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 [21] Appl. No. **826,961**
 [22] Filed **May 22, 1969**
 [45] Patented **June 28, 1971**
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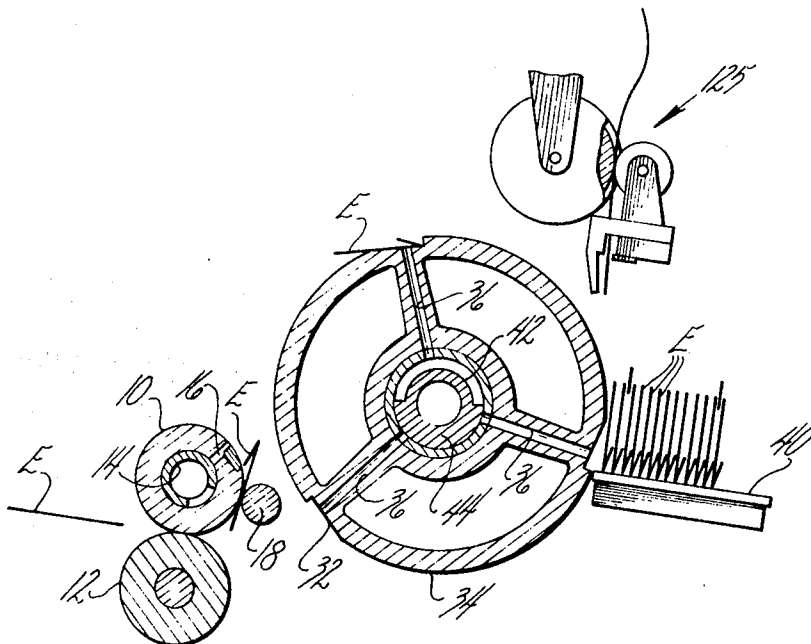
[54] **ARTICLE COUNTING SYSTEM**
12 Claims, 8 Drawing Figs.

[52] U.S. Cl..... **93/93,**
93/62, 235/92, 235/98
 [51] Int. Cl..... **B31b 1/98,**
B65b 57/20, G06m 7/06
 [50] Field of Search..... **93/62, 93;**
235/92, (33), 98

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ABSTRACT: In a machine for handling articles, such as flat blanks, wherein the blanks are transferred part way around suction rolls or wheels, a system for counting such blanks, including a magnetically operated reed switch for generating successive count signals proportional in time to the angular speed of rotation of the rolls or wheels, and a pressure sensitive pickup for producing an inhibit signal whenever suction pressure is lost due to a missing blank. The number of count signals is reduced by any inhibit signal and the result fed to a counter which thereby records the number of actual blanks handled. The counter, through a variable time delay controls the operation of a device for grouping predetermined numbers of these blanks for banding or the like.



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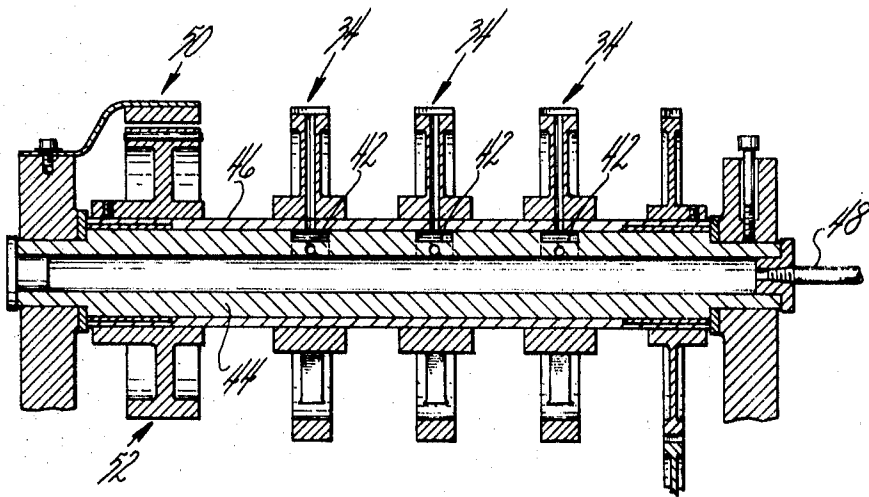
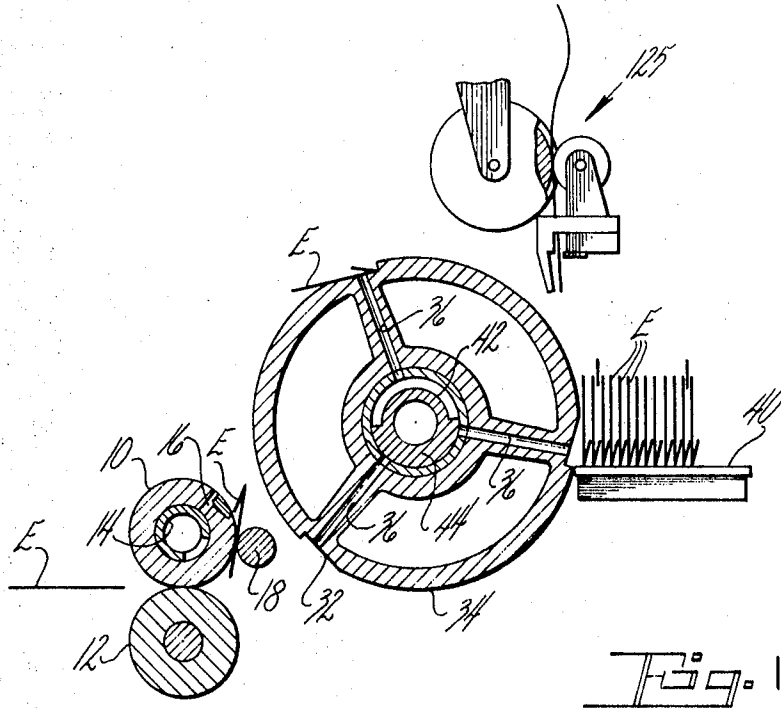
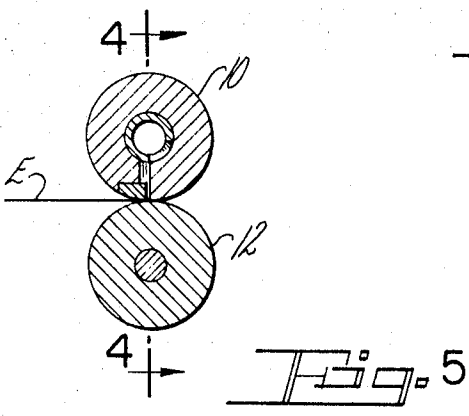
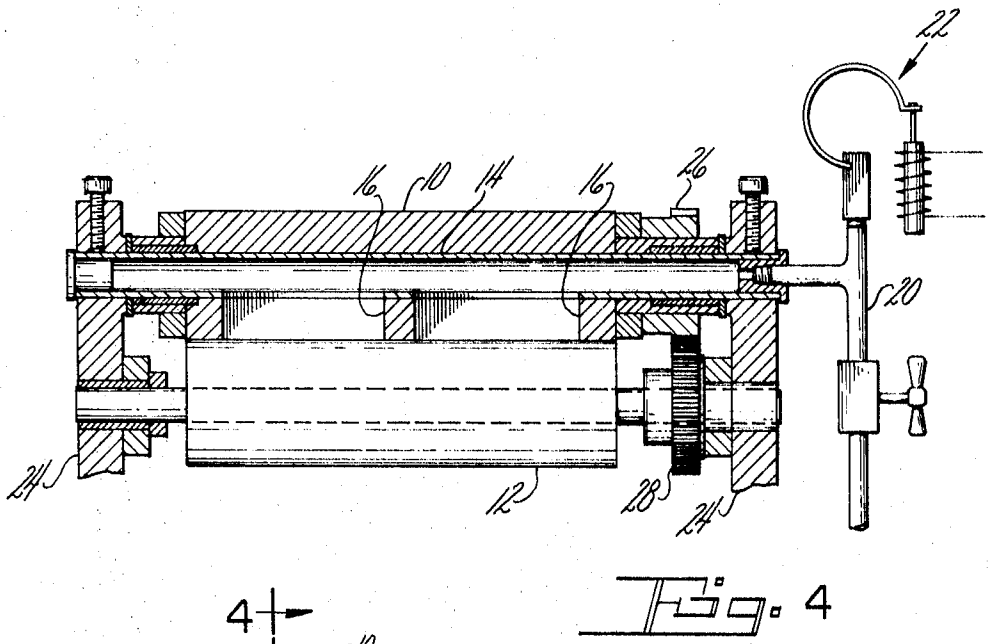
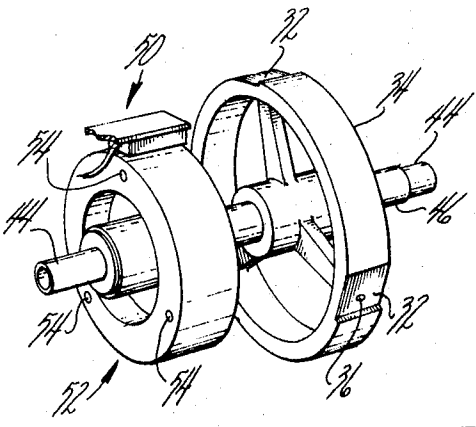


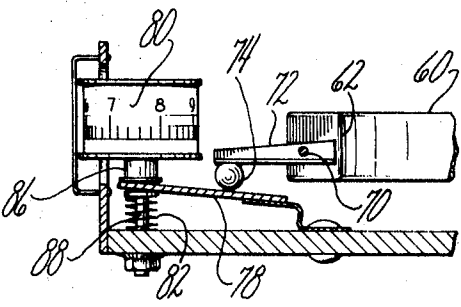
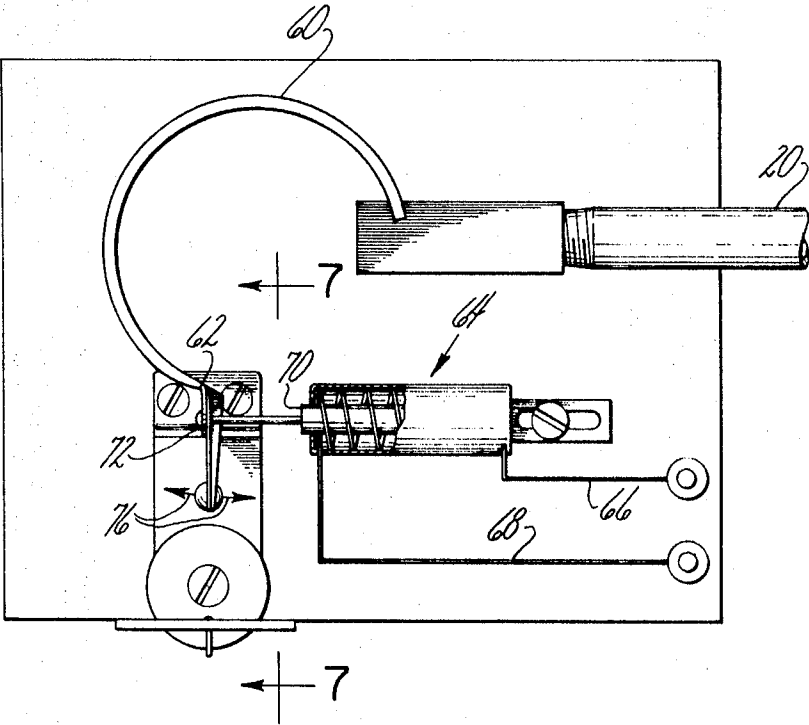
Fig. 2

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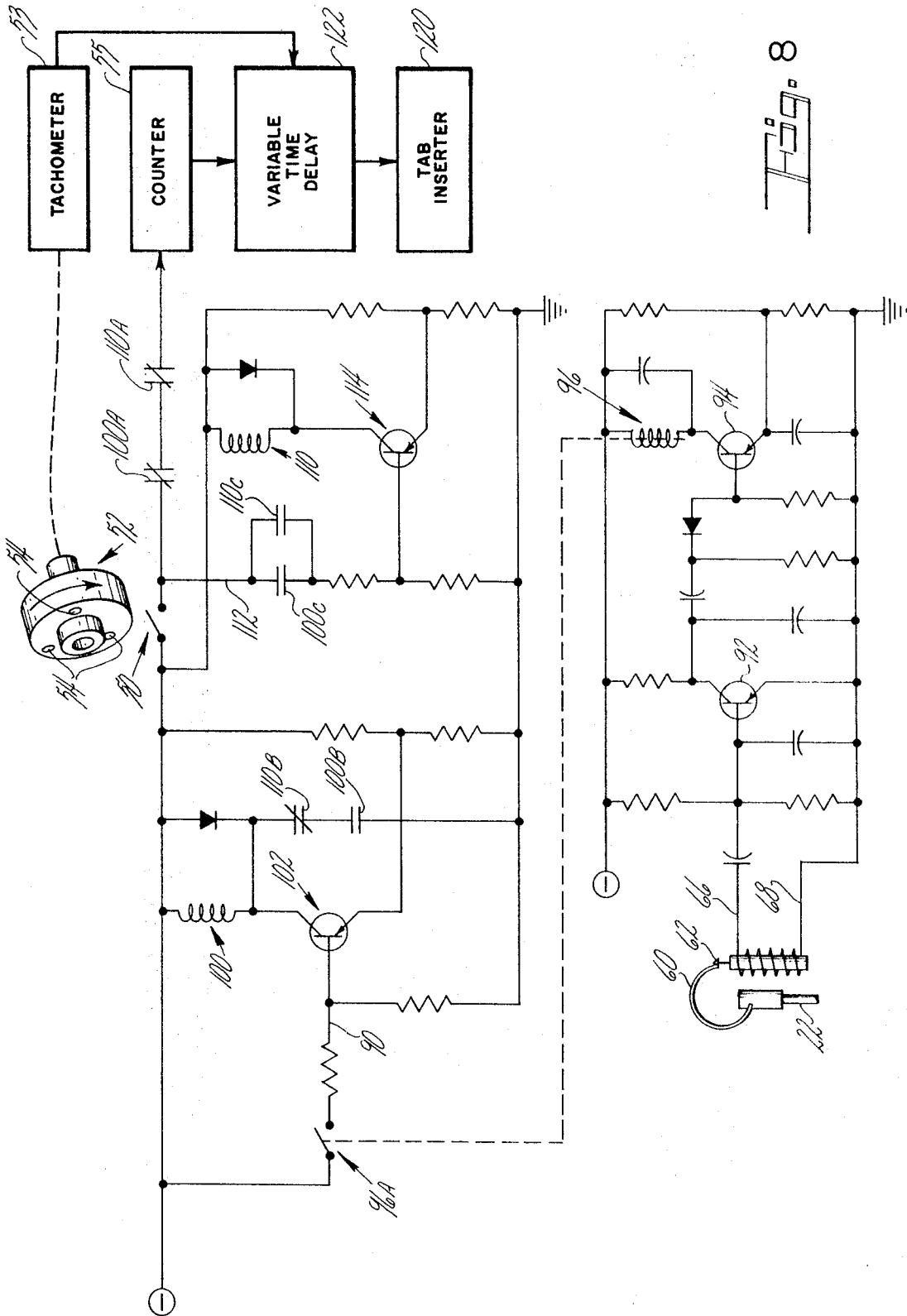


FIG. 8

ARTICLE COUNTING SYSTEM

BACKGROUND OF THE INVENTION

The counting system to be described in detail herein is especially useful in envelope handling machines, but may also be used in any machine for handling other articles, as for example, generally flat blanks. A typical envelope folding and stacking mechanism is shown and described in U.S. Pat. No. 2,612,088 issued to Heywood on Sept. 8, 1952 and assigned to the assignee herein. Prior art counting devices for such a machine, and for envelope handling machines generally, have usually required each envelope being handled to be individually counted. A typical system for counting envelopes and for automatically inserting tabs between predetermined numbers of such envelopes is referred to in U.S. Pat. No. 2,795,172 issued to Hanson June 11, 1957 and assigned to the assignee herein.

In the Hanson U.S. Pat. a photoelectric eye generates successive signals for an electronic counter, and a conventional control on the counter generates a signal for operating a solenoid in the mechanism disclosed for inserting a separator tab between predetermined numbers of the discharged envelopes on a stacking table. At the speeds encountered in present-day machines, it has been found that the resulting count has not been accurate or reliable enough for existing requirements. One reason for the failure of such a photocell count system to yield the necessary reliability can be attributed to the inhospitable environment, or atmosphere generated in the machine itself for such a count system. Paper envelopes being cut, trimmed and folded produce a fine dust which interferes with the counting of the envelopes in a photocell system such as that referred to in the Hanson U.S. Pat. No. 2,795,172. Attempts have been made to alleviate this problem by directing an air jet onto the photocell, but because of the minute size of the particles themselves this approach has not given satisfactory results. Another disadvantage to the use of an air jet is that the air jet itself tends to interfere with the normal path of movement of the paper envelopes through the machine.

The system disclosed herein not only solves the foregoing problem, but also obviates the necessity for "setting-up" a photocell count system each time that the machine operator has a change in envelope size or shape. As will be seen from the description to follow the counting system described does not have varying setup requirements each time an envelope size or shape variation is encountered.

SUMMARY OF INVENTION

This invention relates to article counting systems, and deals more particularly with a system for generating provisional count signals proportional in time to the speed of the machine for handling such articles, means being provided for inhibiting, or cancelling, one or more of these count signals when one or more missing articles are sensed by a novel transducer element.

A general object of the present invention is to provide a counting system which does not depend upon the sensing of each article being fed through the machine, but which depends indirectly upon sensing only missing articles, thereby providing a system of vastly improved reliability over prior-art counting systems, especially during high speed operation.

A more specific object of the present invention is to provide an article or blank counting system of the foregoing character which is especially well suited to counting envelope blanks as they are transferred from the suction roll of an envelope-forming machine onto the delivery wheel which deposits the envelopes in stacked relationship at a discharge station of the machine.

Still another object of the present invention is to provide a blank counting system for an envelope handling machine wherein a conventional electronic counter can be reliably used to operate a tab inserting mechanism of the type referred to in U.S. Pat. No. 2,795,172 even at the relatively high operating speeds of present-day machines.

In keeping with the foregoing object of the present invention it is also a purpose of the present invention to provide means for delaying the insertion of separator tabs between predetermined numbers of envelope blanks stacked at the discharge station of the machine, such delay being variable to provide a means for accommodating variations in the machine operating speed.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a vertical sectional view of the downstream end of a typical envelope handling machine, showing a tab insertion device of the type commonly used to separate predetermined numbers of envelopes as they are stacked at the discharged station of such a machine.

FIG. 2 is a vertical sectional view of the delivery wheel shown in the machine of FIG. 1.

FIG. 3 is a perspective view of one end portion of the delivery wheel of FIG. 2.

FIG. 4 is a vertical sectional view of the suction roll shown in the machine of FIG. 1.

FIG. 5 is a vertical sectional view of the suction roll, also showing its associated backup roll, at a slightly later instant of time than that shown in FIG. 1.

FIG. 6 is a detailed view of the pressure sensitive transducer shown in FIG. 4.

FIG. 7 is a sectional view taken on the line 7-7 of FIG. 6.

FIG. 8 is a combined schematic and electric circuit diagram showing the functional interrelationship of the various elements comprising the presently preferred form for a blank counting system of the present invention.

DETAILED DESCRIPTION

Turning now to the drawings in greater detail, FIG. 1 shows in schematic fashion the downstream portion of an envelope handling machine, particularly a flap-folding and envelope-stacking mechanism of the type shown in the Heywood U.S. Pat. No. 2,612,088. The formed envelopes E, E are fed horizontally toward the right between a continuously driven suction roll 10 and its associated backup roll 12, and the suction roll rotates on a hollow shaft 14 having a fixed port in its lower right-hand quadrant for communication with a radially extending port 16 in the roll 10. As so constructed and arranged the envelope blank E follows the curvature of the periphery of the suction roll 10 from the generally horizontal position shown to the near vertical position wherein it is located between the bite of the suction roll 10 and a smaller roll 18 as shown. FIG. 5 shows the suction roll 10 and its associated backup roll 12 at a slightly later instant of time wherein the next successive envelope blank is being received therebetween, and it will be apparent that the rotation of the suction roll 10 is timed in relationship to other rolls in the machine so as to operate in timed relationship with the feeding of the envelope blank E to the position shown in FIG. 5. The reader is referred to the Heywood U.S. Pat. No. 2,612,088, for a more detailed description of the upstream portion of the machine. FIG. 4 shows the suction roll 10 in longitudinal section, being taken on the line 4-4 of FIG. 5, and also illustrates a vacuum line 20 for providing the suction source to the hollow interior of the fixed shaft 14. A novel transducer element 22 for sensing loss of vacuum pressure in the line 20 will be described in greater detail hereinbelow. FIG. 4 also shows a portion of the fixed framework of the machine 24, 24, with the meshing gears 26 and 28 for operating the suction roll 10 and its backup roll 12 at the proper peripheral speed for feeding the envelope blanks therebetween. The axial extent of the radially extending ports 16, 16 in the suction roll 10 is also shown in FIG. 4, and it will be apparent that the envelope will be transferred at least part way around the suction roll 10 from the generally horizontal position taken upon entry between the bite of the rolls 10 and 12 and the generally vertical position shown in FIG. 1 between the bite of the rolls 10 and 18.

Still with reference to FIG. 1, the generally vertically disposed envelope E between the bite of the suction roll 10 and the smaller backup roll 18 will be seen to be engaged by the flat 32 on a larger diameter roll or delivery wheel 34 having a radially extending slot 36 which is adapted to be evacuated for holding the envelope E in position at the flat 32 for transfer around the upper periphery of the wheel onto a generally horizontally extending stacking table 40 comprising the discharge station of the machine. More particularly, the delivery wheel 34 has three such flats with an envelope E being held in the uppermost flat as a result of its associated radially extending port 36 communicating at its inner end with a relieved portion 42 of the fixed shaft 44 upon which the delivery wheel 34 rotates. Thus, suction is selectively applied through the radially extending ports 36, 36 in the delivery wheel to cause the envelopes E, E to adhere to the peripheral portions or flats of the wheel so as to be carried by the wheel as it rotates in the clockwise direction as viewed in FIG. 1. When the envelope reaches the stacking table 40 this radially extending port 36 is no longer connected to this source of suction, and hence the vacuum will be broken with respect to that particular envelope allowing it to remain upon the table in a stacked configuration. FIG. 2 shows the delivery wheel as comprising a plurality of discs so as to be readily adapted to handling envelopes of various length, all of said wheels 34, 34 being mounted upon a common sleeve 36 which rotates on the shaft 44. The shaft 44 defines the relieved portions, indicated generally at 42, 42, and said shaft 44 is hollow and communicates with a source of vacuum indicated generally at 48. FIG. 3 shows one of the delivery wheel discs 34 in perspective, and also shows a magnetically operated reed switch 50, together with the means for operating said switch to generate count signals proportional in time to the angular speed of rotation of the delivery wheel 34. As indicated generally at 52 an annular housing is provided on the sleeve for rotation therewith, and carries three magnets 54, 54 corresponding in angular position to the three flats 32, 32 on the delivery wheel 34. As shown schematically in FIG. 8, the housing 52 thereby provides a means for sequentially closing the reed switch 50 in the circuit shown, as well as providing an input signal to a tachometer 53. Although the delivery wheel 34 is shown with a diameter of approximately three times that of the suction roll 10, it is a feature of the particular envelope-handling machine illustrated that the peripheral speeds of the roll 10 and the delivery wheel 34 are closely matched to one another, and hence the suction roll 10 rotates at approximately three times the speed of the delivery wheel 34.

In accordance with the present invention, circuit means is provided for cancelling one of the six successive count signals generated in response to a closing action of the reed switch 50 each time that the transducer element 22 senses a loss in suction pressure as a result of the absence of an envelope blank between the suction roll 10 and its backup roll 12. The means for sequentially closing and opening the reed switch 50 comprises the device 52 described hereinabove. The transducer element for generating an inhibit pulse when the suction is lost due to the absence of an envelope comprises a bourdon tube 60 having a fixed end communicating with the source of vacuum 20, referred to with reference to FIG. 4, and having a free end 62 connected to an electromechanical transducer 64 for producing an output signal in the lines 68 and 69 proportional to the change in suction pressure in the tube 60. The electromechanical transducer element itself comprises a fixed coil having a movable plunger 70, of permanent magnetic material, which is connected to the free end of the bourdon tube 62 as best shown in FIG. 6 by the arm 72 extending outwardly from the free end of the tube. As best shown in FIG. 7 the arm 72 also carries a steel ball 74 which is adapted to move in the direction of the arrows 76, 76 shown in FIG. 6 in response to changes in suction pressure. The ball 74 can be brought into engagement with a friction surface 78 for imparting frictional damping to the motion of the bourdon tube 60. The amount of frictional damping can be varied by rotating

the barrel 80 so as to permit the spring 82 to act upon the free end of the plate defining said friction surface 78. Thus the friction plate can be moved into frictional engagement with the ball 74 with a force which can be conveniently varied. Rotation of the barrel 80 in a clockwise direction will cause threaded collar 86 of the underside of the barrel 82 to travel down the fixed threaded post 88 reducing the frictional force between the plate and the steel ball 74. The graduated scale on the barrel 80 is provided for achieving a predetermined setting of the barrel 80 found by experience to minimize any tendency of the bourdon tube 60 to move into undesirable vibrations at a particular machine speed.

FIG. 8 shows in schematic fashion the annular housing 52 which carries the three magnets 54, 54 for momentarily closing the reed switch 50 to generate the series of count signals, and to provide an input for the tachometer 53. These count signals are normally fed to an electronic counter 55, at least when the normally closed contacts 100A and 110A are not opened by their respective relay coils 100 and 110 to be described. Thus, there is provided a convenient means for producing a series of count signals proportional to the angular speed of rotation of the suction roll 10, the wheel 34 turning at one-third the speed of the roll 10 and having three magnets therein.

Turning now to that portion of the circuitry for achieving a cancellation of each so-called count signal for every missing envelope blank, FIG. 8 shows in its lower portion a two-stage amplifier for amplifying the output signal of the transducer 22 to provide an inhibit pulse in the conductor 90 shown in the upper portion of FIG. 8. The two-stage amplifier is of conventional construction having a pair of transistors 92 and 94 arranged in series, with the output of the latter being used to energize a reed-type relay coil 96 having a pair of normally open reed contacts 96A which are adapted to be momentarily closed to generate the above-mentioned inhibit pulse in the conductor 90. An inhibit relay coil 100 is adapted to be energized through an additional transistor 102 to momentarily open the normally closed set of conventional contacts 100A referred to hereinabove. A normally open set of contacts 100B in said inhibit relay 100 serve to latch the relay 100 and to keep the contacts 100A open until the deenergizing of the relay 110.

Since reed switch 50 is designed to remain closed for several microseconds longer than the duration of the inhibit pulse, cancellation relay 110 and its associated circuitry, including contacts 110A, and contacts 110B, take over from the inhibit relay 100 to prevent any portion of a particular count signal, which is to be inhibited, from reaching the counter 55.

Cancellation relay 110 is controlled through conductor 112 by the particular count pulse when inhibit relay contacts 100C close. A transistor 114 which is biased on when the controls 100C close, provides an energizing current to the relay 110. The normally closed contacts 110B of relay 110 then open unlatching the inhibit relay 100 so it is out of the system, and the normally closed contacts 110A of relay 110 open and prevent the count signal from reaching the counter 55. The cancellation relay 110 remains energized or latched through its now closed normally open contacts 110C until the count pulse ends. When the count pulse does end, by the opening of the contacts 50, the bias to the transistor 114 is lost causing cancellation relay 110 to deenergize and its contacts 110A to reclose to allow a succeeding count pulse to reach the counter 55.

To summarize the operation of the circuitry illustrated in FIG. 8, the three magnets 54, 54 in housing 52 repeatedly close the contacts 50 to generate successive count signals for the counter 55 corresponding to the envelope blanks being transferred, provided only that none are missing. A missing envelope causes the vacuum in the suction roll to collapse, and the bourdon tube 60 to flex, generating an output signal to the two-stage amplifier shown in FIG. 8. The reed relay 96 is energized by the amplifier output, closing reed contacts 96A momentarily to provide an inhibit pulse for inhibit relay 100.

The inhibit relay contacts 100A thus open to prevent the associated count signal from reaching the counter 55, and the cancellation relay 110 is also energized directly through the count signal itself to open its contacts 110A to be sure that no part of that count signal is allowed to reach the counter 55, the contacts 110A not reclosing until the count signal is completed.

Still with reference to FIG. 8 the electronic counter 55 can be seen to operate a tab inserter 120, which inserter may be of conventional construction to provide a separator tab between predetermined numbers of envelopes as described hereinabove. An important feature of the preferred embodiment of the present system is shown schematically in FIG. 8 as means for delaying the operation of the inserter 120 by an interval which is inversely proportional to the speed of operation of the machine. Since the tab inserter 125 directs a separator tab between the envelope E being discharged onto the table 40 and the delivery wheel 34 it will be apparent that the delay interval is a function of the rotational speed of the wheel 34. The variable time delay 122 shown in FIG. 8 is programmed to delay the signal from counter 55 as it is fed to the inserter 120 accordingly. That is, the faster the speed of the delivery wheel 34, as sensed through the tachometer 53, the less delay interval required by the device 122. Conversely, the slower the wheel 34 rotates, then the greater delay interval that is required by the device 122. It will be apparent that the programmed delay in the unit 122 may be either continuously variable over the range of machine speeds, or it may be such that a range of speeds result in two or more delay intervals.

I claim:

1. A system for providing a continuous count of articles being handled in a machine wherein a suction roll has at least a portion of its periphery defining a port which is adapted to be provided with a suction pressure during a portion of the angular travel of said roll for carrying each article at least part way around said roll, said system comprising means for producing a series of count signals proportional to the angular speed of rotation of said roll, means responsive to an abrupt change in the suction pressure at said port for generating an inhibit pulse when the suction is lost due to the absence of an article, and circuit means for cancelling one of said count signals in response to each such inhibit pulse.

2. The combination defined in claim 1 wherein said means for producing said count signals comprises a fixed magnetically sensitive reed switch, and at least one magnet so mounted in said machine as to rotate past said reed switch at a speed proportional to the speed of said suction roll.

3. The combination defined in claim 1 wherein said means for generating said inhibit pulse comprises a bourdon tube one end of which is in communication with said suction port of said roll, an electromechanical transducer connected to the free end of said tube for producing an output signal proportional to the change in suction pressure in said tube, and signal conditioning means for producing an inhibit pulse when said output signal pattern indicates a loss of suction pressure due to

the absence of an article, said articles comprising generally flat blanks such as envelopes.

4. The combination defined in claim 3 wherein said means for producing said count signals comprises a fixed magnetically sensitive reed switch, and at least one magnet so mounted in said machine as to rotate past said reed switch at a speed proportional to the speed of said suction roll.

5. The combination defined in claim 4 wherein said inhibit pulse is shorter in duration than said count pulse, said circuit means including relay means for cancelling one of said count signals each time such an inhibit pulse is generated, and a counter for continuously recording the number of resulting count signals.

6. The combination defined in claim 5 further characterized by means responsive to said counter for grouping predetermined numbers of said blanks adjacent the downstream end of said machine.

7. The combination defined in claim 3 wherein said inhibit pulse generating means also includes means for damping the motion of the free end of said bourdon tube.

8. The combination defined in claim 4 further characterized by a fixed shaft for rotatably supporting said suction roll, said shaft having an internal bore communicating with a vacuum source and having an open segment for providing suction at said suction roll port during said portion of the angular travel of said suction roll.

9. The combination defined in claim 8 further characterized by a blank delivery wheel adjacent the downstream end of said machine, said wheel having a plurality of blank receiving areas thereon for transferring said blanks at least part way around said wheel, a discharge platform for receiving said transferred blanks in stacked edgewise relationship, said delivery wheel being driven in timed relationship with said suction roll and having one of said reed switch closing magnets mounted adjacent each such blank receiving area for producing a series of count signals proportional to the angular speed of said wheel and hence of said suction roll.

10. The combination defined in claim 9 wherein said inhibit pulse is shorter in duration than said count pulse, said circuit means including relay means for cancelling one of said count pulses each time such an inhibit pulse is generated, and a counter for continuously recording the number of resulting count signals.

11. The combination defined in claim 10 further characterized by means responsive to said counter for inserting a separator tab between predetermined numbers of said blanks on said discharge platform.

12. The combination defined in claim 11 further characterized by variable time delay means between said counter and said tab inserting means, said delay means being programmed to delay insertion of the separator tabs during low speed operation and to decrease the delay during high speed operation of the machine, and a machine speed pickup for providing an input signal for said programmed time delay means.