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(54) **A machine for loading bundles of signatures and similar products onto pallets.**

(57) The machine is intended to load onto pallets (P) bundles (B), of signatures and similar products, fed to the machine in approximately vertical dispositions. The machine comprises a supporting frame (11) provided with horizontal movement guides (13) having an input end (14) facing outwardly of the frame (11). Mounted on the frame (11) is a horizontal overhead guideway (23) that has an input end (24) which overlies the other end (15) of the movement guides (13), and an output end (25) which, in use, overlies the pallet (P) intended to receive the bundles (B). A carriage (16) provided with a tilting platform for carrying the bundles (B) is movable on the movement guides (13). Associated with the tilting platform of the carriage (16) are control means which hold the platform itself in an approximately vertical position for receiving the bundles (B) when the carriage (16) is located at said input end (14) of the movement guides (13), and which tilt the platform towards a horizontal position when the carriage (16) reaches the end of the movement guides (13) overlain by the input end (24) of the overhead guideway (23). A gripper device (30), acting in a substantially horizontal plane, is movable along the overhead guideway (23) and is capable of undergoing vertical translation movement, at least adjacent the input and output ends (24, 25) of the overhead guideway (23). The gripper device (30) is therefore able both to pick up, adjacent the input end (24) of the overhead guideway (23), a bundle (B) supported by the tilting platform of the said movable carriage (16) when at the said other end (15) of the movement guides (13), and, following translation along the overhead guideway (23) towards the output end (25) thereof, to deposit this bundle (B) taken up from the platform of the movable carriage (16) onto a pallet (P).

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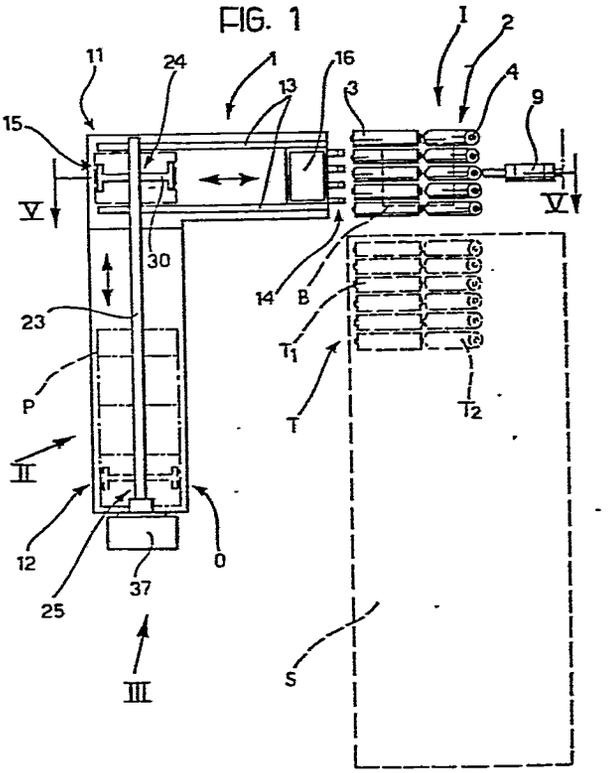
FIG. 1



A machine for loading bundles of signatures and similar products onto pallets

The present invention relates to machines for loading onto pallets, bundles of signatures and similar products such as loose sheets, magazines, and made-up or bound books. In particular, the invention relates to a machine which enables pallets to be loaded with bundles, of signatures and similar products, supplied to the machine in an approximately vertical disposition, that is, an arrangement in which the products forming the bundle are superimposed one upon another in an approximately vertical direction.

The bundles in question, which are also referred to by the generic term "packs", are formed in a cyclic manner at a high rate of production by a stacking machine, (stacker) : one such stacking machine is described, for example, in Italian Patent application No. 67,657A/83 by the same applicant.

To achieve speed and efficiency of working it is necessary to form bundles or packs of considerable weight and dimensions. The manual handling of the bundles to transfer them to subsequent processing operations is therefore difficult, or at least inconvenient.

The transportation problem has been partially resolved by loading the bundles on pallets which can be raised and transferred by means of fork lift trucks. There remains, however, the problem of rapidly loading the bundles onto the pallets.

A further difficulty is the fact that, because of the subsequent operations, it is necessary that the bundles be deposited onto the pallets in a horizontal disposition and in a predetermined orientation:

for example, in the case of bundles of signatures intended for making up into magazines, it is considered preferable, or even essential, for the signatures to be orientated with their spines facing downwards. In general, such an arrangement is not easily and immediately achievable when the bundles are loaded onto a pallet at the output of a stacking machine which superimposes the signatures in approximately vertical directions. As a result, it becomes necessary to provide a machine for loading such bundles onto pallets, which will be able to effect,in a reliable manner, the action of over-turning the bundles themselves.

The object of the present invention is to provide a machine that enables bundles, of signatures and similar products, formed by a stacking machine in approximately vertical dispositions,to be automatically taken and loaded onto a pallet in horizontal dispositions in an ordered and programmed stacking cycle. A particular objective of the invention is to provide a machine which can operate in a completely automatic cycle in such a manner as to prevent any accidents to operators who might need to come near the area in which the machine is installed.

According to the present invention this object is achieved by a machine of the above described type, characterised in that it comprises:

- a support frame provided with horizontal movement guides having an input end facing outwardly of the frame,
- an overhead guideway mounted horizontally on the frame and having an input end overlying the other end of the movement guides and an output end which, in use, overlies a pallet intended to receive the bundles,

- a carriage movable along the said movement guides and provided with a tilting platform for carrying the bundles; control means being associated with the said tilting platform for maintaining the platform in an approximately vertical position for receiving the bundles when the carriage is at the said input end of the movement guides and for causing tilting of the platform towards a horizontal position as the carriage reaches the said other end of the movement guides overlain by the input end of the overhead guideway, and

- gripper means arranged to act in a substantially horizontal plane and movable along the said overhead guideway, the gripper means being arranged to effect, at least adjacent the input and output ends of the overhead guideway, vertical translation movement for the purpose of picking up, adjacent the input end of the overhead guideway, a bundle supported on the movable carriage when at the said other end of the movement guides, and for the purpose, following translation along the overhead guideway towards the output end of the overhead guideway, of depositing onto the said pallet a said bundle taken up from the carriage.

Preferably, the machine of the invention is intended to be used in conjunction with a machine for forming bundles of signatures and the like that is provided with an output conveyor with an approximately horizontal conveyor table for the bundles. In this case, the machine of the invention is characterised by the fact that it comprises a tipping unit for the bundles provided with a pivotal conveyor platform for the bundles, the tipping unit being interposable between the said output conveyor and the input end of the said movement guides in such a manner that the said pivotal conveyor

platform defines a terminal portion of the said output conveyor and the pivoting of the pivotal platform causes the bundles successively fed thereto to fall towards the tilting platform of the said movable carriage when the carriage is located at the input end of the said movement guides.

According to a presently-preferred embodiment, the said tipping unit comprises two flat, substantially orthogonal, rows of tippable rollers, one of which constitutes the said pivotal conveyor platform and the other of which is intended to cooperate in lateral thrust transmission relation with each of the said successively supplied bundles in order to cause the bundle to fall towards the tilting platform of the movable carriage.

In a particularly advantageous embodiment, a plurality of detectors is associated with the said overhead guideway, each detector being sensitive to the gripper means reaching a respective predetermined position in its movement along the overhead guideway, and being arranged to initiate vertical translation of the gripper means at the said respective predetermined position.

The mounting of each such detector is selectively adjustable to vary the corresponding position at which the vertical translation of the element is initiated. This adjustment is normally carried out such that the distance between each two adjacent detectors, measured in the direction of movement of the gripper means along the overhead guideway, is substantially identical with one of the transverse dimensions of the bundle to be loaded on the pallet.

The invention will now be described, purely by way of non limiting example, with reference to the attached drawings, in which:

Figure 1 is a schematic plan view of a machine according to the invention, which illustrates a possible arrangement of the machine itself in a chain for the formation of bundles of signatures and the like in the printing or publishing industry,

Figure 2 is a first perspective view in the direction of arrow II of Figure 1 which illustrates the structure of the machine according to the invention,

Figure 3 is another perspective view of the same machine in the direction of arrow III of Figure 1,

Figure 4 is a further perspective view, from above, in the direction of arrow IV of Figure 2, and

Figure 5 is a schematic section taken on line V-V of Figure 1.

In the drawings, numeral 1 generally indicates a machine intended to load onto a pallet P, in an ordered manner, bundles B of signatures and similar products which are supplied to the machine itself by a stacker generally indicated S.

In a particularly advantageous arrangement, the stacker S is that described in Italian Patent Application No. 67,657-A/83 by the same applicant, already cited hereinabove.

The bundles B are made up of signatures superimposed one upon another in a stacking direction which, when the bundles B are supplied to the machine 1 is orientated in an approximately vertical direction. More specifically, the stacker S is provided with an

output conveyor T constituted by two flat rows of rollers T_1 and T_2. The first of these rows (T_1), formed by rollers the axes of which lie in an approximately horizontal plane, constitutes a conveyor bed for the bundles B. The other row T_2, formed by rollers the axes of which are orthogonal to the axes of the rollers of the row T_1, constitutes, on the other hand, a support bed or, more properly, a roller bed, for one side of each bundle. With reference to the perspective views of Figures 2 to 4, the bundles B leave the stacker machine S moving along the conveyor T in the direction away from the observer. A binding or strapping station is disposed in an intermediate position along the conveyor T; at this station R (visible in Figure 3) bands of plastics material F are applied around each bundle B in order to place the bundled signatures under axial compression and confer a degree of structural rigidity to the bundle B so as to allow the horizontal stacking thereof.

As already indicated above, the bundles B which move along the rollers T_1 and T_2 of the output conveyor T of the stacker machine S are arranged in an approximately vertical disposition; the stacking direction of the signatures is, in fact, inclined towards the interior of the stacking machine at an angle of the order of about $10\text{-}20^{\circ}$ to the vertical. In this way the advance of a bundle B along the conveyor T is reliably ensured without any risk of it accidentally toppling over towards the outside of the stacker machine.

Normally the spines of the signatures collected in the bundle B face towards the exterior of the stacker machine S. The present machine 1 enables such bundles B to be stacked on the pallet P in such a way that

the spines of the signatures face downwardly, this being a particularly advantageous arrangement in view of the subsequent operations to which the signatures themselves are to be passed.

It is however noted that the application described here relating to bundles of signatures constitutes only one example of the possible applications of the machine 1. The machine itself is in fact able to provide automatically an action of pick-up, transfer and loading onto pallets of any type of bundles formed by superimposed flat or flattened objects such as, for example, sheets, bundles of sheets, magazines and books. The same term bundle, utilised in the present description and in the claims which follow, must therefore be interpreted as indicative of any stack or block, even of irregular form, constituted by such superimposed objects.

In the preferred embodiment illustrated here, and as clearly visible in Figure 1, the machine 1 is generally L-shaped in plan with two branches extending orthogonally with respect to one another. It is also possible to identify for the machine 1 an input or feed end generally indicated I and situated adjacent the output of the conveyor T of the stacker machine S, and an output or discharge end, generally indicated O, adjacent which is disposed the pallet P on which the bundles B are to be loaded.

Reference numeral 2 generally indicates a tipping unit disposed at the input or feed end I of the machine 1. The unit 2 is constituted by two flat rows of rollers 3 and 4 having substantially identical characteristics respectively, to the "horizontal" row of rollers T_1 and to the "vertical" row of rollers T_2 of the output conveyor T of the stacker S.

The tipping unit 2 can therefore be disposed at the output of the conveyor T with its rollers 3 aligned with the rollers T_1 and its rollers 4 aligned with the rollers T_2 so that the tipping unit 2 constitutes a terminal section of the conveyor T itself.

As can be best seen in Figure 5, the rollers 3 and 4 are mounted on a structure or support frame 5 comprising two arms 5a, 5b rigidly connected together in a generally L-shape configuration. In particular, in the frame 5 are distinguishable a "horizontal" arm 5a which supports the rollers 3, and a "vertical" arm 5b, which supports the rollers 4.

In the region where the two arms 5a, 5b join, the frame 5 has an asosciated horizontal support shaft 7 which is supported by a base 8 in a manner enabling rotation of the shaft 7 about its axis. A pneumatic actuator 9 which acts between an intermediate region of the arm 5b of the frame 5 and a bracket 10 extending from the supporting base 8, controls the pivoting of the frame 5 (and of the rollers 3 and 4 mounted thereon) about the axis of rotation of the shaft 7.

The pneumatic actuator 9 and the bracket 10 are situated on the rear side of the frame 5, that is, on the side opposite that on which the movement of the bundles B takes place.

By controlling the operation of the actuator 9, the rows of rollers 3 and 4 which are orthogonal to one another can be made to tip towards the exterior of the stacker S in the direction schematically indicated by an arrow in Figure 5. This action causes any bundle B which is on the rollers 3 and 4 to tip or fall

towards the rest of the machine 1.

The tipping or falling of the bundles B is caused both by the pivoting of the row of rollers 3 which define the base platform on which the bundles B rest and by the pivoting of the rollers 4, which cooperate, in thrust transmission relation, with the side of the bundle B which lieson the rollers 4. In this way it is possible to impart to each bundle B a combined rotation and falling movement which can be controlled with precision thereby avoiding the possibility that the bundle B might accidentally fall out of the machine 1. The overall effect of tipping or "ejecting" the bundle B can be further controlled by means of a further actuator 9a mounted on the frame 5, the actuator rod of which carries a plate arranged to exert on the base of the bundle a force expelling the latter from the tipping unit 2.

Reference numeral 11 generally indicates a frame which supports the main part of the machine 1. The frame 11 is generally L-shaped in plan with a first arm extending towards the input end I approximately at right angles to the direction of advance of bundles B along the conveyor T, and a second arm extending towards the output end O parallel to the said direction of advance of bundles B on the conveyor T. The frame is constituted by a reticular structure of metal sections welded together. The frame is moreover provided on its outer surface with metal meshes or sheets of transparent material serving as protective panels intended to prevent the accidental introduction of objects, or access by operators into the interior of the frame 11 itself.

Adjacent the output end O an aperture 12 is provided in the lower part of the frame to allow a pallet P to be deposited on the ground within the frame itself, this pallet P being that upon which it is desired to stack the bundles B in horizontal dispositions. After the bundles B have been stacked on the pallet P, the aperture 12 allows the pallet to be taken away by means of a fork lift truck.

On the first arm of the frame 11, that is, on the arm facing towards the input end I, are fixed two pairs of horizontal movement guides 13 the structure of which can be seen better in the vertical section of Figure 5. In particular, the guides 13 are constituted by a pair of rectilinear upper guides 13a each of which extends along one of the sides of the first arm of the frame 11, and by a pair of lower guides 13b each of which extends below one of the upper guides 13a. Both the upper guides 13a and the lower guides 13b have channel-like cross sections open towards the interior of the frame 11. As can be seen better in Figure 5, starting from the end furthest from the tipping unit, each lower guide 13b initially extends in close proximity to the corresponding upper guide 13a and then diverges gradually downwardly along an approximately circular path near the end facing towards the tipping unit 2.

In correspondence with this latter end, referred to below and in the claims which follow as the input end 14 of the guides 13, the guides 13 themselves face outwards from the frame 11 and are positioned directly in front of the tipping unit 2. The opposite end of the guides 13, indicated 15, is on the other hand situated at the zone of meeting of the two arms of the frame 11.

A carriage for transporting bundles B is mounted on the guides 13 and is generally indicated by reference numeral 16. The carriage 16 is primarily constituted by a platform or rectangular plate 17 of metal the major sides of which extend parallel to the guides 13. Approximately midway along each of the major sides, the platform 17 is provided with two support rollers 18 each of which runs within one of the upper guides 13a.

In correspondence with its front edge, that is, its shorter side that faces towards the tipping unit 2, the platform or plate 17 is provided with two further support rollers 19, each of which runs within one of the lower guides 13b.

The platform or plate 17 is further provided in the region of its front edge with a plurality of arms or prongs 20 which extend from the platform 17 itself towards the tipping unit 2 in a direction at right angles to the platform itself. The arms or prongs 20 constitute a support structure for the bundles B which are successively loaded onto the platform 17 in a manner which will be described hereinbelow.

An electric motor 21 (Figure 5) effects movement of the carriage 16 along the guides 13 via a chain transmission generally indicated 22. When the carriage 16 is driven by the transmission 22 towards the input end 14 of the guides 13, the rollers 19 which run in the lower guides 13b pull the front edge of the platform 17 downwards, whilst the rollers 18 maintain the mid portion of the platform in the plane defined by the upper guides 13a. The overall effect obtained is one of tipping of the carriage 16, the platform 17 of which assumes the approximately vertical position illustrated in solid outline and indicated E_1 in Figure 5.

On the other hand, when the carriage 16 is moved towards the output end 15 of the guides 13, the rollers 19 maintain the front edge of the platform 17 in a raised position in which this front edge of the platform is located practically at the same height as the mid portion supported by the rollers 18. The platform 17 is thus disposed in a horizontal position schematically illustrated in broken outline and indicated E_2 in the right hand part of Figure 5.

Preferably, as illustrated in Figure 5, the rollers 19 project slightly below the platform 17 so that, when the carriage 16 is located close to the output end 15 of the guides 13, the platform 17 is located in an exactly horizontal position.

When the carriage 16 is located adjacent the input end 14 of the guides 13, it faces the tipping unit 2 in such a way as to ensure the secure reception of the bundles B which, as a result of the pivoting of the rows of rollers 3 and 4 controlled by the pneumatic actuator 9, have been given a tipping or falling movement towards the input end 14 of the guides 13. In fact when in its approximately vertical position indicated E_1, the platform 17 and the prongs 20 that extend therefrom form a receiving structure complementary to the support (and "ejection") structure for the bundles B defined by the rollers 3 and 4.

Again, although the orientation of the platform 17 in its position (E_1) has been loosely described as "vertical", the platform 17 is in practice inclined at an angle of about 10-20^{o} to the vertical. The purpose of this is to avoid the possibility of the bundles B loaded onto the platform accidentally falling off.

The chain-dashed line generally indicated C in Figure 5 identifies the position of the rollers 3 and 4 of the tipping unit 2 when the rollers 3 and 4 have been tipped by the actuator 9 to transfer a bundle carried by the rollers onto the platform 17.

The size of the tipping movement effected by the actuator 9, is adjusted in such a way that, when the rollers 4 are positioned at the end of their movement towards the input end 14 of the guides 13, the notional plane defined by the upper faces of the rollers 3 coincides for practical purposes with the plane defined by the upper sides of the arms or prongs 20. In this way the bundles B can be transferred from the tipping unit 2 onto the carriage 16 without risk of the bundles B accidentally being mis-positioned or falling from the machine.

Reference 23 generally indicates a guide or rail mounted horizontally in an overhead position on the portion of the frame 11 defining the second arm thereof.

The rail 23 extends at right angles to the guides 13. The rail 23 has two opposite ends indicated 24 and 25. The end 24 which, as will be better understood hereinafter, constitutes the input end of the portion of the transport path of the bundles B defined by the rail 23, overlies the output end 15 of the guides 13.

The opposite end 25 which is situated at the output end O of the machine 1, overlies the loading region where the pallet P is disposed. The angle or corner region of the frame 11, where the input end 24 of the rail 23 overlies the output end of the guides 13, is clearly visible in Figure 5. In this Figure the reference numeral 15a indicates one of the elements of a photocell sensor arranged to detect the presence of a bundle B lying in a horizontal position on the carriage 16 at the output end 15 of the guides 13.

The structural element 23, generally depicted as an overhead guide or rail, is in effect constituted by two parts, that is, by a lower supporting crosspiece 23a, of double T section, welded to the structure of the frame 11, and by a guide or rail proper 23b which has a generally T-shape profile and is fixed by bolts to the upper face of the crosspiece 23a.

A pneumatic motor 26 is mounted on the frame 11 at the output end 25 of the rail 24. This motor 26 controls, via a chain transmission 27, the movement along the guide 23b of a pick-up and transport unit for the bundles B.

The pick-up and transport unit for the bundles B is substantially constituted by a carriage 28 provided with ball bearings which accurately guide the carriage in its translation movement along the guide 23b. Mounted on the carriage 28 is a support structure extending vertically and generally indicated 29.

The support structure 29 includes a plurality of vertical guides which guide the vertical translation movement of a gripper device 30 constituted,preferably,by the gripper device described in detail in Italian Patent No. 1 020 747. The gripper device 30 is intended to pick-up the bundles B lying on the platform 17 of the carriage 16 when the carriage is located at the output end of the guides 15, and to deposit the bundles B onto the pallet P after having completed a translation movement along the rail 23 from its input end 24 towards its output end 25.

In structural terms (Figure 2) the gripper device 30 comprises a movable assembly 31 which is vertically displaceable by actuators 32 mounted on the structure 29 itself. The movable assembly 31 is provided with a pair of parallel horizontal guides 33 in which slide two opposed jaws 34. These jaws are powered by further

pneumatic actuators 35 which control the opening and closing movement thereof. During a closure operation, the jaws 34 of the gripper device 30 approach one another to clamp the opposite ends of a bundle B in the gripper device. The gripper device 30 is preferably provided with autonomous control elements which will not be described herein detail, but which allow the closure of the jaws to be controlled automatically when the gripper device 30 is placed on a bundle to be picked up from the platform 17 of the carriage 16, and to open again when the bundle B is placed on the surface of the pallet P or on another bundle B already stacked on the pallet P.

For the purpose of understanding the present invention it is sufficient to note that the control elements associated with the gripper device 30 are able to control not only the opening and closing movement of the device 30, but also vertical translation movement, in both directions, of the device 30 itself both at the input end 24 of the rail 23 (that is, at the output end 15 of the guides 13), and at the output end 25 of the rail 23 (that is, in the region in which the pallet P to be loaded is positioned).

The translation movement of the carriage 28 (and consequently of the gripper device 30) in the region of the output end 25 of the rail 23, is controlled using a plurality of proximity sensors 36 some of which are visible in Figure 4. The proximity sensors 36 are mounted on the crosspiece 23a, which supports the guide 23b, in a direction of alignment parallel to the direction of movement of the carriage 28. Each sensor 36, which is a proximity sensor sensitive to the passage of the carriage 28, is mounted on a slide

element 36b the mounting position of which on the crosspiece 23a can be selectively adjusted in dependence on operational requirements.

Whenever, during its translational movement along the guide 23b, the carriage 28 passes in front of one of the sensors 36, this sensor outputs a signal which is transmitted to a central control unit 37 mounted on the frame 11 at the end of the section of the frame 11 on which the overhead rail 23 is mounted.

The central control unit 37 controls the operation of the pneumatic actuator 9 (and of the actuator 9a), the electric motor 21, the pneumatic motor 26, the actuators 31 and 32, and the control devices associated with the gripper device 30, in a predetermined cycle of operations which will now be described starting from an initial situation in which the carriage 16 is located at the input end 14 of the guides 13, the carriage 28 is located at the input end 24 of the rail 23, and the gripper device 30 carried by the carriage 28 is in a raised position with the jaws 34 open above the output end 15 of the guides 13.

It is also assumed that a pallet P has been positioned at the output end O of the frame 11 by introducing it into the frame 11 through the aperture 12.

Now suppose that a bundle of signatures B which has been subjected to a binding or strapping operation at the work station R, is caused to advance on the conveyor T towards the tipping unit 2. At the end of its advance along the conveyor T the bundle B is transferred onto the tipping unit 2 which is held by the actuator

9 in the position illustrated in solid outline in Figure 5.

As soon as the bundle B has moved over the rollers 3 and 4 into a position directly in front of the guides 13, the central control unit 37 causes operation of the actuator 9, thereby effecting pivoting of the frame 5 of the unit 2 about the shaft 7. As a result of the pivoting of the frame 5, which takes place in the direction of the arrow shown in Figure 5, the rollers 3 and 4 impart a falling movement to the bundle B lying thereon causing it to slide towards the carriage 16. This movement is encouraged by the cooperating action of the actuator 9a which pushes the base of the bundle B towards the arms 20 of the carriage 16.

The bundle B is thus moved across to rest on the platform 17 of the carriage 16 which is located in an approximately vertical position E_1. The bundle is supported on the platform 17 by the arms or prongs 20 which cooperate with the smaller side faces of the bundle B. As already mentioned, the chain-dashed line in Figure 5 schematically indicates the outline of the rollers 3 and 4 and of a bundle B supported thereon when the frame 5 on which the rollers are mounted is tipped forward by the actuator 9. When the bundle B has been deposited on the carriage 16 the central control unit 37 activates the motor 21 that controls the movement of the carriage 16. The chain transmission 22 driven by the motor 21 gradually draws the carriage 16 towards the output end 15 of the guides 13.

During movement towards this output end, the platform 17 of the carriage 16 gradually passes from the approximately vertical position E_1 towards the

horizontal position E_2. Thus, movement of the bundle B from the input end 14 towards the output end 15 of the guides 13, is accompanied by tipping of the bundle towards a horizontal position.

In the application referred to by way of example in the present description, the bundles B are supplied to the machine 1 with the spines of the signatures facing the exterior of the stacker machine S. Consequently, these bundles come to lie on the carriage 16 with the spines of the signatures facing towards the platform 17. When the platform 17 reaches the horizontal position E_2 these spines are therefore facing downwardly.

When the carriage 16 reaches the output end 15 of the guides 13 under the action of the drive transmission 22, a microswitch (not visible in the drawings) stops the motor 21 causing the movement of the carriage 16 to cease. The presence of the bundle B lying in a horizontal position on the carriage 17 is detected by the photocell sensor 15a which outputs a corresponding signal to the central control unit 37. The central control unit 37 now commands the actuators 32 to effect gradual lowering of the gripper device 30 towards the bundle B. The fact that the lowering of the gripper device 30 is initiated by the signal emitted by the photocell 15a and not by the microswitch which controls the stopping of the motor 21 ensures that the gripper device 30 is lowered towards the platform of the carriage 16 only when the carriage supports a bundle B, thereby avoiding unwanted actuation of the gripper device which could be dangerous.

After having received the corresponding control signal from the central control unit 37, the

actuators 32 effect the gradual lowering of the gripper device 30 towards the platform 17 of the carriage 16. When, upon such lowering, the movable assembly 31 comes into contact with the bundle B, the actuators 35 effect clamping of the jaws, these latter being initially open. As a result, the gripper device 30 closes on the ends of the bundle, gripping it firmly therewithin. Several moments after the closure of the gripper device 30, the central control unit 37 again activates the actuators 32, this time in a sense causing gradual raising of the gripper device 30 towards the rail 23.

The bundle B is therefore gradually raised with respect to the carriage 16 which is subsequently returned to the input end 14 of the guides 13 to receive a new bundle B from the tipping unit 2. For this purpose the central control unit 37 issues a corresponding actuation signal to the motor 21 after having verified that the bundle B has been raised by the gripper device 30. After the gripper device 30 has been fully raised by the actuators 32, the central control unit 37 activates the pneumatic motor 26 to cause the gradual displacement of the carriage 28, and of the gripper device 30 supported thereby, towards the output end 25 of the rail 23. The pneumatic motor 26 is kept activated until the carriage 28 reaches an end-of-stroke position identified by one of the proximity sensors 36.

In general, the central control unit 37 is programmed in such a way that the amplitudes of successive translation movements performed by the carriage 28 along the rail 23 in the direction from the input end 24 to the output end 25 of the rail 23, vary in a predetermined cyclic manner. The purpose of this particular operating

characteristic will be more fully explained hereinbelow.

When, in its movement along the rail 23, the carriage 28 reaches its said end-of-stroke position as determined by one of the proximity sensors 36 (regardless of whichever proximity sensor it is) the central control unit 37 stops the pneumatic motor 26 and activates the actuators 32 in the sense which again causes the gradual lowering of the gripper device 30.

As a result of the action of the actuators 32, the gripper device 30 which carries the bundle B held fast therewithin, is gradually lowered towards the pallet P.

When, as a consequence of the lowering of the gripper device, the bundle B comes into contact with the upper face of the pallet P (or with the upper face of a bundle B already deposited on the pallet) the actuators 32 are stopped, thus halting the lowering movement of the gripper device 30.

At this point the central control unit 37 activates the actuators 35 such as to cause opening of the jaws 34. The bundle B is thus disengaged from the gripper device 30 and deposited on the pallet. Thereupon the actuators 32 are again activated in a sense to cause raising of the gripper device 30 towards the rail 23. Upon completion of the raising stroke of the gripper device 30, the central control unit 37 re-activates the motor 26 in the sense causing the gradual return of the carriage 28 and the gripper device 30 towards the input end 24 of the rail 23.

In this way, the gripper device 30 is returned to its initial position from where it can again be lowered towards the carriage 16 in order to pick up from the carriage 16 a new bundle B to be deposited onto the pallet P. The process of transporting this new bundle from the input end I of the frame 11 towards the output end O where it is deposited on the pallet P, is achieved by a sequence of operations entirely similar to that previously described.

However, the successive translation movements of the carriage 28 carrying the gripper device 30 towards the output end 25 of the rail 23 have differing amplitudes according to a cyclic law. With reference to the exemplary embodiment illustrated in which there are five proximity sensors 36, during the operation of transporting the first bundle B to be deposited on the pallet P, the carriage carrying the gripper device 30 advances along the rail 23 until it reaches the position identified by the sensor 36 nearest to the input end 24. During the operation of transporting the next bundle B, the carriage 28 advances until it reaches the position identified by the next sensor 36. During the operation of transporting the third bundle, the carriage 28 advances until it reaches the position identified by the third proximity sensor 36, and so on until during the operation of transporting the fifth bundle B the carriage 28 advances until it reaches the position identified by the proximity sensor 36 spaced furthest from the input end 24 of the rail 23.

In this manner, the five successively transported bundles are deposited alongside one another on the

pallet P. The fact that the mounting positions of the sensors 36 on the crosspiece 23a can be selectively adjusted makes it possible for the distance between the positions in which the carriage 28 carrying the gripper device 30 stops at the end of successive bundle-transportation movements, to be adjusted in dependence on the transverse dimensions of the bundles B themselves, that is, in dependence on the transverse dimension (measured in a direction orthogonal to the direction of stacking of the signatures) of the face intended to be uppermost when placed on the pallet P.

It is thus possible to adjust with a high degree of precision the distance which separates two bundles deposited in adjacent positions on the pallet P whereby to avoid marginal superimposition of successively-deposited bundles (which would lead to the deposited bundles eventually toppling in disarray) or the formation of excessively large inter-spaces between adjacent bundles.

The cycle of successive transport operations previously described with reference to the five sensors 36, permits the formation on the pallet P of a first row or, more properly, a first layer of five bundles B adjacent to one another. Onto this layer can subsequently be deposited further bundles picked up in sequence by the carriage 16. The formation of the second layer of bundles B is achieved in a manner entirely analogous to that previously described with reference to the formation of the first layer, with the single difference that the bundles of the second layer are placed onto the bundles already deposited on the pallet. During the operation of transportation of

the first bundle B of the second layer, the carriage 28 carrying the gripper device 30 stops in the position identified by the proximity sensor 36 nearest to the input end 24 of the rail 23. During the operation of transporting the second bundle of the second layer, the carriage 28 advances as far as the position identified by the second proximity sensor and so on.

Naturally, it is also possible to form the successive layers of bundles B by following a back-and-forth pattern, that is, by depositing a first bundle B of the second layer over the last-deposited bundle of the first layer.

The selection of the placement pattern for the stack of bundles can be effected by acting on the central control unit 37.

Further layers can be formed on top of the second layer of bundles B until a stack of bundles of the desired height and dimensions has been formed.

Naturally, the only limit imposed on the formation of successive layers is that set by the fact that the overall height of the stack formed on the pallet P must be less than the height of the aperture 12 in the frame 11. If this were not the case it would no longer be possible to remove the stack from the frame 11.

The present description has been made with reference to a preferred embodiment of the invention.

CLAIMS

1. A machine for loading onto pallets (P) bundles (B), of signatures and similar products, supplied to the machine in approximately vertical dispositions, characterised in that it comprises:

- a support frame (11) provided with horizontal movement guides (13) having an input end (14) facing outwardly of the frame (11),

- an overhead guideway (23) mounted horizontally on the frame (11) and having an input end (24) overlying the other end (15) of the movement guides (13) and an output end (25) which, in use, overlies a pallet (P) intended to receive the bundles (B),

- a carriage (16) movable along the said movement guides (13) and provided with a tilting platform (17) for carrying the bundles (B); control means (18, 19) being associated with the said tilting platform (17) for maintaining the platform (17) in an approximately vertical position (E_1) for receiving the bundles (B) when the carriage (16) is at the said input end (14) of the movement guides (13) and for causing tilting of the platform (17) towards a horizontal position (E_2) as the carriage (16) reaches the said other end (15) of the movement guides (13) overlain by the input end (24) of the overhead guideway (23), and

- gripper means (30) arranged to act in a substantially horizontal plane and movable along the said overhead guideway (23), the gripper means being arranged to effect, at least adjacent the input and output ends (24, 25) of the overhead guideway (23), vertical translation movement for the purpose of picking up, adjacent the input end (24) of the overhead guideway (23), a bundle supported on the movable carriage (16) when at the said other end (15) of the movement guides (13), and for the purpose, following translation along the overhead guideway

(23) towards the output end (25) of the overhead guideway (23), of depositing onto the said pallet (P) a said bundle taken up from the carriage (16).

2. A machine according to Claim 1, intended to be used in conjunction with a machine (S) for forming bundles of signatures and the like (B) that is provided with an output conveyor (T) with an approximately horizontal conveyor bed (T_1) for the bundles (B), characterised in that it includes a tipping unit (2) for the bundles (B) provided with a pivotal conveyor platform (3) for the bundles (B), the tipping unit being interposable between the said output conveyor (T) and the input end (14) of the said movement guides (13) in such a manner that the said pivotal conveyor platform forms a terminal portion of the said output conveyor (T) and pivoting of the pivotal platform (3) causes bundles (B) successively fed thereto to fall onto the tilting platform (17) of the said movable carriage (16) when the carriage (16) is at the input end (14) of the said movement guides (13).

3. A machine according to Claim 2, characterised in that the said tipping unit (2) includes two substantially mutually orthogonal flat rows of tippable rollers (3,4) one of which (3) constitutes the said pivotal conveyor platform and the other of which (4) is intended to cooperate in lateral thrust transmission relationship with each of the said successively supplied bundles (B) in order to cause the bundle (B) to fall towards the tilting platform (17) of the movable carriage (16).

4. A machine according to Claim 3 or Claim 4, characterised in that the said tipping unit (2) includes a fluid pressure actuator (9) which

controls the pivoting of the said pivotal platform (3).

5. A machine according to any of Claims 1 to 4, characterised in that the said movement guides (13) and the said overhead guideway (23) are substantially rectilinear and orthogonal to one another.

6. A machine according to any of the preceding Claims, characterised in that the said movement guides (13) include a pair of upper parallel rectilinear horizontal guides (13a) and a pair of lower guides (13b) each of which extends below a respective upper guide (13a) in close proximity to the upper guide (13a) at the said other end (15) of the movement guides (13) and divergent downwardly from the corresponding upper guide (13a) at the input end (14) of the movement guides; and in that the said tilting platform (17) of the carriage (16) is substantially constituted by a plate-like body having first support members (18) running in the said upper guides (13a) and second support members (19) running in the said lower guides (13b); the said second support members (19) lying between the said first support members (18) and the input end (14) of the movement guides (13).

7. A machine according to Claim 6, characterised in that the said tilting platform (17) is of rectangular form and has two lateral edges each of which extends in a plane parallel to the said movement guides (13), and a front edge facing the input end (14) of the said movement guides (13); and in that the said first support members (18) are situated in corresponding intermediate positions along the said lateral edges and the said second support members

(19) are disposed adjacent the said front edge.

8. A machine according to any preceding claim, characterised in that a plurality of detectors (36) is associated with the said overhead guideway (23), each detector being sensitive to the gripper means (30) reaching a respective predetermined position in its movement along the overhead guideway (23), and being arranged to initiate vertical translation of the gripper means (30) at the said respective predetermined position.

9. A machine according to Claim 8, characterised in that adjustment means (36b) are associated with each said detector (36), the adjustment means enabling selective adjustment of the said respective predetermined positions at which vertical translation of the gripper means (30) is initiated.

10. A machine according to Claim 8 or Claim 9, characterised in that the spacing between two adjacent said detectors (36), measured in the direction of movement of the gripper means (30) along the overhead guideway (23), is substantially identical to one of the transverse dimensions of the bundles (B) to be loaded onto the pallet (P).

FIG. 1

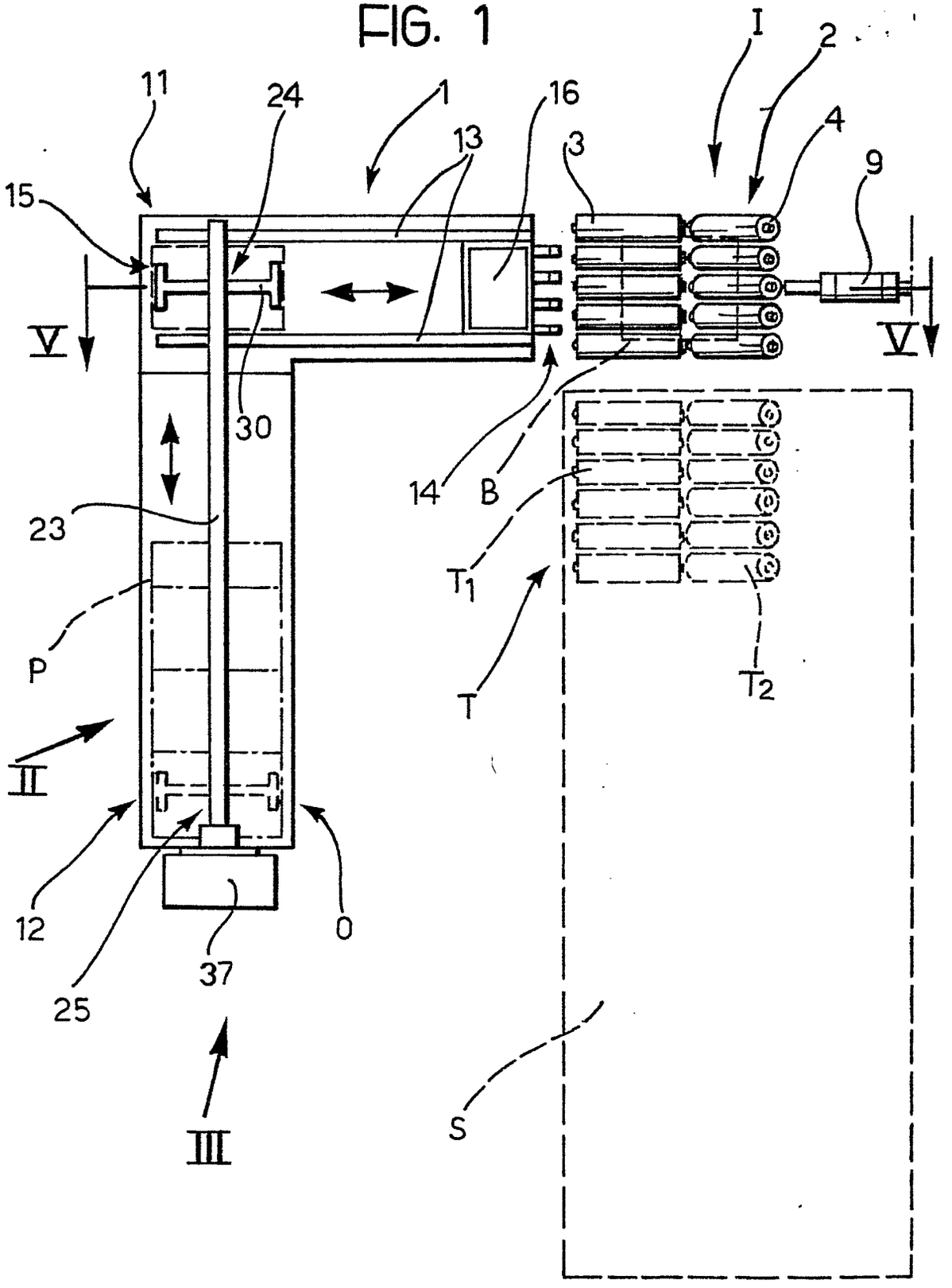


FIG. 2

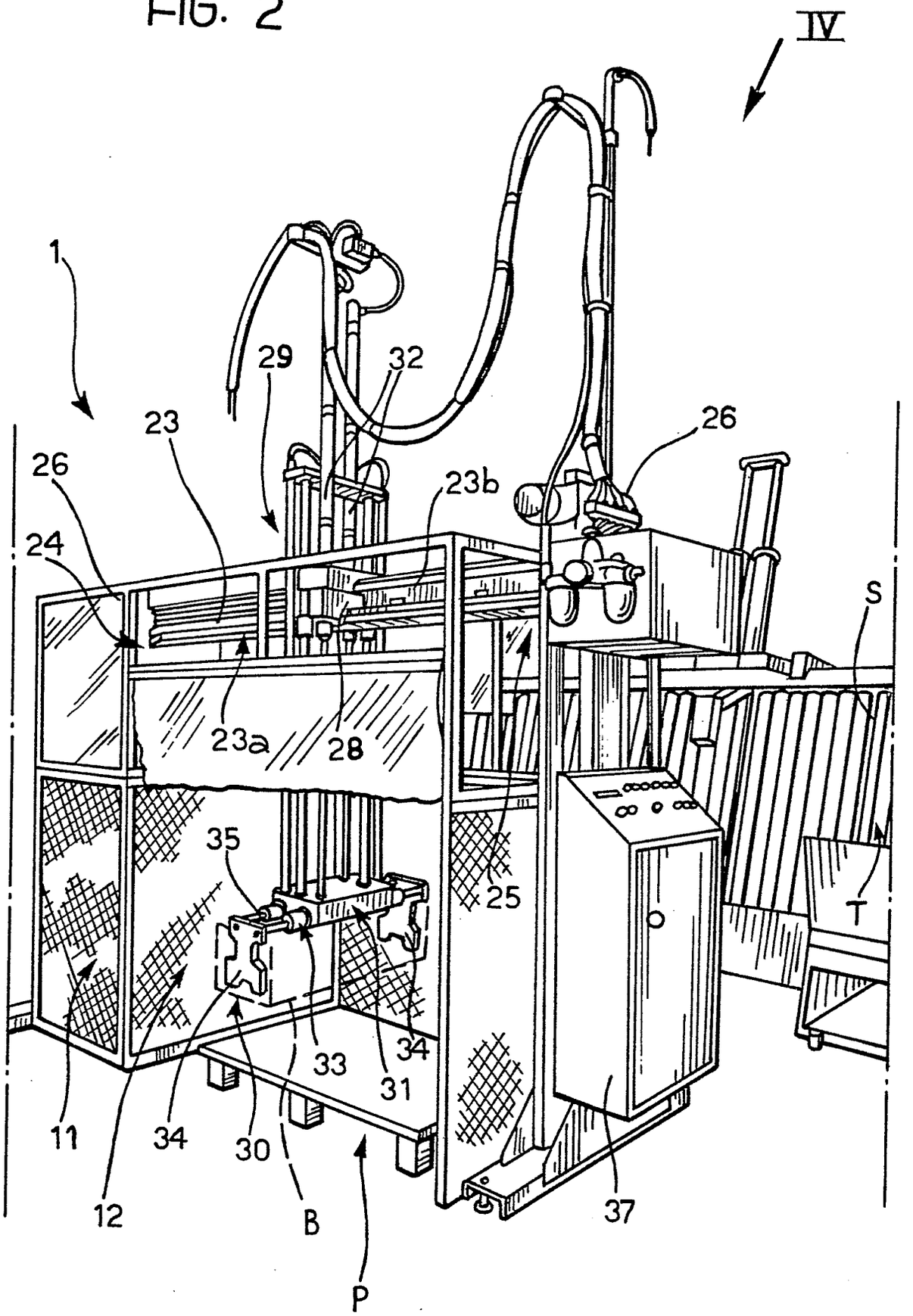


FIG. 3

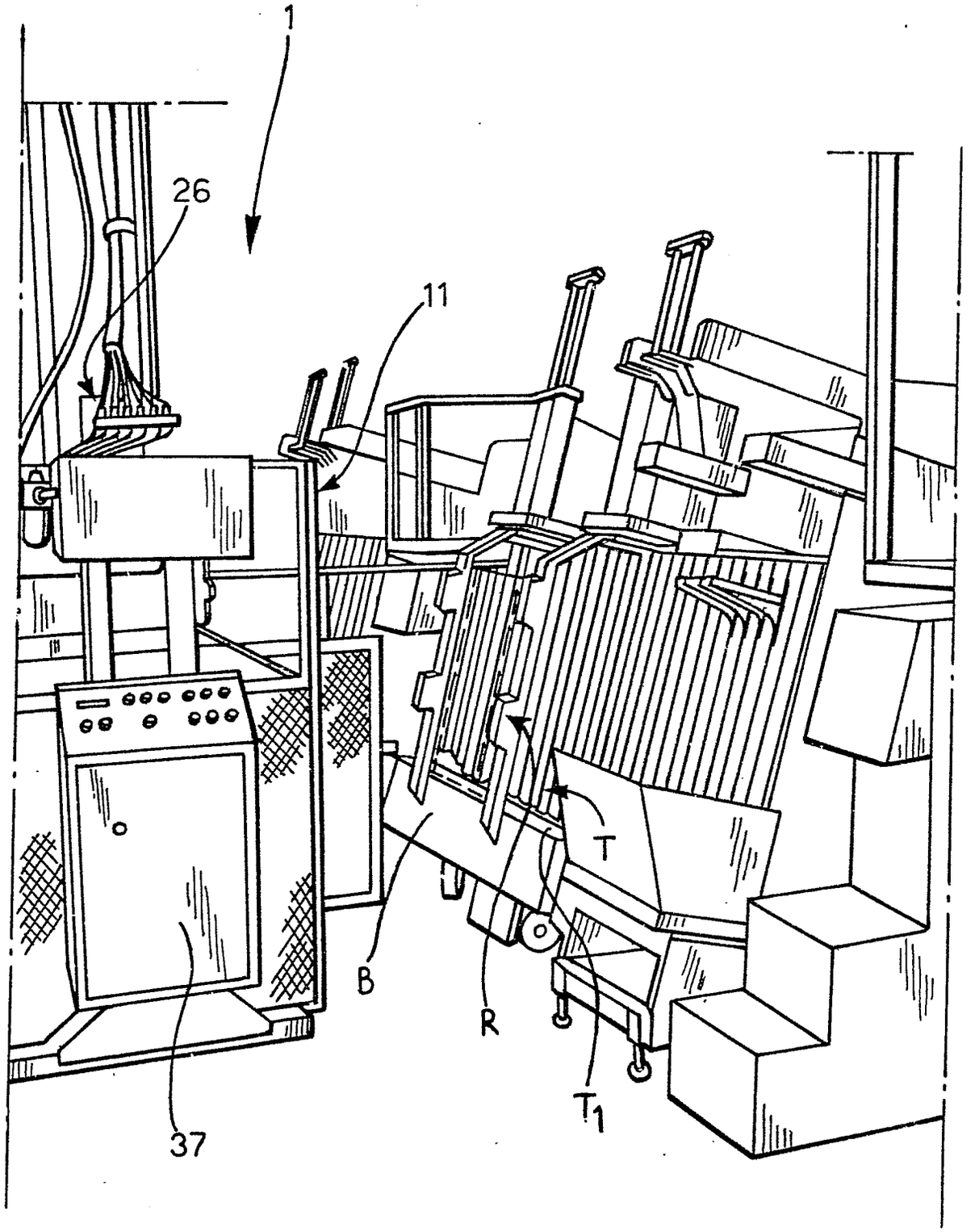
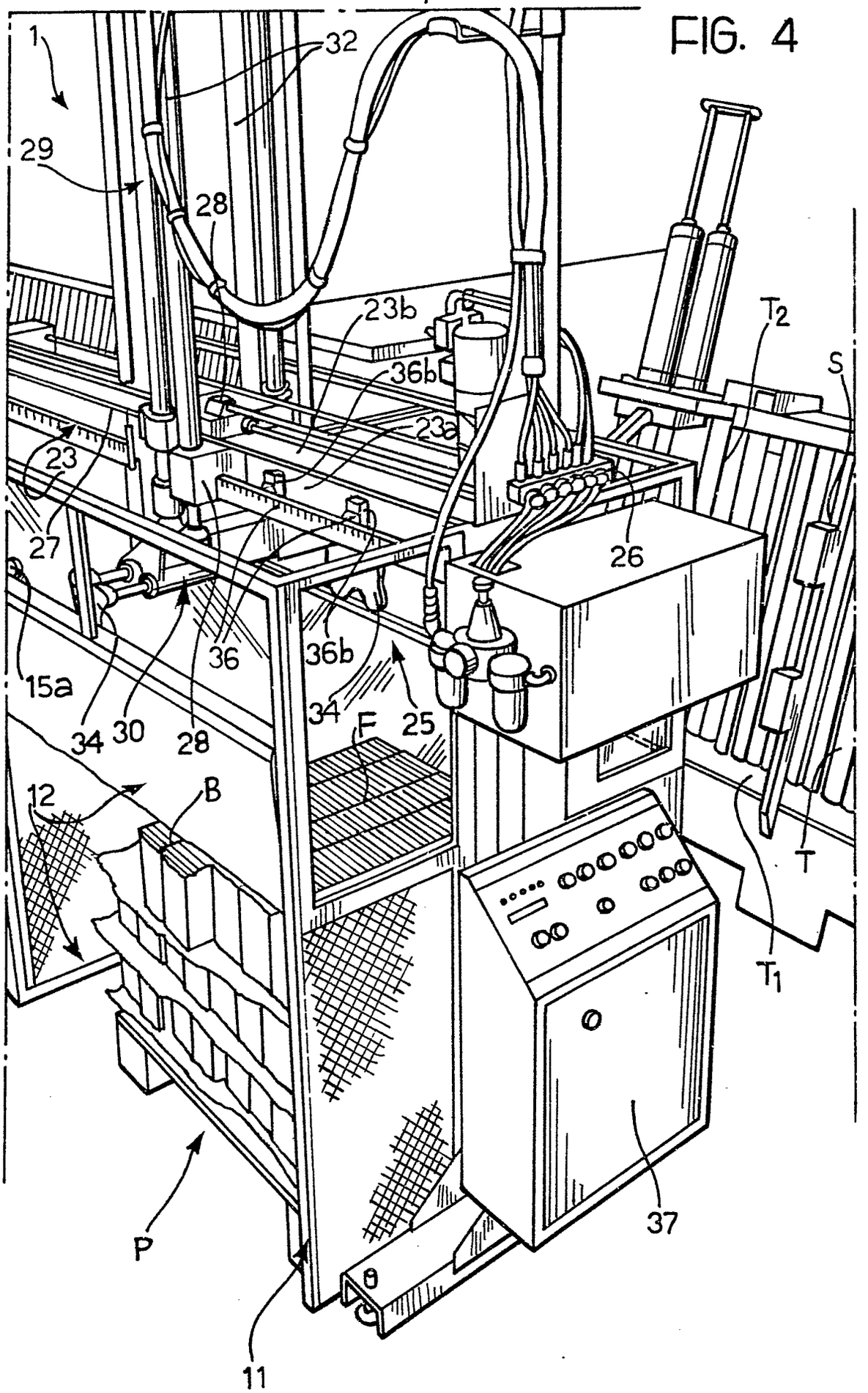


FIG. 4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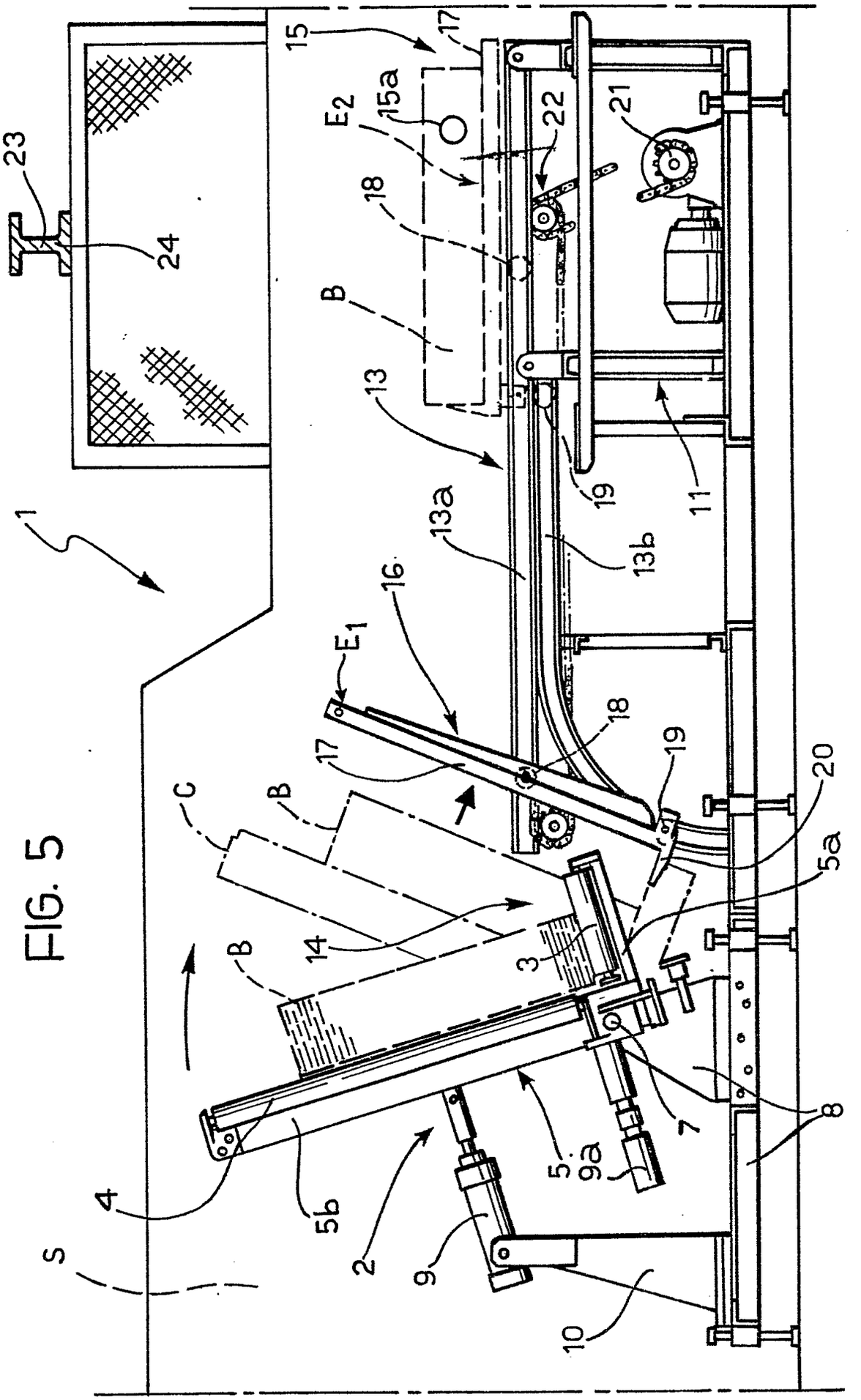
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FIG. 5