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<p>(21) International Application Number: PCT/CA90/00281 (22) International Filing Date: 31 August 1990 (31.08.90) (30) Priority data: 487,615 2 March 1990 (02.03.90) US (71) Applicant: COMPUTAINER SYSTEMS INC. [CA/CA]; 560 Raymur Avenue, Vancouver, British Columbia V6A 3L2 (CA). (72) Inventors: COATTA, Bernard, Joseph ; 404 - 1330 Quay-side Drive, New Westminster, British Columbia V3M 6H1 (CA). HARGREAVES, John, Edward ; 18870 - 123B Avenue, Pitt Meadows, British Columbia V3Y 2H4 (CA). COATTA, Terry, James ; 3831 Richmond Street, Richmond, British Columbia V7E 2W5 (CA).</p>	<p>(74) Agent: WIGGS, Blake, R.; Barrigar & Oyen, 480-601 West Cordova Street, Vancouver, British Columbia V6B 1G1 (CA). (81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CM (OAPI patent), DE*, DE (European patent)*, DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent). Published <i>With international search report.</i></p>
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(54) Title: COMPACT, HIGH DENSITY STORAGE OF CARGO CONTAINERS

(57) Abstract

A multi-level cargo container storage rack (10). A container transport aisle (32) extends through the rack from top to bottom and between opposed ends of the rack. A plurality of container storage positions are provided on each level (12, 14, 16, etc.) and on each side of the aisle (32). A container elevator (34) vertically displaces containers within the aisle (32) to a selected level. A container transfer mechanism (36) transfers containers between the elevator (34) and a selected side of the selected level. The storage positions on each side of the aisle (32) are horizontally displaceable toward or away from the aisle, along each of the levels.

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COMPACT, HIGH DENSITY STORAGE OF CARGO CONTAINERS**Field of the Invention**

This application pertains to the storage of cargo containers in a multi-level rack capable of horizontally
5 displaceably receiving multiple containers on each level under programmed control.

Background of the Invention

Inbound cargo shipping containers are conventionally
10 unloaded from container ships by cranes and transported by container carrying vehicles into a dockside container storage yard. The same cranes and vehicles are used to transport outbound containers from the container yard and load them onto container ships for export.

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If the container yard is large relative to the number of containers which must be stored then the containers are laid on the ground in rows. If the container yard is small relative to the number of containers which
20 must be stored (as is typically the case) then the containers are stacked atop one another to conserve valuable space.

Containers stored in the yard are commonly
25 shuffled from one location to another in a continuous effort to speed the loading and unloading of container ships. For example, a group of containers may be moved to clear an area in the yard to receive an inbound shipload of containers. The inbound containers can be unloaded and
30 moved into the cleared common storage area more quickly than would be the case if each inbound container had to be moved into a random storage location in the yard. Similarly, a group of outbound containers may be moved into a pre-cleared yard storage area in preparation for loading the
35 entire group of outbound containers onto a ship which is about to arrive, or which is being unloaded. The outbound containers can be loaded onto the ship from a common storage area more quickly than would be the case if each

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outbound container had to be moved to the ship from a random storage location in the yard.

The continuous shuffling of stored containers causes a number of problems. Although records are usually kept of the yard location in which each newly arriving container is stored, those records are often not updated to reflect every shuffling movement of each container. For example, if an outbound container is stacked beneath two other containers which are not outbound, then those two must be lifted off the outbound container and moved to another storage location before the outbound container can be moved. The other two containers are not normally moved back into the stack location from which they were moved. Moreover, the operator who moves them may not note their new location(s) in the yard's records. Even though those two containers may be moved only a short distance, confusion can result when they have to be located for loading or for transport to an outbound ship, especially if they are repeatedly moved in a series of unrelated shuffling operations. Time is thus wasted while "lost" containers are located.

The ability to manage container movements is also adversely affected by the inability to precisely locate and track the movement of individual containers within the yard. Even if a container's location is known, repeated shuffling operations may have "buried" that container beneath and/or behind many other containers, all of which must be moved (i.e. shuffled) to gain access to the desired container. Repeated container shuffling also increases the potential for damaging the containers.

Computerized systems have been developed to automate the process of locating and tracking individual containers stored within a container yard. However, because such systems typically rely on human driven ve-

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hicles to move containers, they require human operator input to indicate that containers have been shuffled into different locations. Such systems are therefore subject to the same problems outlined above if the operator fails to input information respecting each and every container movement. In a busy container yard, with many simultaneous container movements continually ongoing, it is impractical to record each and every container movement. Even if the location of every container in the yard is known, and even if every container movement is tracked to reflect the new location of every shuffled container, significant time is still required for conventional container handling equipment to shuffle the containers about the yard and transport them to and from container ships.

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The present invention provides a programmable, compact, high density container storage apparatus which facilitates precise location of every stored container; precise tracking of every container movement; and, controllable container shuffling capable of significantly reducing the time required to move selected containers between container ships and the container storage apparatus.

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Summary of the Invention

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In accordance with the preferred embodiment, the invention provides a multi-level container storage rack. A container transport aisle extends through the rack from top to bottom and between opposed ends of the rack. A plurality of container storage positions are provided on each of the levels and on each side of the aisle. A container elevator means is provided for vertically displacing containers within the aisle to a selected one of the levels. A container transfer means is also provided for transferring containers between the container elevator means and a selected side of the selected level. The storage positions on each side of the aisle are preferably

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horizontally displaceable toward or away from the aisle, along each of the levels.

The container transfer means horizontally transfers inbound containers from the container elevator means onto the selected side of the selected level. Storage positions on each side of the aisle are interconnected (advantageously, in endless loop fashion) such that transfer of a container from the container elevator horizontally displaces, away from the aisle, containers previously transferred onto the side of the level to which the container is transferred. In other words, the container transfer means horizontally transfers the container from the elevator into a storage position adjacent the aisle on a selected side of the selected level, which in turn horizontally displaces all other storage positions on the selected side of the selected level one storage position away from the aisle.

The container transfer means horizontally transfers outbound containers from the selected side of the selected level onto the container elevator means. Slidable transfer of a container from a selected side of a selected level onto the elevator horizontally displaces, toward the aisle, containers remaining on the selected side of the selected level. In other words, the container transfer means horizontally transfers the container from a storage position adjacent the aisle on a selected side of a selected level onto the elevator, which in turn horizontally displaces all other storage positions on the selected side of the selected level one storage position towards the aisle.

Brief Description of the Drawings

Figures 1(a) through 1(n) are elevation views showing one end of a cargo container storage apparatus constructed in accordance with the preferred embodiment of

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the invention and depicting the sequence of steps by which four selected containers may be retrieved from storage for transportation to a container ship.

5 Detailed Description of the Preferred Embodiment

The drawings depict a container storage rack 10 having multiple levels 12 through 30. A suitably anchored framework (not shown) supports rack 10 and containers stored therein. A container transport aisle 32 extends
10 through rack 10 from top to bottom and between opposed ends of rack 10. A plurality of container storage positions are provided on each of levels 12 through 30, on both sides of aisle 32. Rectangles depict the ends of containers stored in individual storage positions within rack 10. Empty
15 storage positions in rack 10 are denoted by the absence of rectangles at the outer ends of levels 12 through 30, on either side of aisle 32.

A container elevator means such as a powered
20 hoist, container spreader, crane or elevator 34 is mounted in aisle 32 for vertically displacing containers within aisle 32 to a selected one of levels 12 through 30. A container transfer means such as a double acting hydraulic cylinder 36 is mounted on elevator 34 for transferring
25 containers between elevator 34 and a selected side of a selected one of levels 12 through 30. The storage positions on each side of aisle 32 are interconnected in endless loop fashion so that they may be horizontally displaced toward or away from aisle 32, along each of
30 levels 12 through 30.

Double acting cylinder 36 horizontally transfers inbound containers from elevator 34 onto a selected side of a selected one of levels 12 through 30. Transfer of a
35 container from elevator 34 horizontally displaces, away from aisle 32, containers previously transferred onto the same side and level of rack 10 to which the inbound con-

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tainer is transferred. More particularly, double acting cylinder 36 horizontally transfers the inbound container from elevator 34 into a storage position adjacent aisle 32 on a side and level of rack 10 selected for storage of the inbound container. Because the storage positions are interconnected as aforesaid, transfer of the inbound container from elevator 34 frees a storage position adjacent aisle 32 to receive the inbound container by horizontally displacing, one storage position away from aisle 32, all other storage positions on the side and level of rack 10 selected for storage of the inbound container.

Double acting cylinder 36 horizontally transfers outbound containers onto elevator 34 from storage positions adjacent aisle 32. Transfer of an outbound container onto elevator 34 horizontally displaces, toward aisle 32, any containers remaining on the same side and level from which the outbound container was transferred. More particularly, double acting cylinder 36 horizontally transfers the outbound container from its storage position adjacent aisle 32 onto elevator 34. Because the storage positions are interconnected as aforesaid, transfer of the outbound container onto elevator 34 does not leave an empty storage position adjacent aisle 32. Instead, transfer of the outbound container onto elevator 34 horizontally displaces, one storage position toward aisle 32, all other storage positions on the side and level of rack 10 from which the outbound container is withdrawn, by dragging the entire group of storage positions (together with any containers stored therein) toward aisle 32 as the outbound container is transferred onto elevator 34. Accordingly, any containers remaining on the same side and level from which the outbound container was transferred remain adjacent one another, with the innermost container immediately adjacent aisle 32.

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The operation of elevator 34 and double acting cylinder 36 may be programmed to store, retrieve, and/or shuffle containers in any desired fashion. For example, Figures 1(a) through 1(n) depict one possible sequence of steps by which four outbound containers labelled 1, 2, 3 and 4 previously stored in rack 10 in the positions shown in Figure 1(a) may be retrieved for transportation to a container ship. As will be seen, the outbound containers are initially moved into a contiguous group of storage positions on the right hand side of level 12 immediately adjacent aisle 32. The contiguously grouped outbound containers are then sequentially transferred into aisle 32 onto container carrying vehicles which transport the containers to the container ship. Those skilled in the art will recognize that this enables the container yard personnel to plan and schedule container movements with considerable flexibility. For example, outbound containers may be contiguously grouped well before the ship is ready to receive them. As soon as the ship is ready the containers may be transferred to the ship rapidly and efficiently. As will be seen, the exact position of every stored container is always known, notwithstanding complex shuffling of containers stored within rack 10.

The following description illustrates how outbound containers 1 through 4 may be contiguously pre-grouped so that they may be sequentially delivered, in ascending numeric order, to the container ship. It will however be understood that the outbound containers need not be grouped before they are delivered to the ship, although grouping will speed the container transfer operation, as aforesaid. It will also be understood that the outbound containers may be grouped in any desired sequence.

Container 4 is "buried" on level 12, on the left side of aisle 32, behind seven "static" containers which are to remain in storage. The seven static containers must

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be shuffled into other storage positions in rack 10 in order to bring container 4 adjacent aisle 32 so that it may be transferred to the grouping area (which, for the purposes of this example, is the right hand side of level 12 immediately adjacent aisle 32). As may be seen by comparing Figures 1(a) and 1(b), the static container adjacent aisle 32 is transferred onto elevator 34 and lifted to level 14. Withdrawal of the static container from the left side of level 12 horizontally displaces (i.e. drags) all of the containers remaining on the left side of level 12 one storage position toward aisle 32. A suitably programmed computer tracks the movement of each container. When the static container aforesaid is withdrawn from level 12 as aforesaid, the computer updates its records to indicate that the containers remaining on the left side of level 12 have moved one storage position toward aisle 32

When the static container has been lifted to level 14, as depicted in Figure 1(b), double acting cylinder 36 horizontally displaces the container to the left, storing it on the left side of level. The static containers previously stored on the left side of level 14 are displaced one storage position away from aisle 32. The computer again updates its records to indicate that the containers previously stored on the left side of level 14 have moved one storage position away from aisle 32; and, that the static container withdrawn from level 12 has moved into the storage position on the left side of level 14 immediately adjacent aisle 32.

30

As may be seen by comparing Figures 1(a) and 1(c), the remaining six static containers behind which container 4 is buried are similarly sequentially shuffled from the left side of level 12 into other static storage positions on the left side of level 14, the left side of level 18 and the right side of level 20 to bring container 4 into position immediately adjacent aisle 32 on the left

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side of level 12, as shown in Figure 1(c). As each container is withdrawn from or inserted into a storage position, the computer updates its records to reflect the new position of that container and all other containers displaced therewith.

As may be seen by comparing Figures 1(c) and 1(d), container 4 is transferred onto elevator 34 from its position adjacent aisle 32 on the left side of level 12 and then immediately transferred from elevator 34 into the position adjacent aisle 32 on the right side of level 12. Container 4 is thus stored within the previously defined grouping area.

Container 3 is buried on level 20, on the left side of aisle 32, behind two static containers which are to remain in storage. The two static containers must be shuffled into other storage positions in rack 10 in order to bring container 3 adjacent aisle 32 so that it may be transferred to the grouping area. As may be seen by comparing Figures 1(d) and 1(e), the two static containers behind which container 3 is buried are sequentially shuffled from the left side of level 20 into other static storage positions on the right side of level 20 and the left side of level 22, to bring container 3 into position immediately adjacent aisle 32 on the left side of level 20. As each container is withdrawn from or inserted into a storage position, the computer updates its records to reflect the new position of that container and all other containers displaced therewith.

As may be seen by comparing Figures 1(e) and 1(f), container 3 is transferred onto elevator 34 from its position adjacent aisle 32 on the left side of level 20, lowered to level 12, and then transferred from elevator 34 into the position adjacent aisle 32 on the right side of level 12, displacing container 4 and the other static

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containers on the right side of level 12 one storage position away from aisle 32. Containers 3 and 4 are thus stored within the grouping area.

5 Container 2 is buried on level 26, on the left side of aisle 32, behind one static container which is to remain in storage. That static container must be shuffled into another storage position in rack 10 in order to bring container 2 adjacent aisle 32 so that it may be transferred
10 to the grouping area. As may be seen by comparing Figures 1(f) and 1(g), the static container behind which container 2 is buried is shuffled from the right side of level 26 into another static storage position on the left side of level 24, to bring container 3 into position immediately
15 adjacent aisle 32 on the right side of level 26. The computer again updates its records to reflect the new position of each shuffled container and all other containers displaced therewith.

20 As may be seen by comparing Figures 1(g) and 1(h), container 2 is transferred onto elevator 34 from its position adjacent aisle 32 on the right side of level 26, lowered to level 12, and then transferred from elevator 34 into the position adjacent aisle 32 on the right side of
25 level 12, displacing containers 3 and 4 and the other static containers on the right side of level 12 one storage position away from aisle 32. Containers 2, 3 and 4 are thus stored within the grouping area.

30 Container 1 is not buried, but is already adjacent aisle 32 so it may be directly transferred to the grouping area without first shuffling any static containers. As may be seen by comparing Figures 1(h) and 1(i), container 1 is transferred onto elevator 34 from its
35 position adjacent aisle 32 on the right side of level 30, lowered to level 12, and then transferred from elevator 34 into the position adjacent aisle 32 on the right side of

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level 12, displacing containers 2, 3 and 4 and the other static containers on the right side of level 12 one storage position away from aisle 32. Containers 1, 2, 3 and 4 are thus stored within the grouping area. The computer again
5 updates its records to reflect the new position of each transferred container and all other containers displaced therewith.

When the container ship (not shown) is ready to
10 receive the outbound containers, four conventional container carrying vehicles (not shown) are driven to rack 10. Aisle 32, elevator 34 and double acting cylinder 36 are constructed to allow the container carrying vehicles to pass through aisle 32 and to allow double acting cylinder
15 36 to transfer containers from rack 10 to the container carrying vehicles.

The first container carrying vehicle is driven into one end of aisle 32 and stopped adjacent container 1.
20 Double acting cylinder 36 transfers container 1 from the grouping area to the first container carrying vehicle, which is then driven out through the opposite end of aisle 32 to the ship, as depicted graphically in Figure 1(j). The computer then updates its records to reflect the fact
25 that container 1 is no longer in storage, and to reflect the new storage positions of containers 2, 3 and 4 and the other static containers stored on the right side of level 12, all of which are horizontally displaced one storage position toward aisle 32 as container 1 is transferred to
30 the first container carrying vehicle.

As the first container carrying vehicle exits aisle 32 with container 1, the second container carrying vehicle is driven into aisle 32 and stopped adjacent
35 container 2, which is now adjacent aisle 32, as may be seen in Figure 1(j). Double acting cylinder 36 transfers container 2 from the grouping area to the second container

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carrying vehicle, which is then driven out through the opposite end of aisle 32 to the ship, as depicted graphically in Figure 1(k). The computer again updates its records to reflect the fact that container 2 is no longer
5 in storage, and to reflect the new storage positions of containers 3 and 4 and the other static containers stored on the right side of level 12, all of which are horizontally displaced one storage position toward aisle 32 as container 2 is transferred to the second container carrying
10 vehicle.

As graphically depicted in Figures 1(l) and 1(m), containers 3 and 4 are similarly sequentially transferred to the third and fourth container carrying vehicles respectively and driven to the ship. Figure 1(n) depicts
15 rack 10 after the four outbound containers have been removed, with the remaining static containers in storage.

Roughly 5% of the container storage positions
20 available within rack 10 should be left vacant at all times to ensure that containers may be shuffled with reasonable flexibility.

As will be apparent to those skilled in the art
25 in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof. For example, aisle 32 need not divide rack 10 into left and right halves, as depicted in the drawings.
30 Instead, the aisle may be on one side or the other of rack 10, with no container storage levels on the opposite side of the aisle. It is however expected that greater container storage capacity and more efficient container shuffling and grouping capability will be attained by
35 providing container storage levels on both sides of aisle 32. As another example, the apparatus may be extended, to provide additional container storage capacity and greater

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shuffling and grouping flexibility, by placing a plurality of multi-level storage racks identical to rack 10 side by side such that aisle 32 extends longitudinally through the entire group of racks.

5

The operation of elevator 34 and double acting cylinder 36 may be programmed for storage, retrieval and/or shuffling of containers in any desired fashion. Containers may be grouped in any desired manner to expedite their transfer between rack 10 and the container ship(s). For example, containers may be grouped according to their destination port, their outbound shipping dates, their ports of origin, or any other desired parameter. The programming may also be optimized, with the aid of known queuing and programming techniques, to minimize the displacement of elevator 34, or to maximize the speed of the shuffling operation as containers are stored, retrieved and/or shuffled into groups. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

20

WE CLAIM:

1. Container storage apparatus, comprising a multi-level container storage rack, a container transport aisle extending along said rack from top to bottom and between opposed ends of said rack, a plurality of container storage positions on each of said levels, container elevator means for vertically displacing containers within said aisle to a selected one of said levels, and container transfer means for transferring containers between said container elevator means and said selected level, characterized in that said storage positions on each side of said aisle are horizontally displaceable, toward or away from said aisle, along each of said levels.
2. Container storage apparatus, comprising:
 - (a) a multi-level container storage rack;
 - (b) a container transport aisle extending through said rack from top to bottom and between opposed ends of said rack;
 - (c) a plurality of container storage positions on each of said levels and on each side of said aisle;
 - (d) container elevator means for vertically displacing containers within said aisle to a selected one of said levels; and,
 - (e) container transfer means for transferring containers between said container elevator means and a selected side of said selected level.
3. Container storage apparatus as defined in claim 2, wherein said storage positions on each side of said aisle are horizontally displaceable, toward or away from said aisle, along each of said levels.
4. Container storage apparatus as defined in claim 3, wherein said container transfer means is further for

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horizontally transferring containers from said container elevator means onto said selected side of said selected level.

- 5 5. Container storage apparatus as defined in claim 4,
wherein said storage positions on each side of said
aisle are interconnected such that slidable transfer
of a container from said container elevator means onto
said selected side of said selected level horizontally
10 displaces, away from said aisle, containers previously
transferred onto said selected side of said selected
level.
- 15 6. Container storage apparatus as defined in claim 3,
wherein said container transfer means is further for
horizontally transferring a container from said
container elevator means into a storage position
adjacent said aisle on said selected side of said
selected level.
- 20 7. Container storage apparatus as defined in claim 6,
wherein said storage positions on each side of said
aisle are interconnected, whereby slidable transfer of
said container into said storage position adjacent
25 said aisle horizontally displaces all other storage
positions on said selected side of said selected level
one storage position away from said aisle.
- 30 8. Container storage apparatus as defined in claim 7,
wherein said storage positions on each side of said
aisle are interconnected in endless loop fashion.
- 35 9. Container storage apparatus as defined in claim 3,
wherein said container transfer means is further for
horizontally transferring containers from said se-
lected side of said selected level onto said container
elevator means.

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10. Container storage apparatus as defined in claim 9,
wherein said storage positions on each side of said
aisle are interconnected such that slidable transfer
5 of a container from said selected side of said se-
lected level onto said container elevator means
horizontally displaces, toward said aisle, containers
remaining on said selected side of said selected
level.
- 10 11. Container storage apparatus as defined in claim 3,
wherein said container transfer means is further for
horizontally transferring a container from a storage
position adjacent said aisle on said selected side of
15 said selected level onto said container elevator
means.
12. Container storage apparatus as defined in claim 11,
wherein said storage positions on each side of said
20 aisle are interconnected, whereby slidable transfer of
said container from said storage position adjacent
said aisle horizontally displaces all other storage
positions on said selected side of said selected level
one storage position towards said aisle.
- 25 13. Container storage apparatus as defined in claim 12,
wherein said storage positions on each side of said
aisle are interconnected in endless loop fashion.
- 30 14. Container storage apparatus, comprising:
(a) a multi-level container storage rack;
(b) a container transport aisle extending along said
rack from top to bottom and between opposed ends
of said rack;
35 (c) a plurality of container storage positions on
each of said levels;

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- (d) container elevator means for vertically displacing containers within said aisle to a selected one of said levels; and,
- (e) container transfer means for transferring containers between said container elevator means and said selected level.
- 5
15. Container storage apparatus as defined in claim 14, wherein said storage positions are horizontally displaceable, toward or away from said aisle, along each of said levels.
- 10
16. Container storage apparatus as defined in claim 15, wherein said container transfer means is further for horizontally transferring containers from said container elevator means onto said selected level.
- 15
17. Container storage apparatus as defined in claim 16, wherein said storage positions are interconnected such that slidable transfer of a container from said container elevator means onto said selected level horizontally displaces, away from said aisle, containers previously transferred onto said selected level.
- 20
- 25
18. Container storage apparatus as defined in claim 15, wherein said container transfer means is further for horizontally transferring a container from said container elevator means into a storage position adjacent said aisle on said selected level.
- 30
19. Container storage apparatus as defined in claim 18, wherein said storage positions are interconnected, whereby slidable transfer of said container into said storage position adjacent said aisle horizontally displaces all other storage positions on said selected level one storage position away from said aisle.
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20. Container storage apparatus as defined in claim 19,
wherein said storage positions are interconnected in
endless loop fashion.
- 5
21. Container storage apparatus as defined in claim 15,
wherein said container transfer means is further for
horizontally transferring containers from said se-
lected level onto said container elevator means.
- 10
22. Container storage apparatus as defined in claim 21,
wherein said storage positions are interconnected such
that slidable transfer of a container from said
selected level onto said container elevator means
horizontally displaces, toward said aisle, containers
remaining on said selected level.
- 15
23. Container storage apparatus as defined in claim 15,
wherein said container transfer means is further for
horizontally transferring a container from a storage
position adjacent said aisle on said selected level
onto said container elevator means.
- 20
24. Container storage apparatus as defined in claim 23,
wherein said storage positions are interconnected,
whereby slidable transfer of said container from said
storage position adjacent said aisle horizontally dis-
places all other storage positions on said selected
level one storage position towards said aisle.
- 25
25. Container storage apparatus as defined in claim 24,
wherein said storage positions are interconnected in
endless loop fashion.
- 30

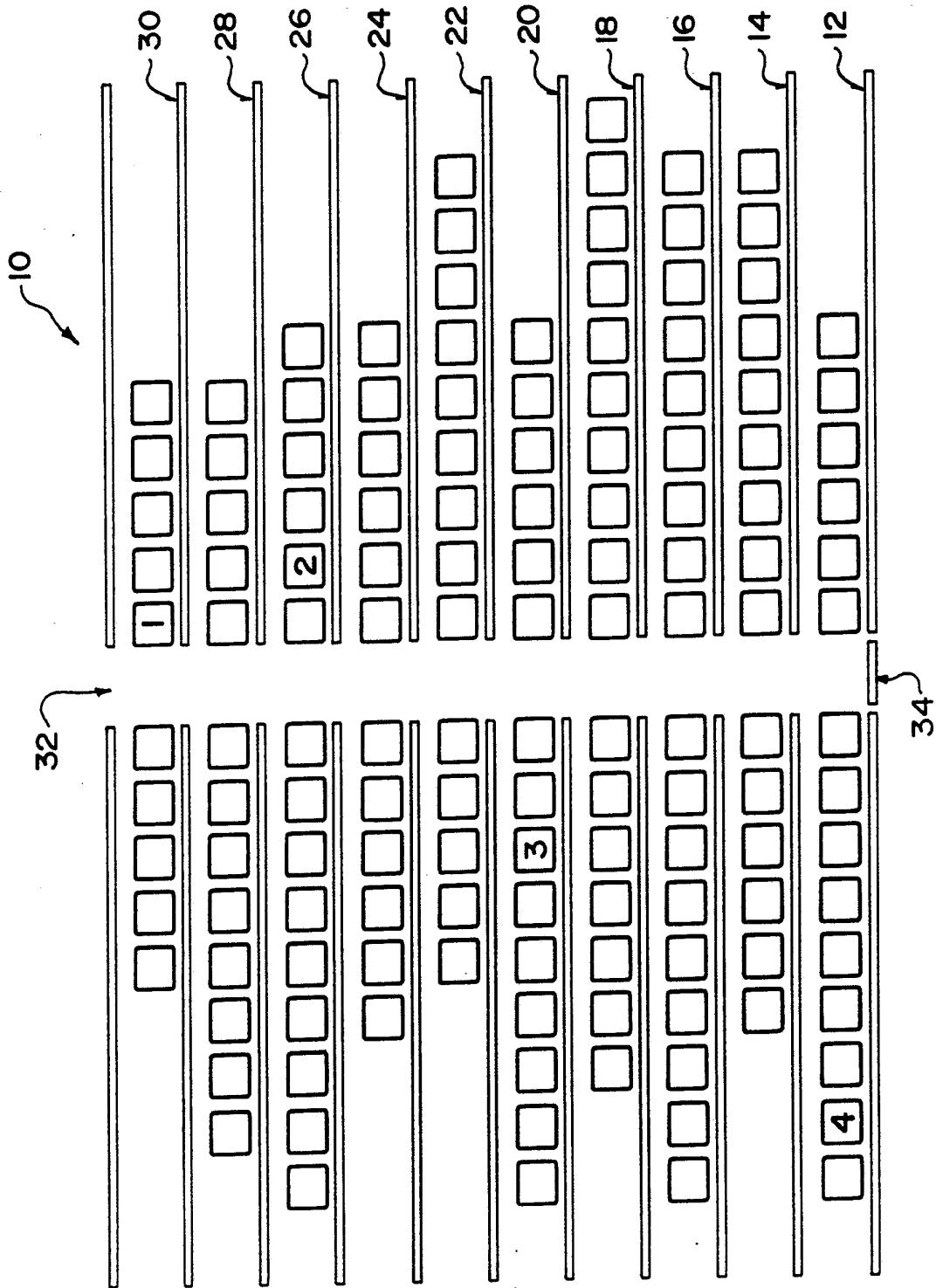


FIG. 1A

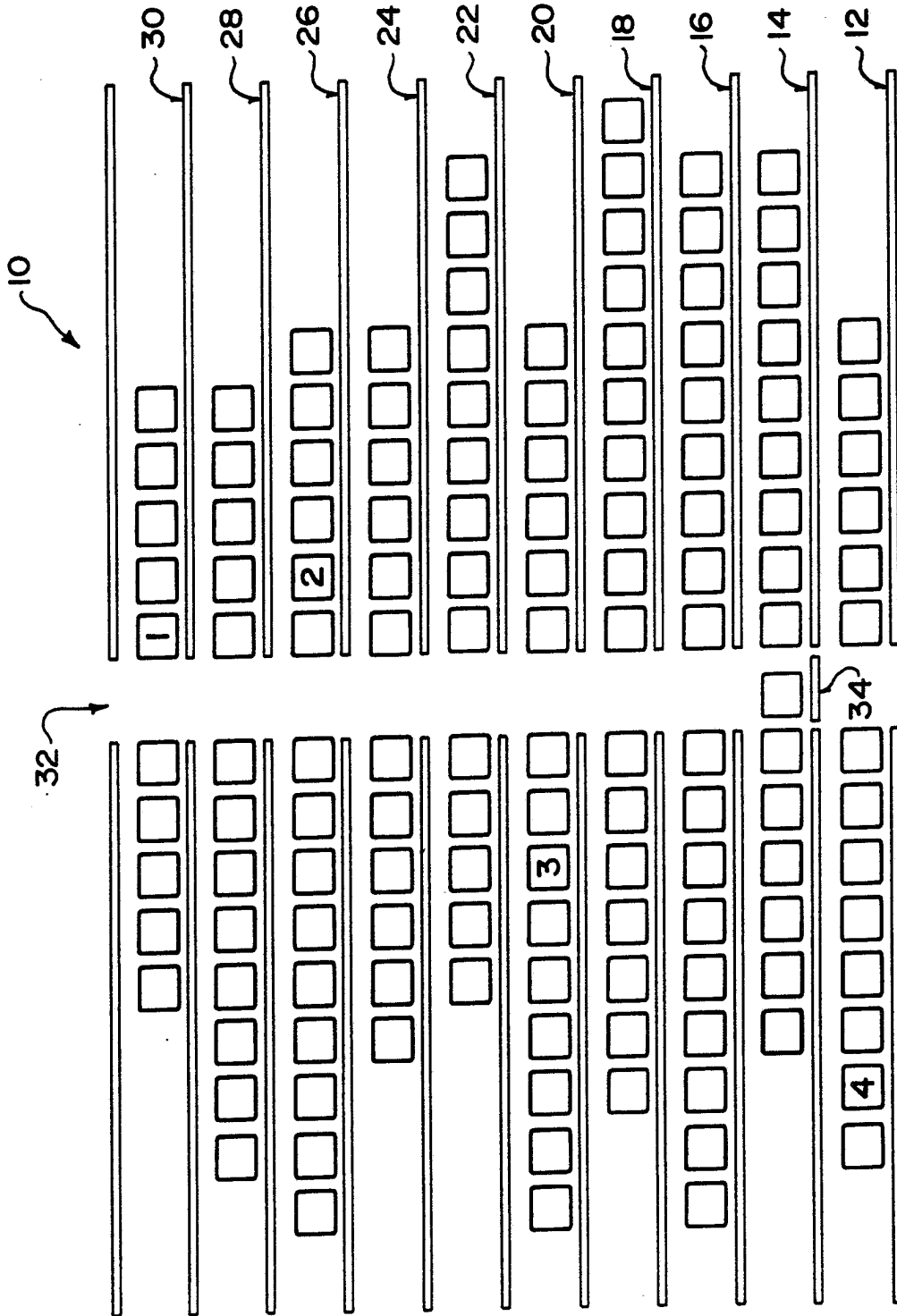


FIG. 1B

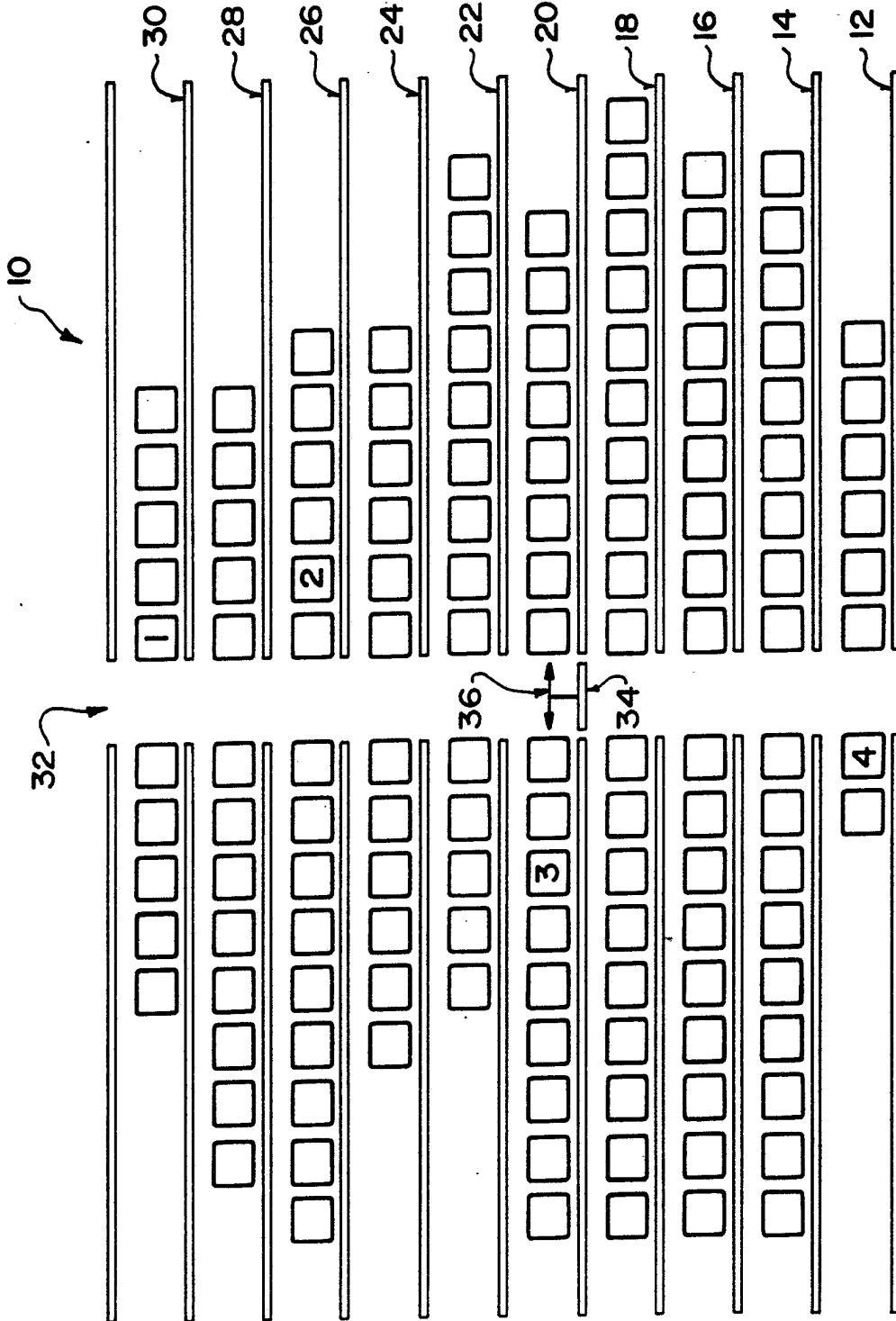


FIG. 1C

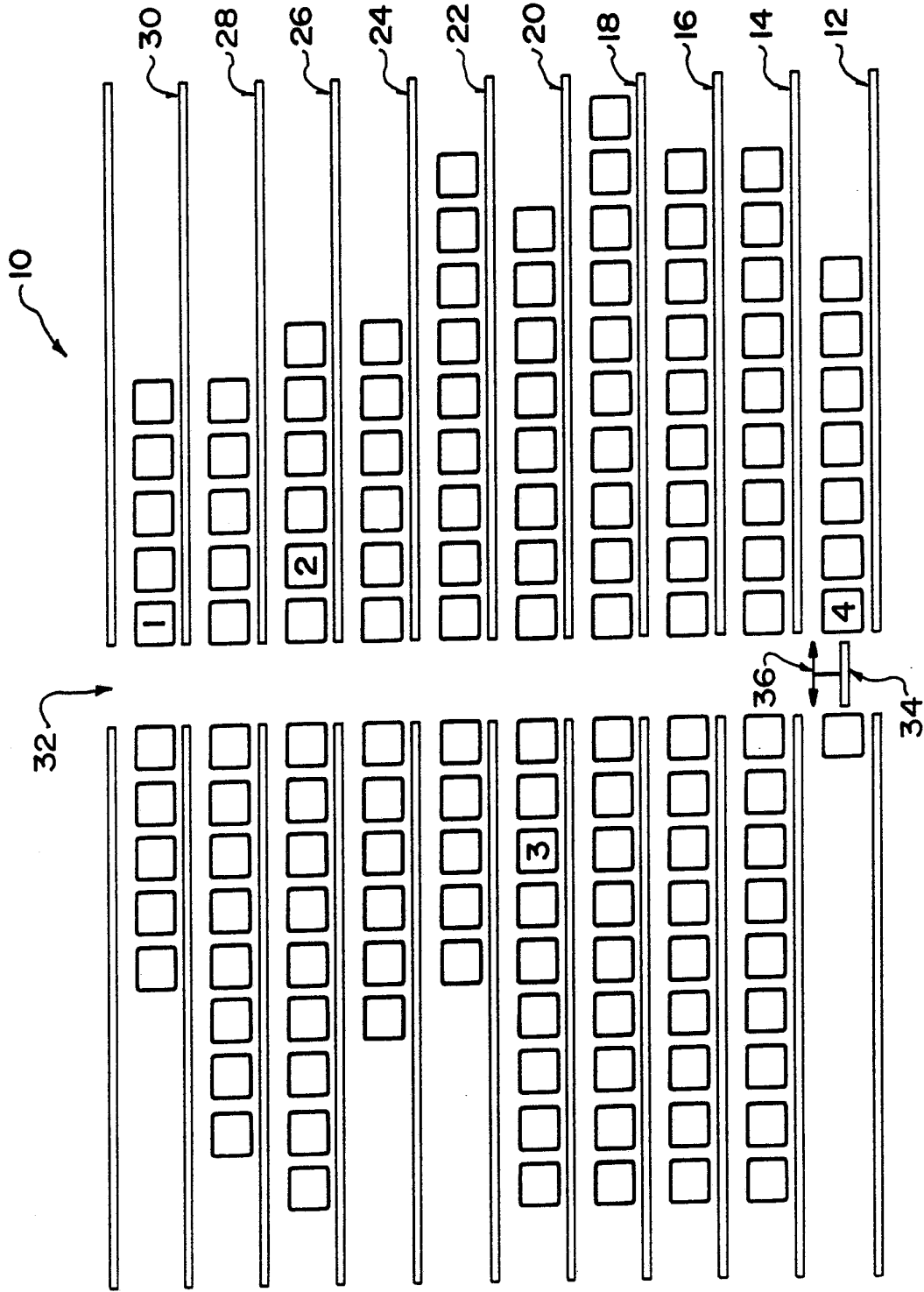


FIG. 1D

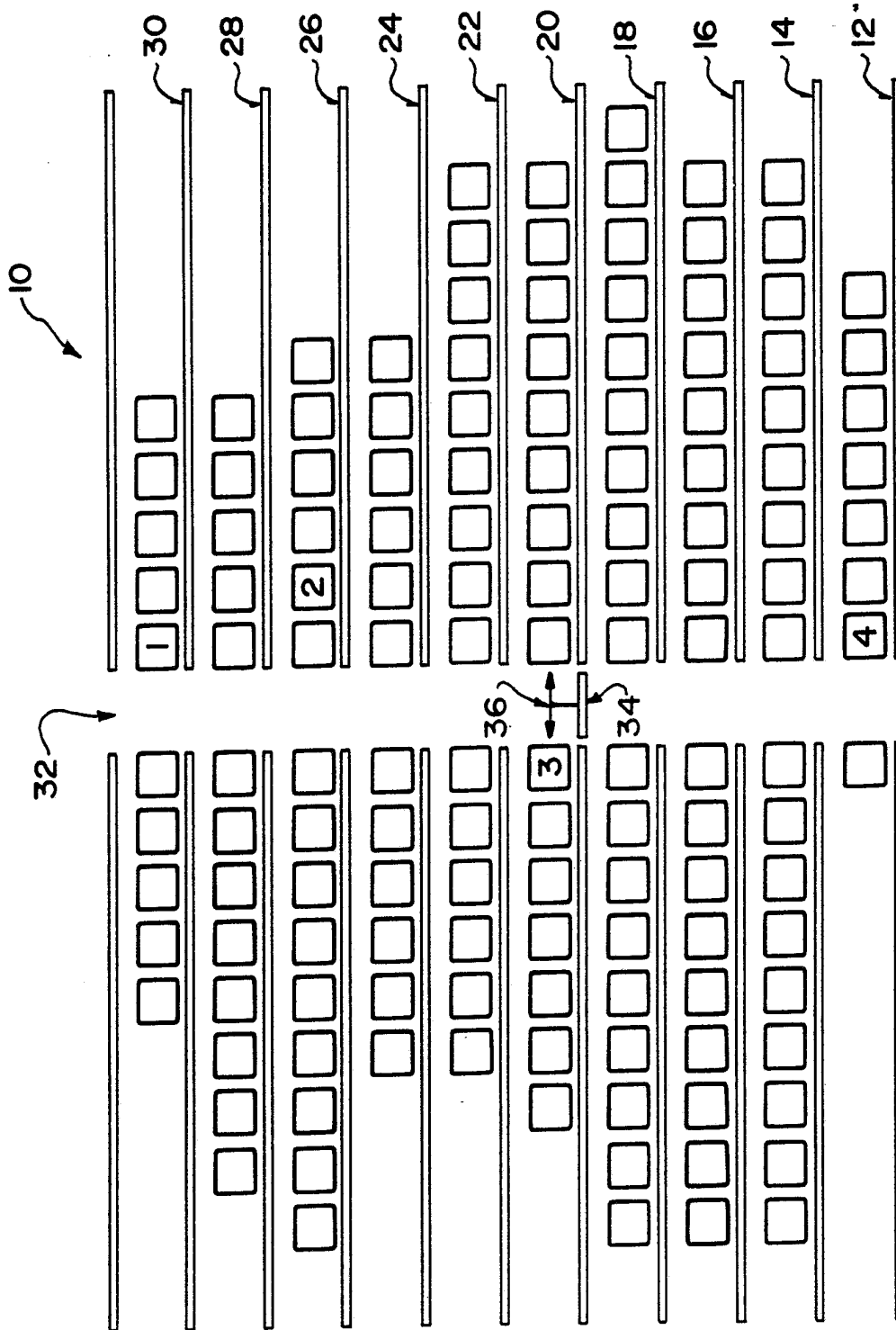


FIG. 1E

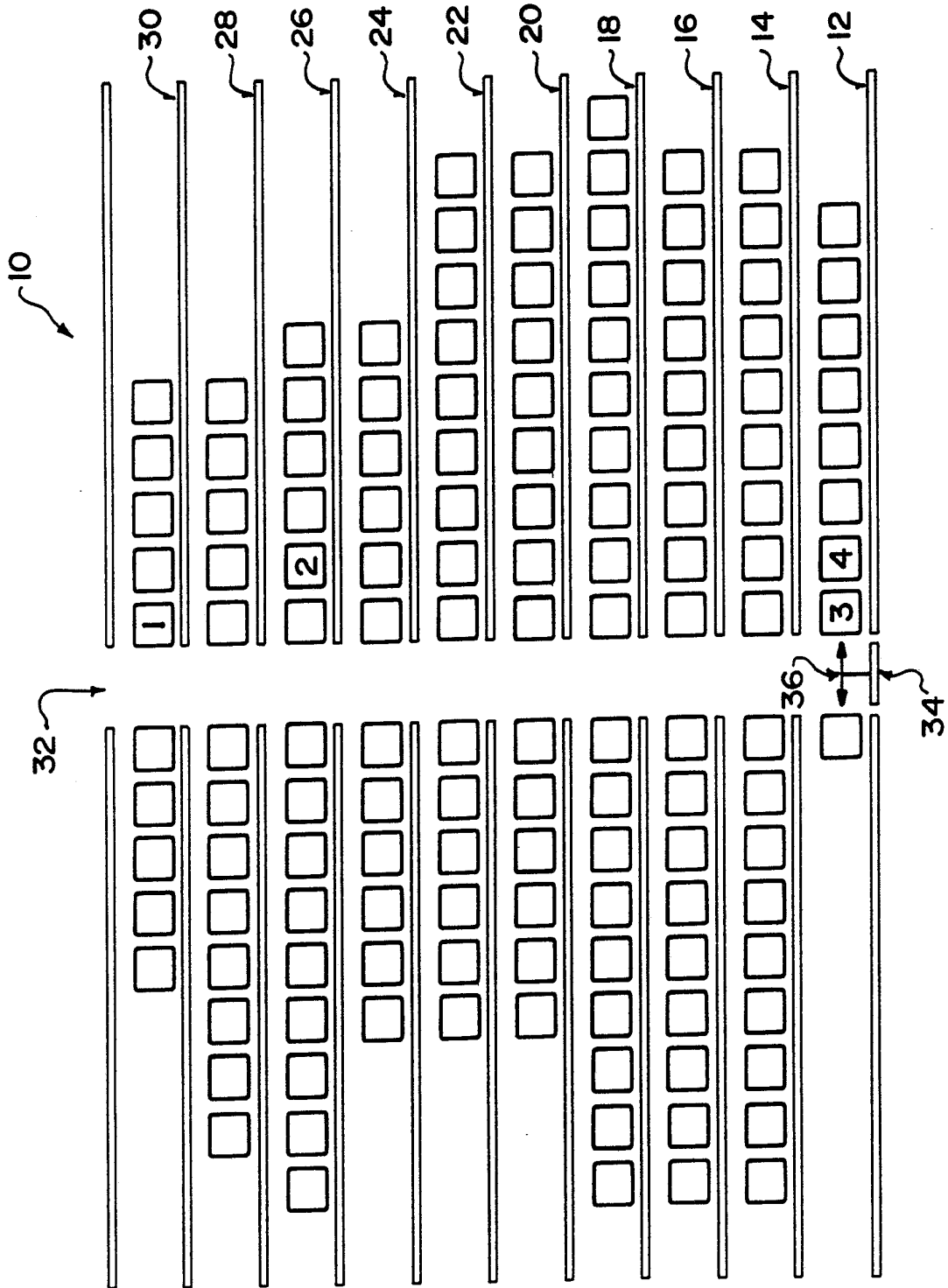


FIG. 1F

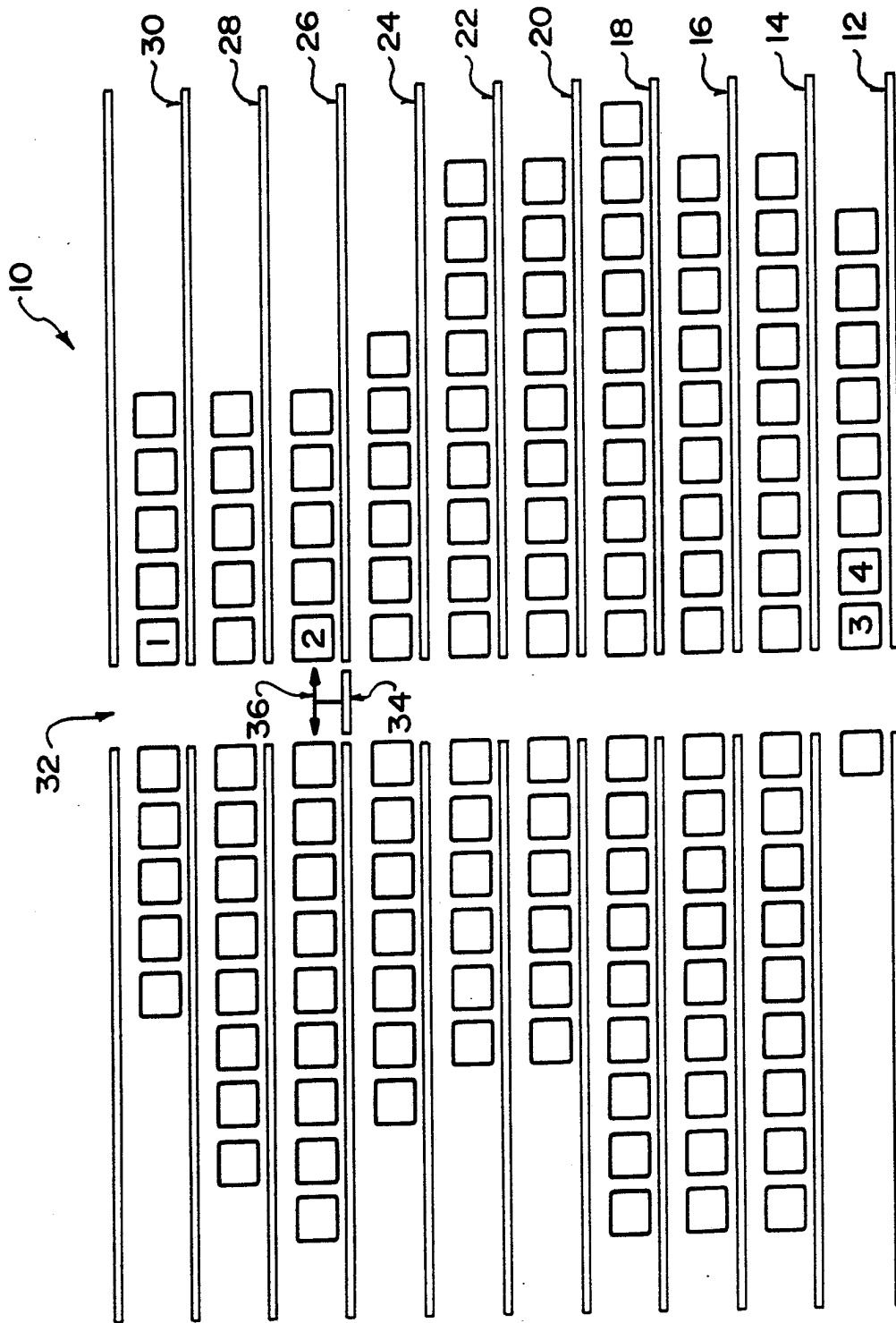


FIG. 16

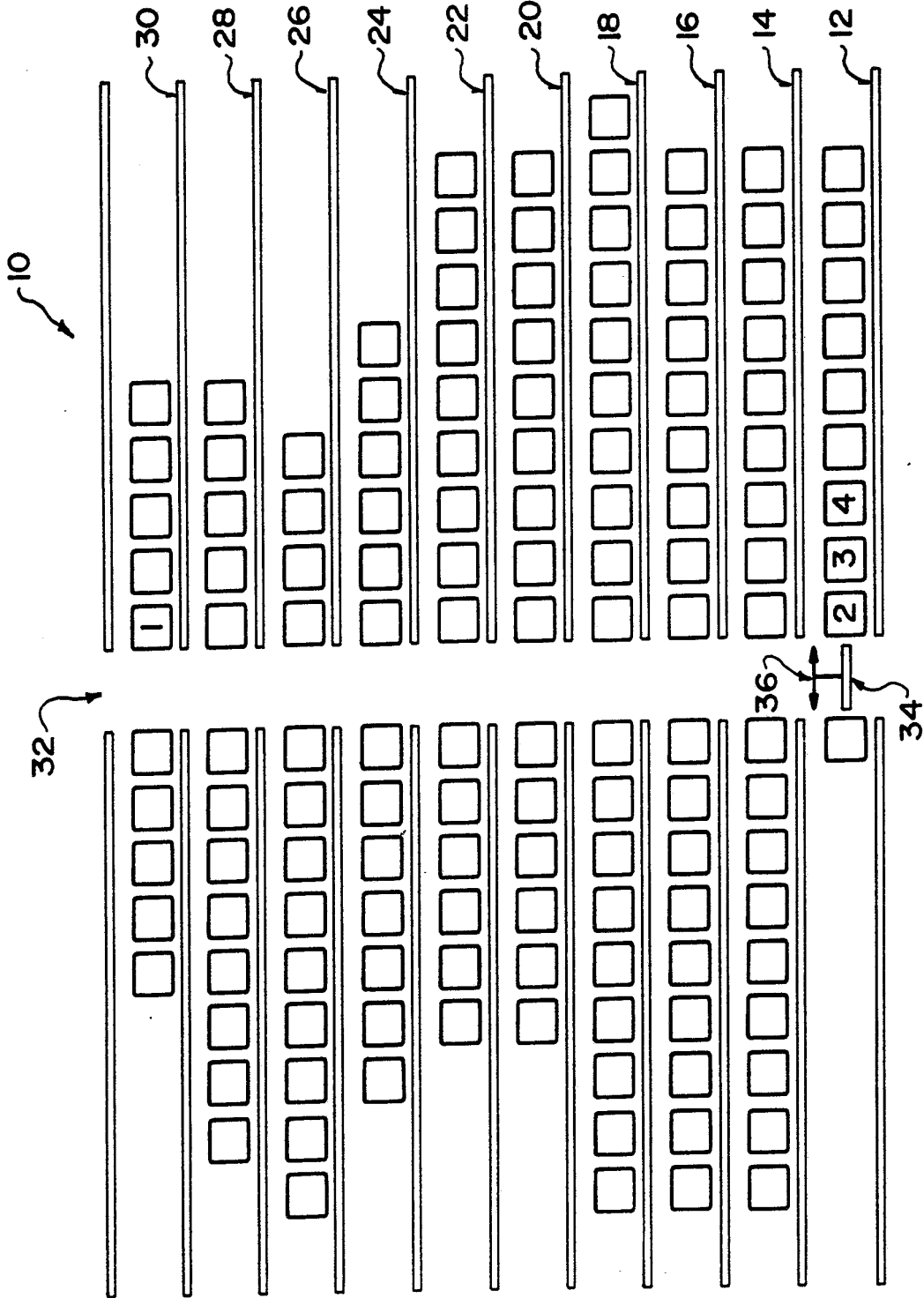


FIG. 1H

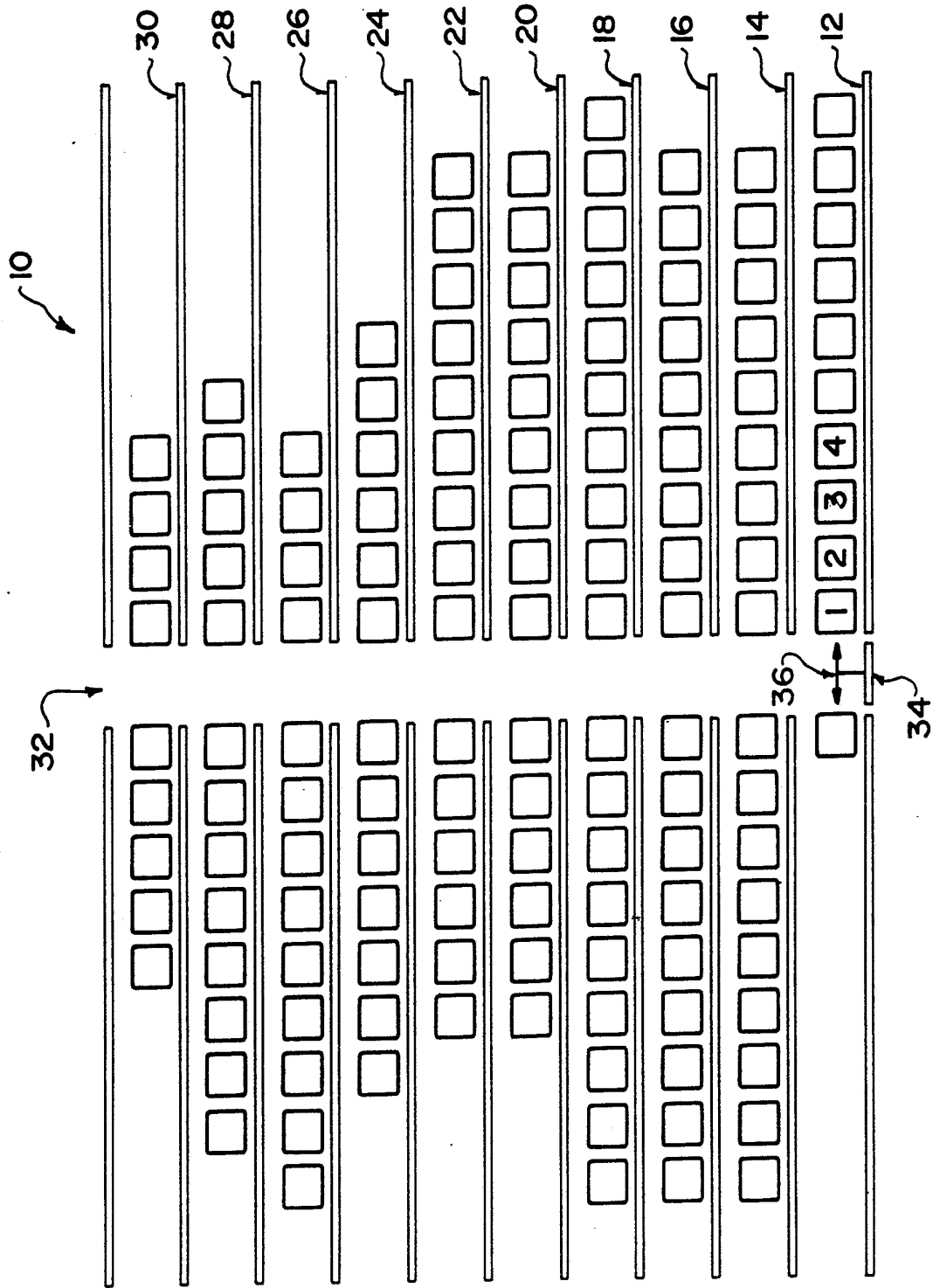


FIG. 11

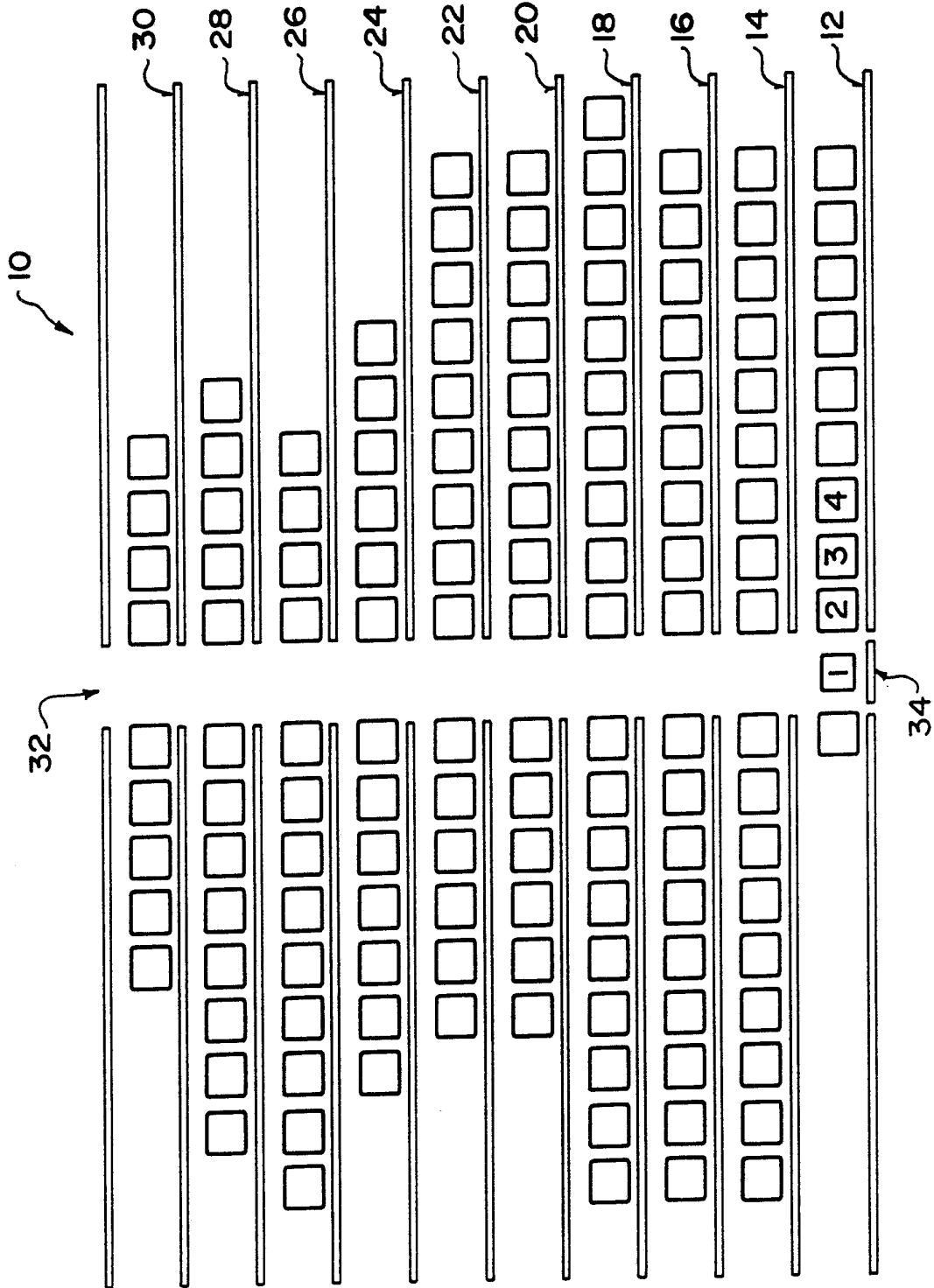


FIG. 1J

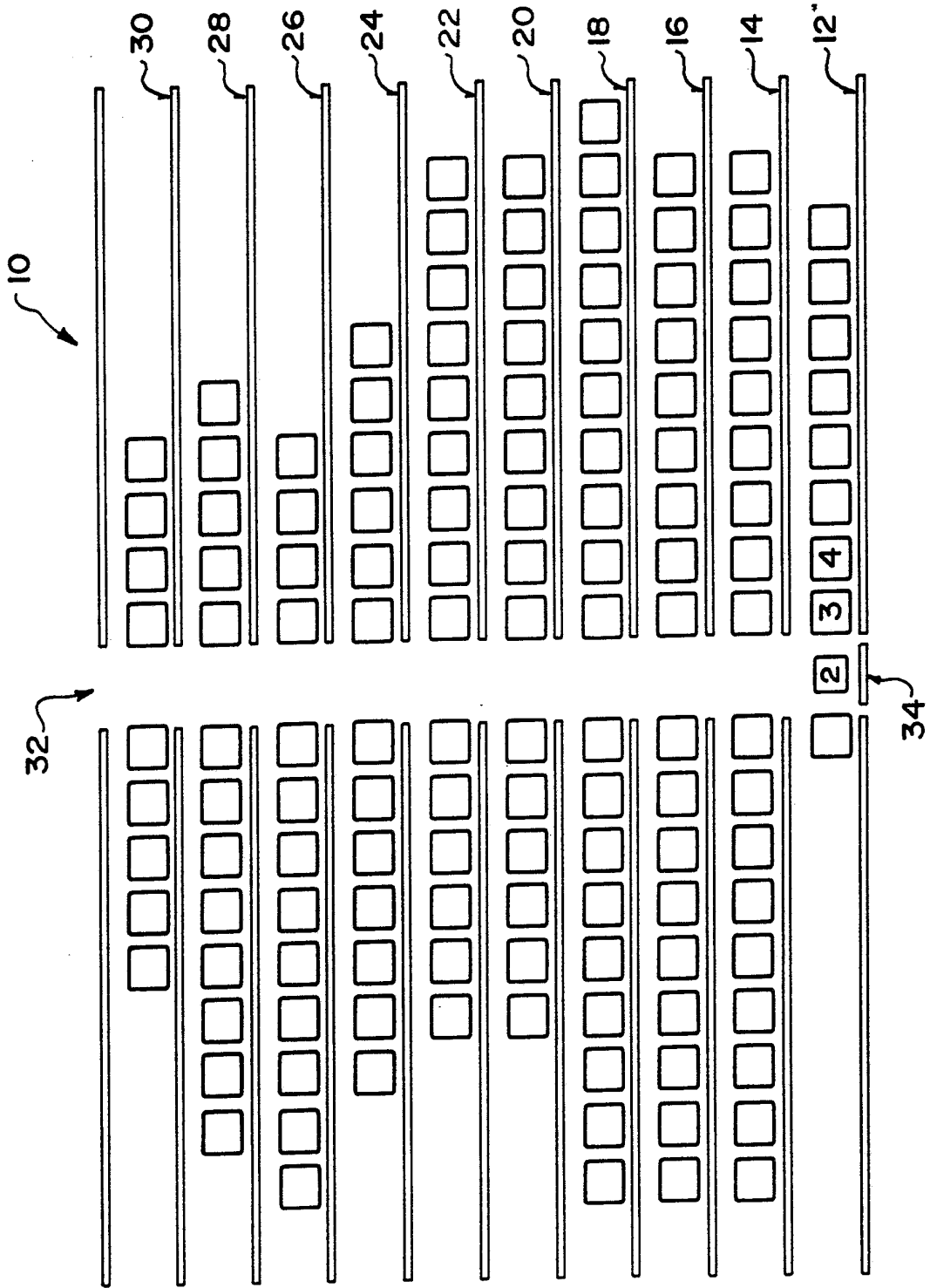


FIG. 1K



FIG. 1L

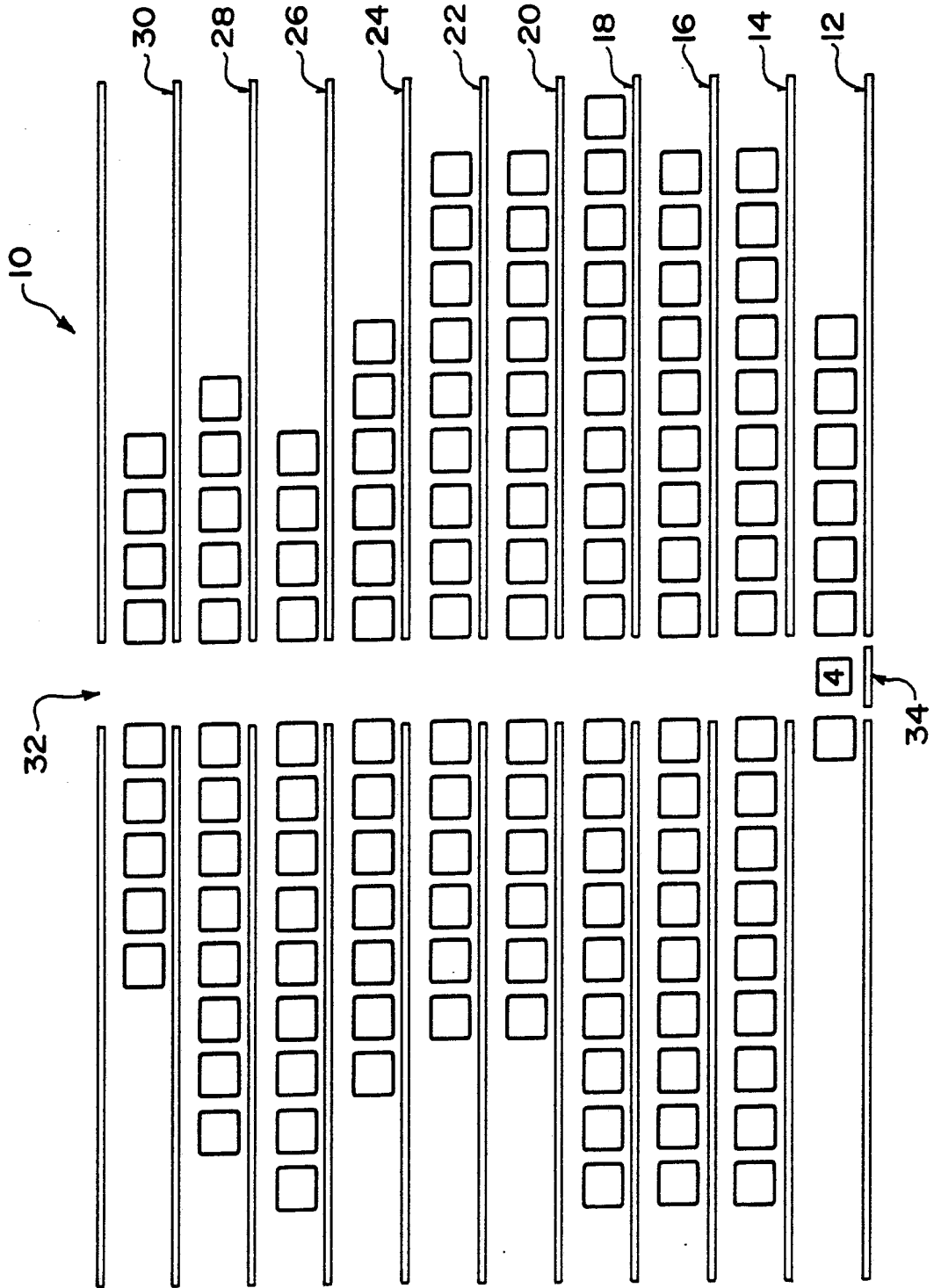


FIG. 1M

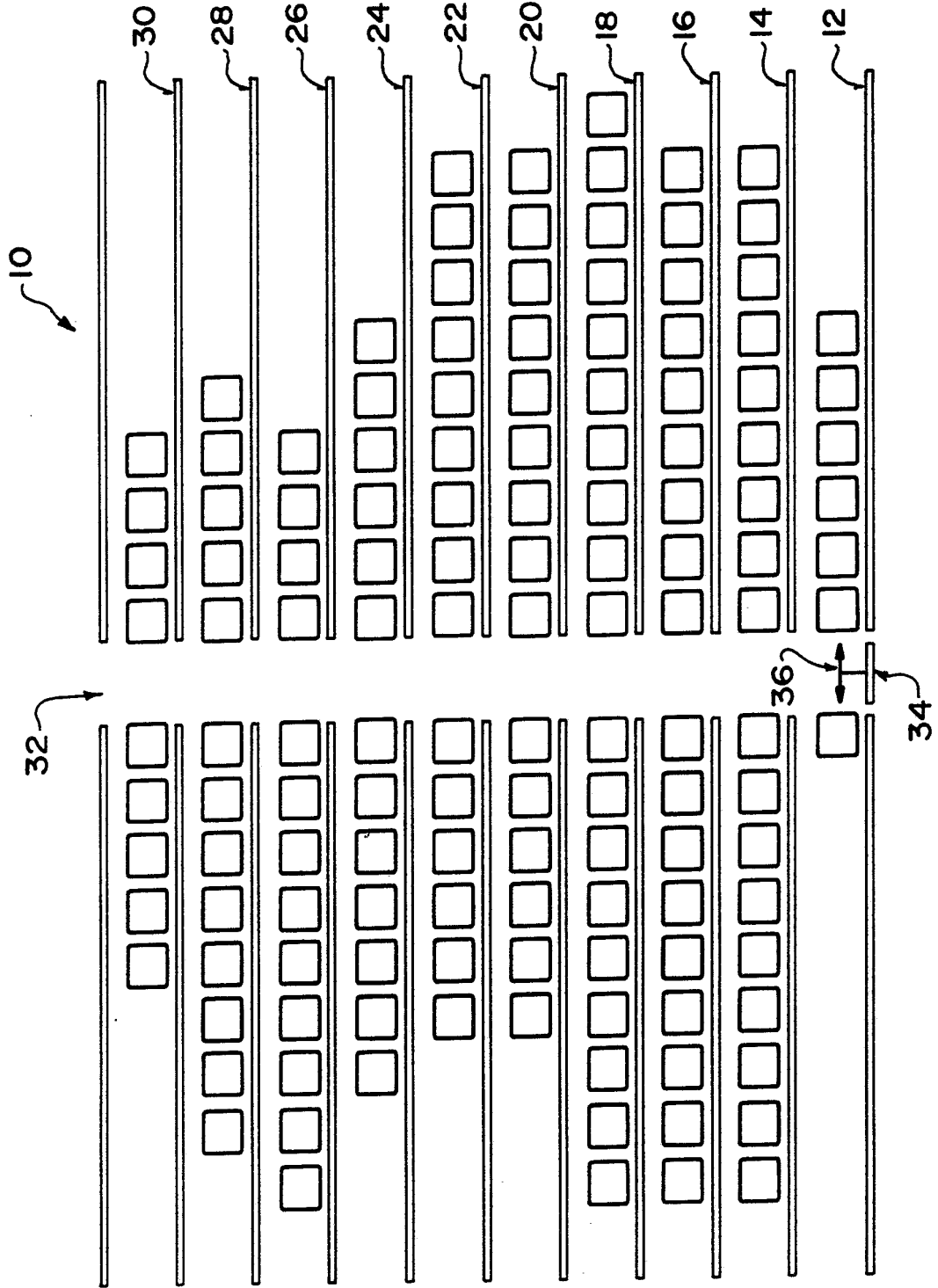


FIG. 1N

INTERNATIONAL SEARCH REPORT

International Application No PCT/CA 90/00281

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁵ : B 65 G 1/04, B 65 G 63/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁵	B 65 G	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	CH, A, 496598 (GABOR JENO SARVARY) 13 November 1970 see column 4, line 32 - column 5, line 27; figures	1-7, 9-19, 21, 22, 23, 24
X	US, A, 3547282 (HARTBAUER) 15 December 1970 see column 12, line 73 - column 14, line 38; figures	1, 14, 15, 16, 17, 18, 19, 21, 22, 23, 24
A	--	2-7, 9-13
A	DE, B, 1212879 (ESSICCATOI FAVA) 17 March 1966 see the whole document	1, 8, 20, 25
A	US, A, 3630402 (YOUNG) 28 December 1971 see the whole document	1

<p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
26th November 1990	19. 12. 90	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	F.W. HECK	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

CA 9000281

SA 39863

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 11/12/90. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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CH-A- 496598	30-09-70	BE-A- 728636 *	01-08-69
		DE-A- 1908525	18-09-69
		FR-A, B 2002275	17-10-69
		GB-A- 1249481	13-10-71
		NL-A- 6902640	22-08-69
		SE-B- 357181	18-06-73
		US-A- 3622020	23-11-71
US-A- 3547282	15-12-70	None	
DE-B- 1212879		None	
US-A- 3630402	28-12-71	US-A- 3779403	18-12-73

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82