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(54) **Inserter apparatus**

(57) Apparatus for inserting a content pack (1) into an envelope (4), the apparatus comprising: a gripping mechanism (6,7); means (17,18) for operating the gripping mechanism (6,7) to hold an envelope (4); means (14-16) for opening a throat of the envelope (4); means (9-13,19) for moving the content pack (1) in a direction toward and into the throat of the envelope (4); means (17,18) for accelerating the envelope (4) in the direction of movement of the content pack (1) while the gripping mechanism (6,7) is operational; and means for releasing the gripping mechanism (6,7) at a predetermined time, to release the envelope (4), the predetermined time being while the content pack (1) is at least partially inserted into the envelope (4), and being predetermined in dependence upon parameters comprising at least the content pack depth and the envelope depth.

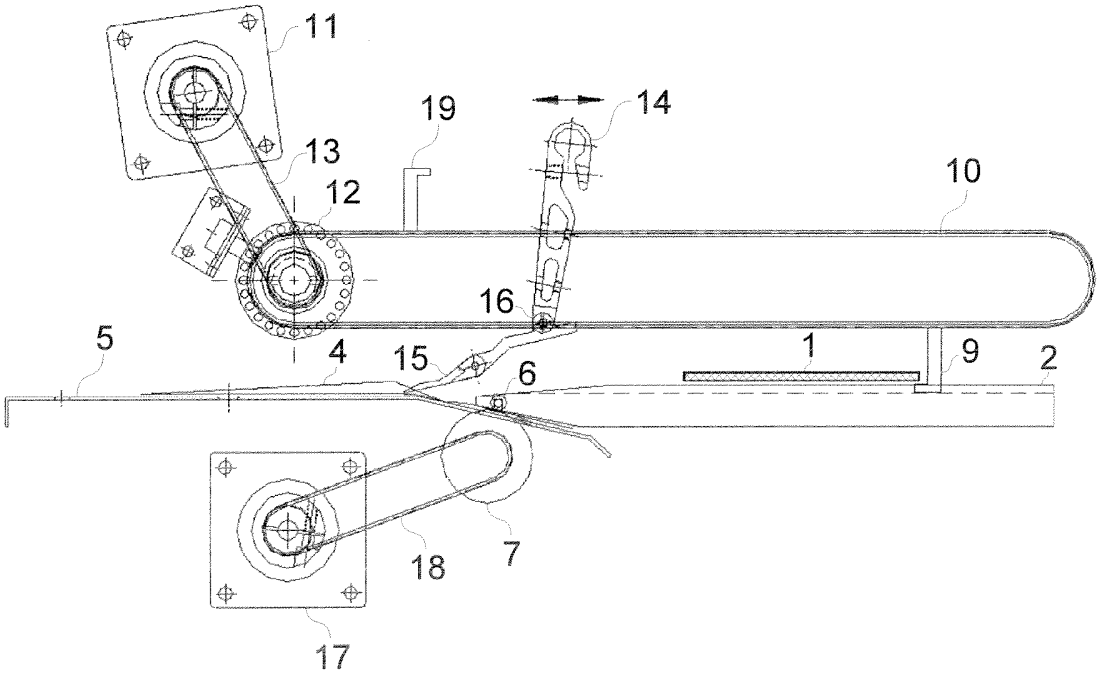


**Fig. 2**

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## Description

**[0001]** The present invention relates to an inserter apparatus particularly for a paper handling machine used for inserting documents and inserts into envelopes, and a method of controlling such apparatus.

**[0002]** In the paper handling industry envelopes are required to be filled with contents which may include documents such as personally printed letters, standard preprinted letters, leaflets, brochures, and other inserts such as credit cards. There are many steps required to fill an envelope with such contents. Firstly both the envelope and the contents (suitably folded if necessary) must be transported from storage hoppers of the respective items along paths which converge at an inserter station. Then the envelope flap must be folded out, the envelope pouch opened enough to give clearance to insert the contents, and then the contents must be pushed into the envelope. The flap of the filled envelope must be closed and sealed, and finally the envelope must be transported away from the inserter station. It is desirable to complete this process at very high speed: up to 3,000 envelopes per hour can be filled in the highest speed machines available today.

**[0003]** Precise tolerances must be observed to ensure that the machine runs smoothly particularly at such high speed so that loss of production is kept to a minimum. If the contents are incorrectly aligned with the opening of the envelope then they will not fit into the envelope pouch and the envelope and/ or the contents will be damaged, and the production line will need to be halted to clear debris from the inserter station. Equally, if the contents are not pushed completely into the envelope then the flap will not fold back, or seal, and production will be lost and delayed.

**[0004]** One way of ensuring accuracy of insertion is to bring envelopes and contents together to an inserter station and push the contents into the envelope while it is stationary, then to move the envelope out of the inserter station for further processing. Although this makes it easier to ensure accuracy, it is a relatively slow method.

**[0005]** A faster method is to begin the insertion process while the envelope is stationary and release it as the insert is moving into the envelope so as to use the momentum of the insert to drive the envelope out of the inserter station. This speeds up the production line but requires very accurate synchronisation to ensure that the envelope is released at precisely the right moment. If the timing is wrong then either the insert does not fit completely into the envelope, or it hits the bottom of the envelope while the envelope is being held, and the impact can then damage the envelope and/ or the insert. In addition a lightweight insert may have insufficient momentum to overcome the inertia of the envelope to drive it fully out of the inserter station.

**[0006]** One attempt to overcome some of these problems involves driving the envelope at the same time as releasing it, for example the envelope holding mechanism may be released using solenoids, which may also be used to drive pressure rollers to apply pressure to connect the envelope with constantly running drive rollers. However positional control and coordination of such a system is difficult and the envelope may move early, ahead of the insert, or late such that the envelope is driven by the insert instead of the rollers.

**[0007]** One known system for synchronising an envelope inserter is described in US 6,418,357. This uses positional information, provided by a sensor, to generate motion profiles to synchronise an envelope drive with an insert drive. US 6,813,870 teaches a method of speeding the insert stage by feeding inserts and envelopes from the same direction. This avoids the loss of speed necessary when they are transported from different directions, which requires that one or both change direction at the inserter station. US 7,051,496 describes a method of feeding envelopes to an inserter station and increases the speed at which this is done by driving the envelopes into continuously moving gripping members at a faster speed than the gripping members are moving. This ensures that the envelopes are fully engaged with the gripping members so that they are accurately positioned in the inserter station, whilst speeding up their transport into it.

**[0008]** It is also desirable that the inserter can accommodate a variety of sizes, shapes, and weights of envelopes and inserts. It will be appreciated that many sizes and shapes of envelopes are available, and inserts can vary in size and in thickness considerably, depending upon the nature and number of the contents. It is a challenge to ensure that the insert and the envelope move in unison and engage together accurately at high speed regardless of size, shape, strength and weight.

**[0009]** According to one aspect of the present invention there is provided apparatus for inserting a content pack into an envelope, the apparatus comprising: a gripping mechanism; means for operating the gripping mechanism to hold an envelope; means for opening a throat of the envelope; means for moving the content pack in a direction toward and into the throat of the envelope; means for accelerating the envelope in the direction of movement of the content pack while the gripping mechanism is operational; and means for releasing the gripping mechanism at a predetermined time, to release the envelope, the predetermined time being while the content pack is at least partially inserted into the envelope, and being predetermined in dependence upon parameters comprising at least the content pack depth and the envelope depth.

**[0010]** Preferably the predetermined time at which the envelope gripping mechanism is released corresponds to the time at which the content pack is substantially fully inserted in the envelope.

**[0011]** The time may be predetermined also in dependence upon the thickness of the content pack.

**[0012]** Stepper motors may be used to drive the content moving means and/or the gripping mechanism

and/or the envelope acceleration means, and such stepper motors may be synchronised.

**[0013]** The parameters from which the predetermined time is calculated may be stored as job-specific data or may be entered by an operator, or may be measured by one or more sensors.

**[0014]** According to one embodiment the gripping mechanism is arranged to grip the envelope flap and the parameters further comprise the flap depth.

**[0015]** For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made to the accompanying drawings, in which:

Figure 1 is a simplified schematic side view of the inserter apparatus according to the present invention;

Figure 2 is a more detailed schematic side view of the inserter apparatus according to the invention;

Figures 3a to 3e illustrate the operation of the inserter apparatus of Figures 1 and 2.

**[0016]** In Figure 1 a content pack 1 is shown, on a content conveyor platform 2, moving in the direction of arrow 3 towards an envelope 4. The envelope 4 rests on an insertion platform 5 with its flap 8 open, and is held in position at the inserter station, by a gripping mechanism which grips the envelope flap 8. The gripping mechanism comprises a grip bearing 6 and grip rollers 7 (one of which can be seen in the figure).

**[0017]** In Figure 2 more detail is shown. The content pack 1 is driven along the content conveyor platform 2, by a kicker drive pawl 9 attached to a kicker pawl belt 10. A second kicker drive pawl 19 is positioned at a diametrically opposed position on the belt 10, so that two content packs can be driven with one rotation of the belt. Of course any reasonable number of pawls may be attached to the belt to drive successive content packs. The kicker pawl belt 10 is driven by a kicker drive stepper motor 11, which drives a wheel 12 by a kicker drive belt 13. The gripping mechanism holds the envelope 4 by its open flap 8 between gripper rollers 7 and gripper bearing 6, and moves it into position in the inserter station so that its flap side faces toward the approaching content pack 1. A second independent stepper motor 17 is used to control the envelope gripper rollers 7 via an envelope gripper belt 18.

**[0018]** When the envelope is correctly positioned, the front and back faces of the envelope are separated by a finger arm comprising a finger 15 hinged at 16 to a lever 14, which is driven in a reciprocating motion so that the finger 15 is driven into the open flap side, i.e. the throat, of the envelope, between the front and back faces. The finger 15 then moves into a more vertical orientation to separate the faces and open the envelope. The content pack 1 is then driven by pawl 9 into the envelope 4 between the faces and the finger 15 is lowered. The direction of motion of the finger 15 is then reversed. As the content pack 1 is driven into the envelope, the gripper drive stepper motor 17 is started to move the flap gripper rollers 7 anticlockwise to drive the flap 8, and thus the envelope 4, out of the gripping mechanism, and accelerate the envelope in a downstream direction on the insertion platform 5.

**[0019]** This is illustrated more clearly in Figures 3a to 3e. In Figure 3a the envelope 4 is positioned in its correct position in the inserter station by the flap gripper stepper motor 17 and the flap 8 is held between the flap gripper rollers 7 and the gripper bearing 6, using a holding current applied to the stepper motor 17. At the same time the kicker pawl 9 starts to move and picks up and pushes the content pack 1 in the direction of arrow 3 towards the envelope 4.

**[0020]** The content pack 1 moves toward the envelope 4 as the finger 15 moves into the throat of the envelope 4 to open it, in advance of the content pack 1 arriving. The content pack 1 then moves into the envelope 4 as shown in Figure 3b. The flap gripper stepper motor 17 starts to drive the flap 8 and thus the envelope 4 as shown in Figure 3c. The exact timing and speed of operation of the flap gripper stepper motor 17 depends upon calculations made using one or more parameters such as the envelope flap depth, the envelope depth, the content pack depth and the content pack thickness. At the same time the friction between the content pack 1 and the envelope 4 may also cause movement of the envelope.

**[0021]** The operation timing is controlled so that when the content pack 1 is fully inserted into the envelope 4, as shown in Figure 3d, the envelope 4 will have been accelerated so that it is moving almost as fast or at the same speed as is the content pack 1, and the kicker drive pawls 9, 19. At this moment, the flap gripper releases the flap 8 because the end of the flap slides out from the grip of the gripping rollers 7 and the grip bearing 6.

**[0022]** In Figure 3e the envelope flap 8 is shown fully released and the envelope 4 is driven by the momentum of the content pack 1 inside it and by the pawl 9.

## Claims

**1.** Apparatus for inserting a content pack into an envelope, the apparatus comprising:

a gripping mechanism;
means for operating the gripping mechanism to hold an envelope;
means for opening a throat of the envelope;
means for moving the content pack in a direction toward and into the throat of the envelope;
means for accelerating the envelope in the direction of movement of the content pack while the gripping mechanism is operational; and
means for releasing the gripping mechanism at a predetermined time, to release the envelope, the predetermined time being while the content

pack is at least partially inserted into the envelope, and being predetermined in dependence upon parameters comprising at least the content pack depth and the envelope depth.

**2.** Apparatus according to claim 1 wherein the predetermined time at which the envelope gripping mechanism is released corresponds to the time at which the content pack is substantially fully inserted in the envelope.

**3.** Apparatus according to claim 1 or 2 wherein the content pack moving means comprises a stepper motor driving a pawl to push the content pack into the envelope.

**4.** Apparatus according to any one of the preceding claims wherein the time is predetermined also in dependence upon the parameter of the thickness of the content pack.

**5.** Apparatus according to any one of the preceding claims wherein the gripping mechanism and the envelope acceleration means are driven by a stepper motor.

**6.** Apparatus according to any one of the preceding claims wherein at least one of the parameters is stored as job-specific data in apparatus control software.

**7.** Apparatus according to any one of the preceding claims wherein at least one of the parameters is entered by an operator during job set-up.

**8.** Apparatus according to any one of the preceding claims wherein at least one of the parameters is measured by a sensor upstream of the inserter.

**9.** Apparatus according to any one of the preceding claims wherein the gripping mechanism is arranged to grip the envelope flap.

**10.** Apparatus according to claim 9 wherein the parameters further comprise the envelope flap depth.

**11.** Apparatus according to any one of the preceding claims wherein the accelerating means is operable via the gripping mechanism.

**12.** Apparatus according to any one of the preceding claims wherein the accelerating means is driven by a first stepper motor.

**13.** Apparatus according to any one of the preceding claims wherein the content pack is driven into the envelope by a pusher pawl driven by a second stepper motor.

**14.** Apparatus according to claim 13 when appended to claim 12 wherein the first stepper motor and the second stepper motor are synchronised.

**15.** Apparatus according to any one of the preceding claims wherein the acceleration of the envelope continues until the gripping mechanism is released.

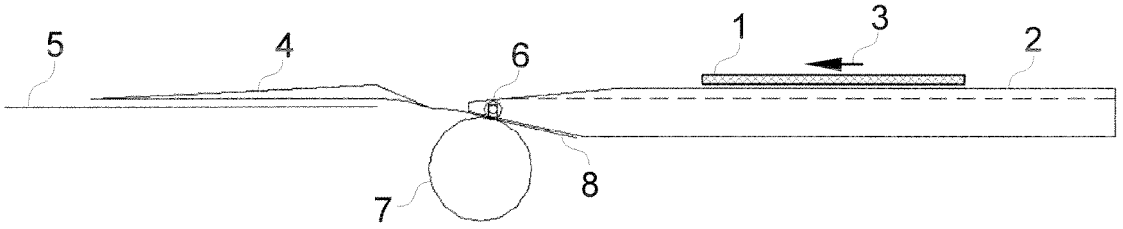



Fig. 1

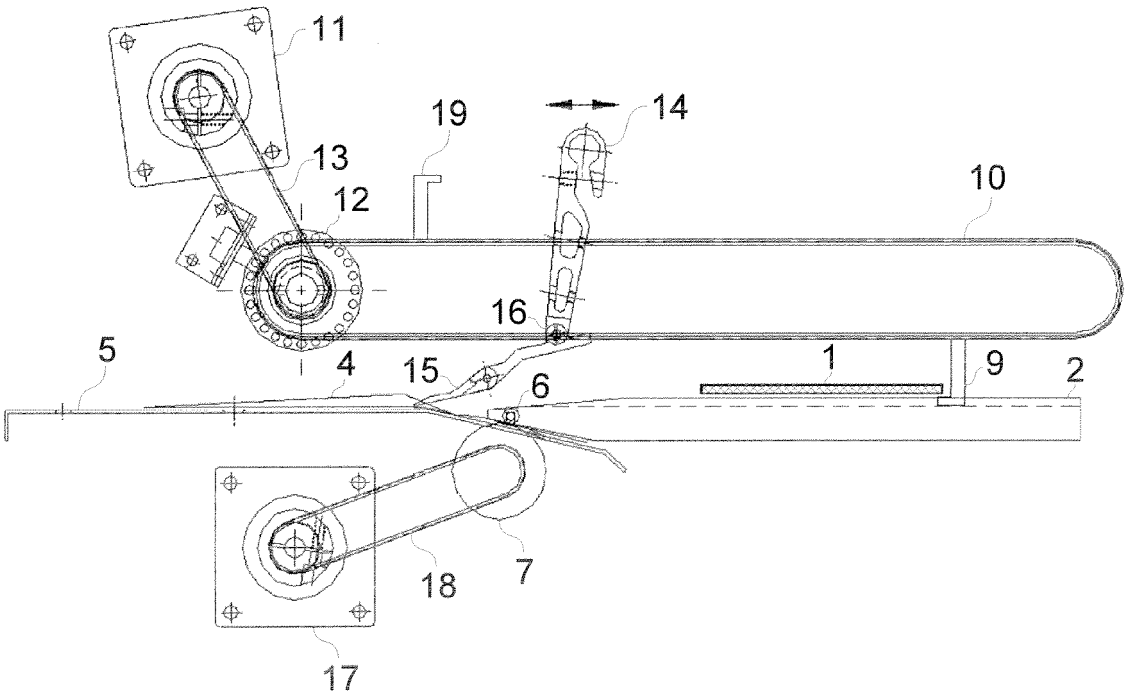
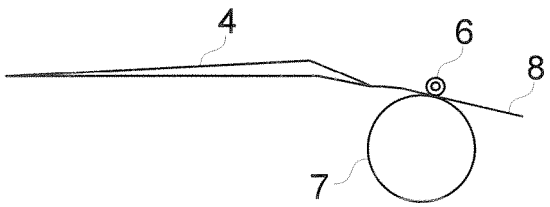



Fig. 2



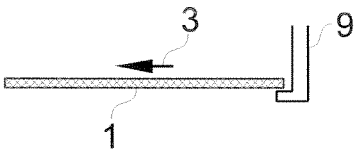




Fig. 3a

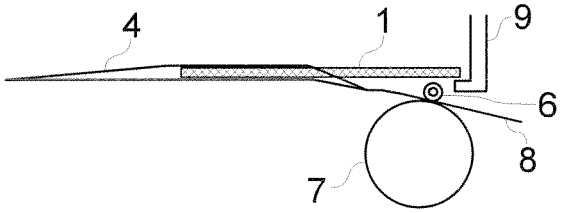



Fig. 3b

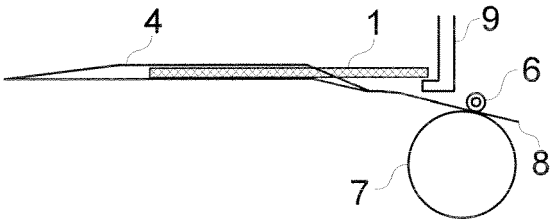



Fig. 3c

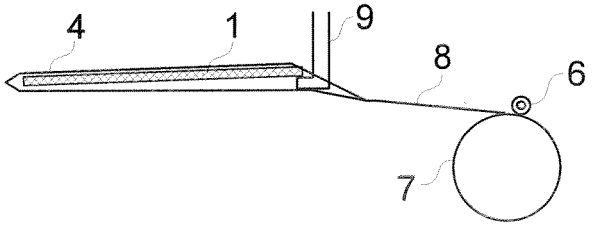



Fig. 3d

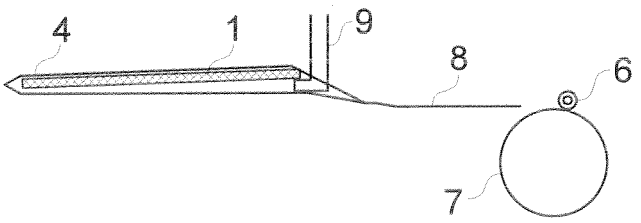



Fig. 3e

## REFERENCES CITED IN THE DESCRIPTION

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