further comprises a plurality of substantially blade-like projections extending from the periphery of said rotary member and counter to said direction, each of said projections defining with the periphery of said rotary member a recess for the entry of the leader of an oncoming sheet whereby such leader rotates said rotary member and is thereby looped to become inverted in response to movement of its leading portion beyond said discharging means.

14. A combination as defined in claim 13, wherein the maximum width of each of said discharging means and means for separably coupling said inverting means to said housing.

15. A combination as defined in claim 1, wherein said rotary member consists of a single piece of synthetic plastic material.

16. A combination as defined in claim 1, wherein said inverting means further comprises a casing for said rotary member and said coupling means is arranged to separably secure said casing to said housing.

17. A combination as defined in claim 1, wherein said inverting means further comprises means for engaging the leaders of successive sheets issuing from said opening and for looping the thus engaged sheets while said discharging means continues to advance the sheets through said opening whereby the sheets are inverted in automatic response to movement of their trailing portions beyond said opening.

18. In a copying machine, a combination comprising means for discharging information-bearing sheets of transfer material, including means for advancing successive sheets in a predetermined direction and along a predetermined path; means for collecting the thus discharged sheets, means for inverting the sheets between said discharging means and said collecting means, including at least one rotary inverting member having a substantially cylindrical surface and being turnable about an axis which is substantially parallel to said path and substantially normal to said direction, said rotary member being turnable by the leaders of successive sheets which are being advanced along said path; and means for braking said rotary member, including resilient means bearing against said cylindrical surface.

19. A combination as defined in claim 1, further comprising means for changing the bias of said resilient means upon said surface.

20. In a copying machine, a combination comprising means for discharging information-bearing sheets of transfer material, including means for advancing successive sheets in a predetermined direction and along a predetermined path; means for collecting the thus discharged sheets, means for inverting the sheets between said discharging means and said collecting means, including at least one rotary inverting member turnable about an axis which is substantially parallel to said path and substantially normal to said direction, said rotary member being turnable by the leaders of successive sheets which are being advanced along said path and comprising a plurality of coaxial ringshaped portions having different outer diameters; and means for braking said rotary member, including a plurality of brake shoes, one for each of said ring-shaped portions, and means for urging selected shoes against the respective ring-shaped portions.