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⑤4 Sheet dispenser.

(57) A sheet dispenser including a vertically displaceable piling table (12) with spring means (21) for urging the table upwardly, and position control means (26) for arresting the lifting of the piling table under the control of position sensing means (35, 36) that is responsive to the position of the upper sheet of a stack of sheets on the piling table. The position control means is arranged to permit downward displacement of the piling table under a force that exceeds the force exerted by a complete stack (13) of sheets. The sheet dispenser permits a ready reloading with sheet packets of uncritical heights.

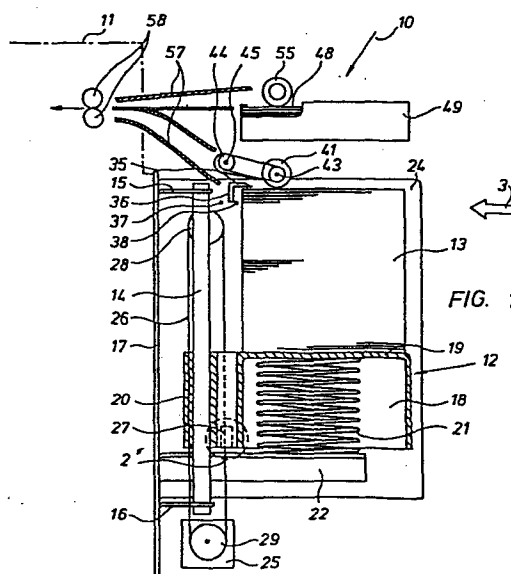


FIG. 1

Sheet dispenser

The present invention relates to a sheet dispenser for removing in succession the top sheet of a stack of sheets, and which is particularly suitable for use in plain paper copying apparatus.

Sheet dispensers of the described kind are known which comprise a vertically displaceable piling table that is coupled for example by an endless belt with an electric driving motor for raising and lowering the table in response to an electric control signal from a sensor that senses the position of the upper sheet of a stack of sheets piled on the table. By such means the upper sheet of a stack of sheets is maintained at a constant level, in spite of the decreasing height of the stack as the sheets are taken off and dispensed one by one by an appropriate mechanism.

Sheet dispensers of the described kind are known for instance from the disclosure of EU Pat. Appl. No. 0 075 974 A1 entitled : "Method of controlling an electrographic device and a device of this kind for carrying out this method; and from EU Pat. Appl. No. 0 060 774 A1, entitled "Machine séparatrice de feuilles".

A difficulty with these dispensers arises when reloading. Prior to reloading, the drive of the piling table must be controlled to lower the piling table over a distance that is at least equal to the thickness of a packet of sheets to be loaded, since usually the sheet dispensing mechanism does not allow the upper sheet of the stack to be above the normal operating level. The lowering of the table by the driving means occurs rather slowly since the mechanism is mostly driven through a high-reduction gear in order to obtain a fine control of the level of the upper sheet. Automatic lowering of the piling table at the moment of depletion of the stack of sheets is feasible, but usually an operator will add paper to the stack between times, and this requires a manual command followed by a waiting period. This waiting period becomes longer as the dispenser is arranged for receiving large sheet stacks, e.g. stacks of 2000 sheets, that are reloaded from packets each of up to 500 sheets.

It is the object of the invention to provide a sheet dispenser which enables an operator to reload the dispenser at any time with one or more stacks of sheets, and without having first to wait for a corresponding lowering of the piling table.

The invention provides a sheet dispenser for removing in succession the top sheet of a stack of sheets of the type comprising a vertically

GV.1265

displaceable piling table for supporting a stack of sheets and which is upwardly displaceable by the action of spring means, position control means for controlling the vertical position of the table in response to a signal from a position sensor sensing the position of the upper sheet of a said stack, and sheet conveying means for engaging the top sheet of a said stack and separating a said sheet from the stack and conveying it towards a required destination; characterised in that the said spring means urges the said piling table when carrying a stack of sheets upwardly so that the top sheet of the said stack of sheets contacts the said sensor, and in that the position control means is a braking means for braking the lifting of the piling table by the action of the said spring means in response to a control signal from the said position sensor, while permitting downward displacement of the piling table against the action of the said spring means under a force exceeding the weight of a complete stack of sheets on the said piling table.

A spring loaded piling table for lifting a stack of sheets is described for instance in USP 3,086,770 entitled "Apparatus for separating flat piled articles", but such a table co-operates with restraining means namely a drum bearing on the upper sheets of the stack of sheets, so that it is less suitable for use in dispersers in that they do not permit easy reloading, even partially, of the piling table with fresh sheets.

In reloading a sheet dispenser according to the invention, an operator can take a set of sheets of arbitrary depth from a packet of sheets, holding one (trailing) end of the set with one hand and locating the opposite (leading) end of the set on top of the depleted stack of sheets on the piling table, pushing the sheet set with the other hand and thus pushing the piling table downwardly, and then advancing the fresh sheet set so as to be congruent with the depleted sheet stack. In an alternative procedure an operator can firstly lower the piling table by pushing on the remaining stack of sheets, and then locate the new set of sheets on the older sheet stack.

According to an advantageous embodiment of the invention, the braking means comprises a flexible belt that is coupled to the piling table and moveable around a rotatable member the rotation of which can be locked by a brake. Such an arrangement is inexpensive, and its mounting and adjustment are uncritical.

The brake may suitably be formed by a permanent-magnet type AC motor GV.1265

with a high-ratio reduction gear. The current-less motor operates as a brake and prevents rotation of the rotatable member by the belt, under the upward biasing force by the spring means of the piling table.

Energizing of the motor slowly causes the unwinding of the belt from the drum, and the corresponding rising of the piling table.

The downward displacement of the piling table under pressure exerted by the operator, the braking means remaining operative, may suitably be obtained by the provision of a uni-directional mechanical coupling between the piling table and the braking means.

The invention will be described hereinafter by way of example with reference to the accompanying drawings, wherein :

Fig. 1 is a diagrammatic side view of one embodiment of a sheet dispenser according to the invention,

Fig. 2 is a detail view of the encircled portion 2 of Fig. 1,

Fig. 3 is a front view of the dispenser according to the arrow 3 of Fig. 1,

Fig. 4 illustrates the driving of the sheet dispensing rollers,

Fig. 5 shows the electric control of the braking motor for the piling table,

Fig. 6 illustrates the reloading of the piling table.

Referring to Fig. 1, there is illustrated a sheet dispenser generally indicated by 10 that can be incorporated in, or be fitted as a separate unit to, a xerographic printing apparatus 11 shown in broken lines. The sheet dispenser is controlled by the xerographic printer to deliver in timed sequence a plain paper sheet to the printer so that a developed toner image may be transferred thereon from a semi-conductor drum onto which it was produced.

The sheet dispenser comprises a piling table 12 for supporting a stack 13 of sheets. The piling table is vertically displaceable along a stationary guide rod 14 that is fitted with brackets 15, 16 to a vertical wall 17 of the dispenser. The piling table is in the present embodiment a one component plastic member that has been integrally formed by injection molding and that has a boxlike part 18 with open bottom and a top-wall forming a platform 19 for the stack of sheets, and a sleeve 20 that slidably fits on the guide rod 14. Inside the part 18 there is provided a compression spring 21 the lower side of which rests on a support 22 that is fitted likewise to the wall 17. The characteristics of the

GV.1265

spring 21 are such that it is capable of urging the piling table 12 upwardly at all vertical positions ranging from the lowest position as illustrated in which the stack of sheets has its maximum height, into the highest position at which the platform 19 takes the position of top sheet of the stack illustrated in the Figure. The piling table is prevented from rotation about the rod 14 by the vertical side walls 23 and 24, see Fig. 3, that may be provided with means (not shown), for accurately adjusting the mutual distance between them.

The upward biasing of the piling table is kept under control by braking means comprising a braking motor 25, an endless belt 26, and a uni-directional coupling 27 between the table and the belt. The belt is in the present embodiment a so-called timing belt which is a flat belt provided with a plurality of teeth at the innerside of the loop, that runs at the upper position over an idler pulley 28 and at the lower position over a pulley 29 that is fitted to the output shaft of a reduction gear-incorporated in the housing of the motor 25.

The uni-directional coupling between the piling table and the belt is illustrated in detail in Fig. 2 which is an enlarged view of the encircled part 2 in Fig. 1. To a wall section of the piling table there are fitted a backing support 30, and a clamping jaw 31 pivotable at 32 and biased by a spring 34 so as to be urged towards the support 30. The clamping jaw is provided with three teeth 33 that are shaped so as to permit downward displacement of the jaw, and thus also of the piling table that is connected therewith, along the stationary belt 26, but to prevent upward movement of the locking mechanism with respect to the belt.

The sensing of the vertical position of the stack of sheets occurs by an angled sensing finger 35 that is arranged for limited vertical displacement and that is provided with a flag 36 for interruption of a ray of light from a light source 37 towards a sensor 38. The horizontal portion of the finger 35 rests on the leading margin of the top sheet of the stack, near a corner of the sheet, and constitutes together with a second finger 40 near the other end of the leading margin, see Fig. 3, a separating means for separating the upper sheet from the stack of sheets as the upper sheet is being advanced by sheet dispensing roller sections 41 and 42. This mechanism is known in the art and is based on the bending of the leading corner portions of the upper sheet as this sheet is being advanced, whereby said corner portions are pulled from under the separat-

GV.1265

ing fingers and jump on top of the fingers, thereby causing the further guidance of the sheet over said fingers.

The sheet dispensing means is formed by two roller sections 41 and 42 that are fitted to a shaft 43 mounted for free vertical displacement within certain limits. The rollers are covered with a material with a friction coefficient that is higher than the mutual friction between the sheets, e.g. rubber or the like, and the shaft 43 is driven through an endless belt driven by a gear 44 fitted to a bodily stationary shaft 45. The shaft 45 is provided with an electromagnetic clutch 46 and a gear 47.

Another stack 48 of sheets that is contained in a magazine 49 provided on top of the stack 13 of sheets, is likewise provided with dispensing roller sections 50 and 51 that are fitted to a shaft 52 that likewise is provided with an electromagnetic clutch 53 and a gear 54. Gears 47 and 54 are driven by an electric motor 55 via a belt 56, see Fig. 4, and appropriate energizing of either one of both clutches permits to select which dispenser mechanism will be operated. The stack of sheets contained in the magazine 49 is spring-biased at its lower side, so that the upper sheet always takes the same position at the dispensing opening of the magazine. The object of the magazine is to contain sheets of a less used type, e.g. front sheets with a pre-printed logo or heading, whereas the stack 13 may comprise unprinted paper sheets.

Sheets dispensed from either one of the two stacks are conveyed via guides 57 towards a pair of sheet driving rollers 58 that take over the further transport of dispensed sheets in the apparatus 11.

The control of the piling table 12 is as follows, with reference to Figs. 1 and 5, and taking the situation that the braking motor 25 is energised, thereby not to exert any braking action on the belt 26. The spring 21 urges the piling table 12 upwardly until the top sheet of the stack 13 lifts the sensor finger 35. Removal of the fan 36 from the position detector 37,38 causes switch 59 to open, whereby the motor 25 is de-energised so that the belt and thereby also the table comes to rest.

As one or a few sheets have been removed from the stack, the position detector 37, 38 is signalled by the lowering finger 36 to energize the motor 25 again, to correspondingly raise the piling table. In order to avoid a repeated energizing and de-energizing of the motor 25, a control circuit 60 has been provided between the switch 55 and the motor 25. The circuit is responsive to the number of sheets dispensed from the stack,

GV.1265

which sheets are counted by a counter 61. Thus, even if the position of the top sheet of the stack has been lowered until the switch 59 is closed, the control circuit 60 keeps the motor circuit interrupted until the counter 61 signals that a pre-set number of, e.g. 10 or 20 sheets has been removed. At that moment the motor circuit is closed and the piling table is raised over a height corresponding with the thickness of the packet of sheets that has been removed.

The floating roller sections 41 and 42 of the dispensing mechanism tolerate the varying level of the top sheet of the stack that results from the described method of control.

The loading of the dispenser with a fresh stack of sheets can occur as follows with reference to Fig. 6 wherein the piling table has been illustrated in the highest position. The operator first switches off the table control mechanism, and then he pushes with one hand on the table thereby to lower the table into a position that may be the lowest position of the table, but that may also be higher provided it leaves sufficient room for the introduction of the new stack of paper. The new stack is then inserted and the control mechanism is switched on so that the table is raised until the top sheet has got the required position.

In an alternative way, e.g. when no upper magazine such as 49 is provided, the operator may put a fresh stack of sheets with the leading end on the table, as illustrated by the broken line rectangle 62, and lower the piling table by pushing on the leading end of the new stack. Once the table has been sufficiently lowered, the new stack of sheets may be further advanced thereby to coincide with the platform of the piling table or with the old stack of sheets thereon.

The following data illustrate one embodiment of a sheet dispenser according to the invention.

Capacity of stack 13 : 2000 sheets

Capacity of magazine 49 : 250 sheets

Vertical course of piling table : 21 cm

Motor 25 : synchronous 50 Hz A.C. motor, 2.8 Watts, reduction gear 1:600,
output shaft 1 revolution/min

Controller 56 : operative every 10 sheets

Spring bias at lower table position : 160 N

Spring bias at upper table position : 40 N

It will be understood that a dispenser according to the present invention.

GV.1265

vention is not limited to the described embodiment.

The piling table can be constructed from sheet metal, and for smaller series of apparatus this may be a cheaper construction than the disclosed injection moulding technique.

The braking means must not necessarily be a motor. For instance spring biased brake shoes may be used that engage a brake disc that rotates together with a belt pulley. Opening of the brake can occur electromagnetically. Still other known braking means may be considered, although it appears that the disclosed use of the permanent magnet type synchronous motor provides a very economic brake in the present application.

The position sensor may be of another type, and may be arranged for very precise control of the position of the piling table in case no floating dispenser rollers are used.

The endless belt of the piling table braking mechanism may be replaced by a straight belt section, one end of which is attached to the piling table and the other end of which is attached to a spring-loaded drum, e.g. a drum biased by an incorporated spiral spring, that winds the belt as the table is being pushed downwardly. The pulling force that can be exerted on the belt by the mentioned drum is notably smaller than the force exerted by the piling table. The drum is further provided with uni-directional locking means so that the drum may wind the belt as the belt becomes slackened by the piling table being lowered, but so that the drum cannot unwind as the table is released by the operator and tensions the belt. The mentioned locking means may be unlocked under the control of suitable top sheet sensing means, thereby to enable the piling table to be raised by the spring means 21 until the top sheet of the stack has obtained the required position.

Finally, the coupling illustrated in Fig. 2 may be replaced by a free-wheel coupling incorporated in the belt pulley 29 of the motor 25, and the belt 26 may be fixedly attached to the piling table 12.

CLAIMS

1. A sheet dispenser for removing in succession the top sheet of a stack of sheets of the type comprising a vertically displaceable piling table for supporting a stack of sheets and which is upwardly displaceable by the action of spring means, position control means for controlling the vertical position of the table in response to a signal from a position sensor sensing the position of the upper sheet of a said stack, and sheet conveying means for engaging the top sheet of a said stack and separating a said sheet from the stack and conveying it towards a required destination; characterised in that the said spring means (21) urges the said piling table (12) when carrying a stack (13) of sheets upwardly so that the top sheet of the said stack of sheets contacts the said sensor (35, 36), and in that the position control means is a braking means for braking the lifting of the piling table by the action of the said spring means in response to a control signal from the said position sensor, while permitting downward displacement of the piling table against the action of the said spring means under a force exceeding the weight of a complete stack of sheets on the said piling table.

2. A sheet dispenser according to claim 2, wherein braking means comprises a flexible belt (26) that is coupled to the piling table (12) and carried on a rotatable member the rotation of which can be locked by a brake.

3. A sheet dispenser according to claim 2, wherein said flexible belt is an endless belt (26) that runs over two vertically spaced pulleys, one of said pulleys being an idler pulley (28) and the other pulley being the said rotatable member (29) that is controlled by a brake.

4. A sheet dispenser according to claim 3, wherein said brake is formed by a permanent magnet type AC motor (25) with a high-ratio reduction gear.

5. A sheet dispenser according to claim 2 or claim 3, wherein the coupling of the piling table to the flexible belt occurs through a unidirectional mechanical coupling (27) that enables an operator to push the table downwardly, the belt (26) remaining arrested.

6. A sheet dispenser according to claims 4 and 5, wherein said unidirectional coupling is formed by a toothed endless belt (26), and a cooperating spring-biased pawl mechanism (31,30) fitted to the piling table.

7. A sheet dispenser according to claim 6, wherein said belt is a

GV.1265

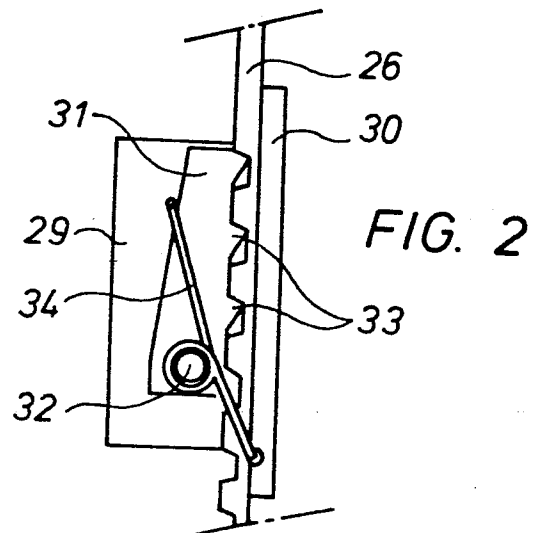
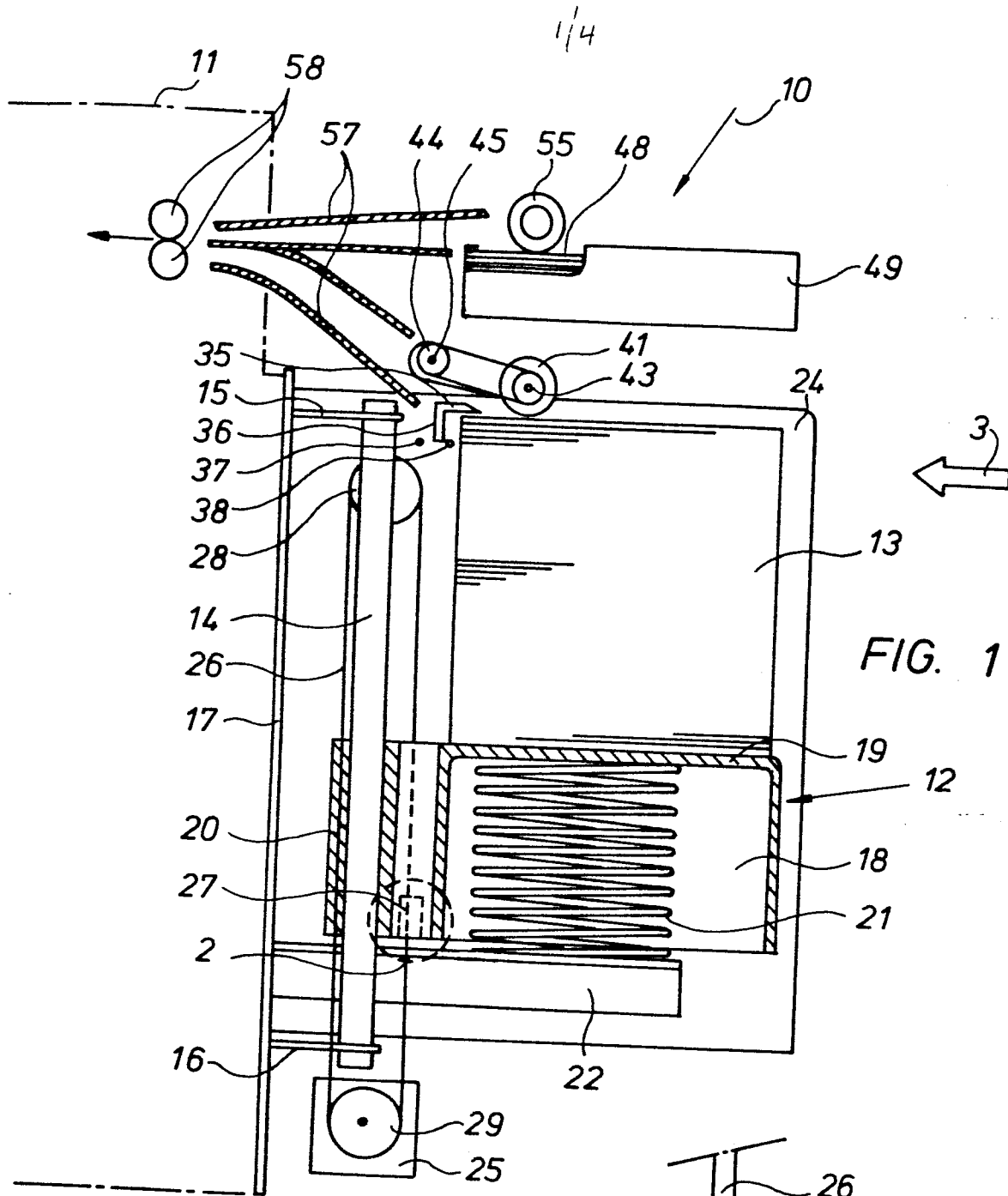
timing belt.

8. A sheet dispenser according to any of claims 1 to 7, wherein said piling table (12) is vertically movable along a guiding rod (14).

9. A sheet dispenser according to any of claims 1 to 8, wherein the sensor co-operates with control means that switches off the control function of the sensor after the upper sheet of a stack on the piling table has been brought up to a predetermined level, and that restores the control function of the sensor after a pre-set number of sheets has been removed from the stack.

10. A xerographic copying apparatus, incorporating a sheet dispenser as claimed in any of claims 1 to 9.

11. A xerographic copying apparatus according to claim 10, incorporating a fixed piling table (49) for holding a second, smaller stack (48) of sheets above the stack (13) of sheets held by the displaceable piling table (12).



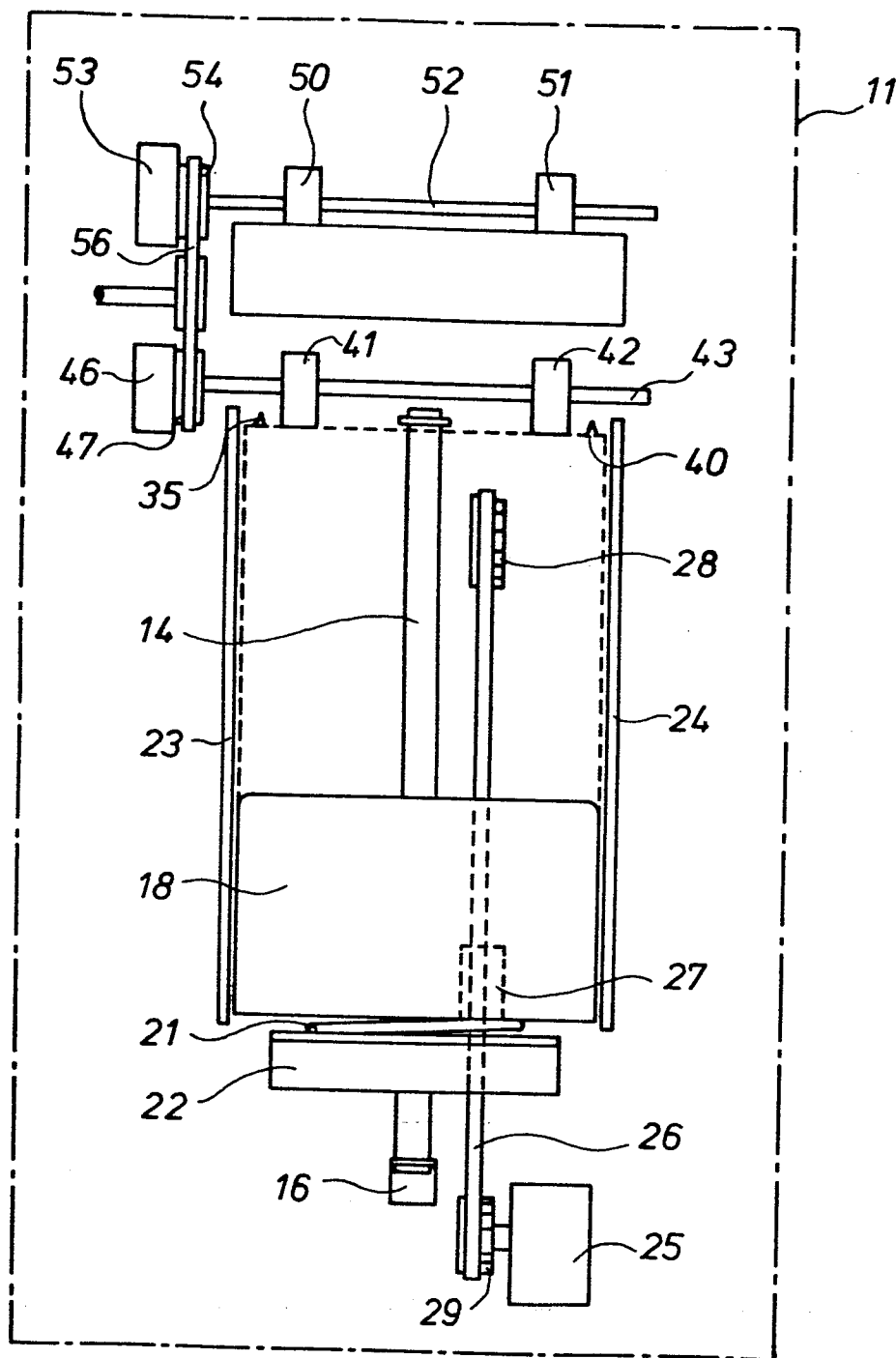


FIG. 3

3/4

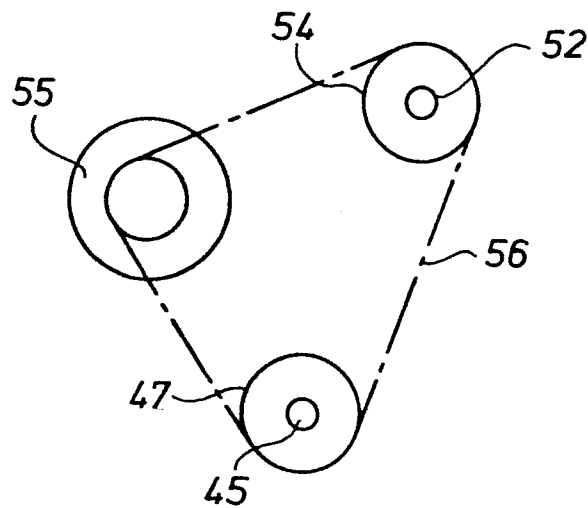


FIG. 4

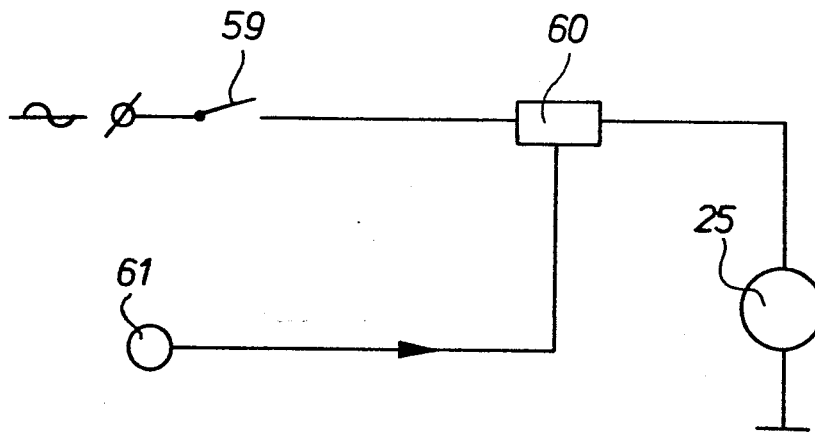


FIG. 5

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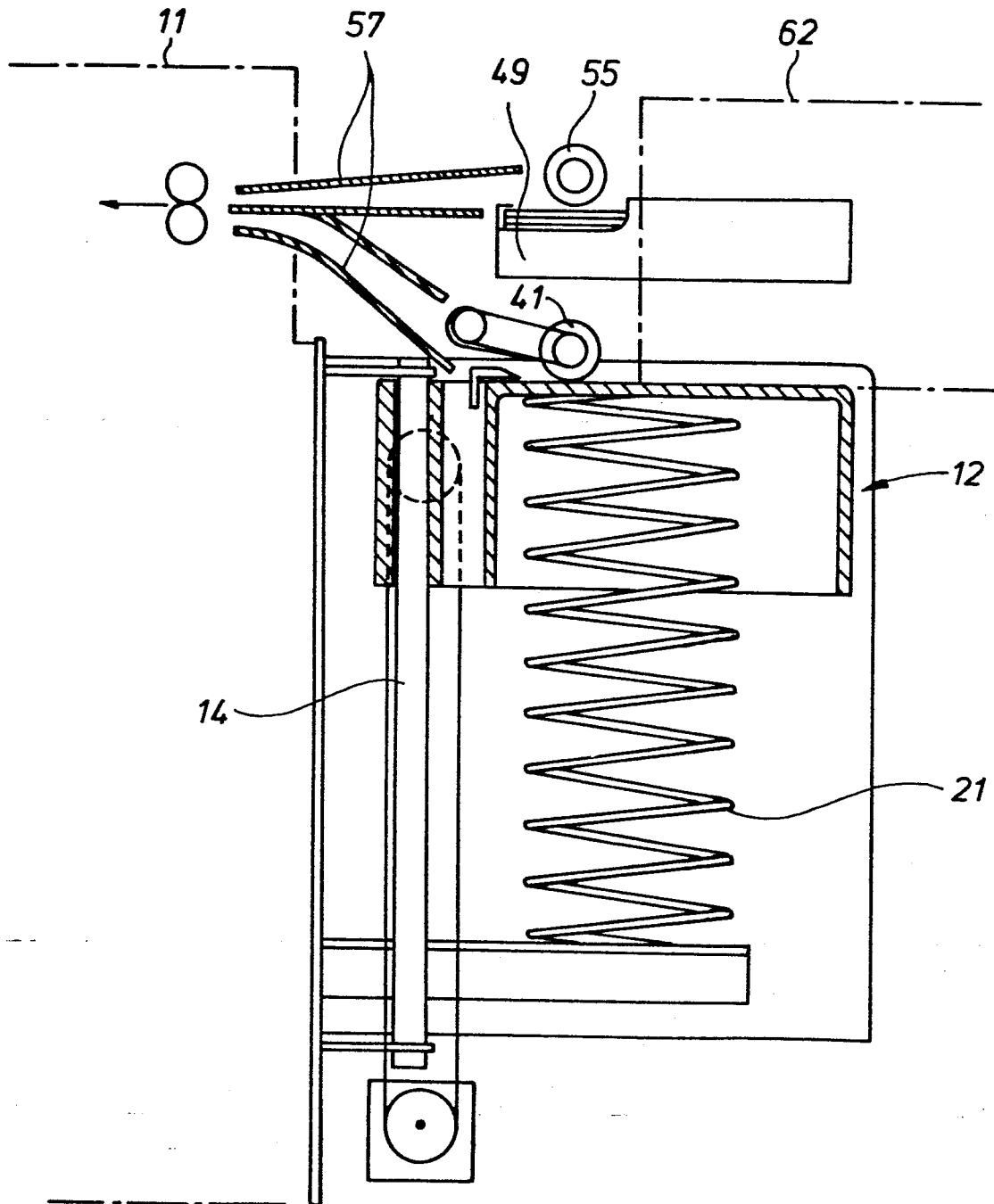


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

01 39790

Application number

EP 83 20 1563

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	US-A-4 049 257 (FRYSTAK) * Abstract; column 3, line 8 - column 4, line 19; claims 1,2; figures 2,4 *	1,8-10	B 65 H 1/12
Y		11	
A		4,5	
Y	--- GB-A-2 019 366 (SAVIN CORP.) * Abstract; page 3, lines 57-74; figures 2,4 *	11	
A		5	
D,A	--- EP-A-0 075 974 (OCE-NEDERLAND B.V.)	1,10	TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
D,A	--- EP-A-0 060 774 (DUPERRIER) * Figure 2 *	1,8	B 65 H G 03 G

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19-06-1984	Examiner MUNKEL H.E.A.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	