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Rana

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[54] **SIGNATURE HANDLING SYSTEM**

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[52] **U.S. Cl.** ..... **214/7,** 93/93 R, 214/6 P, 214/152

[51] **Int. Cl.** **B65g 57/00**

[58] **Field of Search** ..... 214/1 S, 6 M, 6 P, 7, 152; 93/93 R, 93 M, 93 DP; 198/133

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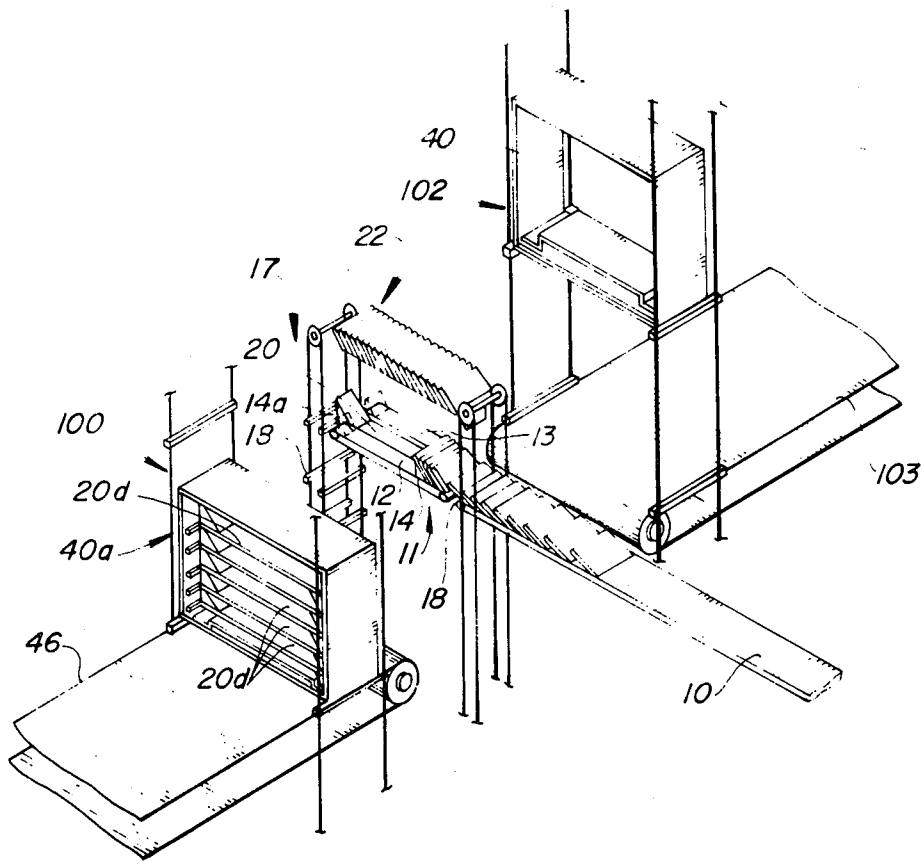
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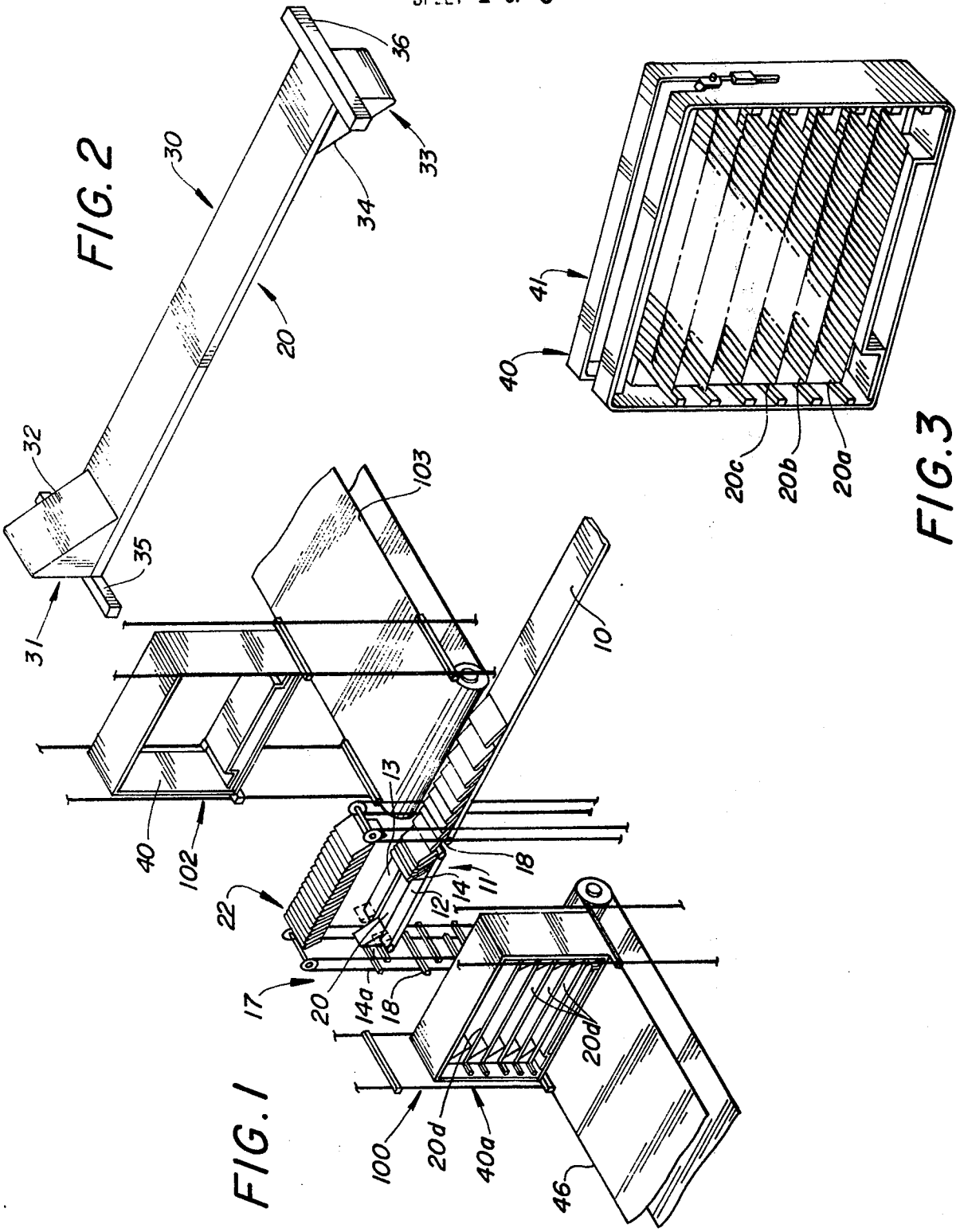
Primary Examiner—Frank E. Werner

[57] **ABSTRACT**

A loose shingled stream of signatures is conveyed to a dense shingling location. A tray is supported at the dense shingling location on an elevator. A dense shingled array of signatures is formed at the dense shingling location. The elevator is raised to move the tray with the dense shingled array thereon to a tray removal location for removal from the elevator. A means is provided for removing the tray from the elevator when it is located at the tray removal location. The means for removing the tray from the elevator comprises a vertically movable carriage having extensible load-carrying arms thereon so that the arms are extensible beneath the tray on the elevator. The arms are then raised to pick up the tray from the elevator and then retracted in order to withdraw the tray. The load-carrying arms are extensible in a direction away from the elevator so that the tray may be deposited on a suitable support on the side of the carriage opposite where the elevator is located.

28 Claims, 9 Drawing Figures




FIG. 2
30
36
33
34
20
32
35
31
FIG. 3
41
40
20c
20b
20a
FIG. 1
103
10
1
13
40
102
18
22
11
14
12
17
20
14a
18
20d
100
20d
40a
46

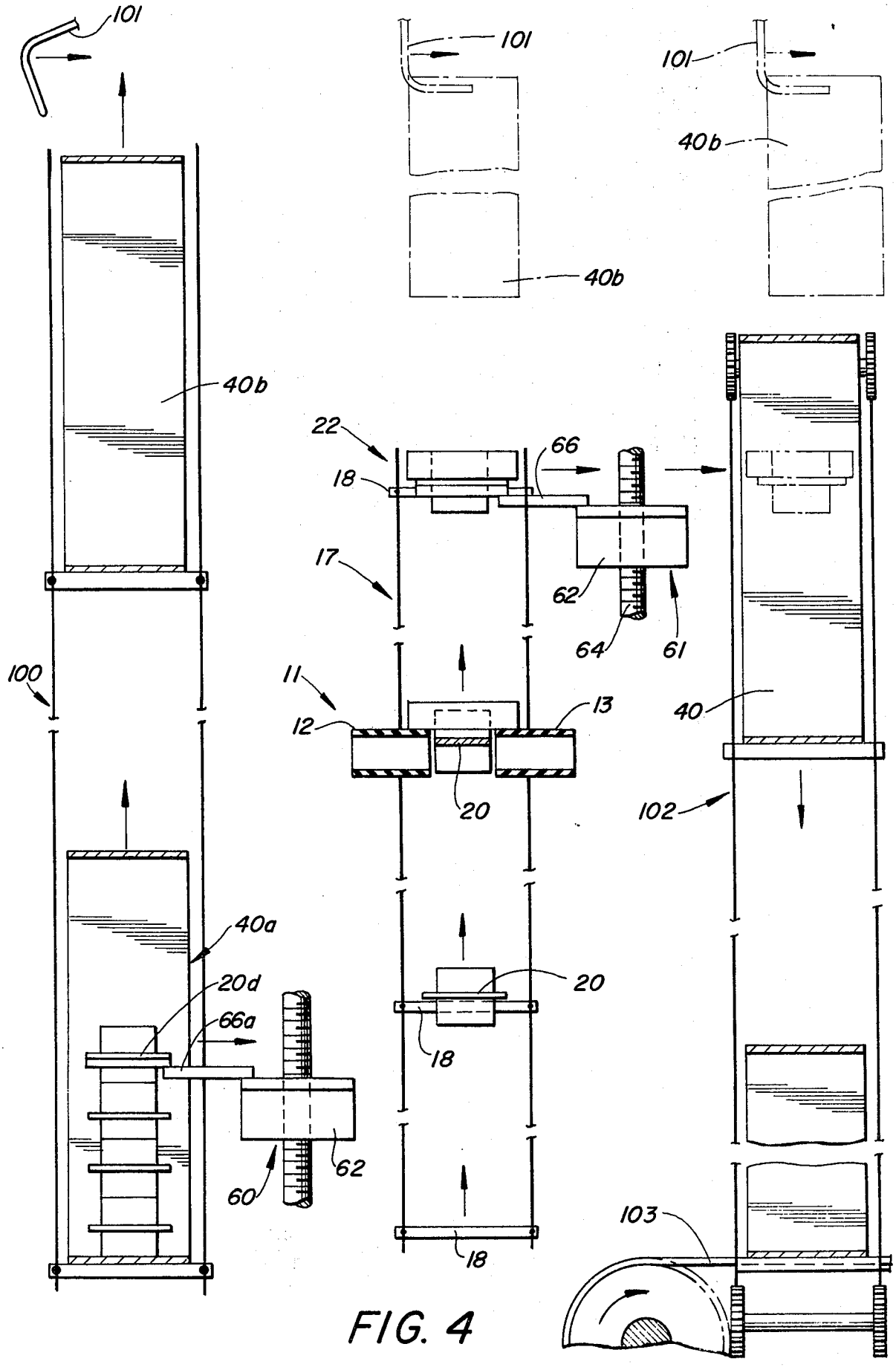

101
40b
100
40a
20d
66a
60
62
22
18
66
17
62
64
61
11
12
13
20
18
20
18
101
40b
101
40b
40
102
103

FIG. 4

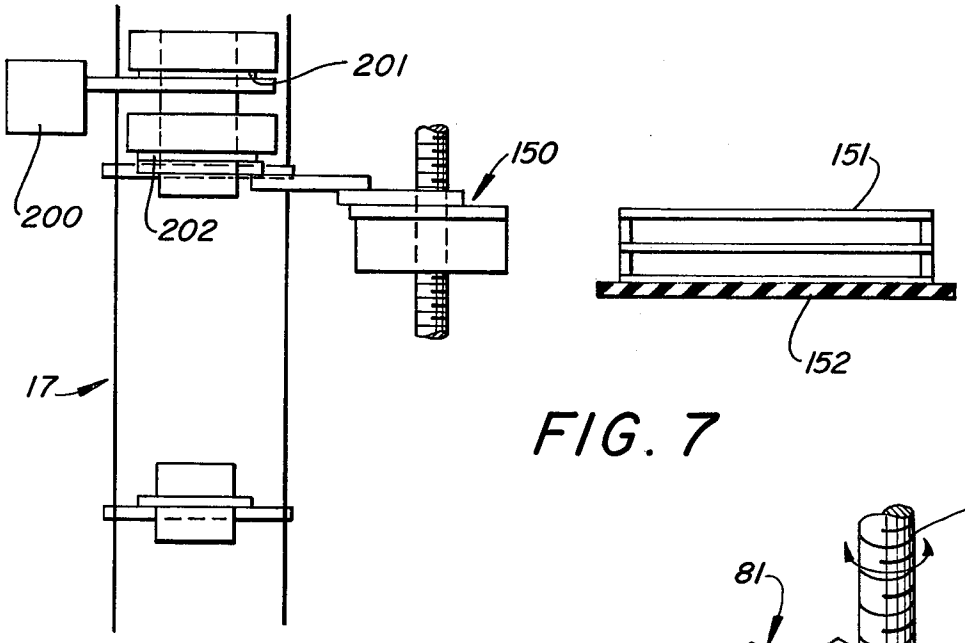


FIG. 7

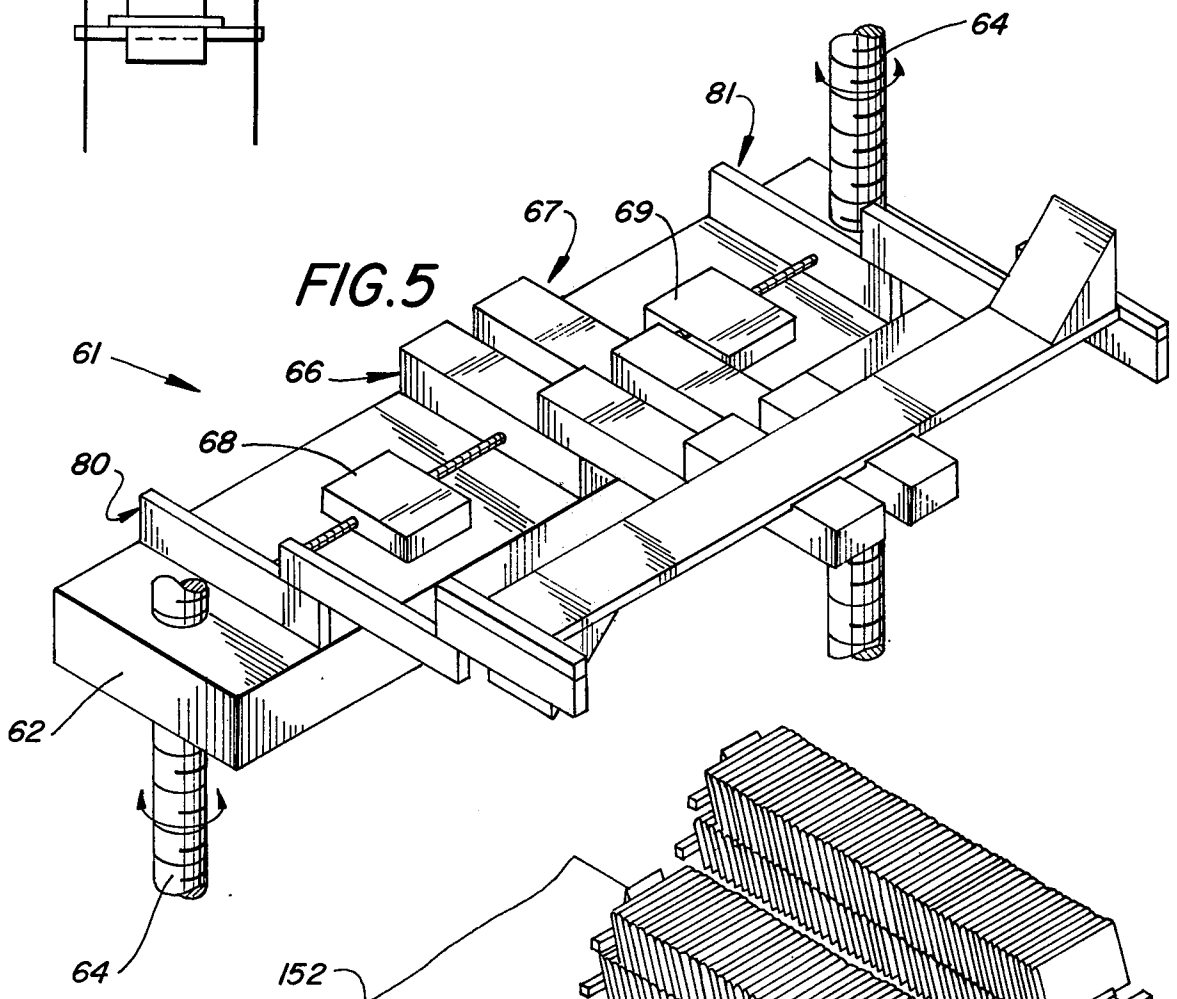


FIG. 5

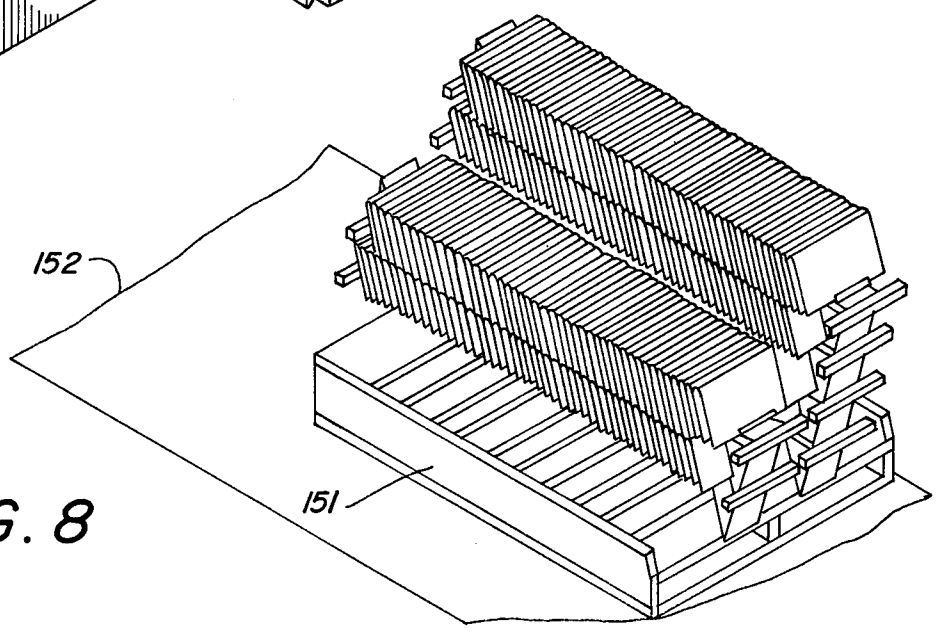


FIG. 8

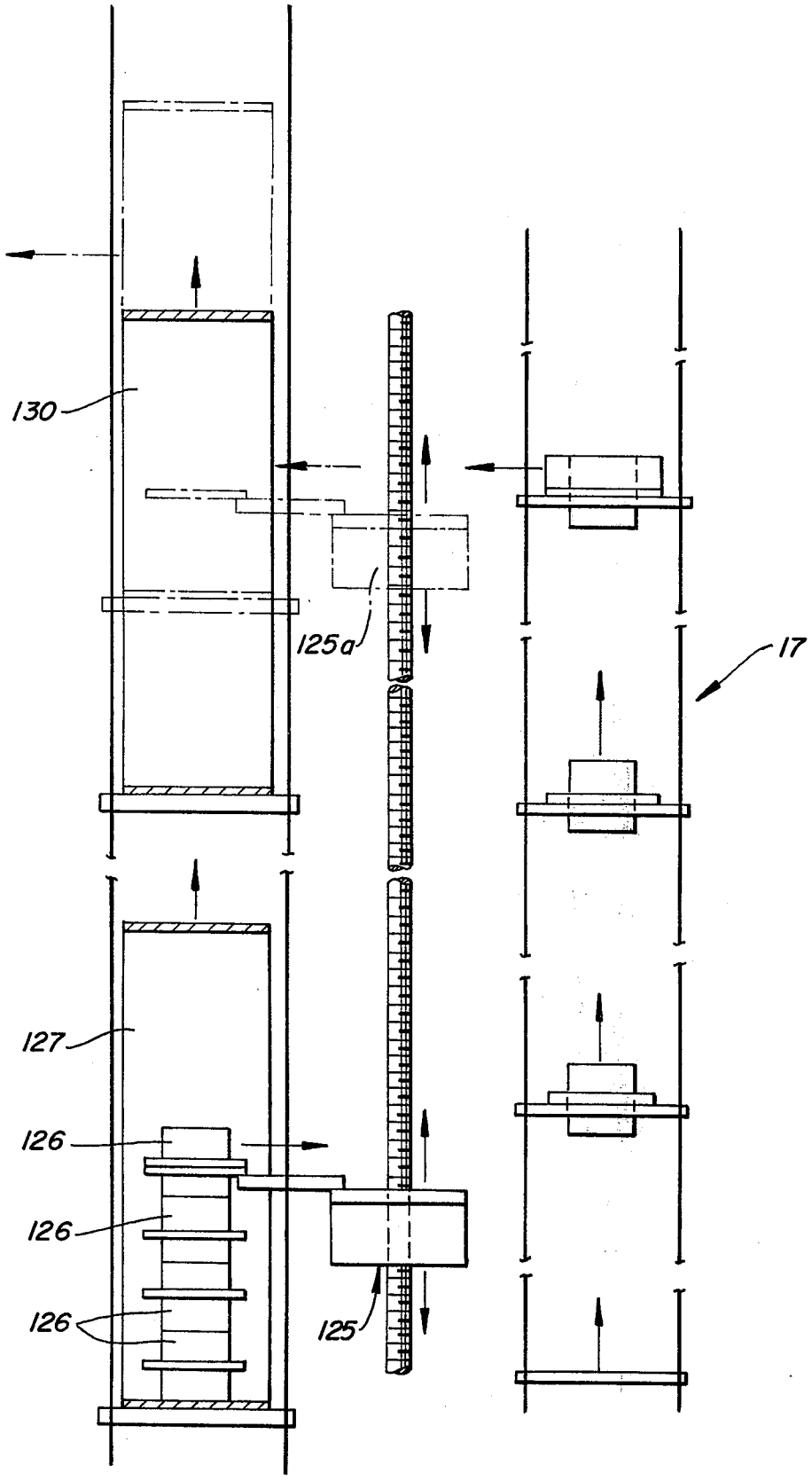
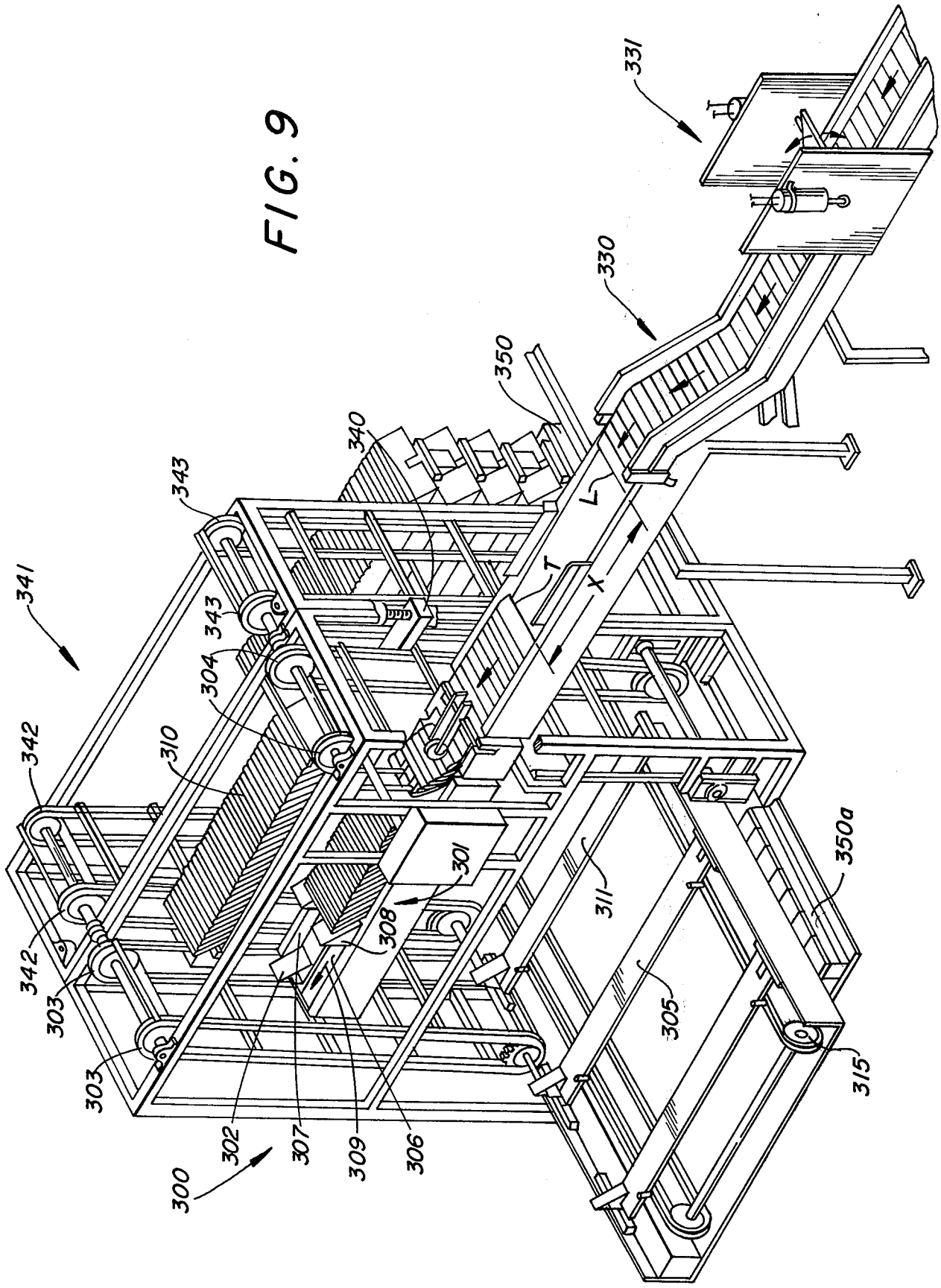


FIG. 6

FIG. 9


331
330
350
340
343
343
341
304
342
310
342
303
303
300
302
307
309
306
308
301
311
305
350a
315
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SIGNATURE HANDLING SYSTEM

BACKGROUND OF THE PRESENT INVENTION

The present invention is directed to a system for handling signatures, and in particular a system in which signatures are formed in a shingled relationship on a tray at a shingling location and wherein the tray is then moved from the shingling location for purposes of storage of the tray and the signatures thereon.

The present invention is related to applications Ser. No. 302,848, filed Nov. 1, 1972, entitled Method and Apparatus for Storing Sheet Material Articles, and Ser. No. 342,739, filed Mar. 19, 1973, entitled Method and Apparatus for Handling Sheet Material Articles, both assigned to the assignee of the present invention. Application Ser. No. 302,848 discloses a particular type of tray for receiving and storing signatures thereon. The tray is formed with a dense shingled array of signatures by a mechanism as shown in application Ser. No. 358,124 filed May 7, 1973, entitled Method and Apparatus for Forming a Dense Shingled Array of Signatures. The disclosures of those applications are specifically incorporated herein for purposes of amplifying the present disclosure.

As set forth in the previous applications, it has been suggested that signatures which are used in making a newspaper, magazine or the like may be printed well prior to the time that the newspaper or magazine is assembled. Those signatures may be stored until it is time for the newspaper or magazine to be assembled. The signatures that are stored are then combined with other signatures in suitable stuffing or gathering machine where the newspaper or magazine is assembled. As noted hereinabove, the signatures preferably are stored on a tray, and a plurality of trays are combined together in a storage module. That module is stored until it is desired that the signatures be combined into a final newspaper or magazine, and at that time the signatures are removed from the module and suitably combined in a stuffing machine.

SUMMARY OF THE PRESENT INVENTION

A primary aspect of the present invention is directed to the removal of filled trays from the mechanism in which the trays are loaded. The invention also involves the positioning of empty trays in the mechanism.

As noted in application Ser. No. 358,124 an elevator mechanism is provided which indexes in a vertical direction. A dense shingled array of signatures is formed adjacent the elevator mechanism so that upon indexing vertical movement of a tray, the dense shingled array of signature becomes located on the tray. The tray is then moved vertically on the elevator mechanism to a position for removal from the mechanism. The elevator mechanism, as disclosed in application Ser. No. 358,124, may support trays in a plurality of positions as follows: (1) an empty tray in a lower position, (2) a tray in a dense shingling location immediately adjacent to where the dense shingled array of signatures is formed and (3) a full tray at a tray removal location.

The present invention is directed specifically to a system which incoroporates an automatic means for removing the full trays from the elevator mechanism and for depositing those full trays on a suitable support which may be either a pallet or a module, or any other suitable support from which the trays may be further handled. The specific mechanism for removing the loaded trays from the elevator mechanism includes a carriage which is vertically movable. The vertically movable carriage includes extensible arms which can be extended to opposite sides of the carriage and may be extended toward the elevator mechanism and under a loaded tray on the elevator mechanism. The carrriage is then moved vertically in order to lift a loaded tray from the elevator mechanism. Once the tray is supported on the extensible arms, the extensible arms may be retracted toward the carraige. The construction of the carriage and the arms is such that the arms may be extended to the opposite side of the carriage and carry the full tray to the side of the carriage opposite the side where the elevator is located. At this location, the carriage may be moved vertically downwardly to deposit the tray onto the support.

Preferably, the carriage incorporates a second set of extensible arms which may be utilized for depositing the tray onto the support. Preferably, the loaded tray is deposited on top of another full tray. In such a case, the first set of arms which engages the loaded tray centrally thereof may interfere with the signatures on the full tray. Accordingly, a second pair of load-carrying arms may engage the loaded tray which is to be deposited at a location outwardly of the first pair of arms and also laterally outwardly of the array of signatures on the full tray on which the loaded tray is being deposited. As a result, there is no interference between the second set of arms and the signatures on the full tray on which the loaded tray is being deposited.

In accordance with one embodiment of the present invention, the trays are deposited on a pallet for purposes of storage. The trays may be removed from the elevator mechanism one at a time, or may be removed a plurality at a time. The pallet may be stored with a plurality of trays on it, and the pallet may be removed from storage when it is desired to use the signatures on the trays for delivery into a suitable stuffing machine.

In accordance with another embodiment of the present invention, a mechanism, i.e., similar to the mechanism for unloading a loaded tray from the elevator, is utilized for depositing an empty tray on the elevator mechanism for delivery by the elevator into the dense shingling location. This mechanism may remove empty trays from a module and deposit them onto the elevator at the desired location. This mechanism includes extensible arms which are extensible to opposite sides of a vertically movable carriage, the carriage being located between the module and the elevator mechanism. The extensible arms extend outwardly and engage an empty tray and move it from one side of the carriage to the opposite side and deposit it on the elevator mechanism. Once deposited on the elevator mechanism, the elevator mechanism, when it indexes, moves the empty tray into the tray-loading position.

In one embodiment of the present invention, the same mechanism which removes an empty tray from a module and deposits it on the elevator mechanism removes the full tray from the elevator and deposits it in a module that has been emptied. The emptied module is moved into position for receiving the full trays, and the mechanism which operates to place the empty trays on the elevator and to remove the full trays from the elevator has sufficient vertical travel to perform these functions.

In other embodiment of the present invention, separate mechanisms may be utilized, one for removing

empty trays from the module and placing them on the elevator mechanism, and another for removing the full tryas from the elevator and depositing the full trays in a module.

DESCRIPTION OF THE FIGURES

Further objects and advantages of the present invention will be apparent to those skilled in the art to which it relates from the following detailed description of preferred embodiments thereof made with reference to the following drawings forming a part of this specification and in which:

FIG. **1** is a schematic view illustrating a system constructed in accordance with the present invention and wherein retriever assemblies are utilized to transfer empty support trays from a storage module to a loading station and to transfer support trays loaded with signatures from the loading station to a receiving station, the retrievers being omitted for purposes of clarity of illustration;

FIG. **2** is a perspective view of a support tray utilized in the system of FIG. **1**;

FIG. **3** is an illustration of full trays disposed in a mdoule for purposes of storage;

FIG. **4** is a schematic illustration, taken generally along the line **4—4** of FIG. **1**, illustrating the transfer of empty trays to the loading station and the removal of full trays;

FIG. **5** is a schematic perspective illustration of a retriever mechanism utilized in the system of FIG. **1**;

FIG. **6** is a schematic illustration of an embodiment of the invention in which a single retriever mechanism is utilized to transfer empty trays to a loading location and to remove full trays;

FIG. **7** is another embodiment of the invention in which full trays are transferred to a storage pallet by a retriever mechanism;

FIG. **8** is an illustration depicting a storage pallet which has been partially loaded by the retriever mechanism of FIG. **7**; and

FIG. **9** is a schematic view illustrating another embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

As noted hereinabove, the present invention relates to a mechanism and system for handling of signatures, and particularly to a stystem in which signatures are formed in a dense shingled array and stored on a tray. The tray is stored until the desired time when the signatures are need for purposes of assembly into a newspaper or magazine in a stuffing machine. As noted hereinabove, application Ser. No. 302,848 discloses a suitable mechanism and tray for receiving and storing signatures. Application Ser. No. 358,124 which is also assigned to the assignee of the present invention, discloses a suitable mechansim for forming the signatures into a dense shingled arrangement on the trays. The present invention is directed to the system and specifically emphasizes the mechanism for removing the full trays from the dense shingling mechanism and also emphasizes the mechanism for loading empty trays into the dense shingling mechanism.

FIG. **1** is a general schematic view illustrating in schematic form portions of one embodiment of the present invention. As shown in FIG. **1**, signatures are conveyed by a conveyer mechanism **10** to a dense shingling location or tray-loading station, generally designated **11**. At the tray-loading location **11** a suitable mechanism is provided for forming the loose shingled stream of signatures into a densely shingled array. The specific mechanism is preferably such as disclosed in application Ser. No. 358,124. However, such a mechanism may take many different forms.

As shown in copending application Ser. No. 358,124 a pair of conveyers **12** and **13** are located at the dense shingling or tray-loading location **11.** The conveyers have wedges **14** thereon which move in a retracting direction as signatures are delivered onto the conveyer belts **12** and **13.** As the signatures move onto the belts **12** and **13,** their lead edge engages the inclined forward surface of the wedges **14** and are deflected upwardly. The signatures then settle and rest on the inclined surface on the wedges **14.** Other signatures engage the inclined surface of the signature which was last delivered to the wedge **14** and the lead edges thereof is deflected upwardly by the supported signature. As signatures are delivered by the conveyer **10** to the conveyers **12** and **13,** the wedge **14** is moved by the conveyers **12** and **13** in a retracting direction to form a dense shingled array of signatures. When the wedge **14** has reached a fully retracted position, as shown in dotted lines in FIG. **1** and designated **14*a***, and elevator mechanism, generally designated **17,** is indexed upwardly.

The elevator mechanism **17** includes a pair of chains at opposite ends of the conveyers **12** and **13.** The chains have suitable support means thereon generally designated **18** for supporting the opposite ends of the trays **20.** The trays **20** are supported at the dense shingling or tray-loading position immediately beneath the surface of the conveyers **12** and **13.** After the wedges **14** have been moved to the far end of the tray, the elevator mechanism indexes upwardly and the tray **20** picks up the dense shingled array of signatures from the conveyer belts **12** and **13** and carries the dense shingled array to a full tray removal position, generally designated **22.**

A tray **20** on which a dense shingled array of signatures is deposited at the loading location is best seen in FIG. **2.** The tray **20** includes a central support portion **30** on which the signatures are formed in a dense shingled array. The tray also includes an upper wedge-shaped end portion **31** having an inclined surface **32.** The signatures, when formed in the dense shingled array, lie or are supported by the surface **32.** The opposite end of the tray **20** has a wedge-shaped portion **33** which projects downwardly and which portion **33** has a tapered surface portion **34** for a purpose to be described hereinbelow. The opposite ends of the tray **20** have suitable support rods or bars **35, 36.** The support bars **35, 36** are adapted to cooperate with suitable support elements **18,** carried on the opposite ends of the elevator mechanism **17** so that the trays may be readily supported by the elevator mechanism **17** with the central portion **30** in a horizontal orientation.

Once the trays are filled with a dense shingled array of signatures, the trays are stored in a suitable storage module **40.** The storage module **40** may be of any suitable construction, and is described in complete detail in the aforementioned application Ser. No. 302,848. In essence, the storage module **40** (FIG. **3**) comprises a frame **41** in which the full trays **20** are supported. Each tray is supported with the signatures on the upper tray being supported on the signatures in the lower tray. For example, the first tray designated **20*a*** in FIG. **3** and the

second tray, generally designated **20***b*, are located so that the central or support portion of the tray **20***b* would be supported in a horizontal orientation on the upper edge of the signatures carried on the tray **20***a*. Moreover, the inclined surface **34** of the wedge portion **33** of the tray **20***b* would engage the signatures carried on the tray **20***a*. Likewise, the tray **20***c* would be supported in a similar manner on the signatures on tray **20***b*. It should be understood that the tray and module structure, as shown in FIGS. **2** and **3**, is merely exemplary and modifications may be made therein without departing from the present invention.

As shown in FIG. **1**, a module **40***a* is positioned adjacent the left side of the elevator mechanism **17**, as viewed in the direction of feed of the signatures to the elevator mechanism. The module **40***a* holds a plurality of trays which are generally designated **20***d* and all of which are empty. The trays **20***d* and the module **40***a* are delivered into position on a suitable conveyor **46**.

In the embodiment of the invention disclosed in FIG. **4**, a suitable retriever mechanism, generally designated **60**, is disposed intermediate the empty tray module **40***a* which holds empty tray **20***d* and the elevator mechanism **17** which moves loaded trays from the loading location **11**. The mechanism **60** is provided for the purpose of removing empty trays from the module **40***a* and placing them on the elevator mechanism **17** at the loading location **11**.

A second retriever mechanism **61** which is similar in construction to the mechanism **60**, is provided to transfer loaded trays **20** from the loading location **11** to the storage module **40**. The retriever mechanism **60** and **61** are of similar construction and may take a variety of different forms. The retriever mechanism **61** specifically includes a carriage, schematically illustrated as **62** in FIG. **5**, and which is vertically movalbe upon rotation of a plurality of screws **64** on which the carriage is mounted. The carriage **62** carries a pair of extensible arm assemblies **66** and **67**.

The arms assemblies **66** and **67** include a plurality of sections which are extendable in opposite directions from a telescopically nested position on the carriage **62**. Although the specific construction of the drive arrangement for the sections of the arm assemblies **66** and **67** is not, per se, part of the present invention, it is contemplated that these drive assemblies will be constructed in a manner similar to that shown in U.S. Pat. Nos. 3,232,455 and 3,596,789. Although only the retriever mechanism **61** is shown in FIG. **5**, it should be understood that the retriever mechanism **60** includes arm assemblies **66***a* and **67***a* of the same construction as the arm assemblies **66** and **67**.

The arm assemblies **66***a*, **67***a* of the retriever mechanism **60** are moved outwardly of the carriage **62** under the influence of reversible drive assemblies similar to the drive assemblies **68** and **69** of FIG. **5** in order to be located beneath a support portion of an empty tray in the module **40***a*. The carriage **62** is then moved vertically in order to engage an empty tray **20***d* with the arm assemblies **66***a*, **67***a*. The arm assemblies **66***a* and **67***a* are then retracted from the module **40***a* and thereby carry the empty tray **20***d* toward the carriage **62**. The carriage **62** then moves vertically to align the tray **20***d* with support elements **18** on the elevator **17**.

The arm assemblies **66***a* and **67***a*, when extended in the direction of the elevator **17**, project between the chains at the opposite ends of the conveyers **12** and **13**. The carriage **62** then moves vertically downwardly and deposits the tray on the elevator supports, specifically the end portions **35, 36** of the tray **30** are received on and supported by the support elements **18** on the elevator mechanism **17**. Any tray that is supported on the elevator mechanism **17** is indexed upwardly into the dense shingling position, as shown in FIG. **1**, when a shingled array has been formed on the conveyers **12** and **13**. The elevator mechanism **17** then raises the tray to remove the shingled signatures from the loading location **11**. The elevator **17** moves the loaded tray **20** to the tray removal position **22** where it is engaged by the retriever mechanism **61**.

The retriever mechanism **61** removes full trays from the elevator mechanism **17** and transfers them to the storage module **40**. With the arm assemblies **66** and **67** extended toward the left (as viewed in FIG. **4**), the arm assemblies extend beneath the loaded tray on the elevator mechanism **17**. Upon raising movement of the carriage **62** under the influence of the screws **64**, the arm assemblies raise the loaded tray from the supports **18** on the elevator mechanism **17**. The arm assemblies **66** and **67** are extensible to the opposite side of the carriage **62** under the influence of the reversible drives **68** and **69**. When the arm assemblies **66** and **67** have been extended to the right, as viewed in FIG. **4**., they extend into the module **40**. This enables the retriever mechanism **61** to deposit a loaded tray **20** in the module **40** on previous trays which have been deposited therein.

The retriever mechanism **61** which removes the full trays **62** from the elevator mechanism **17** and deposits them in the module **40** is provided with a second set of load-carrying arms, which are generally designated **80, 81**. The second set of extensible arms are provided for the purpose of engaging the end portions **35, 36** of a full tray immediately before the full tray is deposited on a full tray already located in the module **63**. The arm **66, 67** engage the full tray centrally thereof in order to support the greatest load and engage in the area of the greatest load of the tray. However, in view of the fact that the arms are located to support the tray and engage the tray in the central portion thereof, when the tray is deposited in the module or on top of another full tray, the arms **66, 67** may interfere with the signatures which are on the tray on which the full tray being deposited is to be received. As a result, immediately before depositing the full tray, the arms **66, 67** are retracted and the second support arms **80, 81** move into and engage the support bars **35, 36** at opposite ends of the tray. This engagement occurs only momentarily for purposes of deposit of the full tray on another tray. When this occurs, the carriage **62** lowers for purposes of depositing the full tray now supported on the additional arms **80, 81** onto the full tray. As a result, the arrangement of the arms **80, 81** is such that the arms are located outside or laterally of the array of signatures on the lower tray, and thereby do not interefere with the signatures on the lower tray.

The reversible drives **68** and **69** are operable to extend and retract the arm assemblies **80** and **81** independently of the arm assemblies **66** and **67**. Therefore, the arm assemblies **66** and **67** can be retracted while the arm assemblies **80** and **81** remain extended. It should be noted that the arm assemblies **80** and **81** have a small width so that they can fit into the space between the loaded trays **20** and the sides of the module **40**.

In the embodiment of the invention shown in FIG. **4**, the empty module **40***a* is located on the left side of the elevator mechanism **17** and is carried in a suitable conveyer mechanism which may index vertically upwardly during operation of the retriever mechanism **63**. As schematically illustrated in FIG. **4**, a suitable elevator mechanism, generally designated **100**, is provided for this purpose. The elevator mechanism **100** may be timed to the operation of the other parts of the mechanism so as to index at the proper time and in the proper sequence of operation. Once the elevator mechanism is indexed sufficently, a module is located in an upper position, designated **40***b* in FIG. **4**. When an empty module is located in the position generally designated **40***b*, a suitable conveyer mechanism is provided for purposes of latching onto and conveying the empty module **40***b* laterally over the elevator mechanism **17**. This conveyor mechanism is generally designated **101**.

Full modules **40** or modules that are being filled, are supported in an elevator mechanism generally designated **102**. The elevator mechanism **102** supports a full module **40** and may be of any suitable construction. As full trays are received in the module **40** on the elevator mechanism **102**, the elevator mechanism lowers the module. When the module **40** is fully loaded, the elevator mechanism **102** is actuated in order to deposit the full module on a conveyer mechanism **103** which removes or moves the full module from the apparatus for purposes of storage. The module **40** which is located on the elevator **102** may be positioned automatically on the conveyer **103** by operation of the elevator **102**. The conveyer **101** may be suitably operated in order to convey an empty module into position over the elevator mechanism **102** and a suitable mechanism, not shown, is actuated in order to release the module and deposit it in position on the elevator **102**.

As noted hereinabove, the present invention provides a mechanism for loading empty trays onto the elevator mechanism and for removing full trays from the elevator mechanism, so that the entire operation of shingling and forming signatures into a dense shingled array and providing for storage of those signatures in a suitable storage container, or support, is effected. Another embodiment of the present invention is illustrated schematically in FIG. **6** in which a single retriever mechanism **125** is utilized to load empty trays onto an elevator and to remove empty trays from the elevator.

The retriever mechanism **125** is provided on one side of the elevator mechanism **17**, namely, the left side as illustrated in FIG. **6**. The retriever mechanism **125** is operable to remove empty trays, designated **126**, from the module **127** which contains the empty trays and is also operable to move vertically to a position such as shown at **125***a* for removing full trays from the elevator mechanism **17** and depositing them in a module for containing full trays, and which module is designated **130**. After a predetermined number of trays have been removed from the module **127** and a predetermined number of full trays have been deposited in the module **130**, the modules **127**, **130** may be indexed vertically for further emptying of the module **127** and further filling of the module **130**. Once the module **130** is completely filled, it is removed from the machine in the direction of the arrow **131**, and the empty module **127** may be indexed up in order to be the next module for receiving full trays.

A further embodiment of the present invention is illustrated in FIG. **7**. The embodiment of the present invention illustrated in FIG. **7** is a simplification of that described in FIGS. **4** and **5**. In the embodiment of the present invention shown in FIG. **7**, the trays may be manually placed on the elevator mechanism **17** and indexed vertically into a tray-loading position. Once the trays are received in the tray-loading position, they are loaded with the signatures and are then indexed vertically to the tray removal position shown in FIG. **7**. In the tray removal position, a suitable retriever mechanism, designated **150** and of a construction similar to that described above in connection with FIG. **5**, is provided for purposes of removing the full trays from the elevator mechanism. The loaded trays are placed on a suitable pallet, designated **151**, on a conveyer **152** (see FIG. **8**). Once the pallet **151** is loaded, the conveyer **152** may be operated in order to remove the full pallet from loading position. The unloading mechanism **150**, as noted hereinabove, moves vertically for purposes of unloading and depositing the full trays on the pallet **151** and may be manually operated through its desired path of movement. Moreover, the elevator mechanism may be operated in order to remove two or more full trays from the elevator mechanism simultaneously. This is true also of the mechanisms disclosed above with respect to FIGS. **4** and **5**, that is, in any one of the embodiments a plurality of loaded trays may be removed from the mechanism at the same time.

To facilitate the removal of two trays at a time from the elevator **17** of FIG. **7**, a latch assembly **200** is provided to hold a loaded tray **201** while a next succeeding tray **202** is loaded with signatures. Once the tray **202** has been loaded, it is moved upwardly into engagement with the tray **201** under the influence of the elevator **17**. The arm assemblies on the retriever **150** are then moved into supporting engagement with the lower tray **202**. The latch assembly **200** is then released and the two loaded trays **201** and **202** are transferred to the pallet **151**.

A still further embodiment of the present invention is schematically illustrated in FIG. **9**. In FIG. **9** a system, generally designated **300**, is provided in which signatures are formed into a dense shingled arrangement at a dense shingling location, generally designated **301**. The dense shingling structure at the dense shingling station **301** is similar to that shown in FIG. **1** and will not be described again in detail. It should suffice, however, to say that at the dense shingling location **301** a tray **302** is supported on an elevator mechanism which includes a pair of chains **303** located at one end of the tray and a second pair of chains **304** located at the other end of the tray. The chains, of course, support the tray at the dense shingling location while an array of densely shingled signatures is formed at the station.

The densely shingeld signatures are formed on a pair of conveyor belts **306**, **307** which carry wedge members **308**. The wedge members retract in the direction of the arrow **309** as the signatures are formed into the dense shingled array. Once the densely shingled array of signatures is formed above the tray **302**, the elevator mechanism indexes vertically upwardly so as to cause the tray to engage the signatures and then pick up the signatures from the belts **306**, **307**. The elevator mechanism continues to move vertically to move the full tray from the dense shingling station **301** into a tray removal position at which tray **310** is located. At the same time,

the elevator mechanism indexes an empty tray, such as the tray designated **311**, into the dense shingling location.

The empty tray **311** may be suitably located for pickup by the elevator chains **303, 304** by sliding the trays into position manually or through the use of an indexing conveyor mechanism which is generally designated **315.** The indexing conveyor mechanism **315** includes a pair of spaced chains which have pusher members on them and which pusher members selectively engage a tray located in position for movement into cooperative engagement with the elevator. The empty trays mamy be manually located in position for engagement by the pushers of the conveyor mechanism **315.** Of course, the manual arrangement is such that the trays are slid along a horizontally extending support and when slid into the last position as shown where tray **325** is located are positioned so as to be engaged by pushers on the chain conveyor **315.**

Of course, as the elevator raises the full tray from the tray-loading position and moves an empty tray **311** into position, the feed of signatures to the dense shingling location **301** must be stopped. In this connection, a suitable gap maker **331** is provided which provides for dividing the main stream of signatures which is delivered by a conveyor mechanism **330** to the dense shingling location **301.** The gap maker **331** includes a mechanism which automatically operates to stop the flow of signatures to the dense shingling location **301** for a predetermined time interval to enable the full tray to be moved out of position. In fact, the gap maker **331** cooperates with the signature stream to divide the main stream of signatures being delivered by the conveyor **330** to the dense shingling location into a plurality of short spaced streams, each of which contains a number of signatures which is appropriate to fill a tray which is received at the dense shingling location **301.** As shown in FIG. **1,** a gap in the signature stream is designated X. The trailing edge of the last signature to fill the tray at the dense shingling location is T, and the leading edge of the first signature for the next tray is designated L. The gap maker **311** may be of any conventional construction and may include a member that engages the signature stream and stops signature feeding for a predetermined time interval.

The full trays **310** which are located in the tray removal position may be removed therefrom by a suitable retriever mechanism, such as indicated in FIG. **5.** This mechanism is not shown in detail in FIG. **9,** but is located immediately to the right of the dense shingling location and is generally designated **340** in FIG. **9.** Once the tray **310** is located in the tray removal position, the mechanism **340** moves vertically and beneath the full tray and the arms thereof are inserted beneath the full tray and raise the full tray from the elevator mechanism. The arms then retract to remove the tray from the position. The arms are extended to the opposite side of the carriage as described above and toward another conveyor mechanism which is generally designated **341.**

The conveyor mechanism **341** includes a pair of chains **342** at one end thereof and another pair of chains **343** at the other end thereof. The mechanism **340** deposits the tray **310** on the conveyor mechanism **341.** The conveyor mechanism **341,** after the full tray is deposited thereon, indexes downwardly to move the full tray downwardly relative to the dense shingling location **301,** but adjacent thereto. The conveyor **341** deposits that full tray **310** onto a pallet **350** which is located beneath the conveyor. The pallet **350** may be positioned beneath the conveyor **341** in any number of ways and as shown in the drawings a pallet **350***a* is moved into position for receipt of full trays from the same side of the mechanism as the individual trays are delivered to the elevator mechanism which supports the trays during the dense shingling operation.

The pallet **350** may be suitably indexed in order to provide a plurality of rows of trays thereon. Once the pallet **350** is loaded, the pallet may be removed from the mechanism by a suitable forklift truck or other handling device for purposes of storage of the pallet with the trays supported thereon.

In the embodiment of the invention illustrated in FIG. **9,** the tray construction is somewhat different from that in the embodiment illustrated in FIGS. **2** and **3.** In the embodiment of FIG. **9,** the trays are provided with a clamp mechanism for clamping the signatures on the tray rather than a mechanism where one tray (the upper tray) has an inclined portion which engages the signatures on the lower tray to clamp the signatures thereon. The specific tray construction in the embodiment of FIG. **9** is illustrated in application Ser. No. 361,176, filed May 17, 1973. It should be obvious that any of the embodiments disclosed in the present application can be utilized with a variety of different tray constructions as discussed hereinabove.

Having described specific preferred embodiments of the invention, the following is claimed:

1. In a system for handling signatures, means for conveying a loose shingled stream of signatures to a dense shingling location, elevator means for supporting a tray at said dense shingling location, means for forming a densely shingled array of signatures at said dense shingling location, means for operating said elevator means to move said tray with said dense shingled array thereon to a tray removal location for removal from said elevator means, and means for removing said tray from said elevator means when said tray is located at said tray removal location, said means for removing said tray from said elevator means including a vertically movable carriage having extensible load-carrying arms thereon, means for extending said load-carrying arms beneath said tray, means for raising said carriage when said arms are located beneath said tray whereby said arms pick up said tray from said elevator means and means for retracting said arms with said tray supported thereon.

2. In a system as defined in claim **1** wherein said load-carrying arms are extensible to opposite sides of said carraige and further including means for extending said arms with said tray supported thereon to the side of said carriage away from said elevator means and means for lowering said carriage to deposit said tray on a tray support.

3. In a system as defined in claim **2** wherein said trays are deposited on top of another full tray and wherein said carriage includes a second pair of load-carrying arms which engage the tray and support the tray outwardly of the first pair of arms and outwardly of the array of signatures on said another tray so as to avoid interference with the array of signatures on said another tray.

4. In a system as defined in claim **1** wherein said elevator means has means for simultaneously supporting

an empty tray thereon, a tray at the dense shingling location and a full tray at said tray removal location, and drive means for indexing said elevator means to move an empty tray to said dense shingling location and move a full tray to said tray removal location.

5. In a system as defined in claim **4** further including means for placing an empty tray on said elevator means.

6. In a system for handling signatures, means for conveying a stream of signatures to a tray-loading location, means for supporting a tray at said tray-loading location, means for moving an empty tray from a module in which empty trays are supported in a stacked arrangement to said tray-loading location, said means for moving an empty tray to said tray-loading location including an elevator which receives an empty tray and moves it vertically to the tray-loading location and means for removing an empty tray from said module and for placing it on said elevator, means for providing a shingled array of signatures on a tray at said tray-loading location, means for supporting a tray support adjacent said tray-loading location, and means for moving said tray with the shingled array thereon from said tray-loading location and for depositing it on the tray support.

7. In a system for handling signatures as defined in claim **6** wherein said means for removing an empty tray from said module comprises a vertically movable carriage having extensible load-carrying arms thereon, means supporting said carriage for vertical movement between said module and said elevator, means for extending said arms into said module for picking up an empty tray, and means for extending said arms to the opposite side of said carriage for placing said tray on said elevator.

8. In a system for handling signatures as set forth in claim **7** further including means for supporting said module and means for moving said module relative to said carriage after empty trays have been removed from said module.

9. A system for handling signatures, said system comprising means for moving a loosely shingled stream of signatures to a loading location, means at the loading location for moving signatures from the loosely shingled stream into a densely arranged group, and means for moving the densely arranged group of signatures from the loading location to a receiving location, said means for moving the densely arranged group including extensible arm means operable from a first extended condition to a retracted condition to move the densely arranged group of signatures from said loading location and operable from said retracted condition to a second extended condition to move the densely arranged group of signatures to the receiving location.

10. A system as set forth in claim **9** further including means for disposing the signatures in a densely arranged group on a support tray, said extensible arm means including means for engaging said support tray.

11. A system as defined in claim **9** further including elevator means for supporting a tray at the dense shingling location and for indexing to receive a densely shingled arrangement of signatures on the tray and wherein said means for moving the densely arranged group includes means for removing the tray from the elevator means.

12. A system as defined in claim **11** further including a second elevator arranged adjacent the means for removing the tray and for receiving the tray from the first-recited elevator mechanism.

13. A system as defined in claim **11** further including means for dividing the main stream of signatures being advanced to the loading location into short spaced streams, each of which contains an amount of signatures appropriate to fill the tray and wherein said elevator mechanism elevates the filled tray vertically when there is a gap in the main stream being fed to the dense shingling location.

14. A method of continuously forming dense shingled stacks from a continuously moving main stream of loose shingled signatures comprising the steps of providing a generally horizontal dense shingling station of a length approximating the length of individual stacks to be formed, moving said main stream along a path the exit end of which coincides with an entrance end of said dense shingling location, vertically introducing a first stack support from below into said station to receive signatures, dividing said main stream into short spaced streams each of which contains an amount of signatures appropriate to fill said first stack support, conveying a first one of said short streams into said dense shingling station and forming a dense shingle of signatures on said first stack support, elevating said filled first stack support vertically and introducing a second stack support from below to occupy the space vacated at the dense shingling station by the filled first stack support, introducing a laterally-movable supporting mechanism below the first stack support and relatively moving said mechanism and said first stack support whereby said first stack support is solely supported on said mechanism, moving said mechanism laterally to a position at which said first stack and stack support may be removed for subsequent handling, and continuing the feeding of signatures, supplying of empty stack supports, dense shingling and the removal of filled stack supports.

15. A method of handling signatures, said method comprising the steps of conveying a loosely shingled stream of signatures to a dense shingling location, supporting a tray at said dense shingling location, forming a densely shingled array of signatures at said dense shingling location, moving the tray with the densely shingled array of signatures thereon to a removal location, and removing the tray with the densely shingled array of signatures thereon from said removal location to a receiving location, said step of removing the tray from the removal location includes the steps of extending an arm beneath the tray, picking up the tray be raising the arm, and retracting the arm.

16. In a system for handling signatures, means for conveying a stream of signatures to a tray loading location, means for supporting a tray having a longitudinally extending support surface at said tray loading location with said support surface in a horizontal orientation, means for forming a horizontally extending shingled array of signatures on said support surface at said tray loading location, and transfer means for moving a tray with said horizontally extending shingled array of signatures thereon from said means for supporting a tray to a tray receiving location, said transfer means including means for moving a tray along a path at least a portion of which extends transversely to the longitudinal axis of the said support surface with said support surface in a horizontal orientation.

17. In a system as set forth in claim 16 wherein said transfer means includes means for forming at said receiving location a vertical array of trays with horizontally extending shingled arrays of signatures thereon.

18. In a system as set forth in claim 16 wherein said means for supporting a tray includes elevator means for moving a tray along a vertical path from said tray loading location to a tray removal location with said support surface in a horizontal orientation, said transfer means including means for engaging a tray at said tray removal location.

19. In a system for handling signatures, means for conveying a stream of signatures to a tray loading location, means for supporting a tray having a longitudinally extending support surface at said tray loading location, means for forming a longitudinally extending shingled array of signatures on said support surface at said tray loading location, and transfer means for moving a tray with said longitudinally extending shingled array of signatures thereon from said means for supporting a tray to a tray receiving location, said transfer means including extensible arm means for enagaging a tray and means for operating said extensible arm means between a retracted condition in which said arm means has a first effective length and an extended condition in which said arm means has a second effective length which is greater than said first effective length to move a tray engaged by said arm means.

20. In a system as set forth in claim 19 wherein said transfer means further includes means for moving said arm means along a path which extends transversely to the path of movement of said arm means between said extended and retracted conditions.

21. In a system as set forth in claim 19 wherein said means for supporting a tray includes means for supporting a tray at said tray loading location with said longitudinally extending support surface in a horizontal orientation, said arm means including means for supporting a tray with said longitudinally extending support surface in a horizontal orientation as said arm means is operated between said extended and retracted conditions.

22. In a system for handling signatures, means for conveying a stream of signatures to a tray loading location, tray support means for supporting each of a plurality of longitudinally extending trays in turn at a tray loading location, empty tray transfer means for moving each of the trays in turn along a first path from a location spaced apart from said tray support means into engagement with said tray support means, means for forming a longitudinally extending shingled array of signatures on each one of said trays in turn at said tray loading location which the one tray is supported by said tray support means, and loaded tray transfer means for enagaing a tray which is supported by said tray support means and which is loaded with a longitudinally extending shingled array of signatures and for moving an engaged tray away from said tray support means along a second path to a receiving location spaced apart from said tray support means with the longitudinally extending shingled array of signatures on the engaged tray.

23. In a system as set forth in claim 22 wherein said loaded tray transfer means includes means for stacking loaded trays in a vertical array at said receiving location with a longitudinally extending shingled array of signatures on each of the stacked trays.

24. In a system as set forth in claim 22 wherein said tray support means includes means for moving each of the trays in turn along a third path extending transversely to said first and second paths.

25. In a system as set forth in claim 22 wherein said loaded tray transfer means includes means for moving a loaded tray with the longitudinally extending array of signatures thereon in a horizontal orientation.

26. In a system as set forth in claim 22 wherein said empty tray transfer means is disposed on a first side of said tray support means and said loaded tray transfer means is disposed on a second side of said tray support means.

27. In a system as set forth in claim 22 wherein said tray support means includes means for supporting a tray at any one of a plurality of levels and for moving a tray between said levels, said empty tray transfer means being operable to move an empty tray into engagement with said tray support means at a first level, and said loaded tray transfer means being operable to enage a loaded tray at a second level which is spaced apart from said first level.

28. In a system as set forth in claim 27 wherein said loading location is disposed at a third level intermediate said first and second levels.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,874,522 Dated April 1, 1975

Inventor(s) Victoriano Fernandez Rana

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

Column 12, line 51 delete "be" and insert --by--.

Column 14, line 41 delete "enage" and insert --engage--.

Signed and sealed this 1st day of July 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
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