United States Patent

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[54] APPARATUS FOR AUTOMATICALLY READING AND SORTING DOCUMENTS

5 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **209/73**
[51] **Int. Cl.** **B07c 3/10**
[50] **Field of Search** 271/13, 52, 56, 87, 73; 209/74

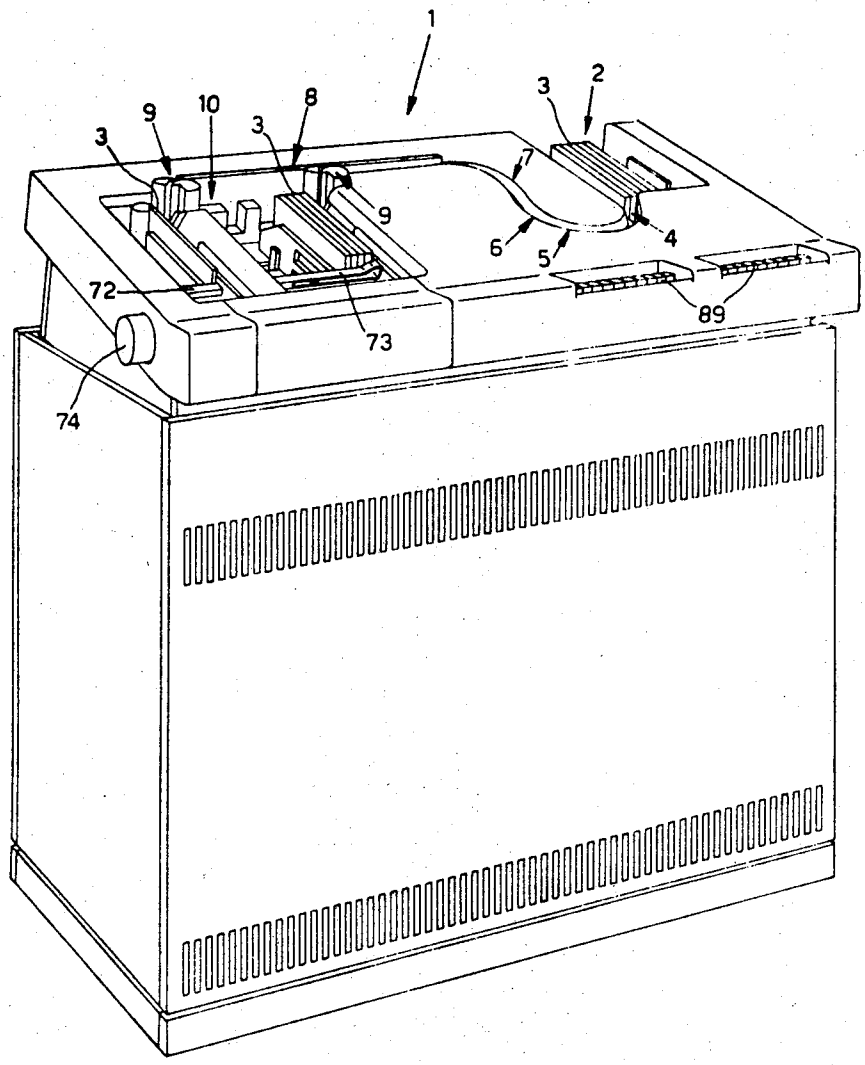
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ABSTRACT: An apparatus for the automatic reading and sorting of documents carrying readable data printed thereon. A feed device consisting of a stripping belt frictionally engages one face of the document which is at the front of a bundle of documents located on an oscillating platform for removing the front document from the bundle, and a rejection band frictionally engages the other face of the separated document to hold back the superposed documents when more than one document is separated from the bundle. The stripped documents are then conveyed along an accelerating and aligning path, where cooperating rollers urge the documents into contact with an aligning surface, the spindles of these rollers having normally an oblique position which can be varied manually by the operator. Subsequently the documents are fed past a reading head, which on the basis of the data picked up from each document controls a sorting means for routing the documents into different collecting pockets.



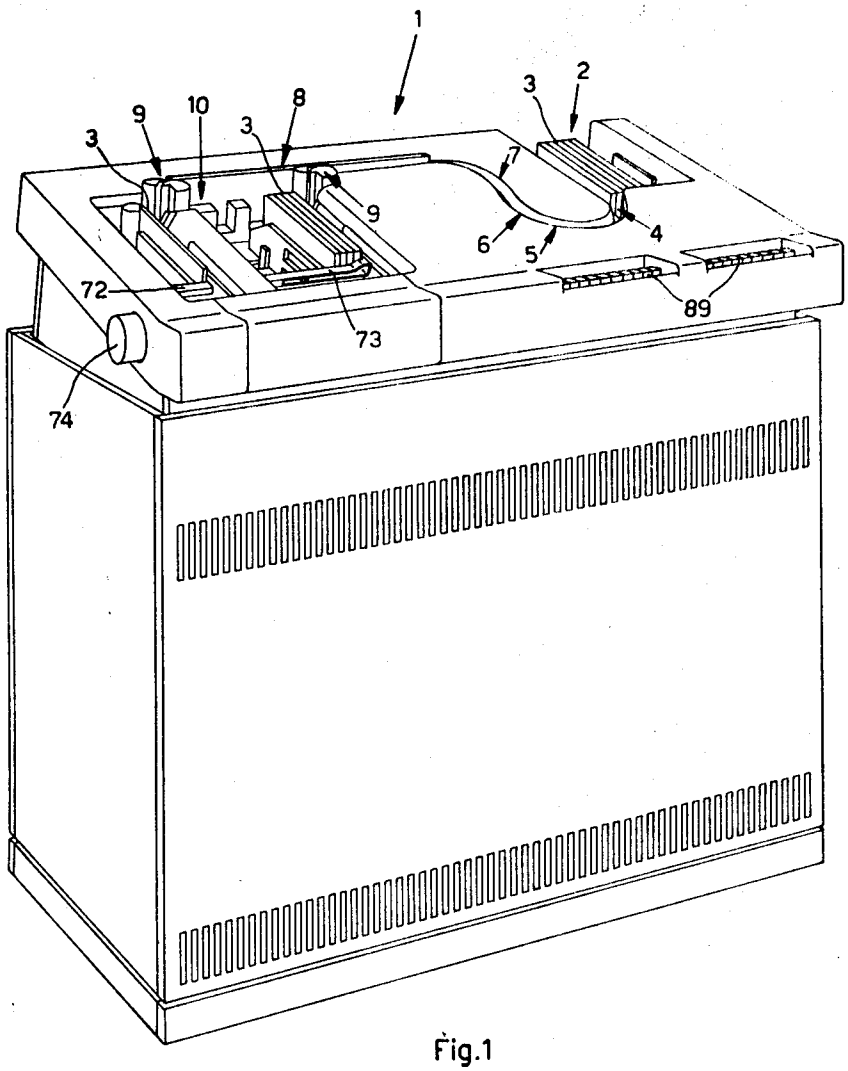


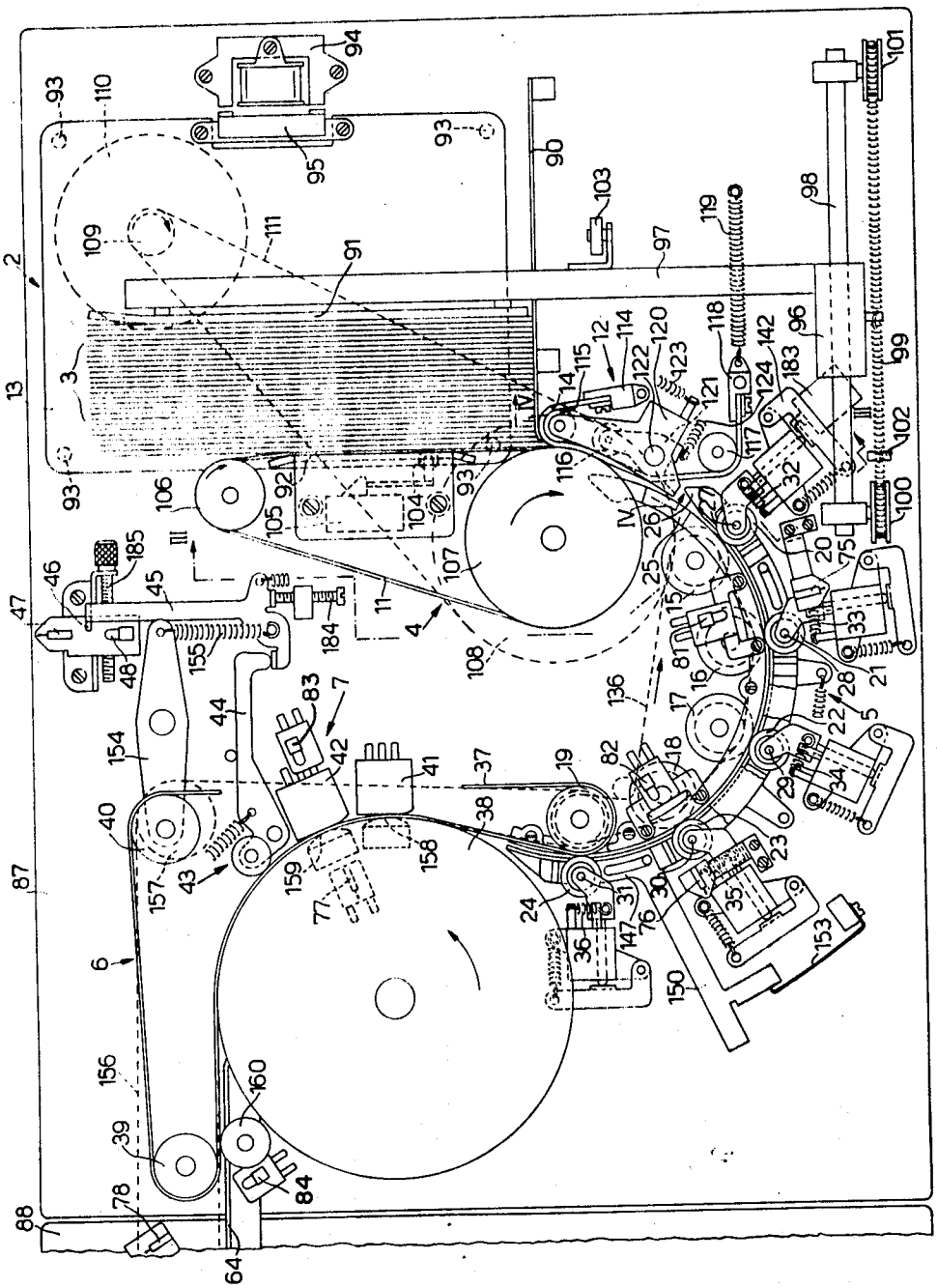
Fig.1

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Fig. 2a

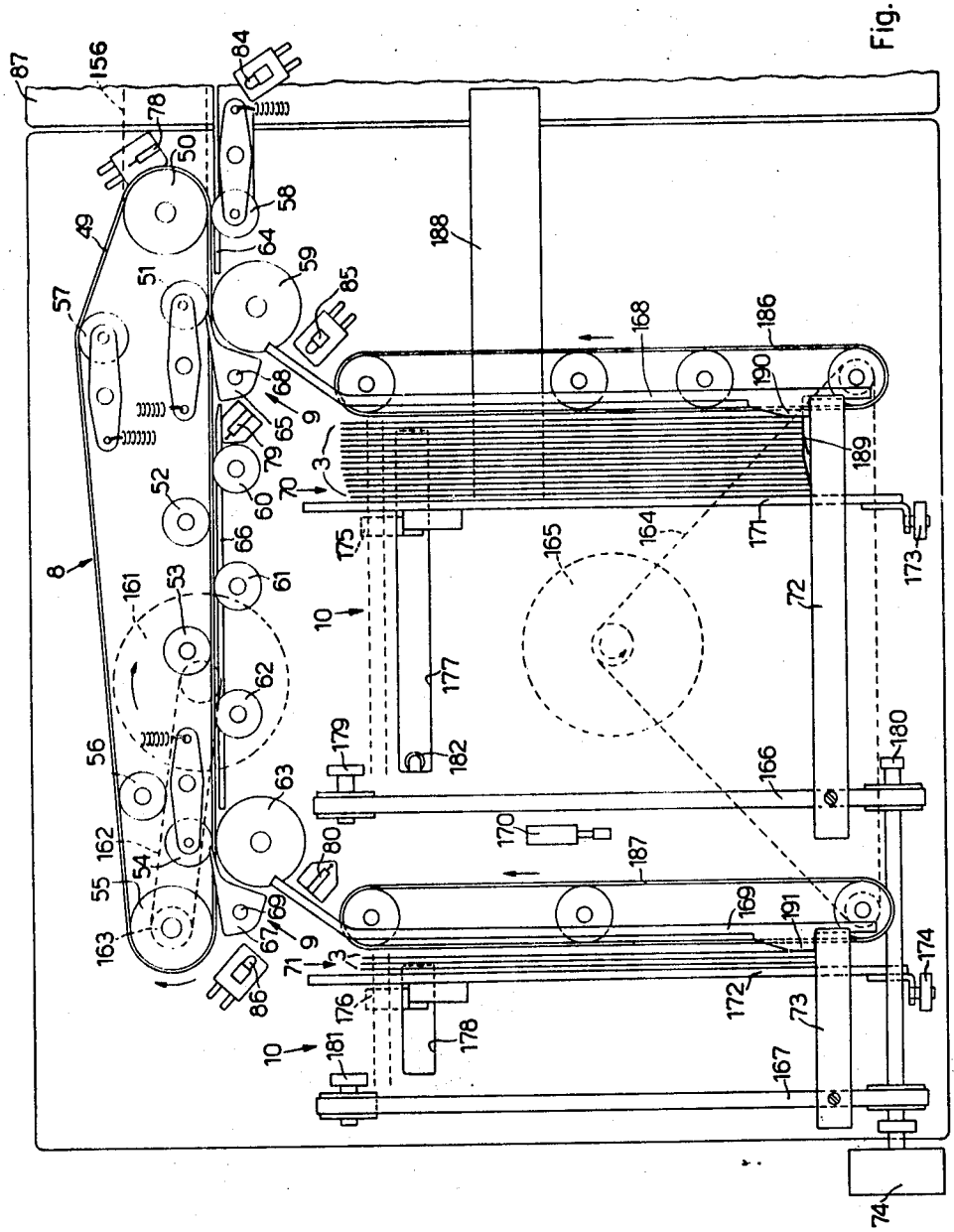


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Fig. 2b



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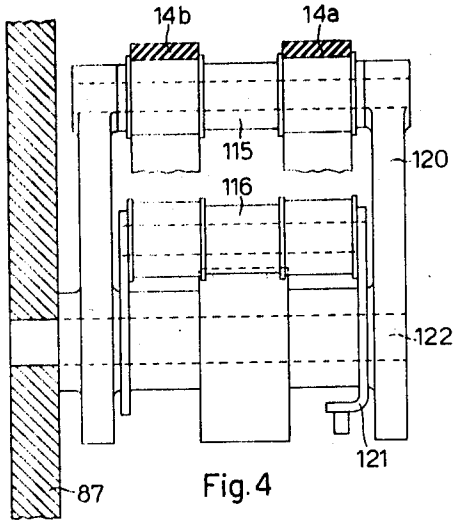


Fig.4

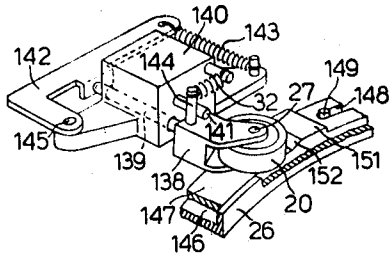


Fig.5

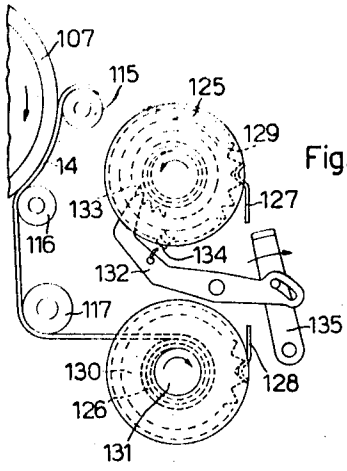


Fig.7

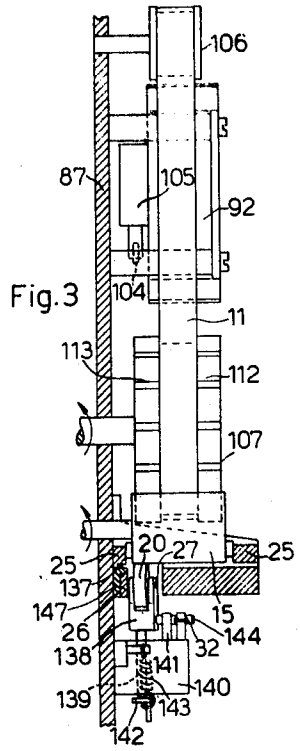


Fig.3

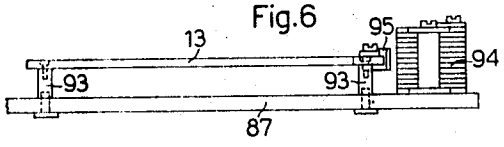


Fig.6

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APPARATUS FOR AUTOMATICALLY READING AND SORTING DOCUMENTS

The present invention relates to apparatus for automatically reading and sorting documents the sorting being effected in accordance with the reading of the date. Apparatus of this type can be used as input devices for other machines for processing data. The documents may be checks for example.

Known apparatus of this type comprises a feed arrangement for separating the documents and conveying them singly along a given path, the feed arrangement being equipped with first means for accelerating the documents along the path and with second means adapted to shift the documents transversely of the path to bring them into contact with aligning means. A reading device reads the data recorded on the documents, and selectively controls means for intercepting the documents and deflecting them into corresponding collecting pockets.

Such apparatus normally processes documents which are all identical in dimensions and thickness and are assembled in separate bundles before being fed for reading and sorting. In some offices, the documents to be processed are not of uniform dimensions and thickness and therefore require many preparatory operations for their subsequent automatic processing.

One of the major drawbacks of known apparatus processing documents of different formats is that of requiring a long path for the acceleration of every single document after it has been stripped from the feed bundle and for the subsequent alignment prior to the operation of reading the document itself. Moreover, in such apparatus, when documents of different formats are dispersed in one and the same feed bundle, the acceleration stage does not permit a regular spacing of the documents along the path, as a result of which the apparatus must be provided with one or more devices for separating any documents which may overlap, these devices being disposed in series along the path of the documents before the documents reach the reading device.

Moreover, in known apparatus for obtaining a spaced feed of the documents along the fixed path section preceding the point where the documents reach the reading device, mechanisms are provided for delaying the advance of the document along the path until a signal permitting the advance of the document is received. Apart from the use of such mechanisms rendering the whole apparatus complicated and, therefore, costly, it requires a supplementary section of path in which to arrange the delay mechanism.

The object of this invention is to obviate these drawbacks.

According to the invention there is provided apparatus for automatically reading and sorting documents comprising a feed device for separating the documents and conveying them singly along a given path, the feed device including first means for accelerating the documents along an initial portion of the path and second means adapted to act simultaneously on each document with the first means to urge the document transversely of the path against an aligning surface, a device for reading the data recorded on the documents, and selectively operable sorting means controlled by the reading device for routing the documents into different collecting pockets.

Preferably the feed arrangement operates step by step to supply one document at a time so that the first and second means act on a single document at a time.

As hereinafter explained, apparatus according to the invention can be arranged to process documents of varying dimensions and thicknesses without prearranging them and can convey the documents one at a time and in order through the reading device.

In some known kinds of apparatus, the mans which effect the alignment of the documents with the aligning guide, in such manner as to center with respect to the reading device the band of the document on which the data is recorded, are constituted by rollers rotating about spindles which are in an oblique position with respect to the conveying path and

disposed so that their peripheries urge the documents frictionally along the path and provide the conveying movement with a component directed towards the aligning guide. Since, in these aligning means, the obliquity of the spindles is fixed, in the case of thin documents which are not sufficiently strong and for particular values of the friction between the rollers and the surface of the documents there may be damage to the aligning edge of the documents themselves, inasmuch as if they were already aligned they are pressed excessively against the aligning guide. In consequence, misalignment with respect to the reading device occurs. So as to reduce the possibility of such damage, in some kinds of apparatus, that length of path where the rollers with inclined spindles act is very short and the alignment is further achieved with the aid of a diversion of the path in a sense transverse of the direction of advance. This solution has the fault of causing the conveying path to occupy a larger space both in the longitudinal direction and in the transverse sense.

These various drawbacks are obviated by a subsidiary feature of the invention in which the spindles are retained in the oblique position by a resilient return system and, under the action of the coupling of the rollers with the documents through friction, after an edge of the latter has come into contact with the aligning guide, are brought into a position perpendicular to the path. It is additionally advantageous to make the inclination of the oblique spindles manually variable.

Known kinds of apparatus are moreover provided with a device for checking the feed of single documents along the conveying path, this device being generally disposed along the path in advance of the reading device and taking the form of a photoelectric detector. This type of device is complicated and it is not very reliable, inasmuch as it operates by checking the passage of the two edges at the front and rear of each document an would therefore not be able to detect the passage of two documents which are perfectly superposed and, moreover, consequent upon the detection of documents which are superposed, acts by interrupting the flow of documents along the conveying path.

These shortcomings can also be obviated in apparatus by the provision of a lever for sensing the thickness of the documents advancing along the path, the sensing lever being included in a system of levers for amplifying the thickness sensed and the checking device being adapted to control the operation of a sorting device when superposed documents are conveyed along the path to prevent the reading thereof and to route the superposed documents into a collecting pocket provided for rejected documents.

The sensing lever can be disposed in such manner as to act along the path in a position close to the reading position.

This checking device is reliable, cheap and easily adjustable by an operator, and which moreover enables the operator to have the documents whose alignment has not been in order at his disposal for possible subsequent reintroduction into the apparatus, after the checking device has come into action, blocking the feed of the data read on the documents in an irregular state and sending these documents into a suitable pocket for rejects.

The embodiment of the invention hereinafter described also has an improved arrangement for selecting the pockets into which the documents are to be sorted in accordance with the data read from the documents, which arrangement is provided with means adapted to be operated manually and enabling the depth of the pockets for collecting the sorted documents to be chosen and varied in dependence upon the size of the documents processed.

The embodiment also has an improved arrangement for feeding single documents removed from a bundle of documents, starting from the document in the front or leading position, by means of a stripping belt acting by friction on a face of the front document and by means of an oscillating platform on which the bundle is placed, the oscillations of the platform being adapted to facilitate the separation of each document from the bundle.

Finally the described embodiment also has improved means for separating documents so that only the document in front is caused to advance and any documents which may be superposed are delayed.

The invention will be described in more detail, by way of example, with reference to the accompanying drawings which illustrate one apparatus embodying the invention and in which:

FIG. 1 is a perspective view of the apparatus;

FIGS. 2*a* and 2*b* together are a plan view of the apparatus without the covering bodywork;

FIG. 3 is a view in section taken on the line III—III of FIG. 2*a* and showing the stripping belt and roller and part of the accelerating and aligning device;

FIG. 4 is a view, partly in section, taken on the line IV—IV of FIGS. 2*a* and showing the rejection band and the rollers which tend to press this band against the stripping roller;

FIG. 5 is a perspective view of an element of the aligning device;

FIG. 6 is a partial side view of the platform on which is placed the bundle of documents to be sorted and of the oscillating device for the platform; and

FIG. 7 shows the form of spools on which the rejection and is wound.

GENERAL DESCRIPTION

Referring to FIGS. 1, 2*a* and 2*b*, the apparatus 1 for automatically reading and sorting documents comprises a document container 2, into which the documents 3 are loaded in the form of a bundle and from which said documents are removed; a document removing and separating unit 4; a document accelerating and aligning unit 5; document conveying units 6, 8; a reading unit 7; a unit 9 for selecting the final dropping path of the documents, and a receiving unit 10 comprising a plurality of pockets. The apparatus described here is adapted to read documents bearing coded magnetic symbols and having varying dimensions.

The documents are fed by a stripping belt 11, which removes the successive documents one by one from the bundle in their original order and carries them to a separating station 12. In order to facilitate the feed of the document which is at the front of the pile 3 with which the container is loaded, two combined expedients are used: the first expedient consists in moving the stripping belt 11 in jumps, each jump being permitted when the document previously fed has travelled beyond a certain point in its journey; the second expedient consists in providing the document container with a platform 13 on which the bundle of documents is placed and which is kept in forced oscillation along the direction perpendicular to the faces of the documents by means of a suitable vibrator.

A large number of documents may be removed at the same time from the bundle and fed towards the separating station 12, in which case they are separated by causing the document in front to advance first and delaying the other superposed documents by means of a rejection band 14 held in position and tensioned by springs.

From the separating station 12 the documents are fed over a certain course included in the accelerating and aligning unit 5, where means which act simultaneously on each single document conveyed are provided. These means are constituted by a plurality of pairs of rollers 15, 20; 16, 21; 17, 22; 18, 23; 19, 24, and by guides 25, 26 (FIG. 2*a*). The accelerating rollers 15, 16, 17, 18 and 19 are driving rollers disposed on the same side with respect to the path along which the documents are conveyed and with their spindles perpendicular to the path itself and act through friction by means of their peripheries on a face of the documents being conveyed. The aligning rollers 20, 21, 22, 23, and 24 are disposed on the opposite side to the rollers 15, 16, 17, 18 and 19 with respect to the conveying path and are pressed resiliently against the rollers 15, 16, 17, 18 and 19, respectively, so as to be rotated frictionally by the latter or by the document conveyed along the path and passing between each pair of opposite rollers.

Moreover, the rollers 20, 21, 22, 23, and 24 rotate about respective spindles 27, 28, 29, 30 and 31, which are normally in an oblique position with respect to the direction of the feed path of the documents and are urged into the oblique position by return springs 32, 33, 34, 35 and 36, respectively. Under the action of the frictional coupling of the aligning rollers with the document carried along between the guides 25 and 26, when a lateral edge of the document has come into full contact with the bottom of an aligning slot parallel to the feed path and defined by the guides 25 and 26, the spindles 27, 28, 29, 30 and 31 swing into a position perpendicular to the path. A belt 37 passes round the accelerating roller 19 and is circulated thereby around a drum 38 and another two rollers 39 and 40. This belt 37 serves to feed the documents, at the same final speed that is imparted by the accelerating rollers 15, 16, 17, 18 and 19, through the reading device 7, which is constituted by a magnetizing head 41 and a magnetic reading head 42. The data read on the document is transmitted to an external storage means.

Along the path, in a position immediately following the reading unit, there is disposed a device 43 for checking the feed of single documents along the path, this device comprising a lever 44 sensing the thickness of the documents advancing along the path, a lever 45 amplifying the thickness sensed and a switch system 46, 47, 48 which acts when superposed documents are conveyed along the feed path as far as the reading station 7 to prevent the reading of these superposed documents and send them into a collecting pocket for rejects.

Thereafter, the documents are fed along the sorting path (FIG. 2*b*) and are carried along through friction by a belt 49 driven by a roller 55 and stretched between a series of other rollers 50, 51, 52, 53, 54, 55, 56 and 57. In addition to the sorting path being defined by a section of the belt 49, it is also defined by a second series of rollers 58, 59, 60, 61, 62 and 63 in contact with the said section of the belt 49 and rotated through friction, and by guides 64, 65, 66 and 67.

The guides 65 and 67 are deflectors which are controlled by the switch system 46, 47, 48 and rotate about their respective pivots 68 and 69 to assume one or the other of two positions, that is alignment or deflection with respect to the sorting path. In the deflecting position (shown in FIG. 2*b*), the deflector 65 routes the document into the receiving pocket 70. The same deflector 65, in the position of alignment with the path, permits the document carried along by the belt 49 to continue along the sorting path. In the deflecting position (shown in FIG. 2*b*), the deflector 67 then routes the document into the receiving pocket 71. The same deflector 67, in the position of alignment with the path, would permit the document carried along by the belt 49 to continue its sorting course, but this eventuality is excluded in the case of the apparatus shown in FIG. 2*b*, i.e. the deflector 67 remains permanently in deflecting position.

The receiving pocket 70 serves to accept and stack the documents considered valid and correctly aligned and read, while the receiving pocket 71 is used to accept the documents which are rejected, that is the documents considered invalid or not correctly aligned and read.

The apparatus also comprises means 72, 73 adapted to be operated by means of a manual control and which permit of varying the depth of the collecting pockets 70, 71 in dependence upon the longitudinal dimension of the documents processed.

The apparatus moreover comprises a series of check points along the conveying path for the documents, in the form of photoelectric cells 75, 76, 77, 78, 79 and 80 associated with lamps 81, 82, 83, 84, 85 and 86, respectively, which each generate a light beam directed at the corresponding photoelectric cell and interrupted by the passage of a document. The methods by which this checking is carried out will be described hereinafter.

The apparatus is mounted on one or more baseplates 87, 88 disposed in a single plane (FIGS. 2*a* and 2*b*) and is equipped with driving systems (indicated by dash lines in FIGS. 2*a* and

2b) which are mounted at the back of the baseplates. Referring to FIG. 1, the apparatus moreover includes the electronic data storing and transmitting unit, which is housed in the space below the mechanical feed and sorting apparatus, and a keyboard 89 for control by an operator. Some of the units included in the apparatus embodying the invention will now be described in greater detail.

DOCUMENT LOADING UNIT

The container 2 for loading the documents 3 in the form of a bundle (FIGS. 2a) is defined by a platform 13 which forms the substantially horizontal base of the container, a fixed sideplate 90, a movable thrust plate 91 and a fixed opposing front plate 92.

When the bundle of documents is loaded, it must be pushed against the sideplate 90, which is fixed to the baseplate 87 and is adapted to provide the minimum friction with the lateral edges of the documents. Due to gravity, the bundle tends to drop towards the plate 90, inasmuch as the baseplate 87 and the platform 13, which is parallel thereto, are slightly inclined as seen in FIG. 1.

The platform 13 (FIGS. 2a and 6) is mounted on the baseplate 87 parallel thereto and spaced therefrom by elastically flexible rubber supports 93 at the four corners of the platform. This mounting system therefore permits the platform 13 to effect oscillations parallel to the baseplate 87 when it receives impulses in a direction parallel to the platform itself. These impulses are applied by means of an electromagnet 94 energized by alternating current, which periodically attracts an armature 95 connected rigidly to the platform 13, so that the latter is subjected to forced oscillations. The oscillatory movement of said platform takes place in the direction of advance of the bundle of documents 3 towards the removing unit and, by means of the friction between the platform and the bottom edge of the documents, this movement facilitates the separation of the documents in the bundle and, moreover, their separation from the platform 13 and from the sideplate 90.

The thrust of the bundle of documents towards the removing unit is applied by the plate 91, which is connected rigidly to a slider 96 by means of a rod 97 so that it is able to slide parallel to the direction of advance of the bundle 3. In fact, the slider 96 is movable along a bar 98 and is drawn towards the left-hand end of said bar 98 by a spiral spring 99 anchored at a fixed point 102. So that the spring may act with sufficiently linear elastic characteristics, that is so that the thrust applied by the plate 91 to the bundle of documents may be kept substantially constant, this spring extends over a long distance and is wound in succession on two spools 100 and 101. The pressure applied by the spring must be sufficient to overcome the friction of the bundle of documents 3 against the platform 13 and the plate 90.

The rod 97 slides parallel to the baseplate 87 by means of the slider 96 and by means of a bearing wheel 103 carried by a bracket fixed to said rod.

The container 2 is moreover provided with a roller 104 mounted on the arm of a microswitch 105 and adapted to indicate by its release that the container is empty since the pressure of the documents against the roller is lacking.

The documents which are loaded into the container may be of varying dimensions: in the case of checks the height may vary, for example, between 50 and 140 mm.; the thickness may vary, for example, between 0.08 and 0.15 mm.; while as regards the length two classes of documents may be considered, namely a short class with a length ranging, for instance, between 75 and 140 mm., and a long class with a length ranging between 140 and 220 mm. Documents preferably in the same class, with different lengths, may also be interspersed in one and the same bundle loaded into the container.

Documents may also be added during the operation of the machine by manually shifting the slider 96 towards the right-hand end of its travel and inserting them at the tail end of the bundle already deposited.

DOCUMENT REMOVING AND SEPARATING UNIT

Referring to FIGS. 2a and 3, the removing unit is mounted on the baseplate 87 and consists essentially of the stripping belt 11 passed round two rollers 106 and 107, of which the first 106 is driven, while the second roller 107 is a driving roller inasmuch as it is connected by means of a coaxial pulley 108 and a belt 111 to the rotating shaft 109 of a motor 110. The elements designated by the references 108, 109, 110 and 111 are shown by dashes in FIG. 2a, since they are mounted underneath the plate 87. The stripping belt 11 bears on the opposing plate 92, which is fixed rigidly to the baseplate 87 and operates in such manner as to tension the belt 11 and hold it flat in the section in which the latter is in contact with the front document and oppose the thrust of the movable plate 91.

The document which is at the front of the bundle 3 is carried along through friction by the stripping belt 11, since the coefficient of friction between the belt 11 and the paper documents is greater than the coefficient of friction between the documents themselves.

The roller 107 which moves the belt 11 is provided with a groove slightly deeper than the thickness of the belt and in which the belt 11 is arranged (FIG. 3), while at the sides of the groove the roller is provided with cylindrical surfaces 112 and 113 having a coefficient of friction with the documents which is greater than the coefficient between the belt 11 and the documents.

Since the surfaces 112 and 113 of the roller 107 project with respect to the surface of the belt passed round the roller, when the front document of the bundle 3 has been caused to advance sufficiently by the belt 11, the document is coupled through friction at its leading portion with the roller 107, which now effects the feed thereof owing to the effect of the greater coefficient of friction and of the greater peripheral speed of the surfaces 112 and 113 with respect to the belt 11.

The feed rate or speed in correspondence with the roller 107 may be, for example, 1 m./sec.

The surfaces 112 and 113 may consist, for instance, of rubber and bear transverse incisions which serve to prevent the surfaces themselves becoming shiny, to increase the coefficient of friction or prevent it being reduced and to reduce the effect of any dust present on the documents processed.

The movement of the feed roller 107 and, therefore, of the belt 11 takes place in jumps, as will be described in detail in the Section "Devices for Checking on the Documents," in such manner as to space the documents only when the preceding one has by that time reached a predetermined point.

The document separating unit 12 consists of a rejection band 14 with one end 114 fixed to the baseplate 87, the band being held resiliently under tension and pressed against an arc of the roller 107 by means of a suitable system of rollers and springs. The rejection band 14 is composed of two straps 14a and 14b (FIG. 4) which are passed round a series of rollers 115, 116 and 117 and are tensioned at the end 118 by a spring 119. The rollers 115 and 116 are mounted at the ends of corresponding levers 120, 121 which are both pivoted coaxially on a pin 122 and controlled by the elastic resistance applied by corresponding springs 123, 124. The rollers 115 and 116 are disposed along an arc of the feed roller 107 and pressed resiliently against the latter; the roller 117, on the other hand, is in a fixed position.

The two straps 14a and 14b cling to the surfaces 112 and 113, respectively, of the feed roller 107 and, since these straps are stationary and have a coefficient of friction with respect to the documents which is lower than the coefficient of friction which the surfaces 112 and 113 have with respect to the documents, the effect which is obtained with rejection band 14 is to slow down and hold back those documents which are fed in superposed relationship with the front document, so that only the latter is caused to advance by separating it completely from the following documents.

FIG. 7 shows a form of mounting for the rejection band **14** which is different to that of FIG. 2*a* and adapted to permit a periodic manual shifting of the rejection band **14** when the length of band in contact with the arc of the feed roller **107** becomes worn.

To this end, the rejection band is passed round a series of tension rollers **115**, **116** and **117** corresponding to those shown in FIG. 2*a*, while its ends are wound on two spools **125**, **126**. Shifting means which can be worked manually by an operator are moreover provided for unwinding the rejection band **14** from the supply spool **125** and winding it on to the spool **126** (which collects the worn portion of a band). For example, the spools **125**, **126** are each held in position by a spring ratchet gear constituted by a spring tongue **127**, **128**, respectively, which engages in a toothing **129**, **130**, respectively, coaxial with the corresponding spool. By manually operating a knob **131** coaxial with the spool **126**, it is possible to overcome the resistance of the tongues **127** and **128** and cause the band **14** to advance from the spool **125** to the spool **126**.

However, since the feed roller **107** when in rotation exerts a dragging action on the band **14** through friction and would tend to unwind it from the spool **125** by causing the latter to rotate, an effective opposing action is exerted by a pawl **132** which is coupled with a gear **133** coaxial with the spool **125**. This pawl is held in the locking position by a spring **134** and can be controlled for the locking and unlocking operations by means of a manually operated handle **135**.

DOCUMENT ACCELERATING AND ALIGNING UNIT

Referring to FIG. 2*a*, when the document leaves the separating station **12** it is received by an accelerating and aligning track or path defined by a pair of guides **25** and **26** fixed to the baseplate **87**. So as to limit the space occupied by this path, it is not rectilinear, but develops through a circular arc along which there are arranged at regular intervals accelerating rollers **15**, **16**, **17**, **18**, **19** mounted with their axes of rotation perpendicular to the plate **87** and acting through suitable apertures formed in the guide (see also FIG. 3) by means of their cylindrical surfaces, which have a suitable coefficient of friction with respect to the documents. Coaxially with these accelerating rollers and underneath the plate **87** there are mounted corresponding pulleys round which a driving belt **136** is passed.

It is to be noted that if the spatial mechanical arrangement of the apparatus should so permit, the series of accelerating rollers could be replaced by a single drum and cylindrical surface of which coincides with the section of accelerating path.

Disposed opposite the accelerating rollers are a series of aligning rollers **20**, **21**, **22**, **23**, and **24**, mounted in such manner as to press against the corresponding accelerating rollers. The aligning rollers **20**, **21**, **22**, **23** and **24** are rotated by the corresponding accelerating rollers, turning on spindles **27**, **28**, **29**, **30** and **31**, which are normally held in an oblique position with respect to the direction of feed of the documents so that the coupling through friction with the document being conveyed supplied a drag component towards the bottom of an aligning slot **137** (FIG. 3) defined by the guides **25** and **26**. All the aligning rollers are mounted in similar manner and, therefore, the mounting and operation of only one will be described with reference in particular to FIG. **5**, which shows the mounting block of the roller **20** in perspective.

Both the accelerating rollers and the aligning rollers may be made of sufficiently hard rubber (for example with a Shore harness of 90–95) and, while the former have a coefficient of friction of, for example, 0.3 with respect to the paper of the documents, the latter have a higher coefficient, for example 0.8.

The roller **20** is mounted in a fork **138** having a pivot **139** which can turn and slide in a block **140** fixed to the baseplate **87**. The fork **138** carries a pin **144** which is normally held against a stop **141** by a spring **32**, so that the spindle **27** of the roller is oblique with respect to the plane of the plate **87**. A lever **142**, pivoted to the block **140** at **145**, presses against the end of the pivot **139** due to the pull of a spring **143**, so that the roller **20** is urged resiliently against the opposite accelerating roller **15**.

It is to be noted that the spring **143** has characteristics which are sufficiently linear to ensure the same pressure even for wear of up to 1 mm. of the diameter of the roller **20**.

On the bend **146** of the guide **26** there is moreover seated a slider **147** controllable by the operator to adjust the inclination of the axes of rotation of the aligning rollers. This slider can slide with respect to the guide **26** by the effect of eyes **148** engaging pins **149** fixed to the bend **146** of said guide. An arm **150** (FIG. 2*a*) enables the movement of the slider **147** to be effected manually, the slider being provided with reliefs **151** having an ascending inclined surface **152** which, due to the effect of the shifting of the slider, can engage the fork **138** and produce a gradual reduction of the inclination of the spindle **27**, to the point of rendering it perpendicular to the baseplate, **87** that is parallel to the spindle of the accelerating roller **15**. A flat spring **153** operates by engaging the arm **150** in such manner as to hold the slider **147** in the selected position.

In operation, the rollers **20**, **21**, **22**, **23** and **24** exert a resilient thrust against the corresponding accelerating rollers **15**, **16**, **17**, **18** and **19** and, due to the effect of the frictional coupling, cooperate in the acceleration of the document along the path defined by the guides **25** and **26**. Moreover, the transverse movement component imparted to the documents by the inclined spindles of the aligning rollers, urges the documents so that their bottom edges come into full contact with the bottom of aligning slot **137** (FIG. 3) formed by the guides **25** and **26** parallel to the direction of the path. The size of this transverse component of the movement can be varied by the operator by operating the arm **150**, so as to meet the requirements of the various formats of documents processed, chiefly in relation to the size and thickness of these documents.

It should moreover be observed that, since the aligning rollers **20**, **21**, **22**, **23** and **24** are only resiliently held in an oblique position by means of the tension springs **32**, **33**, **34**, **35** and **36**, when the documents have reached the position of alignment they apply a reaction which tends to bring each aligning roller into a position parallel to the feed path. In this way, possible damage to the edges of the documents because of prolonged pressure against the bottom of the slot **137** and, therefore, the consequent misalignment are obviated.

DOCUMENT CONVEYING AND READING UNITS

The belt **37** is passed round the last accelerating roller **19** and is thereafter passed round the drum **38** and two rollers **39** and **40**, the latter of which is mounted on a lever **154** and serves to hold the belt **37** under tension by means of a spring **155**. The drum **38** and the rollers **37** and **39** are driven by a driving belt **156** located on the underside of the baseplate **87** and passed round corresponding pulleys and also round a loose pulley **157** (FIG. 2*a*) and a driving pulley coaxial with the roller **50** (FIG. 2*b*).

The drum **38** is formed by a rubber-covered upper disc having a thickness equal to the width of the belt **37** with which it is coupled and a lower steel disc, fast with the upper disc, the cylindrical surface of which constitutes a reference for the operation of checking the thickness of the document being conveyed.

The document fed by the accelerating and aligning path is therefore removed by the belt **37** and the drum **38**, which carry it along, holding it tightly between them, through the reading and thickness checking stations, then to transfer it along the sorting path over the guide **64** and the driven roller **160**.

The bottom band of the document, which has magnetic characters marked on it, travels along the path section coinciding with the arc of the drum **38** round which the belt **37** is passed without having any elements in contact with it except the magnetizing head **41** and the reading head **42**, which are disposed in a lower position with respect to the disc **38**.

The two heads **41** and **42** slide on the front face of the document bearing the magnetic symbols, while on the rear face and opposite the heads there slide two leaf spring **158** and **159**, respectively, which, by exerting a pressure, keep the document sheet adhering perfectly to the two heads **41** and **42**.

The documents pass first in front of the magnetizing head **41** and then in front of the reading head **42**. These documents, which travel along in an aligned state with the short side perpendicular to the plane of support, have in the bottom band one or two strips parallel to the long side and containing printed magnetic characters, for example of the coded numerical-type CMC7. The block of coded information is contained along the magnetic strips between two symbols indicating the beginning and the end of the block. The reading of the magnetic strips takes place from right to left, starting from the least significant digit. The rate at which the documents are read varies, in keeping with the length of the documents themselves, from about 200 to 300 documents per minute with the documents of the maximum dimensions provided for.

The electronic part of the machine comprises, in addition to the heads for magnetizing and reading the characters, a logic circuit for recognizing the coded magnetic characters.

DOCUMENT SORTING AND RECEIVING UNITS

Referring to FIG. **2***b*, the sorting path, which is arranged on the baseplate **88**, is defined by the lower part of the conveying belt **49**, the guides **64**, **65**, **66** and **67** and a series of rollers **58**, **59**, **60**, **61**, **62** and **63** in contact with the belt and related thereby through friction. The roller **58** bears resiliently against the belt **49**, being carried by a lever to which the pull of a spring is applied.

The belt **49** is passed round a series of rollers **50**, **51**, **52**, **53**, **54**, **55**, **56** and **57**, of which the roller **55** is the one transmitting the movement, since it is connected to a motor **161** through the medium of a pulley **163** coaxial with the roller and of a belt **162** (the motor, pulley and belt being underneath the baseplate **88**). The rollers **51**, **54** and **57** moreover have a spring lever mounting so as to tension the belt **49**.

As already stated hereinbefore; through the medium of a belt **156** located below the plates **87** and **88**, the roller **50** transmits the movement both to the conveying belt **37** and to the accelerating rollers and the entire system for conveying the documents from the accelerating path up to the sorting path therefore operates at substantially identical speed.

The guides **65** and **67** can pivot about the respective spindles **68** and **69** and act as deflectors when they receive a command which positions them so as to intercept the documents carried along the sorting path and deflect them towards the receiving pockets.

The accepted documents are introduced into the receiving pocket **70** in the same order that they had in the feed container, while the documents considered invalid by the checking devices are introduced into the pocket **71** in succession.

It is possible for the operator to adjust the depth of the pockets easily according to the dimensions of the documents processed and to effect the emptying of the pockets without interrupting the working cycle.

The pockets **70** and **71** are of different transverse widths, but are structurally alike. Each of them is defined at the front by a belt **186**, **187**, respectively, passed round a series of rollers, so as to offer a first conveying support to the documents as they drop into a pocket. These belts **186** and **187** are driven by means of another belt **164** connected to a motor **165** mounted below the baseplate **88**. The base of the pockets is defined by the baseplate **88**. The length of each of the pockets **70** and **71** is defined by a movable wall **72**, **73**, respectively, connected at one end to a belt **166**, **167**, respectively, passed around pulleys, while at the other end the walls rest and can slide on supporting bars **168** and **169**, respectively.

By operating the knob **74**, it is possible to shift the movable walls **72** and **73** simultaneously so as to vary the length of the receiving pockets. When these walls **72** and **73** are brought into the positions corresponding to the dimensions of the documents of the short class, the closing of a microswitch **170** is produced, the microswitch causing a certain action on the aligning roller **20**, as will be described in the following section.

Each of the receiving pockets **71**, **72** is also defined laterally by a slidable plate **171**, **172**, respectively, supported at one end by a wheel or castor **173**, **174**, respectively, and at the other end by a bearing **175**, **176**, respectively, which can slide with respect to a rod (shown in dashes in FIG. **2***b*, because it is mounted below the baseplate **88**), window **177**, **178**, respectively, permitting connection between each bearing and the respective plate. Both the plates are urged towards the end-of-travel position on the right by means of springs (not shown in the drawing) mounted below the baseplate **88** and attached to the bearings **175** and **176**, respectively. The movable walls **72**, **73** and the plates **171** and **172**, respectively, are provided with suitable windows (not shown in the drawing) which make the mutual transverse displacement possible. Stops **179**, **180** and **181** limit the maximum displacement of the plates **171** and **172** to the left. Towards the end of its travel, the plate **171** trips a microswitch **182** which signals the filling of the main receiving pocket.

The dropping of the documents **3** into the selected pocket **70** or **71** edges place partly through gravity and partly through the pull effected by the belts **186** and **187**, respectively. So as to slow down the speed with which the documents drop into the pocket **70** and, therefore, deaden the impact against the wall **72**, the latter carries a spring strip **189** mounted in a position close to the belt **186**. Moreover, so as to facilitate the translation of the stack of documents collected in the pocket **70** to the left as new documents are inserted in the pocket, the plate **171** is equipped with a thin blade **188** sliding on the baseplate **88** during the sliding of the plate itself and having the function of holding the stack of documents slightly raised with respect to the baseplate **88** so as to avoid friction between the latter and the bottom edge of the documents.

Finally, in order to avoid the documents in the rear or tail position in the piles collected in the pockets **70** and **71** being damaged by the continuous sliding action of the belts **186** and **187**, respectively, the supporting bars **168** and **169**, respectively, may be provided with projections **190** and **191**, respectively, which serve to space the documents from the belts themselves once the documents have been inserted in the pockets.

DEVICES FOR CHECKING THE DOCUMENTS

The apparatus comprises a series of document checking devices disposed in the lading container, along the conveying path and in the receiving pockets.

When there are no longer any documents in the feed container **2** to keep the microswitch **105** closed by pressing against the roller **104**, the microswitch signals by opening that the container is empty and prevents the connection for transmitting data from the apparatus to the outside.

Following the feed from the loading container, the documents undergo a reading check and an obstruction check along the path of travel.

The reading check is a check of validity of the character read by the head **42**. Nonrecognition of a character during the reading of a text causes the entire message to be erased in the storage memory and the relevant document is automatically sent into the reject pocket **71** (by suitably commanding the selection of the deflectors **65** and **67**). This rejected document may then be put into circulation again manually.

It should be observed that the operation of the apparatus can be continuous and, in these circumstances, there are no interruptions in the case of a rejected document, or the operation can be step-by-step, that is with the feed, reading and sorting of one document at a time.

The obstruction check is effected along the entire path from feed to reception of the documents and, in cases of working

accidents, so as to avoid damage or destruction of the documents, the immediate arrest of the machine is produced, with stopping of the motors and signalling for the intervention of the operator.

A series of signals obtained sequentially along the path of the documents will now be taken into consideration. It is assumed that the peripheral speed of the rollers **15** and **20** at the beginning of the accelerating path is greater than the peripheral speed of the stripping roller **107** and that the distance between the point of contact between said rollers **15** and **20** and the point where the band **14** separates from the roller **107** is a little less than the length of the documents of the short class. The documents of the short class fed by the separating unit to the accelerating path are therefore engaged simultaneously by the roller **107** coupled to the band **14** and by the rollers **15** and **20** only for an instant.

In the case of the documents of the long class, so as to avoid their being simultaneously in engagement between the roller **107** and the band **14** and the rollers **15** and **20** over a long path section, with a slipping effect because of the different peripheral speeds, it is necessary to nullify the engagement of the pair of rollers **15** and **20** and replace this instead by that of the pair of rollers **16** and **21**. To this end, as already explained hereinbefore, when the machine is operated with documents of the long class, the walls **72** and **73** are shifted in such manner as to have receiving pockets **70** and **71** of the same length as the documents being processed; in this case there is no action on the microswitch **170**, which controls an electromagnet **183** (FIG. **2***a*) which remains energized and attracts the lever **142**, thus eliminating the resilient thrust of the aligning roller **20** against the accelerating roller **15**.

On the other hand, when the machine is operated with documents of the short class, the shifting of the walls **72** and **73** into the position corresponding to the length of the documents being processed causes the closing of the microswitch **170** and, therefore, the deenergization of the electromagnet **183**, thus enabling the load of the aligning roller **20** on the accelerating roller **15** to be restored.

The microswitch **170** also effects a selection of the photoelectric cells **75** and **76** and, for documents of the short class the photoelectric cell **75** is enabled, while for these of the long class the photoelectric cell **76** is enabled.

A timing system checks the feed of the documents along the accelerating path and signals an obstruction condition if, after the passage of a document in front of the first photoelectric cell (**75** or **76**, according to the class of document) and within a certain time, a following document does not arrive.

Another check system is constituted by a counter which checks the number of documents present along the path section between the first photoelectric cell and the photoelectric cell **77** disposed in correspondence with the reading head.

In the case of documents of the long class, not more than one document must be present in the path section between the photoelectric cells **76** and **77**, while in the case of documents of the short class not more than three documents must be present in the path section between the photoelectric cells **75** and **77**. The photoelectric cells **75** and **76**, enabled or rendered operative selectively, therefore cause the aforesaid counter to count forward by one unit each time a document passes, while the photoelectric cell **77** shifts the same counter back by one unit each time a document passes. The counter is moreover zeroized whenever the feed stops because the document container is empty. The photoelectric cell **77** moreover signals with the passage of the tail of each document the end of the reading of such document.

On the curves where the documents drop into the receiving pockets **70** and **71** there are disposed the photoelectric cells **79** and **80**, respectively, which signal obstruction whenever they are obscured by a document for a time longer than a certain preestablished period.

Another time check is effected along the sorting path section. In the case of documents of the long class, there is checked the time taken by each document to travel along the path section between the pair of photoelectric cells **77** and **79** or **77** and **80**, selected according to the result of the validity check of the reading of the document effected by the head **42**; in the case of documents of the short class, on the other hand, there is checked the time taken by each document to travel along the path section between the pair of photoelectric cells **78** and **79** or **78** and **80**, selected according to the result of the validity check of the reading of the document effected by the head **42**.

In a position close to and immediately following the reading head **42** there is arranged the device sensing the thickness of the documents, which is constituted by the lever **44** carrying at one end a wheel pressing against the lower disc of the drum **38** due to the effect of the pull of a spring. The lever **44** controls the amplifying lever **45** which is adapted to intercept by means of a projection **46** the light beam directed by the lamp **48** towards the photoelectric cell **47**. By operating a micrometer screw **184**, it is possible to adjust the sensitivity of the thickness checking device, while the micrometer screw **185** permits the adjustment of the position of the group consisting of the lamp **48** and the photoelectric cell **47**. When there is an obstructions, caused by superposed or folded documents, the lever **44** controls through the lever **45** the obscuring of the photoelectric cell **47**; the obstruction is signalled as effective if it lasts for a time longer than a preestablished period.

Finally, it is necessary to explain the feature, already mentioned, that the stripping device can operate step-by-step in such a manner as to cause one document at a time to advance along the accelerating path. To this end, the coaxial rollers **107** and **108** are rendered fast by a friction clutch which can be engaged and disengaged on command. The stripping belt **11** and roller **107** are therefore controlled by the motor when the aforesaid friction clutch is engaged and, in this case, they cause the front document of the bundle **3** to advance until it is fed along the accelerating path. When the tail of this document passes beyond the photoelectric cell **75**, in the case of documents of the short class, or the photoelectric cell **76**, in the case of documents of the long class, the friction clutch is disengaged, so that the stripping roller **107**, since it is no longer controlled by the motor, tends to stop and not feed the following separated document any further. Then, when the tail of the first document fed has passed beyond the point corresponding to the photoelectric cell **7**, the friction clutch is reengaged, so that the stripping roller **107** can cause the following document to advance towards the accelerating path.

Lastly, stopping of the motors of the apparatus occurs when the receiving pockets are full. To this end there is provided for the main pocket **70** the signalling microswitch **182** which is closed by the thrust of the plate **171**. A similar signalling microswitch can be provided for the reject pocket **71**.

What we claim is:

1. Apparatus for automatically reading and sorting documents comprising

a loading container for holding a bundle of documents, said container comprising a substantially horizontal platform for engaging one edge of the documents in said bundle and being mounted on flexible supports, a fixed sideplate perpendicular to said platform and engaging another edge of the documents of said bundle,

a movable thrust plate substantially perpendicular to said platform and to said sideplate and biased with constant thrust in a direction parallel to said sideplate for engaging the back of said bundle,

a fixed front plate positioned opposed relationship to said thrust plate for engaging the front of said bundle and opposing the action of said thrust plate,

a feed device for separating and conveying along a given path the document that is at the front of said bundle, said feed device comprising a driven belt stretched between rollers adjacent to said loading container for frictionally engaging one face of said front document, said stripping belt passing over said front plate and being interposed

between said front plate and said front document whereby said front plate backs said stripping belt, said feed device further including a normally stationary rejection band disposed along said path downstream of said stripping belt for frictionally engaging the other face of said front document to hold back the superimposed documents when more than one document is separated from said bundle,

a reading device for reading the data on said documents positioned along said path downstream of said feeding means,

selectively operable sorting means controlled by said reading device according to the data read from said documents for routing said documents into collecting pockets located at the end of said path, and

means for vibrating said platform in a direction perpendicular to the plane of frictional engagement between said stripping belt and said front document to facilitate the separation of said front document from said bundle.

2. Apparatus according to claim 1, wherein the rejection band is normally fixed and stretched between two winding spools, said spools being manually windable moving an unutilized portion of said rejection band from one of said spools and winding a worn portion of said band on the other of said spools.

3. Apparatus according to claim 1, wherein said feed device includes

first means for accelerating the documents along an initial portion of the path and second means acting on the documents for urging them transversely of the path against an aligning surface, said first and second means simultaneously frictionally engaging the opposite faces respectively of each of the conveyed documents,

said second means comprising aligning rollers pivotable about an axis perpendicular to their axis of rotation and normally biased toward a predetermined oblique position with respect to said path, whereby, under the action of said rollers the documents are moved toward said aligning surface and after the edge of the document has come into contact with said aligning surface, said rollers pivot to a position parallel to said path,

said second means further including a slider controllable by the operator for adjusting the normal angle of said rollers with respect to said path.

4. Apparatus according to claim 1, wherein said feed device operates step-by-step to supply one document at a time, the movement of said stripping belt being commanded by a motor selectively coupled to said stripping belt through a friction clutch, said clutch being engaged and disengaged in response to a photoelectric system located downstream of said rejection band in said path and sensing the passage of a predetermined edge of the conveyed document, whereby when said clutch is disengaged said stripping belt is not driven by said motor and does not feed documents.

5. Apparatus according to claim 1, wherein each of said collecting pockets is defined laterally by a slidable plate urged against the documents received in said pocket, and is defined at the bottom by a movable baseplate supported by a belt mounted around pulleys, means being provided for manually shifting of said baseplate in order to vary the depth of the collecting pockets in accordance with the longitudinal dimension of the documents.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,602,369 Dated August 31, 1971

Inventor(s) Francesco Bernardis

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet, insert -- [32] Priority July 30, 1968 Italy 52634-A/68 -- . Column 1, line 70, "mans" should read -- means -- . Column 7, line 66, "harness" should read -- hardness -- . Column 9, line 29, "related" should read -- rotated -- .

Signed and sealed this 14th day of November 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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