

- (21) Application No 8117255
 (22) Date of filing
 5 Jun 1981
 (30) Priority data
 (31) 55/078242U
 (32) 5 Jun 1980
 (33) Japan (JP)
 (43) Application published
 20 Jan 1982
 (51) INT CL³ G06M 9/02
 (52) Domestic classification
 G4D BH
 (56) Documents cited
 GB 1566348
 GB 1410125
 GB 1316463
 (58) Field of search
 G4D
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(54) Paper sheet counting apparatus

(57) The suction heads (4) are stopped and held at positions at which one of the heads (4) is precisely opposite to the face of the paper sheets (A). The cylinder (1) carrying the heads has recesses (3) in its periphery each corresponding to one of the heads (4); each recess has a sloping lead-in 3a. A pawl (2a) of a stopper (2) engages one recess when the rotary cylinder (1) is stopped to terminate the counting operation. The stopper (2) is rotatably mounted by a slot (2b) onto shaft (5) and a damping spring (6) urges the stopper (2) in the direction of slot 2b. In order to stop the rotary cylinder (1), the cylinder (1) is rotated in the reverse direction, and the stopper (2) is moved from a retracted position to an engaging

position, where upon the pawl (2a) of the stopper (2) slips down along the slope (3a) to engage one of the recesses, the damping spring (6) absorbing the shock of engagement.

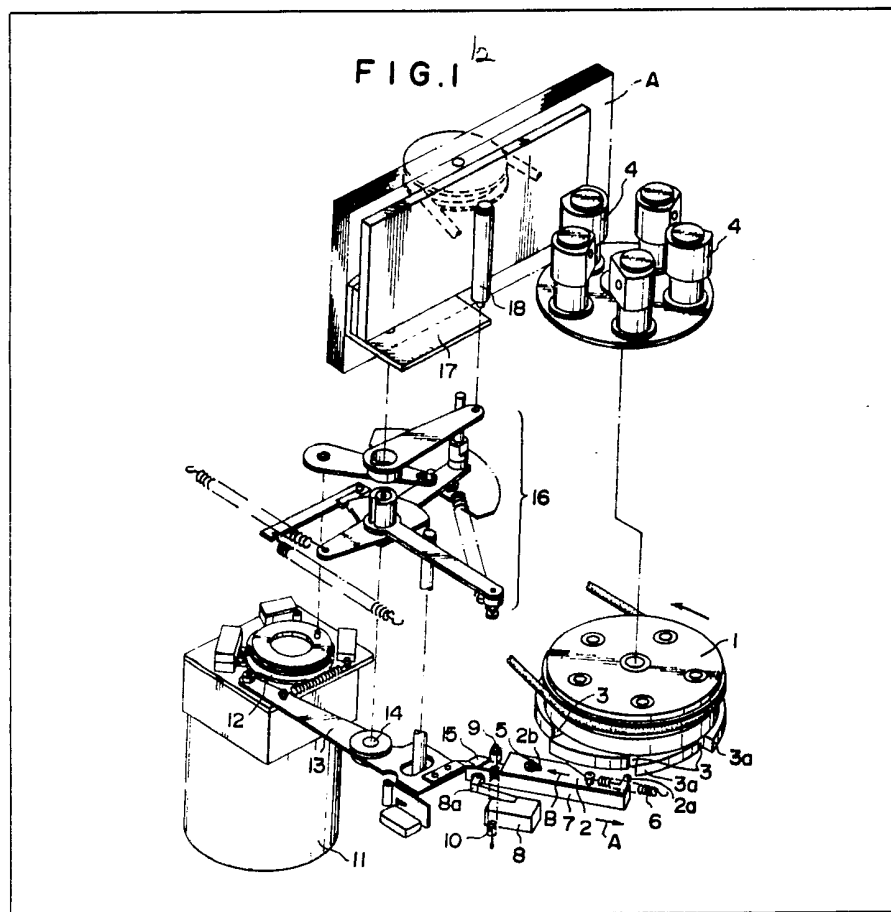


FIG. 2

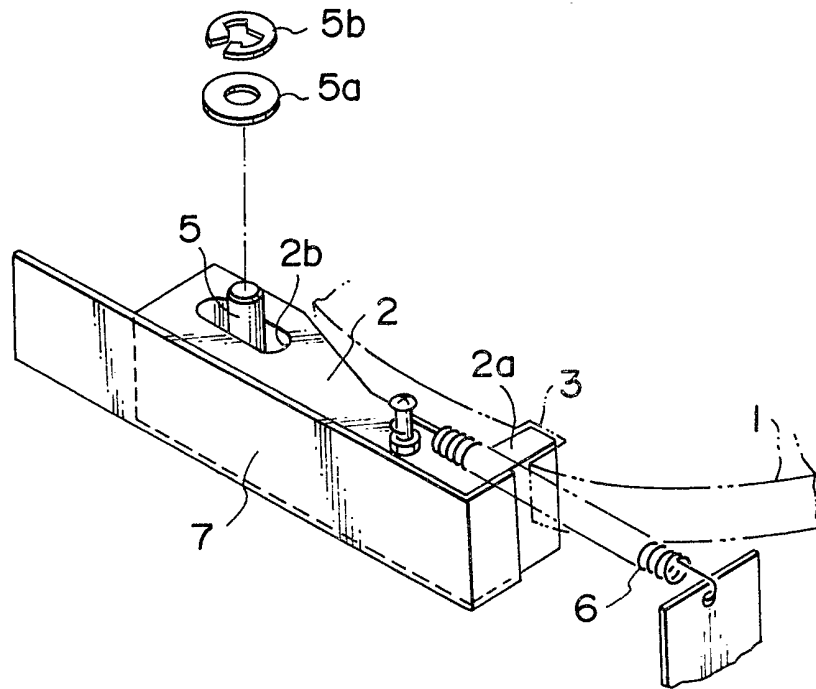
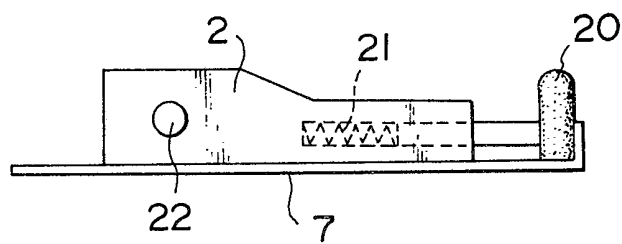


FIG. 3



SPECIFICATION

Paper sheet counting apparatus

5 The present invention relates to paper sheet counting apparatus having suction heads which are stopped at one of a plurality of predetermined angular positions when one paper sheet counting operation cycle is terminated.

10 In paper sheet counting apparatus having suction heads, paper sheets are successively sucked by the suction to be brought separately from a stack station including a holder and a press roller. The sucking port of one of the suction heads is generally faced oppositely to the face of the stacked paper sheets to be ready for the next counting operation cycle after the preceding operation cycle for counting an instructed number of paper sheets has been completed. In conventional apparatus of this type, a plurality of equi-spaced engaging recesses corresponding to a plurality of the suction heads provided on a peripheral face of a rotary cylinder on which the suction heads are carried; for example, five equi-spaced recesses may be provided on a circular periphery. When one counting operation cycle is completed, a stopper having a latch or pawl, which is to be engaged with or fitted into one of the recesses thereby to stop the rotary cylinder at a fixed angular position, is swung to a position for stopping the rotational movement of the rotary cylinder. The stopper is normally held at a retracted position with its latch or pawl separated from the recesses.

However, in this apparatus of the prior art, both the stopper and the peripheral face of the rotary cylinder having the engaging recesses are made of the same or different metal and the cylinder is rotated in the reverse direction under a relatively high acceleration force as one counting operation cycle is completed and the rotary cylinder is rotated in order to engage the latch or pawl with one of the recesses. With such a construction, a loud crashing sound is generated when the pawl or latch of the stopper abuts against one of the recesses. Another disadvantage of the prior art apparatus is that the contacting portions are rapidly abraded.

The invention provides paper sheet counting apparatus comprising a rotary member carrying a group of suction heads, and means for stopping the suction heads at predetermined angular positions to be ready for immediately sucking the first sheet of the next counting operation cycle, the means comprising a peripheral face provided on the rotary member and having engaging recesses each corresponding to one of the suction heads to determine the angular positions of the suction heads when one paper sheet counting operation cycle is terminated and the rotary mem-

ber is stopped, a stopper having a pawl to be engaged with one of the recesses to stop and fix said rotary member during the standstill time when the suction heads are stopped at a predetermined angular position, said stopper having an elongated hole extending in a longitudinal direction thereof to receive a shaft about which the stopper is rotatable, the stopper being movable relative to the shaft in the longitudinal direction within the extent defined by the length of the elongated hole, and a resilient member for damping the sliding movement of the stopper relative to the shaft when the pawl is engaged with one of the engaging recesses.

The pawl or latch of the stopper, which is one of the contacting portions contacting or abutting under relatively high acceleration force, may be made of a resilient but anti-friction and abrasion-proof material such as hard synthetic resin or hard synthetic rubber.

Embodiments of the invention will now be described, by way of example, with reference to the appended drawings, in which:

90 *Figure 1* is an exploded general perspective view of an embodiment perspectively showing main parts of the device according to the invention;

95 *Figure 2* is a more detailed perspective view showing the embodiment shown in Fig. 1; and

Figure 3 is a plan view showing another embodiment of the invention.

100 Firstly referring to Fig. 1, a rotary cylinder 1 is rotated by a driving assembly, not shown. The rotary cylinder 1 has a peripheral face on which five equispaced recesses 3 are provided to engage with a pawl 2a of a stopper 2. At the left side, as viewed in Fig. 1, of each of the recesses 3, there is formed a slipping slope 3a. The number, five in this embodiment, of the engaging recesses 3 is equal to the number of suction heads 4 carried on the rotary cylinder 1, and each recess serves to stop the rotary cylinder 1 at a position at which one of the suction heads 4 is opposed to the face of the stacked paper sheets in face-to-face relationship.

The stopper 2 may be made of an anti-friction or abrasion-proof metal and has an elongated hole 2b extending in the longitudinal direction thereof. A shaft 5 secured to a base plate, not shown, is slidably inserted through the elongated hole 2b of the stopper 2. A clamp piece 5b for preventing the stopper 2 from slipping off the shaft 5 is fixedly secured at the upper end of the shaft 5 against a washer 5a. The stopper 2 is biased in the direction shown by the arrow A in Fig. 1 by the action of a coil spring 6 so that the shaft 5 is positioned at the one extremity of the elongated hole 2b. A side plate 7 is integrally formed at one edge of the stopper 2, and the outer face of the side plate 7 abuts against an actuator 8a of a microswitch 8 for detecting

whether the pawl 2a of the stopper 2 engages with one of the engaging recesses 3 or not. On the other end of the stopper opposite to the end at which the pawl 2a is secured, there is provided a projecting stud 9 which is connected to a coil spring 10. By the resilient action of this tension coil spring 10, the stopper 2 is urged to swing about the shaft 5 in the counter-clockwise direction as viewed in the Fig.

The stopper 2 is positioned, as viewed in Fig. 1, against the spring action of the coil spring 10 with its pawl 2a separated from the peripheral face of the rotary cylinder 1 during the time period when the rotary cylinder 1 is rotated to allow the suction heads 4 to suck paper sheets to continue the counting operation. In detail, while the paper sheets are subjected to counting, the projecting stud of the stopper 2 is pressed by a press member 15 secured at one end of a swingable arm 13 which can swing about the axis 14 and urged to swing by the action of a cam plate 12 maintained at a predetermined position by a rotating holder motor 11. Reference numeral 16 designates a link mechanism for transferring a holder 17 and a paper press roller 18 or other related members for holding a bundle of paper sheets A to a paper sheet charging station, not shown. However, detailed description of these members will not be given herein, because the structure and operation thereof has been known in the art.

The operation of this embodiment of the present invention will be described hereinafter. When the rotary cylinder 1 is driven to rotate, the paper sheets A held between the holder 4 and the press roller 18 are sucked by the suction heads 4 successively one by one to be counted. During this operation, the projecting stud 9 of the stopper 2 is pressed by the press member 15 of the swingable arm 13 to the position shown in Fig. 1 where the pawl 2a of the stopper 2 is separated from any of the engaging recesses 3 provided on the peripheral face of the rotary cylinder 1. After the counting operation for counting the paper sheets A is completed, a signal for stopping the driving motor, not shown, for the rotary cylinder 1 is generated to stop the rotational movement of the rotary cylinder 1. At the same time, a signal for actuating the holder motor 11 is generated to rotate the cam plate 12 by a pre-set angle. As the cam plate 12 is rotated by the pre-set angle, the swingable arm 13 is swung about its swing shaft 14 in the clock-wise direction to allow the press member 15 of the arm 13 to be separated from the projecting stud of the stopper 2. As a result, the stopper 2 is rotated about the shaft 5 in the counter-clockwise direction under the action of the coil spring 10 so that the pawl 2a abuts against a portion of the peripheral face of the rotary cylinder 1, for instance a portion of a slipping slope 3a.

However, when the pawl 2a of the stopper 2 abuts against one portion of one slipping slope 3a, any one of the suction heads 4 is not opposed precisely to the face of the bundle of paper sheets with its sucking port opposing in the face-to-face relationship to the face of the bundle of paper sheets. Such a positioning is undesirable in that the next cycle counting operation cannot be commenced immediately and correctively. To avoid stoppage of the suction heads 4 at the aforementioned undesirable positions, a signal for actuating the driving motor for driving the rotary cylinder 1 in the reverse direction is generated, whereupon the rotary cylinder 1 is rotated in the reverse direction, i.e. the clockwise direction in the Fig. which is the direction reverse to the rotation direction thereof during the counting operation, at a relatively high speed. As the rotary cylinder 1 rotates in the clockwise direction, the pawl 2a of the stopper 2 slips down along the slipping slope 3a to fall in a recess 3 to stop rotational movement of the rotary cylinder 1 (see Fig. 2), whereupon the stopper 2 suffers a high impact or shock as a reaction force from the rotary cylinder 1.

However, in this embodiment of the present invention, the stopper 2 is damped by the spring action of the coil spring 6 and somewhat slides in the direction of the arrow B having its elongated hole guided by the shaft 5. The impact from the rotary cylinder 1 is effectively damped by this sliding movement. Hence, the crashing generated by the collision of the pawl 2a of the stopper 2 against the recess on the peripheral face of the rotary cylinder can be reduced. Furthermore, the engaging portions or contacting portions of the pawl and the recess are not subjected to friction and impact forces of higher than the predetermined strength, since the stopper 2 can slide to some extent as mentioned hereinabove. Abrasion of the contracting portions is prevented by the aforementioned damping action of the coil spring 6.

Although the stopper 2 of the preceding embodiment is composed of an antifriction metal, the effects of suppressing the crashing sound and the abrasion prevention action can be further improved when the stopper is manufactured from a hard synthetic resin or a hard synthetic rubber material having the antifriction and abrasion-proof properties.

Referring now to Fig. 3 showing another embodiment of the present invention, the stopper 2 is rotatably attached to a shaft 22 which is secured to the base plate, not shown. A pawl 20 is provided on the stopper 2 so that the pawl is outwardly biased by the action of a spring 21 toward the angled portion of the side plate 7. It is preferable that the pawl 20 is made of a hard synthetic resin or a hard synthetic rubber and the other portions of the stopper 2 made of a metal.

In this embodiment, when the rotary cylinder 1 is rotated in the clockwise direction after completion of the counting operation in a similar manner to the above-described first embodiment, the impact from the rotary 1 is also effectively damped by the sliding movement of the pawl 20 against the action of the spring 21 while the stopper 2 is maintained stationary.

- 10 As will be apparent from the foregoing, the above embodiments having the structure and function as aforementioned can effectively suppress the crashing sound generated when the stopper is struck against one of the engaging recesses, and further can prevent abrasion of the contacting portions. Nevertheless, a pawl can be integral with the stopper which is provided with an elongated hole, and a shaft about which the stopper can swing is fitted through the elongated hole so that the stopper can be slide relative to the shaft and at the same time the stopper can swing about the shaft moving relative to the shaft in the longitudinal direction of the stopper. With the construction described above, embodiments of the invention are simple in construction and can be easily manufactured.

Although the present invention has been described exemplarily with specific embodiments thereof, it should be understood that various modifications, changes and variations will be appreciated in the light of the disclosure herein by a person having ordinary skill in the art without departing from the spirit and scope of the invention.

Accordingly, the foregoing disclosure should be interpreted as illustrative only and not in a limiting sense.

40 CLAIMS

1. Paper sheet counting apparatus comprising a rotary member carrying a group of suction heads, and means for stopping the suction heads at predetermined angular positions to be ready for immediately sucking the first sheet of the next counting operation cycle, the means comprising a peripheral face provided on the rotary member and having engaging recesses each corresponding to one of the suction heads to determine the angular positions of the suction heads when one paper sheet counting operation cycle is terminated and the rotary member is stopped, a stopper having a pawl to be engaged with one of the recesses to stop and fix said rotary member during the standstill time when the suction heads are stopped at a predetermined angular position, said stopper having an elongated hole extending in a longitudinal direction thereof to receive a shaft about which the stopper is rotatable, the stopper being movable relative to the shaft in the longitudinal direction within the extent defined by the length of the elongated hole, and a resilient member for damping the sliding movement of

the stopper relative to the shaft when the pawl is engaged with one of the engaging recesses.

2. Apparatus as claimed in Claim 1 wherein stopper is made of a hard synthetic resin material or a hard synthetic rubber material having anti-friction and shock-resistant properties.

3. Paper sheet counting apparatus substantially as hereinbefore described with reference to and as shown in Figs. 1 and 2 or Figs. 1 and 2 as modified by Fig. 3 of the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1982.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.