(12) UK Patent Application (19) GB (11) 2 259 961 (13) A

(43) Date of A publication 31.03.1993

(21) Application No 9204456.9

(22) Date of filing 02.03.1992

(30) Priority data
(31) 9116680 (32) 25.09.1991 (33) KR

(51) INT CL5
F16D 41/18

(52) UK CL (Edition L)
F2C C1D11X C1D3
U1S S1879 S2210 S2243

(56) Documents cited
GB 1088181 A

(58) Field of search
UK CL (Edition K) F2C
INT CL5 F16D

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(54) Torque-transmitting means in paper sheet feeding apparatus

(57) An automatic paper sheet feeding apparatus for automatically feeding paper sheets one by one at regular intervals comprises a cylindrical bushing 10 attached to an automatic paper sheet feed roller shaft 3 and having a detent part 10*b* and an elastic piece 10*a* allowing elastic motion axially of the shaft 3 and a cylindrical part 20*a* joined with a feed gear 20 and having an elastic piece 20*b* allowing elastic motion axially of the shaft 3 and bearing against the elastic piece 10*a* of the bushing 10. The shaft 3 is inserted into the gear 20 through the bushing 10 so that the gear 20 can rotate on the shaft 3. The elastic piece 20*b* of the gear 20 is engaged with the detent part 10*b* of the bushing 10, to transmit torque to the shaft 3 and roller 2 so that automatic paper sheet feeding operation is performed. As a sheet is transferred, the live velocity of roller 2 approaches that of a roller 8 and a gap (Figs 6B and 6C) is produced between piece 20*b* and part 10*b*.

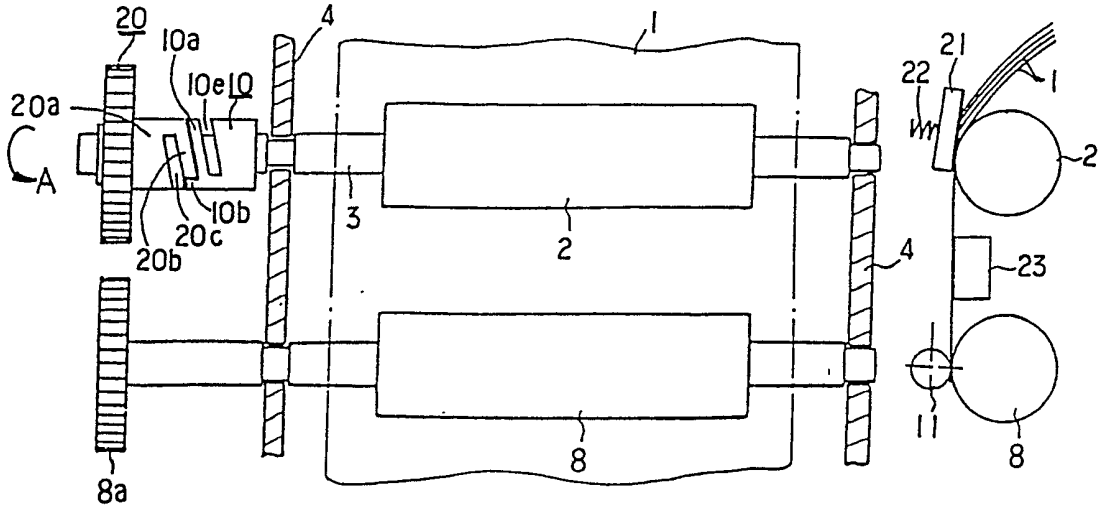

FIG. 4

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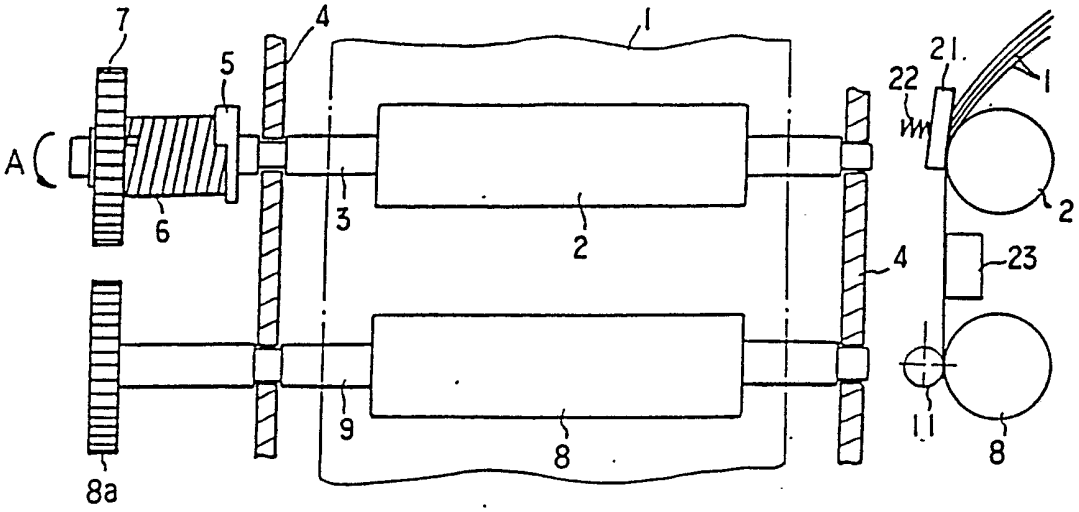
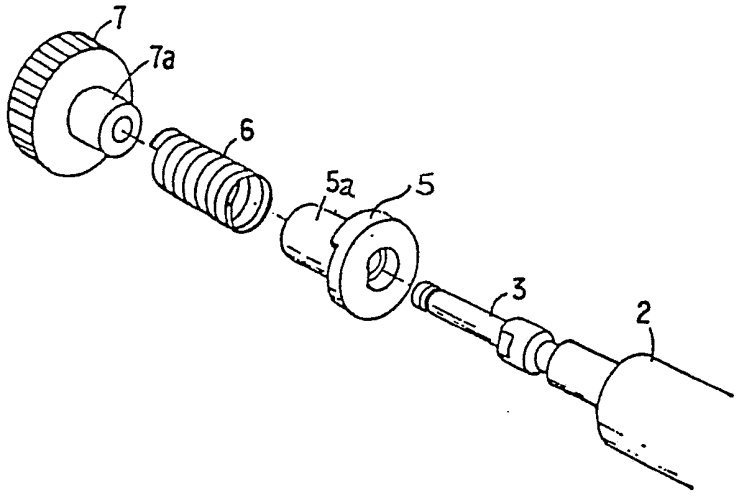


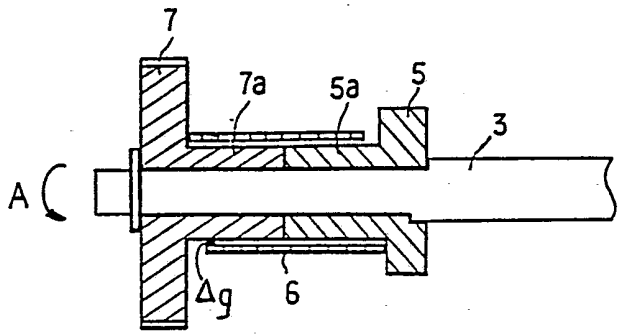
(PRIOR ART)

FIG. 1



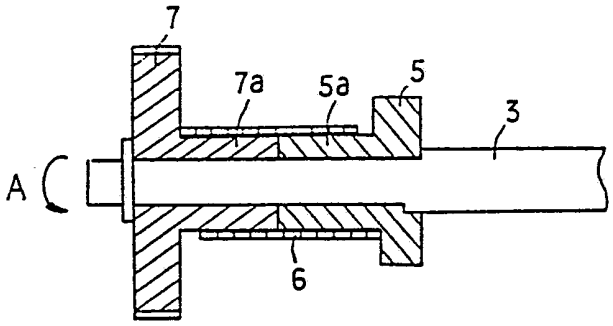
(PRIOR ART)

FIG. 2



(PRIOR ART)

FIG. 3A



(PRIOR ART)

FIG. 3B

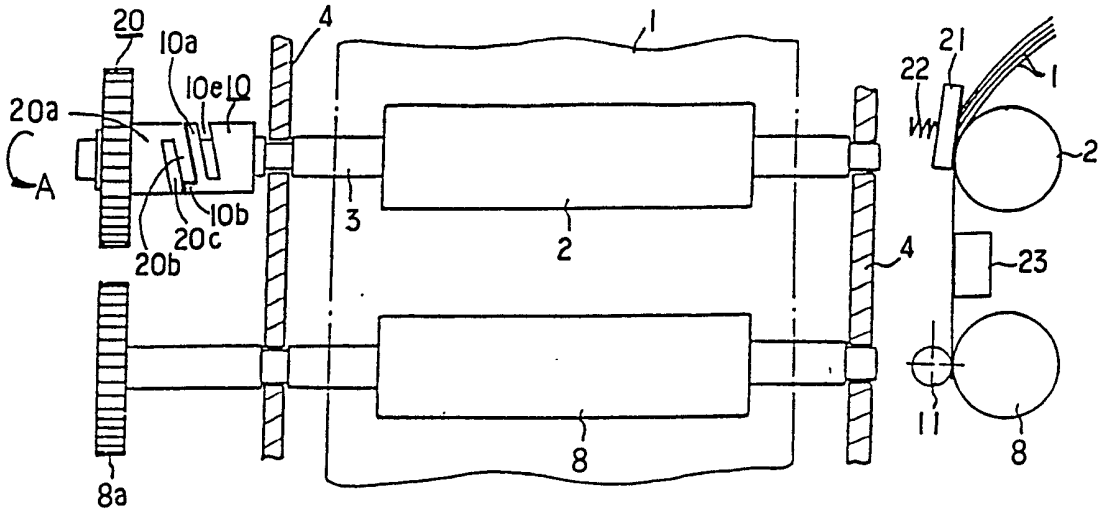

20
10a
4
1
21
22
1
20a
10e
10
A
2
3
2
4
23
20b
20c
10b
11
8
8a
8

FIG. 4

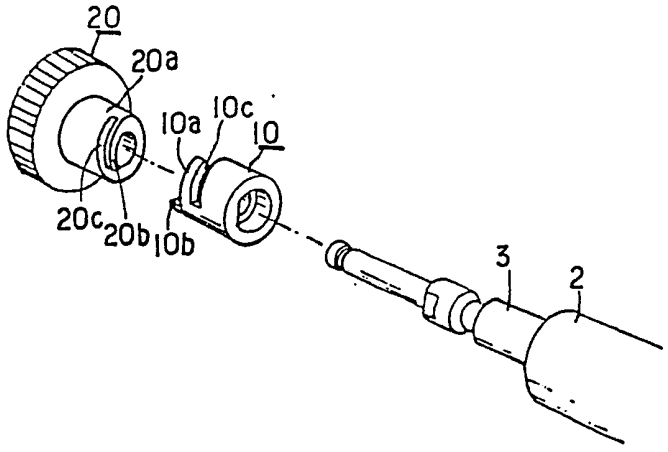

20
20a
10a
10c
10
20c
20b
10b
3
2

FIG. 5

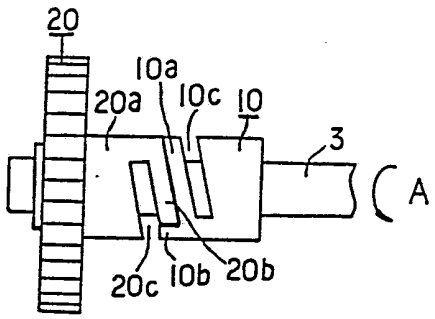


FIG. 6A

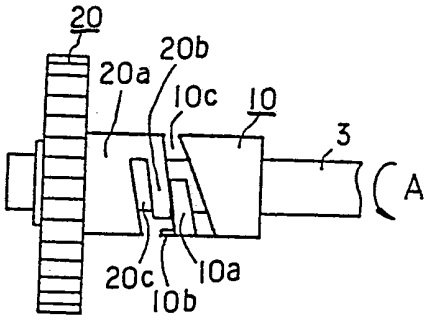


FIG. 6B

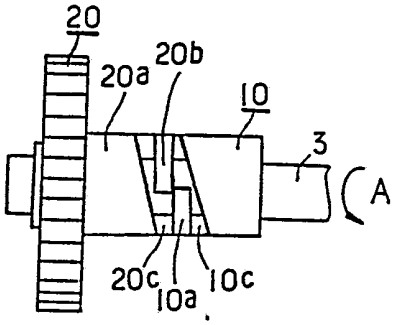


FIG. 6C

PAPER SHEET FEEDING APPARATUS

The present invention relates to paper sheet feeding apparatus, and particularly, although not exclusively, to paper sheet feeding apparatus capable of feeding a stack of paper sheets into a paper sheet receiving part automatically and accurately one by one at regular intervals in a copying transmitting machine such as a facsimile machine or a photocopier.

Generally, if a transmitting signal is generated when a number of paper sheets are set in a paper sheet supply part of a copying transmitting machine, a respective paper sheet feeding apparatus begins to feed paper sheets from the lowest paper sheet one by one in order and transmits desired information by scanning images on the paper sheets.

In Figures 1 to 3 of the accompanying diagrammatic drawings:

Figure 1 shows a conventional automatic paper sheet feeding apparatus in plan view and side view;

Figure 2 is a separated-perspective view of essential parts of the conventional automatic paper sheet feeding apparatus;

Figure 3A is a cross-sectional view of the assembled essential parts of the conventional automatic paper sheet feeding apparatus; and

Figure 3B is an operating diagram of a clutch spring for operating the conventional paper sheet feed roller.

Conventionally, in order to successively feed a number of paper sheets one by one, a device shown in Figure 1 may be used. A cylindrical automatic paper sheet feed roller 2, for feeding the paper sheets 1 set in a paper sheet supply part from a front edge of the paper sheet, is fixed at a middle part of a paper sheet feed roller shaft 3 of the automatic paper sheet feed roller 2, and the paper sheet feed roller shaft 3 is supported at a frame 4 so as to be rotatable. A paper sheet feed rubber 21 is selectively contacted with paper sheet feed roller 2 by a spring 22. An end of the paper sheet feed roller shaft 3 is mounted in a cylindrical part 5a of a bushing 5. A cylindrical part 7a of an automatic paper sheet feed gear 7 and the cylindrical part 5a of a bushing 5 are inserted into a clutch spring 6, the clutch spring 6 blocking or transferring power applied to the paper sheet feed gear 7 from a motor (not shown) to the paper sheet feed roller 2.

A cylindrical transfer roller 8 which is positioned in parallel with the automatic paper sheet feed roller 2 and transmits the paper sheets, is fixed at the middle of a transfer roller shaft 9 of the transfer roller 8, and the transfer roller shaft 9 is supported at the frame 4 so as to be rotatable. A pinch roller 11 applying pressure to the transfer roller 8 is supported at another frame during the transferring of the paper sheet. A transfer gear 8a is fixed at an end of the transfer roller shaft 9 adjacent to the frame 4, delivering rotary power from outside to the transfer roller 8.

If the paper sheet 1 is fed to the automatic paper sheet feed roller 2, the paper sheet feed gear 7 and transfer gear 8a turn in a direction A. Accordingly, as shown in Figure 3B, the clutch spring 6, between the cylindrical part 7a of the automatic paper sheet feed gear 7 and the cylindrical part 5a of the bushing 5, is compressed in the rotating direction. The power

applied to the automatic paper sheet feed gear 7 is transmitted, through the clutch spring 6 and the bushing 5, from the outside to the paper sheet feed roller shaft 3, thereby turning the paper sheet feed roller shaft 3 in the direction A. By this rotation, the paper sheet 1 is transferred from the automatic paper sheet feed roller 2 to the transfer roller 8, and a paper sheet reader 23 begins to read the paper sheet from the front edge thereof. Next, the paper sheet 1 is introduced between the pinch roller 11 and the transfer roller 8 by a friction force, and then transferred with a tension force, which is caused by the fact that the linear velocity of the automatic paper sheet feed roller 2 is slower than that of the transfer roller 8.

As the paper sheet 1 is transferred, the linear velocity of the paper sheet feed roller 2 approaches the linear velocity of the transfer roller 8. Between the rotary bushing 5 joined with the paper sheet feed roller shaft 3 and the automatic paper sheet feed gear 7 of constant velocity there is generated a phase travelling difference ΔQ which is proportional to the length of the paper sheet 1. This phase travelling difference ΔQ is caused by the velocity difference between the automatic paper sheet feed roller 2 and the automatic paper sheet feed gear 7. As a result, as shown in Figure 3A, the compressed spring clutch 6 comes to loosen gradually, forming a gap Δg between the outer circumferences of the cylindrical parts 5a and 7a and the inside circumference of the clutch spring 6, so that the automatic paper sheet feed roller 2 comes to turn with the transfer roller 8 at the same linear velocity.

On the other hand, when a back edge of the paper sheet 1 slips out of the automatic paper sheet feed roller 2, as shown in Figure 3B, the automatic paper sheet feed gear 7 turns in the direction A by as much as the phase

travelling difference, so that the clutch spring 6 surrounding the cylindrical part 7a of the automatic paper sheet feed gear 7 and the cylindrical part 5a of the bushing 5, is compressed toward the A-direction. The paper sheet feed gear 7 turns to the A-direction along with the paper sheet feed roller shaft 3. Thereby, the power from the exterior is delivered to the paper sheet feed roller shaft 3 of the automatic paper sheet feed roller 2 through the bushing 5, and then the next paper sheet is supplied to the automatic paper sheet feed roller 2. That is, the phase travelling difference between bushing 5 and the paper sheet feed gear 7 makes a feed interval between the front edge of the paper sheet 1 and the back edge of the paper sheet, thus enabling the paper sheets to be fed one by one.

Accordingly, in the conventional paper sheet feed apparatus, in order to achieve the above-described operation, that is a role for blocking or transferring the external power of the automatic paper sheet feed gear 7 to the bushing 5, the clutch spring 6 must be delicately assembled so as to provide a very small gap between the clutch spring 6 and the cylindrical parts 5a and 7a. As the assembling of such a clutch spring is not easy, however, an expert for assembling the clutch spring is needed, and moreover, using of the clutch spring brings about the raising of the cost.

Therefore, preferred embodiments of the present invention aim to provide an automatic paper sheet feeding apparatus which can reduce cost and simplify assembly thereof by decreasing the number of parts of the apparatus.

According to one aspect of the present invention, there is provided a paper sheet feed apparatus comprising:

a driving shaft;

paper sheet feed roller means for receiving a paper sheet and mounted for rotation with said driving shaft;

transfer roller means for receiving a paper sheet from said paper sheet feed roller means and positioned apart from and in parallel with said paper sheet feed roller means;

paper sheet feed gear means mounted for rotation about said driving shaft and having a first elastic piece formed at an end thereof, said first elastic piece being movable axially of said driving shaft; and

a bushing mounted on said driving shaft between said paper sheet gear means and said paper sheet feed roller means and having detent means positioned at an end thereof and a second elastic piece adjacent to said detent means, said second elastic piece being arranged to bear against said first elastic piece:

wherein, in use, said first elastic piece slides against said second elastic piece until said first elastic piece pushes said detent means to rotate said driving shaft and paper sheet feed roller means, thereby to transmit a paper sheet from said paper sheet feed roller means to said transfer roller means.

Preferably, said first elastic piece and said second elastic piece bear against one another and are inclined at a common angle, so that said two elastic pieces slide against each other with an elastic force.

Preferably, an outermost portion of said second elastic piece and an outermost portion of said detent means are aligned on a line which extends perspectively to the axis of said driving shaft.

Preferably, a first groove is formed inside of said first elastic piece and a second groove is formed inside of said second elastic piece, said first and second grooves being the same as said first and second elastic pieces in width.

Preferably, said first elastic part is formed at an end of a cylindrical portion of said paper sheet feed gear means.

The invention extends to a copying and/or facsimile transmitting machine having a paper sheet feed apparatus according to any of the preceding aspects of the invention.

For a better understanding of the invention and to show how the same way may be carried into effect, reference will now be made, by way of example, to Figures 4 to 6 of the accompanying drawings, in which:

Figure 4 shows one example of an automatic paper sheet feeding apparatus according to the present invention in plan view and side view;

Figure 5 is a separated-perspective view of drive transmission parts of the automatic paper sheet feeding apparatus of Figure 4; and

Figures 6A to 6C are respective side views of the drive transmission parts of Figure 5, in different operating states of the paper sheet feeding apparatus of Figure 4.

In the figures, like reference numerals denote like or corresponding parts.

With reference to Figure 4 and Figure 5, the construction of the illustrated embodiments of the present invention will be described.

A paper sheet feed roller shaft 3 of an automatic paper sheet feed roller 2 is rotatably mounted on a frame 4, the roller 2 being for feeding a number of paper sheets 1 in a paper sheet supplying part to a paper sheet receiving part. The paper sheet feed roller shaft 3 is connected to and inserted into a bushing 10 which rotates along with the paper sheet feed shaft 3. A detent part 10b is positioned in an end of the bushing 10, and a groove 10c is formed in a middle portion of the bushing 10 with a given length, so that an elastic or resilient piece 10a is positioned between the detent part 10b and the groove 10c.

A cylindrical part 20a of an automatic paper sheet feed gear 20 similarly has an elastic or resilient piece 20b and a groove 20c. The elastic piece 20b is positioned in an end of the cylindrical part 20a. The groove 20c is formed adjacent to the elastic piece 20b. The elastic piece 20b of the automatic paper sheet feed gear 20 is engaged with the detent part 10b in the bushing 10 assembled with the paper sheet feed roller shaft 3, delivering external power to the paper sheet feed roller shaft 3 through the bushing 10.

A transfer roller 8 is positioned in parallel with the automatic paper sheet feed roller 2. The elastic pieces 10a, 20b are inclined at the same gradient, so that as the transfer roller 8 rotates more rapidly, with a paper sheet 1 gripped by both rollers 2 and 8, power of the automatic paper sheet

feed gear 20 is not transmitted to the paper sheet feed roller shaft 3, so that the automatic paper sheet feed roller 2 rotates at the same linear velocity as the transfer roller 8. The width of detent part 10b of the bushing 10, the widths of the elastic pieces 10a and 20b, and the widths of the grooves 10c and 20c are the same. The leftmost portions of the elastic piece 10a and the detent part 10b (as seen in the drawings) are vertically aligned. The right side of the elastic piece 20b of the cylindrical part 20a is formed so as to slide against the left side of the elastic piece 10a of the bushing 10.

The operational effect of the illustrated embodiment of the present invention will now be described.

If the paper sheet 1 is delivered to the automatic paper sheet feed roller 2 which is in contact with a paper sheet feed rubber 22 by a spring 21, power from a motor (not shown) is applied to the automatic paper sheet feed gear 20, turning the paper sheet feed gear 20 in direction A. The elastic piece 20b formed on the cylindrical part 20a of the automatic paper sheet feed gear 20 slides against the elastic piece 10a of the bushing 10, pushes the detent part 10b, which turns in the A-direction.

Thus, power of the paper sheet feed gear 20 is delivered to the bushing 10, turning the automatic paper sheet feed roller 2 in the A-direction, transmitting the paper sheet 1 to the transfer roller 8 by the friction force between the paper sheet feed roller 2 and the paper sheet feed rubber 21. The paper sheet 1 is read by a paper sheet reader 23, from a front edge of the paper sheet. The front edge of the paper sheet 1 enters between the transfer roller 8 and the pinch roller 11, and the paper sheet 1 is transmitted under

tension, which is caused by the fact the linear velocity of the transfer roller 8 is faster than that of the automatic paper sheet feed roller 2.

As the paper sheet 1 is transferred, the linear velocity of the paper sheet feed roller 2 approaches the linear velocity of the transfer roller 8. At this time, between the bushing 10 rotating together with the paper sheet feed roller shaft 3 and the automatic paper sheet feed gear 20 rotating at a constant velocity, there is generated a phase travelling difference, which is proportional to the length of the paper sheet 1. The elastic piece 20b on the cylindrical part 20a of the automatic paper sheet feed gear 20 slides on the elastic piece 10a of the bushing 10, as shown in Figure 6B, rotating each other under the tension. Accordingly, the gap between the detent part 10b on the cylindrical part of the bushing 10 and the lowest part of the elastic piece 20b formed on the cylindrical part 20a of the automatic paper sheet feed gear 20, gradually widens. The automatic paper sheet feed gear 20 moves slower than the automatic paper sheet feed roller 2. Then, as shown in Figure 6C, the elastic piece 20b on the cylindrical part 20a and the elastic piece 10a of the bushing are pushed into the grooves 10c and 20c respectively by the tension thereof. Thereupon, the automatic paper sheet feed roller 2 rotates faster than the automatic paper sheet feed gear 20, and the linear velocity of the automatic paper sheet feed roller 2 becomes the same as that of the transfer roller 8, transmitting the paper sheet 1.

At this time, since power of the automatic paper sheet feed gear 20 is not delivered to the paper sheet feed roller shaft 3, even if the paper sheet is very long, the paper sheet can be transmitted by the above-described operation.

On the other hand, when the back edge of the paper sheet 1 slips out of the automatic paper sheet feed roller 2, the elastic piece 20b on the cylindrical part 20a of the automatic paper sheet feed gear 20 (which is rotating at constant velocity) slides on the elastic piece 10a of the bushing 10 connected to the paper sheet feed roller shaft 3, under the state that power is not delivered thereto. Following this sliding movement, the elastic piece 20b pushes the detent part 10b of the bushing 10. Thereupon, power of the automatic paper sheet feed gear 20 is delivered to the bushing 10, turning the automatic paper sheet feed roller 2. Thereafter, the operation for feeding a subsequent paper sheet is performed by the automatic paper sheet feed roller 2.

As described above, the phase travelling difference ΔQ generates a feed interval between the back edge of the preceding paper sheet and the front edge of the subsequent paper sheet, so that the paper sheets are fed one by one.

As described hereinabove, a paper sheet feeding operation is effected, keeping the feed interval between paper sheets automatically by using the elastic piece on the cylindrical part of the automatic paper sheet feed gear and the elastic piece of the bushing, and even an irregular paper sheet can be fed automatically and transmitted without problem.

Moreover, since the paper sheet feeding operation and the paper sheet transmitting operation are reliably carried out without a spring clutch, problems caused by spring clutches are avoided, and the cost is decreased.

While a preferred specific embodiment of the present invention has been particularly shown and described, it will be apparent to those skilled in

the art that in the foregoing, changes in form and detail may be made without departing from the spirit and scope of the present invention.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS:

1. Paper sheet feed apparatus comprising:

a driving shaft;

paper sheet feed roller means for receiving a paper sheet and mounted for rotation with said driving shaft;

transfer roller means for receiving a paper sheet from said paper sheet feed roller means and positioned apart from and in parallel with said paper sheet feed roller means;

paper sheet feed gear means mounted for rotation about said driving shaft and having a first elastic piece formed at an end thereof, said first elastic piece being movable axially of said driving shaft; and

a bushing mounted on said driving shaft between said paper sheet gear means and said paper sheet feed roller means and having detent means positioned at an end thereof and a second elastic piece adjacent to said detent means, said second elastic piece being arranged to bear against said first elastic piece:

wherein, in use, said first elastic piece slides against said second elastic piece until said first elastic piece pushes said detent means to rotate said driving shaft and paper sheet feed roller means, thereby to transmit a paper sheet from said paper sheet feed roller means to said transfer roller means.

2. An apparatus as claimed in claim 1, wherein said first elastic piece and said second elastic piece bear against one another and are inclined at a common angle, so that said two elastic pieces slide against each other with an elastic force.

3. An apparatus as claimed in claim 1 or 2, wherein an outermost portion of said second elastic piece and an outermost portion of said detent means are aligned on a line which extends perspectively to the axis of said driving shaft.

4. An apparatus as claimed in claim 1, 2 or 3, wherein a first groove is formed inside of said first elastic piece and a second groove is formed inside of said second elastic piece, said first and second grooves being the same as said first and second elastic pieces in width.

5. An apparatus according to any of the preceding claims, wherein said first elastic part is formed at an end of a cylindrical portion of said paper sheet feed gear means.

6. Paper sheet feed apparatus substantially as hereinbefore described with reference to Figures 4 to 6 of the accompanying drawings.

7. A copying and/or facsimile transmitting machine having a paper sheet feed apparatus according to any of the preceding claims.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
9204456.9

Relevant Technical fields

(i) UK Cl (Edition K) F2C

(ii) Int Cl (Edition 5) F16D

Search Examiner
A BURROWS

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
31 MARCH 1992

Documents considered relevant following a search in respect of claims 1-7

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 1088181 A (MINNESOTA MINING) Figures 10, 10a: lines 90 -104 page 6; lines 44, 45 page 7; lines 108-116 page 7	

axw - c:\wp51\doc99\fil000109

Category	Identity of document and relevant passages	Relevant to claim(s.

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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