Oct. 10, 1967 A. ERK 3,345,923

SHEET COLLECTING MECHANISM

Filed April 25, 1963 3 Sheets-Sheet 1

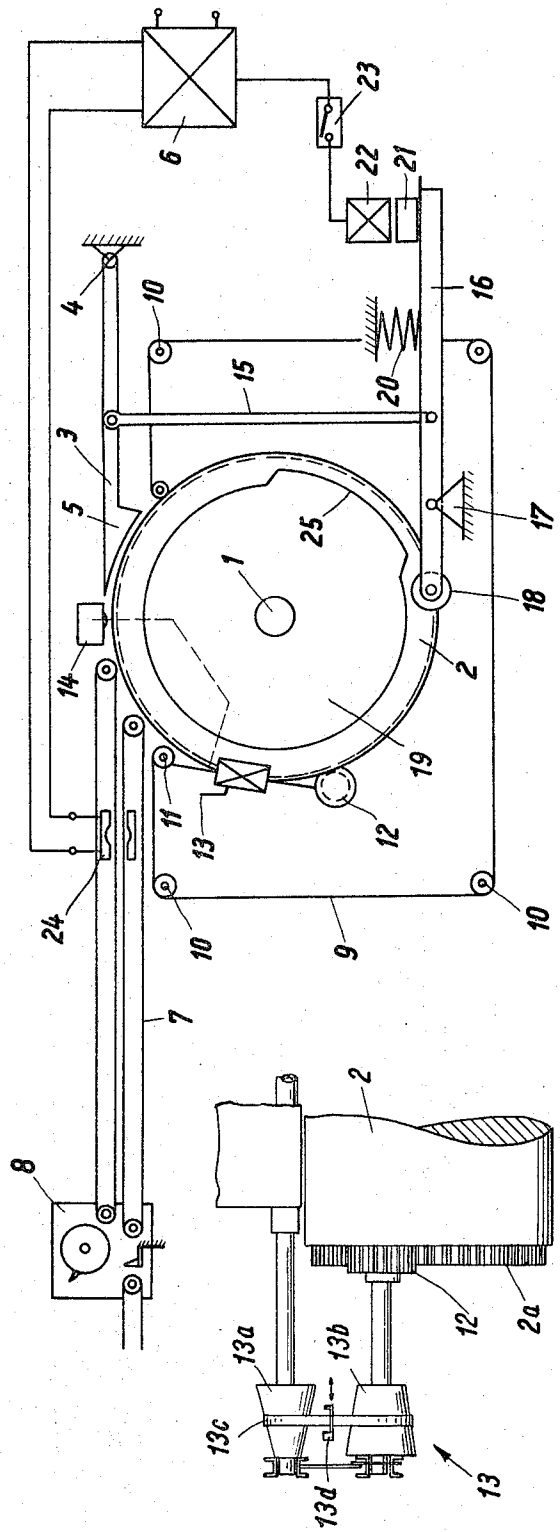

Fig. 1

Fig. 4

Inventor:
AMIR ERK

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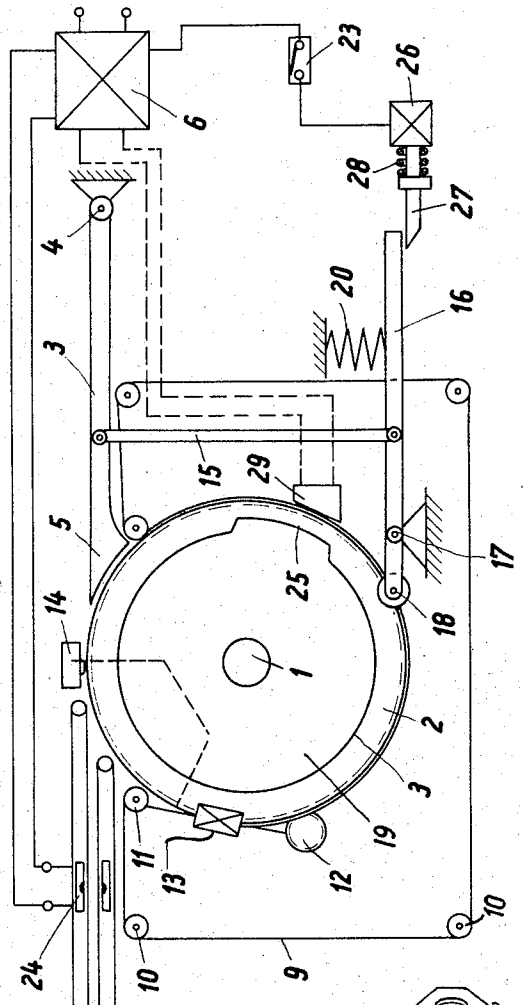

Fig. 2

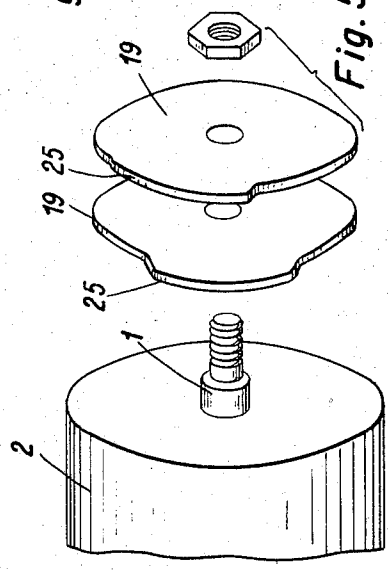

Fig. 5

Inventor:
AMIR ERK

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SHEET COLLECTING MECHANISM

Filed April 25, 1963 3 Sheets-Sheet 3

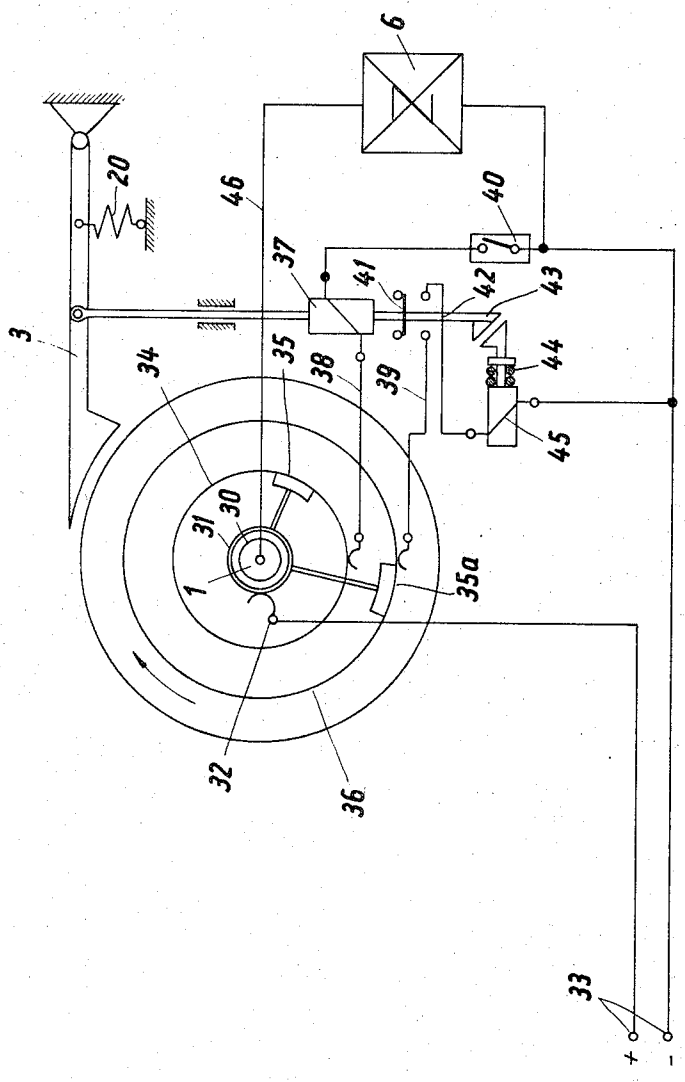

Fig. 3

Inventor:
AMIR ERK

United States Patent Office

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3,345,923

SHEET COLLECTING MECHANISM

Amir Erk, 84 Mittelweg, Braunschweig, Germany

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Claims priority, application Germany, Apr. 27, 1962, E 22,787
10 Claims. (Cl. 93—93)

The invention relates to an apparatus for gathering sheets of paper or cardboard or foils or other products in leaf form, and for advancing the pack consisting of a predetermined number of sheets to stackers, the apparatus being equipped with a gathering cylinder, a deflector-stripper and driven sling bands cooperating with the gathering cylinder. Hereby, the term "deflector-stripper" is used to designate the member in form of a switch tongue which leads the sheets on and off the collecting cylinder.

The above-described apparatus have become well established on account of their low cost of construction as compared with other gathering devices for materials in leaf form, and they are generally used in tandem with a crosscutter so as to collect the sheets produced by the crosscutter and then advance them to stackers or other associated machines.

In these known apparatus, considerable difficulties are encountered, especially in the case of changes in operating speeds and in the number of sheets to be gathered each time. These difficulties consist first of all in the fact that, in spite of the special system for driving the sling bands, there is no assurance of a secure and perfect gathering of the sheets on the cylinder. Since the length of the sling bands that is in contact with the periphery of the cylinder varies with the number of sheets on the cylinder, and since there is a difference in the amount of friction between the sling bands and the sheets on the one hand and between the sheets themselves on the other, a variable slippage between the bands and the cylinder is inevitable. The result is a shingling or overlapping of the sheets on the cylinder, which becomes particularly evident in the case of high rotational speeds of the gathering cylinder. This causes the sheets to be damaged in the stacking step or already to be injured when the deflector-stripper switches to the stripping position, and it is a frequent cause of disturbances in operation.

In order to prevent the above-mentioned shingling, the diameter of the band driving roll has been selected in such a manner, on the basis of the average slippage between the bands and the cylinder as determined by practical experimentation, that an approximate equalization is achieved in gathering a particular number of sheets on the cylinder. However, when the number of sheets per pack changes, or when the feeding of the sheets to the gathering cylinder is irregular as in the case of gathering cylinders used in tandem with sorting systems, or when the friction characteristics of the sheets vary, it is impossible to equalize the slippage by means of the size of the band driving roll.

Another difficulty encountered with the system described lies in the control of the deflector-stripper. Hitherto a cam has been used to shift it into the stripping position, the said cam being driven by the gathering cylinder through a gear train at a rotatory speed per unit of time that varies according to the number of sheets to be gathered. When the number of sheets is changed, then, one or more of the change gears of the transmission must be replaced accordingly, and the circumferential length of the cam must also be changed, which is usually accomplished by replacing the cam. Consequently, these deflector-stripper controlling or operating systems are expensive on account of the change-gear transmission

which they require, and they necessitate interruptions in operation whenever the number of sheets per pack is changed. Furthermore, the prior-art operating systems are entirely unusable when the feed of sheets to the gathering cylinder is irregular, because then they advance packs containing different numbers of sheets, and sometimes they even put out single sheets, resulting in considerable difficulties in the stacking operation.

It is a principal object of the invention to prevent the above-mentioned difficulties in gathering and stacking sheets, and to improve the known apparatus so that the sheets will be gathered on the cylinder without shingling, regardless of the number of sheets to be gathered per pack, even in the case of irregular sheet feed, and so that, furthermore, it will be possible to operate the deflector-stripper according to the number of sheets per pack desired in each case, even when the sheet feed is irregular, at the same time eliminating the expenses hitherto required for the transmission and the change gears.

To solve the above-mentioned problems, the invention provides for the adjustable driving of the sling bands and provides a system for controlling the deflector-stripper, wherein two switching devices cooperate, one of which permits the deflector-stripper to be switched into the stripping position only over that peripheral portion of the cylinder that is not covered by the sheets, while the other switching apparatus is controlled by an adjustable counting mechanism and releases the deflector-stripper only after a certain number of sheets have been collected on the gathering cylinder.

The controllability of the sling band drive then makes it possible without difficulty to compensate for the slippage that occurs, which differs according to the conditions of operation. It is possible to provide a separate drive for the sling bands; expediently, however, an intermediate gear that meshes with the peripheral gear of the gathering cylinder serves to drive the bands, the said intermediate gear turning the band driving roll through an infinitely variable speed transmission.

Compensation for the slippage by adjustment of the sling band drive can be performed manually. It is advantageous, however, to provide a preferably photoelectric sensing device to detect the sheet displacement on the gathering cylinder and to automatically regulate the speed change transmission accordingly. The transmission in this case needs to be designed only for a transmission ratio range of about 1 to 1.2 as the slippage never exceeds 20%.

The deflector-stripper controlling system also provided by the invention assures that the deflector-stripper always operates in the sheet rhythm and switches into the stripping position only when the cylinder has assumed a predetermined position.

Systems operating directly in tandem with a crosscutter from which each sheet runs to the gathering cylinder can be equipped with a counting mechanism which is operatively connected with the gathering cylinder and performs one counting step with each revolution of the cylinder. However, according to another feature of the invention, the counting mechanism can instead be connected with a preferably photoelectric system for the registration of the sheets fed to the gathering cylinder. This latter improvement finds application preferably whenever it is possible that the feeding of the sheets to the gathering cylinder may be irregular.

Counting mechanisms of the prior art are used, which are adjustable in such a manner that the disengagement of a pawl or the de-energizing of a holding magnet which they produce is performed in each case after a certain variable number of stepping or counting operations.

Experience has shown that it is of advantage to equip the apparatus with a combined mechanical and electrical or mechanical and electromagnetic operating or tripping device for the operation or release of the deflector-stripper. To this end, an embodiment of the invention provides a cam which rotates with the gathering cylinder and which cooperates with a cam follower mounted at one end of a lever which is mechanically connected with the deflector-stripper and is held by an electromagnet or by a pawl, against the urging of a spring, in a position wherein it keeps the follower and cam out of contact, the counting mechanism being designed to trip the pawl or deenergize the magnet only when the cam lobe is presented to the cam follower.

To operate the counting mechanism, the gathering cylinder can cooperate with an impulse generator, preferably an inductive impulse generator, whose impulses are fed, through an amplifier if desired, to the counting mechanism.

Instead of a partially mechanical and partially electrical operation of the system that controls the deflector-stripper, it is possible according to a further embodiment of the invention to have an all-electrical system by using an electromagnet to switch the deflector-stripper into the stripping position, pairs of contacts being provided in the circuit of the said electromagnet which are operated according to the position of the gathering cylinder, the said pairs of contacts being disposed in series with an additional pair of contacts controlled by the counting mechanism.

Further details of the invention will become apparent from the description of the embodiment represented in the drawings.

The drawings show a number of gathering devices constructed according to the invention.

FIG. 1 schematically represents a novel apparatus for the gathering of sheets, wherein the system that controls the deflector-stripper is operated mechanically in part and in part electromagnetically.

FIG. 2 shows an embodiment of the system that differs from the embodiment in FIG. 1.

FIG. 3 schematically illustrates an electrical and electromagnetic control for holding and releasing the deflector-stripper.

FIG. 4 shows a detail of the apparatus, and

FIG. 5 is an exploded view of the cam means used.

In the drawings, **1** designates the shaft of the gathering cylinder **2**. A deflector-stripper **3** cooperates with the gathering cylinder, the said deflector-stripper being fastened at a pivot point **4** to a stationary part of the apparatus in such a manner that its fingers **5** directed towards the gathering cylinder can be moved away from the gathering cylinder (to a position in which it deflects the sheets onto the cylinder), or can be moved into the stripping position in which they enter into circumferential grooves created in the gathering cylinder. In all the drawings, **6** designates a counting mechanism having electrical contacts which momentarily open or close after a predetermined number of counting steps.

In FIGS. 1 and 2, the conveyors **7** serving to carry the sheets to the gathering cylinder are represented schematically. In these embodiments, these conveyors are disposed in tandem with crosscutters **8**, to which material is fed in continuous sheet form by other conveyors which are not shown in the drawings, the said material being cut into sheets by crosscutter **8** and then passing over conveyor **7** to gathering cylinder **2**. The gathering cylinder is equipped with sling bands **9**, which are guided around guide rollers **10**, and a driving roll **11**. The power for the operation of driving roll **11** is in this case derived from the gathering cylinder **2**, an intermediate gear **12** meshing with the peripheral gear **2***a* of cylinder **2**, and powering the driving roll **11** through an infinitely variable speed change transmission **13**, which may consist of truncated cones **13***a*, **13***b* and a belt **13***c* adjusted by arm **13***d* (FIG. 4).

The speed change transmission **13** is connected in the embodiments in FIGS. 1 and 2, as indicated by a broken line, with a photoelectric sensing device **14**, which serves to determine the sheet displacement on the gathering cylinder and serves for the automatic control of transmission **13** through a servo-motor not shown in the drawing; when the slippage between the sling bands **9** and gathering cylinder **2** varies, the transmission ratio of transmission **13** is varied accordingly. As the sheets are always placed on the gathering cylinder with their trailing ends in superposed position and always take up the same position on the periphery of the cylinder, independently of their length, the photoelectric cell **14** can be directed onto said area of the periphery so as to adjust the transmission in the one or other direction when the sheet ends are displaced due to shingling. This is also a well known arrangement which is conventional whenever sheets are kept in alignment or register by means of photoelectric devices, and need, therefore, not to be set forth in more detail.

In FIGS. 1 and 2, the deflector-stripper **3** is connected through a pull rod **15** to a lever **16** which is attached at pivot point **17** to a stationary part of the apparatus. At the end of lever **16** next to the gathering cylinder there is mounted a cam follower **18** which cooperates with a cam **19** rotating synchronously with the gathering cylinder. The end of lever **16** opposite cam follower **18** is under the influence of a compression spring **20**, and, in the embodiment in FIG. 1, it is furthermore attached to the armature **21** of a holding electromagnet **22**. Electromagnet **22** is connected through switch **23** with the counting mechanism **6**, which in turn is connected with a photoelectric system **24** for the registration of the sheets carried to the gathering cylinder.

The manner of operation of the system controlling the deflector-stripper **3** is the following:

When the deflector-stripper is in the deflecting position shown in FIG. 1, electromagnet **22** is energized so that lever **16** draws cam follower **18** out of contact with cam **19** against the effect of spring **20**. When the number of sheets gathered on cylinder **2** and registered by the photoelectric system **24** arrives at the total preset in counting mechanism **6**, the latter, by the operation of switch **23**, causes electromagnet **22** to become de-energized, so that cam follower **18** is brought by the effect of spring **20** into contact with cam **19**. This makes it possible for the deflector-stripper to come into the stripping position as soon as cam follower **18** rolls off cam lobe **25**. That is to say, the impulses emitted by the photoelectric sensing system are fed to counting mechanism **6** through a delay system installed, if desired, in the counting mechanism, in such a manner that the de-energizing of electromagnet **22** or the contact between cam follower **18** and cam **19** takes place precisely within the time in which cam lob **25** is presented to cam follower **18**, cam lobe **25** being disposed in relation to gathering cylinder **1** in such a manner that, when the cam follower rolls off of the cam lobe, the portion of the periphery of the cylinder that is not covered by the sheets is presented to the deflector stripper.

After the shifting of deflector-stripper lever **3** into the stripping position, cam follower **18** remains in contact with the cam for almost one full revolution of the latter, and during this time the deflector-stripper remains in the stripping position. Switch **23** needs to open for only a very brief time to produce this effect, because once cam follower **18** contacts the cam, electromagnet **22** is incapable by itself of overcoming the effect of spring **20**, on account of the slight pulling force it has over the great air gap created between the magnet and the armature. Not until cam follower **18** has run back up onto cam lobe **25** can lever **16** swing back and, by means of

pull rod **15**, return deflector-stripper **3** to the deflecting positon.

To make it possible to vary the length of cam lobe **25**, it is expedient to provide two cam disks **19** having lobes **25** disposed offset from one another, which can be rotated against one another on shaft **1** and can be locked in the position desired (FIG. 5).

The collected packs of sheets are fed by a conveyor arranged parallel to the deflector-stripper onto a conventional stacker platform which can be lowered as the stacking progresses and may be vibrated to assist the registering of the sheets. The present invention is not concerned with details of the stacker, which may be of conventional construction and is, therefore, not shown in the drawings.

In the embodiment represented in FIG. 2, which is substantially the same as the one in FIG. 1, instead of the electromagnet **22** cooperating with armature **21**, a solenoid device **26** is provided, which is equipped with a pawl **27** which is held in the engaged position by the effect of a spring **28**. In this case, solenoid **26** is not energized, i.e., switch **23**, which is in series with it, is open, when the deflector-stripper is in the deflecting position. When the counting mechanism has been preset to the desired number of sheets, and the impulses emitted by the photoelectric system **24** reach a total corresponding to that number, switch **23** is momentarily closed (rather than opened as in FIG. 1), so that solenoid **26** is energized and pulls pawl **27** out of engagement. The cam follower lever **16** thus released now performs, along with the other parts associated with it, the same movements as described in the case of the embodiment of FIG. 1 when magnet **22** was de-energized.

Instead of the photoelectric sensing device **24**, which is used particularly when the feeding of the sheets is irregular, counting mechanism **6** can be connected, if the crosscutters and gathering cylinders are coupled directly together, with an impulse generator which causes one count to be registered in the counting mechanism upon each revolution of the cylinder. This impulse generator is represented schematically in FIG. 2 and is designated by the number **29**. It can be designed as an inductive transducer and can cooperate with an armature disposed adjustably on the periphery of the gathering cylinder, so that the impulses can be coordinated with the position of the gathering cylinder.

In FIG. 3, an electrically operated system is shown in which, for the sake of simplicity, the conveyors and the sling bands and all other parts not necessary to the operation of the deflector-stripper **3** are omitted from the drawing. In the embodiment in FIG. 3, a solid conductive metal ring **31** is placed on shaft **1** of the gathering cylinder, with an insulating ring **30** between them, the said metal ring being connected through a brush **32** to one pole of a voltage source **33**. Shaft **1** also bears insulating disks **34** and **36** which bear conductive segments **35** and **35***a*. Brushes slide on the circumferences of the insulating disks **34** and **36**, the said brushes being connected by conductors **38** and **39** to a relay **37** and a switch **41**, respectively. Conductor **38** is connected through relay **37**, which operates the deflector-stripper **3**, and through a switch **40**, which is controlled by the counting mechanism **40**, to one pole of the voltage source **33**. Relay **37** does not respond upon each rotation of the gathering cylinder, but instead can respond only when switch **40**, which is in series with it, is closed by the counting mechanism **6** when the desired number of sheets has been gathered on the gathering cylinder.

In the embodiment in FIG. 3, the counting mechanism is coupled with shaft **1** of the gathering cylinder, so that, after a certain number of revolutions of the gathering cylinder, depending on how it is set, it causes switch **40** to close, the impulse that closes it being so timed that it closes just when the brush associated with conductor **38** comes into contact with segment **35**.

When relay **37** responds, it shifts the deflector-stripper into the stripping position, while simultaneously operating the catch and pawl mechanism **43**, whose catch is formed by the prolongation **42** of the deflector-stripper operating rod, and whose pawl is created on the prolongation of the plunger of a solenoid device **45**. The winding of solenoid device **45** is connected at one end to the negative pole of voltage source **33** and at the other end to a working contact of switch **41**, so that, when segment **35***a* is contacted by the brush to which conductor **39** is attached, and when switch **41** is closed, the circuit of the said winding is closed. When solenoid **45** is energized, it disengages the catch and pawl mechanism **43** against the effect of spring **44**, and thus causes deflector-stripper **3** to return to the deflecting position under the effect of compression spring **20**.

The purpose of switch **41** is to prevent solenoid **45** from being energized upon each revolution of the gathering cylinder, because it can be energized only when the deflector-stripper is in the stripping position, since only then is switch **41** closed.

On account of the mechanical coupling between shaft **1** of the gathering cylinder and the counting mechanism **6**, the embodiment in FIG. 3 is suitable only for installation directly in tandem with a crosscutter, since the operation of the deflector-stripper is coordinated only with the rotation of the gathering cylinder.

I claim:

1. Apparatus for gathering sheets into packs of a predetermined number of sheets and advancing them to stackers, comprising a gathering cylinder having a periphery which is larger than the length of the sheets to be collected, means to feed the sheets onto the cylinder to form packs thereon covering part of the cylinder periphery and leaving part thereof uncovered, sling bands cooperating with and partially encircling said cylinder, means to drive said sling bands, means to control the speed of said bands so as to compensate for slippage of said sheets and to ensure that said part of the cylinder periphery remains uncovered by sheets, a deflector-stripper adapted to operate in a raised or lowered position being positioned above the cylinder and adjacent to the outlet of said feed means, said deflector-stripper in the raised position adapted to deflect said sheets to a position between the sling bands and the cylinder, and in the lowered position to strip said packs from the cylinder, and means to control the deflector-stripper to position it in either the raised or lowered position, said control means comprising, in cooperation, (a) an adjustable counting mechanism and a first switching device which is operated by said counting mechanism and releases the deflector-stripper into stripping position after a predetermined number of pack-forming sheets has been collected on the cylinder and counted, and (b) an adjustable control device and a second switching device which is operated by said control device and allows actuation of said stripper-deflector by said first switching device only when the stripper-deflector registers with said uncovered part of the cylinder.

2. Apparatus as set forth in claim **1** wherein the means to drive the sling bands comprises a peripheral gear on the cylinder, a second gear meshing with said peripheral gear, an infinitely variable speed drive transmission connected to said second gear, and a drivng roll driven by said transmission.

3. Apparatus as set forth in claim **1** wherein said counting mechanism is operatively connected with the gathering cylinder and performs one count upon each revolution of the cylinder.

4. Apparatus as set forth in claim **3** wherein the means for controlling the deflector-stripper comprises an impulse generator consisting of an inductive transducer which actuates the adjustable counting mechanism.

5. Apparatus as set forth in claim **1** wherein the means for moving the deflector-stripper to the stripping position comprises cam means revolving with the gathering cylinder and cooperating with a cam follower disposed at one

end of a lever which is mechanically connected to the deflector-stripper and is held by holding means against the effect of a spring in a position in which it keeps the cam follower and the cam out of contact with one another, the counting mechanism releasing said holding means when the cam lobe is presented to the cam follower.

6. Apparatus as set forth in claim 5 wherein said holding means is an electromagnet and wherein said cam has a lobe which serves to return the deflector-stripper to the deflecting position in which it is held by said electromagnet until an impulse is emitted by the counting mechanism.

7. Apparatus as set forth in claim 5 wherein said cam means comprises two cam discs having lobes disposed offset from one another, said cam discs being rotatable against each other to adjust the total length of the lobes.

8. Apparatus as claimed in claim 1 wherein said adjustable control device comprises an electromagnet for moving the deflector-stripper into the stripping position, an electric circuit for actuating said electromagnet, and switch contacts in said circuit operated in coordination with the

position of the gathering cylinder, said switch contacts being disposed in series with an additional contact of said first switching device operated by said counting mechanism.

9. Apparatus as set forth in claim 8 wherein at least one of said switching contacts, which is operated in coordination with the position of the gathering cylinder, has a switching disk rotating synchronously with the gathering cylinder, which is equipped with contact segments.

10. Apparatus as set forth in claim 8 wherein said contact segments are adjustable.

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TRAVIS S. McGEHEE, *Primary Examiner.*

FRANK E. BAILEY, *Examiner.*