PATENT SPECIFICATION (11) 1 562 719

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(21) Application No. 53645/76 (22) Filed 22 Dec. 1976
(31) Convention Application No. 9311
(32) Filed 9 Jan. 1976 in
(33) Italy (IT)
(44) Complete Specification published 12 March 1980
(51) INT CL³ B65H 39/055
(52) Index at acceptance
B8R 414 471 475 491 611 691 722 T8

(19)

(54) A MACHINE FOR FORMING SETS OF INTERLEAVED SHEETS

(71) I, ROMANO CONTI, an Italian Citizen, of 21 Via Gozzi, Prato, Firenze, Italy, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns apparatus for forming sets of interleaved sheets.

According to the invention there is provided apparatus for forming sets of interleaved sheets comprising sheet supply means including a support for supporting a row of stacks of sheets and transfer means operative to take and deliver the uppermost sheets of the stacks; and a conveyor unit comprising a lonitudinally-slotted table extending alongside the sheet supply means for the transfer means to deliver each said uppermost sheet to a respective reception space thereon and sheet progressing means operative, the transfer means to deliver each said uppermost sheet to a respective reception space thereon and sheet progressing means operative, in synchronism with the sheet supply means to progress the sheets in a conveying direction by a step corresponding to the spacing of the reception spaces; said sheet progressing means comprising a plurality of transverse rows of fingers and a reciprocating drive, of adjustable amplitude, operative on each reciprocation to raise the fingers from a starting position to project upwards through the slots in the table with each row at a respective location adjacent a respective one of the reception spaces, then to move said finger rows in the conveying direction thereby to step forward all the sheets on the table, and then to retract the finger rows and return them to the starting position; characterised in that the fingers are mounted on longitudinal bars so as to be adjustable in their spacing therealong, the reciprocating drive serving to reciprocate the bars so as firstly to engage the finger rows with the rear edges of the respective sheets, then to cause the bars to project upwards through the table whilst moving in the conveying direction, thereby to raise the sheets from the table whilst they are being stepped forward.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a diagrammatic side elevation illustrating a preferred embodiment of the apparature of the invention with its drive at the beginning of its sheet stepping movement, the apparatus being set up for handling relatively small sheets;

Fig. 2 is a view corresponding to Fig. 1, but showing the apparatus with the drive at the end of its sheet stepping movement;

Fig. 3 is an enlarged detail of part of Fig. 1, but showing the apparatus set up for handling relatively larger sheets;

Fig. 4 is an enlarged cross-sectional detail taken along the line IV—IV of Fig. 1;

Fig. 5 is an enlarged sectional detail taken on the line V—V of Fig. 3;

Fig. 6 is a diagrammatic plan illustrating how sheets are transferred from the sheet supply means to the conveyor unit in a first part of the cycle of operation of the machine of Figs. 1 to 5;

Fig. 7 is a view similar to Fig. 6 but showing how the sheets on the conveyor unit are stepped forward in a subsequent part of the cycle of operation of the apparatus;

Fig. 8 is a view comparable with Fig. 6, but showing the apparatus being used to handle sheets of larger size; and

Fig. 9 is a view comparable with Fig. 7, but again showing the apparatus handling the large size of sheets.

Referring firstly to Figs. 1, 2, 4, 6 and 7, and in particular to Figs. 4 and 6, the illustrated apparatus comprises sheet supply means including a frame 1 providing a support for supporting a row of stocks of sheets. Nine such stacks are indicated respectively by the references P1 to P9 in Fig. 6 from which it will be appreciated that a tenth stack can be accommodated on the support as indicated at P10. An odd number of the stacks will be used, for example the nine stacks P1 to P9 as indicated in Fig. 6, in instances where sheets, such as forms, are required to be interleaved with carbon paper sheets. If desired, the first stack P1 can be omitted instead of the last

stack P10, when only nine sheet stacks are being handled by the machine.

A respective location is defined on the support, for each stack, by a respective side fence 3, respective head stops 5 and a respective adjustable corner piece 6.

As is illustrated diagrammatically in Fig. 4, the sheet supply means also includes transfer means operative to take and deliver the uppermost sheets of the stacks. Such transfer means comprises, for each sheet stack, at least one suction gripper the initial position of which is indicated at 7A in Fig. 4. For taking and delivering the uppermost sheet from its respective stack, the gripper is firstly lowered onto its sheet stack to take up its respective sheet. Thereafter, it is raised (if necessary) sufficiently to pass over the head stops 5, and is then moved laterally of the apparatus, in the direction indicated by the arrow f1 in Fig. 4, until it reaches the position indicated at 7B, whereupon the suction is cut-off to release the taken up sheet to deliver it to a respective reception space on a conveyor unit, indicated generally by the reference numeral 10, extending alongside the support of the sheet supply means. Considered with reference to Fig. 6, therefore, it will readily be understood that upon operation of the transfer means, the uppermost sheet of the stack P1 is taken up and delivered to a respective reception space on the conveyor unit where it is indicated as F1, the uppermost sheet of stack P2 is delivered to its reception space where it is indicated as F2 and so on with all the sheet stacks up to P9 and P10 (if present) whose uppermost sheets are delivered to respective reception spaces and are indicated at F9 and F10.

The conveyor unit 10 comprises a longitudinally-slotted tube 12 for receiving the delivered sheets as at F1 to F10 in Fig. 6. As can be seen from Fig. 4, this table 12 is laterally inclined downwards away from the sheets supply support, towards a fence 12A so that sheets delivered to the table will tend to align themselves by gravitating down the incline until their corresponding edges abut the fence 12A. The longitudinal slotting of the table 12 is such as provide therealong these parallel slots which enable sheets progressing means, including transverse rows of upwardly-projecting fingers 14, to protrude upwards through the table 12 and effect stepwise forward movement of all the sheets on the table 12, as will shortly be described in detail.

The fingers 14 are carried by longitudinal bars 15 of which there is one in register with each of the slots in the table 12, these bars 15 being carried by a plurality of crossbeams 15A below the table 12. Each finger 14 is removable from its bar 15 so that its position thereon is adjustable, this enabling the fingers 14 to be arranged in rows so located that upon raising of the bars 15, each row of fingers 14 is adjacent the rear edge of the respective delivered sheet F1 to F10, as can be seen from Fig. 6. Drive means for the crossbeams 15A, (and therefore for the bars 15) comprises a sliding bar 18 slidably located in spaced-apart bearing brackets 20 disposed at intervals along and below the table 12. These brackets 20 are arranged to be raised and lowered, in unison, being carried at the free ends of respective levers 22 which are pivotable about respective bearing stubs 22A fixed to the framework of the apparatus. Raising and lowering movement of the brackets 20 is transmitted thereto by way of respective short connecting rods 24 which connect the brackets 20 to respective radial arms 26 projecting from a common shaft 28 extending along the apparatus below the table 12. The shaft 28 is coupled by a further radial arm and a connecting link, indicated collectively by the reference numeral 30, to a rocker lever 32 which is pivoted substantially at its middle at 34 and is operated by its other end engaging a tappet cam 36 provided on a shaft 38 which, when the apparatus is in use, runs continuously.

The above-described components of the drive means serve for the raising and lowering of the bars 15, and therewith of the fingers 14. The drive means also comprises components which serve, in synchronism with this raising and lowering, to shift the bars 15 to and fro in the longitudinal direction.

As already mentioned, the sliding bar 18, which carries the crossbeams 15A, and therefore the bars 15, is slidable in the longitudinal direction in the bearing brackets 20. A linked rod 42 connects the sliding bar 18 with the upper end of a rocking lever 44 which is pivoted by its lower end at 46 to the framework of the apparatus. In turn, the rocking lever 44 is coupled by a connecting rod/crank system, indicated generally by the numeral 48, to a shaft 40 which is driven continuously from the shaft 38 by way of bevel gears (see Fig. 4). As can be seen in detail in Fig. 5, the connecting rod/crank system 48 comprises a crank 50 whose crank pin 52 is linked with the rocking lever 44 by way of a connecting link 54 and pivot pin 56. The crank 50 is a variable-throw crank which is steplessly variable by adjusting the crank pin 52 along a slot 50A in the crank, and Fig. 5 shows the crank pin 52 adjusted to its position of maximust throw corresponding to large sheets (larger than those shown in Figs. 6 and 7) being handled by the apparatus.

Provision is also made for adjusting the pivot pin 56 along slots 44A formed in the double thickness presented by the articulated lever 44 for securement of said pin 56, as can be seen from Fig. 5. This adjustment possibly enables the position of the sliding bar 18, at the end of its longitudinal movement in the bearing brackets 20, to be adjusted.

The variable-throw arrangement of the crank 20 permits variation of the angular swing of the rocking lever 44 with corresponding variation of the amplitude of reciprocation or the stroke of the bars 18 and rows of fingers 14 in the longitudinal direction of the table 12. Thus, it is possible to modify this stroke in order to correlate it to the size of the sheets being handled by the apparatus and being transferred to the table 12 by the transfer means. When the crank throw is at a minimum, the angular stroke α of the rocking lever 44 is correspondingly at a minimum for handling the minimum size of paper sheets for example the small sheets shown in Figs. 6 and 7. The drive imparted to the bar 18, both by way of the rocking lever 44 and by way of the common shaft 28 and its radial arms 26 is such that, in driving each rotation of the shaft 38, which corresponds to one cycle of operation of the drive the bars 18 are firstly raised to cause the rows of fingers 14 to project upwards through the table adjacent to but slightly spaced from the rear edges of the respective sheets F1 to F9 delivered to the table 12, as can be appreciated from Fig. 6. Then forward movement of the bars 18, longitudinally of the table 12, in the conveying direction f2 (Fig. 1) causes the fingers 14 to engage against the rear edges of the sheets F1 to F9 to cause initial movement of the sheets in the conveying direction and simultaneously ensure proper alignment thereof. The bars 18 continue both to rise and to move forward in the direction f2, with the result that after the fingers have aligned the respective sheets, such sheets are engaged from below by the bars 18 which then lift them off the table whilst completing movement of the sheets forward by one step equal to the initial spacing between the sheet stacks P1 to P9. The fact of lifting the sheets from the table 12 eliminates friction therebetween, the disadvantages of sliding movement thereby being avoided. Fig. 7 illustrates the delivered sheets on the table 12 having been so stepped forward, the sheets F1 to F9 now lying in register with the sheet stacks P2 to P12 respectively.

The sheets F1 to F9 having been brought to this position, the drive operates to withdraw the bars 18 and the fingers 14 by lowering them to below the table and brings them back to an initial position ready to perform a fresh reciprocation or cycle of operations.

Before this next cycle commences, however, the transfer means operates to take the next uppermost sheet of each of the stacks P1 and P9 and delivers these sheets onto the table 12.

It will thus be appreciated that with continuous operation of the apparatus, present at the positions occupied by the sheets F1 to F10 are respective piles each containing one more sheet than at the preceding position. Each pile starts as a single sheet at F1 and receives a respective further sheet at each of the positions F2 to F9 (or F10), reaching the downstream end of the table 12 as a collated interleaved set.

It is to be noted that the spacing between the adjacent rows of fingers 14 is slightly greater than the maximum size of the sheets and corresponds to the distance between the adjacent faces 3, so the sheets are always centred and retained in the respective interspace between the corresponding adjacent transverse rows of fingers 14, thereby ensuring regular stepping forward of the sheets or of the sets of sheets which are progressively formed along the table 12, even when running at a relatively high transfer speed involving relatively high acceleration of the sheets. The sheets moved by each row of fingers 14 do not tend to and cannot overlap the sheets of the pile in front thereof, owing to the presence of the next adjacent row of fingers 14 which retains the sheets and prevents partial superimposition thereof. On the other hand, even if irregularity or overlapping should occur in the positioning of one or other of the piles, the subsequent raising of the fingers 14 in correspondence with the interspaces between the piles of sheets has the effect, after a few cycles of operation, of causing separataion of the overlapping piles.

The stepwise movement accomplished with an angular stroke α of the rocking lever 44 corresponds to the spacing between the successive stacks P1 and P9 when the apparatus is set up for a size of sheets corresponding to those illustrated for the stocks P1 to P9 in Figs. 6 and 7. As will be appreciated from the above description, the apparatus, and in particular the conveyor unit, is designed to permit the possibility of handling sheets of larger size than those of Figs. 6 and 7, for instance up to twice the size of said sheets of the stacks P1 to P9. To achieve this, a number of adjustments have to be made. In particular, firstly, it is necessary to eliminate some of the fences 3 to accommodate the stocks of larger sheets for example as illustrated at P11, P12 etc. up to P15 in Figs. 8 and 9, which sheets may be of a larger size up to twice the size of the sheets in the stacks P1 to P9. Also, the fingers 14 which correspond to the removed fences 3 must also be removed, in such a manner that the sheet piles indicated at F11 to F15 in Figs. 8 and 9, can be accommodated in the interspaces defined between the adjacent rows of fingers 14 which are cyclicly caused to project through and move longitudinally of the inclined table 12. Moreover, it is necessary to modify the stroke of the drive for the fingers 14. This is simple to effect, by adjusting the eccentricity of the connecting rod crank ssytem 48, by adjusting the crank pin 52 from its position of minimum eccentricity towards the maximum eccentricity position along the slot 50A, and locking said pin 52 in its newly-adjusted position. This

operation should be effected after the pivot pin 56 has been slackened so that it can move along the slots 44A during the adjustment of the crank throw. This avoids movement of the bars 18 and rows of fingers 14 during adjustment of the throw of the crank 50. The pins 52 and 56 are accordingly freed in their slots 54A and 44A respectively whilst the eccentricity is adjusted, this allowing sliding of the pivot pin 56 relative to the rocking lever 44 which stays in the position previously attained, and then the pivot pin 56 is locked up against in the new position into which it has assumed, as a result of the adjustment of the throw of the crank pin 52, along the slots 44A. This adjustment having been effected, each rotation of the shaft 40 causes swinging of the rocking lever 44 through an angle β which is greater than the angle α, because of the increased throw of the connecting rod crank system 48, and which corresponds to a reciprocation amplitude, as indicated by the arrow f3 of Fig. 3, of the fingers 14, corresponding to the longer sheets and the stacks thereof located on the apparatus.

Thus, the necessary adjustment of the conveyor unit is effected very easily. Hence the setting-up of the apparatus in order to work with different sheet sizes, between a maximum and a minimum is correspondingly easy. Whilst the illustrated apparatus has been described as handling alternatively small sheets and large sheets which are twice the width of the small sheets, it can of course readily be set up to operate with sheets of any intermediate size therebetween. According to the illustrated embodiment, the machine can be equipped for small sheet sizes (with which are obtainable sets up to nine or ten sheets), or for larger sizes to obtain sets up to a maximum of five sheets. Other possibilities of sheet sizes between these two limits can be obtained with suitable positioning of the sheet stacks and the fingers 14.

WHAT I CLAIM IS:—

1. Apparatus for forming sets of interleaved sheets comprising sheet supply means including a support for supporting a row of stacks of sheets and transfer means operative to take and deliver the uppermost sheets of the stacks; and a conveyor unit comprising a longitudinally-slotted table extending alongside the sheet supply means for the transfer means to deliver each said uppermost sheet to a respective reception space thereon and sheet progressing means operative, in synchronism with the sheet supply means to progress the sheets in a conveying direction by a step corresponding to the spacing of the reception spaces; said sheet progressing means comprising a plurality of transverse rows of fingers and a reciprocating drive, of adjustable amplitude, operative on each reciprocation to raise the fingers from a starting position to project upwards through the slots in the table with each row at a respective loocation adjacent a respective one of the reception spaces, then to move said finger rows in the conveying direction thereby to step forward all the sheets on the table, and then to retract the finger rows and return them to the starting position; characterised in that the fingers are mounted on longitudinal bars so as to be adjustable in their spacing therealong, the reciprocating drive serving to reciprocate the bars so as firstly to engage the finger rows with the rear edges of the respective sheets, then to cause the bars to project upwards through the table whilst moving in the conveying direction, thereby to raise the sheets from the table whilst they are being stepped forward.

2. Apparatus as claimed in claim 1 wherein the reciprocating drive comprises a lever swingable by an adjustable-throw crank.

3. Apparatus as claimed in claim 2 wherein the crank throw adjustment is stepless.

4. Apparatus as claimed in claim 1, 2 or 3 in which the support of the sheet supply means comprises seat-defining means defining seats for the respective stacks of sheets and adjustable to the size of the sheets required to be formed into sets.

5. Apparatus for forming sets of interleaved sheets substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1980
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1562719 COMPLETE SPECIFICATION
7 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1

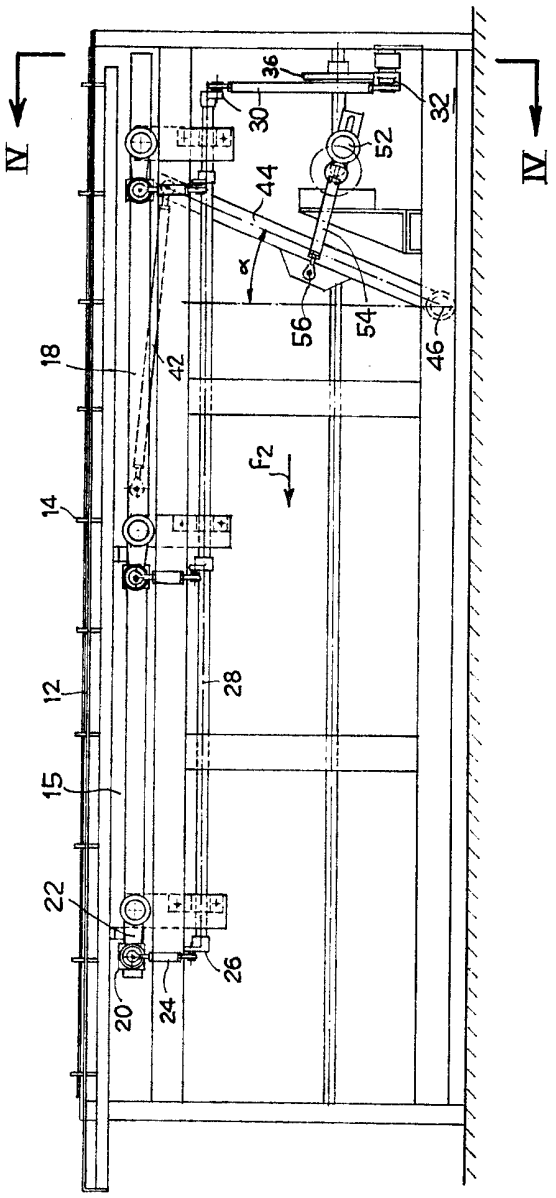
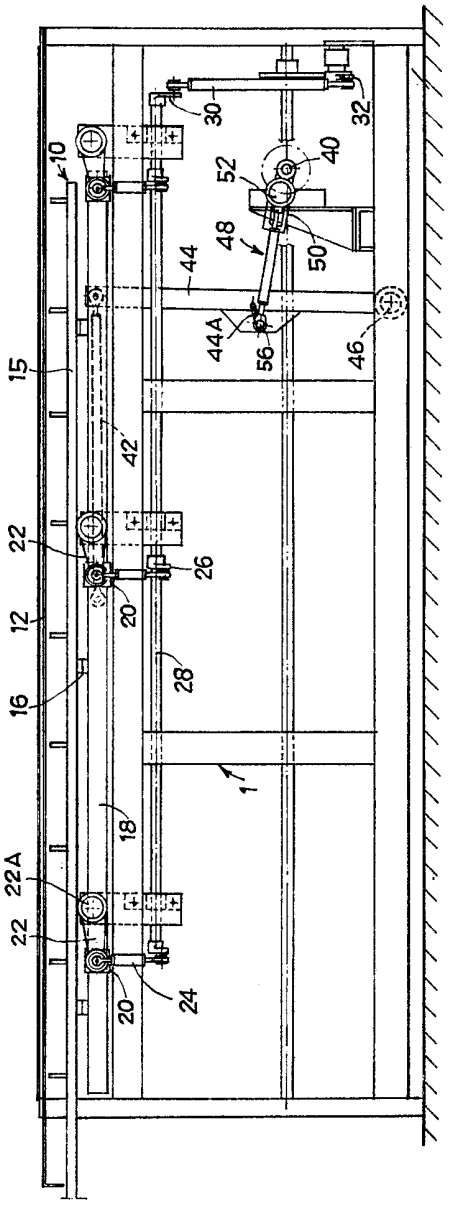


FIG. 2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48
50
44
44A
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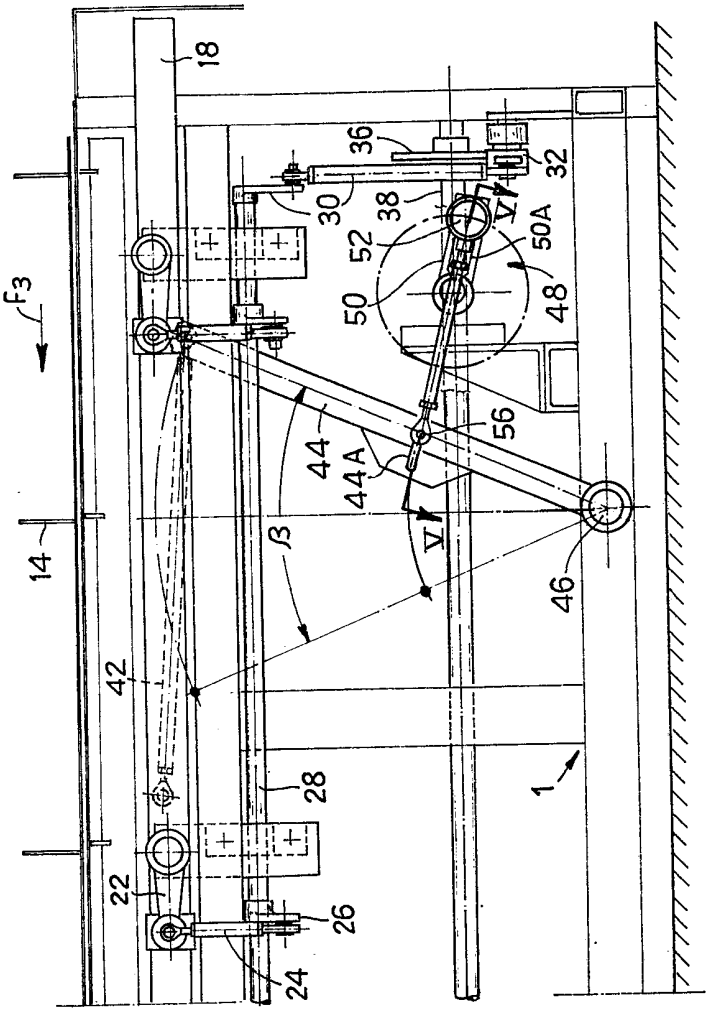
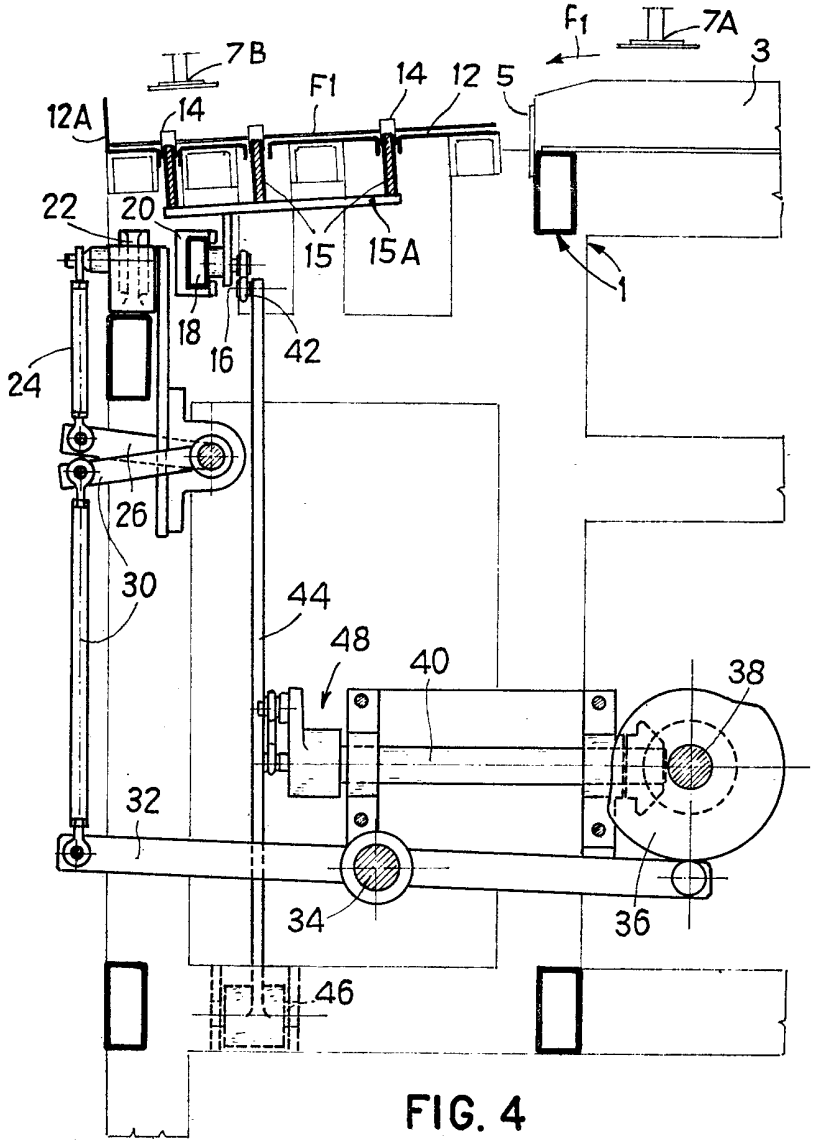
22A
22
20
24

FIG. 3




F1
7A
3
7B
F1
14
12
5
12A
14
22
20
15
15A
1
18
16
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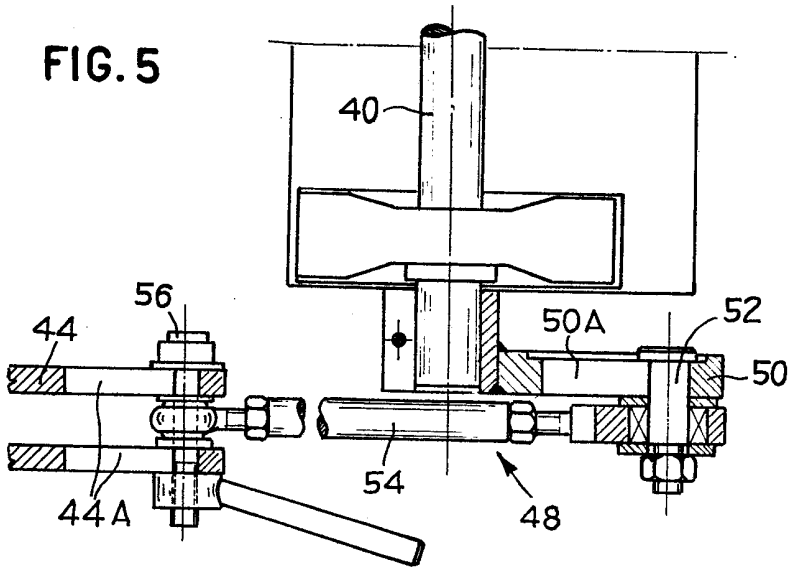
40
38
32
34
36
46

FIG. 4

FIG. 5



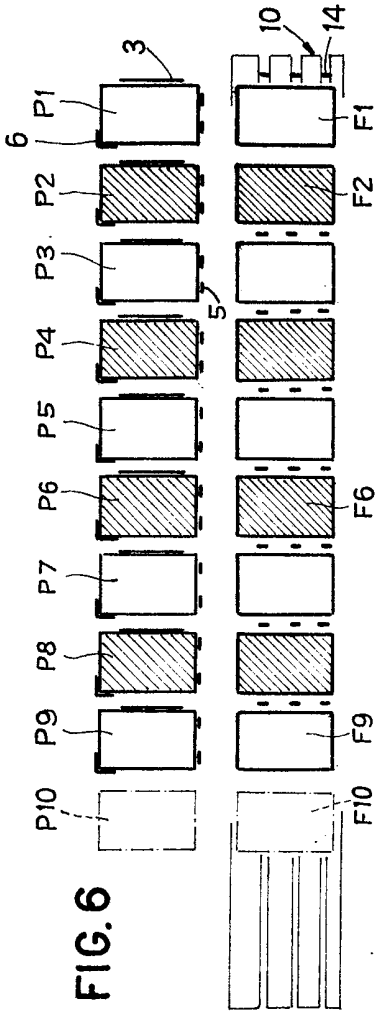
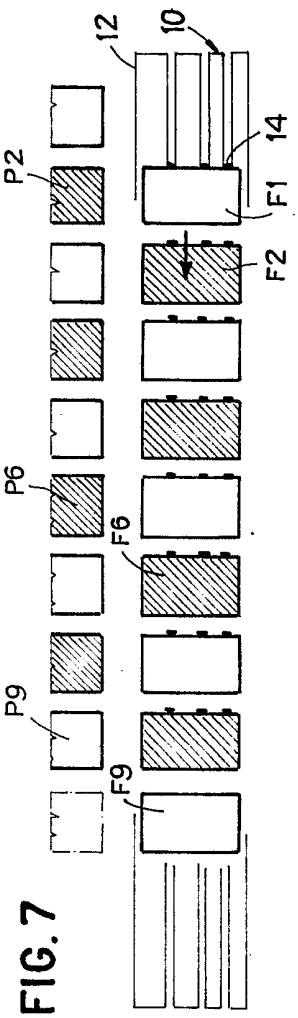

6
3
10
14
P1
F1
P2
F2
P3
5
P4
P5
P6
F6
P7
P8
P9
F9
P10
F10

FIG. 6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10
14
P2
F1
F2
P6
F6
P9
F9

FIG. 7

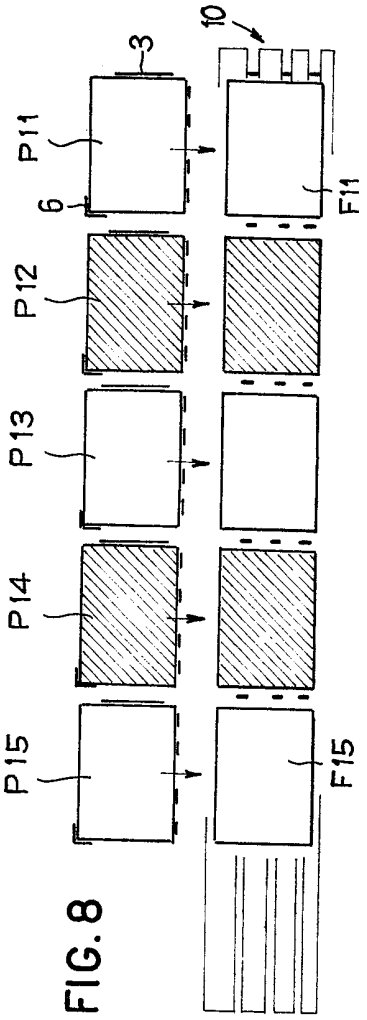

FIG. 8

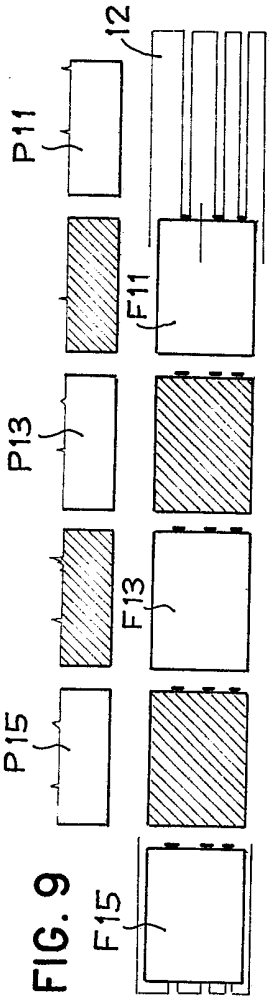

FIG. 9