

[54] DATA ACCESSING SYSTEM

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[51] Int. Cl. **B65g 1/06**

[58] Field of Search **214/16 B, 16.4 A, 16.4 R; 340/174.1 C; 235/61.114, 64.115; 242/180, 181, 68.3**

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[57] ABSTRACT

A tape reel retrieval system having a plurality of bins or frames which can be stacked in groups depending on the size of the tape library. Each bin includes a plurality of reels, each in its own storage box, each box having an open side and interior gripping fingers. The frame carries a bridge which is movable along the reels until it reaches a selected one which it then extracts from the side-by-side reel arrangement. The reel is removed from the box, the box is returned to its storage location, and the reel is carried to the end of the bin by a gripping and transfer device on the bridge. The reel is then transferred to a conveyor which takes the reel to a point of use adjacent a tape transport.

10 Claims, 15 Drawing Figures

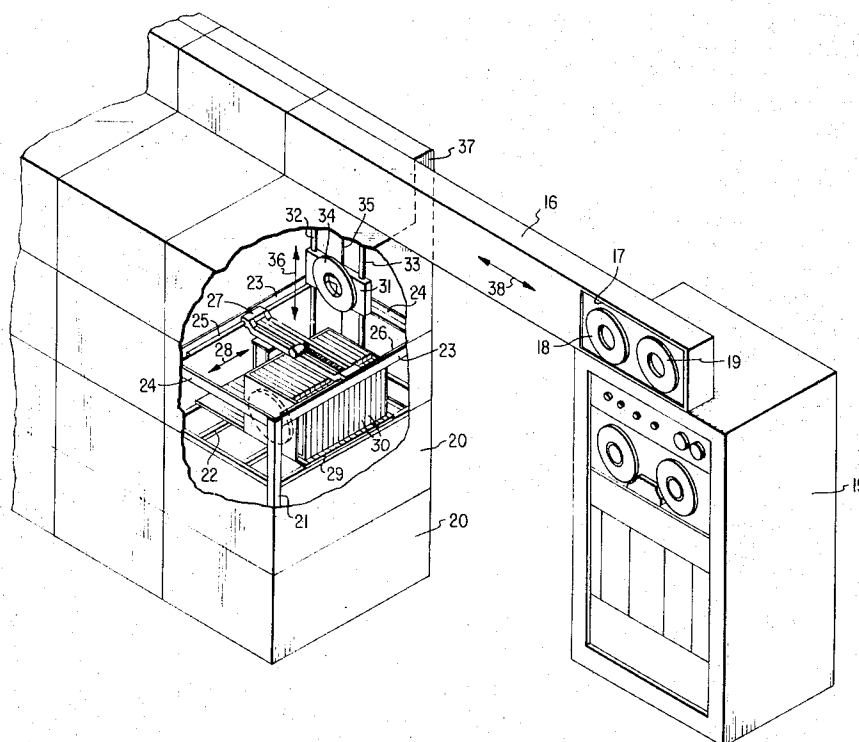
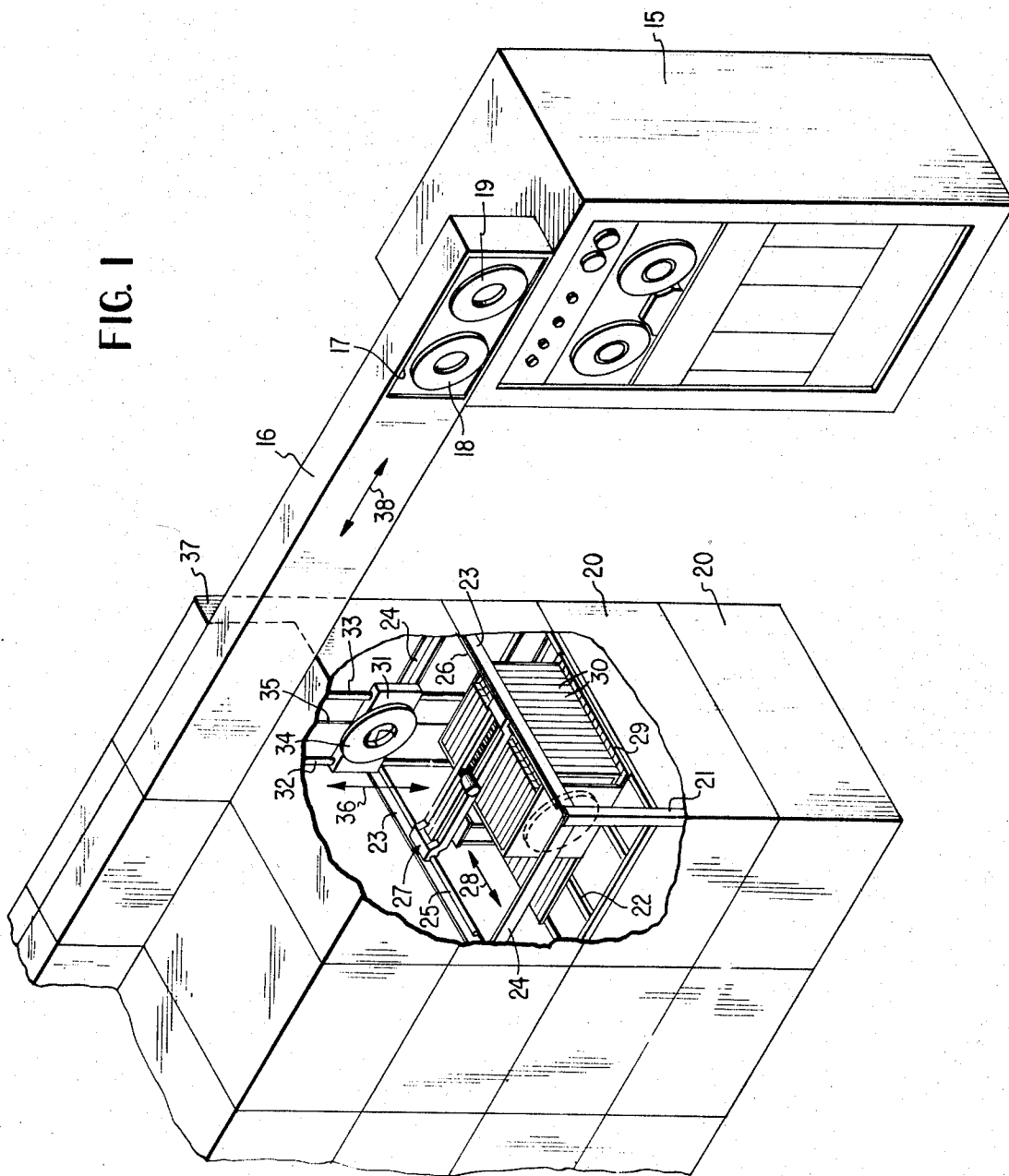


FIG. 1



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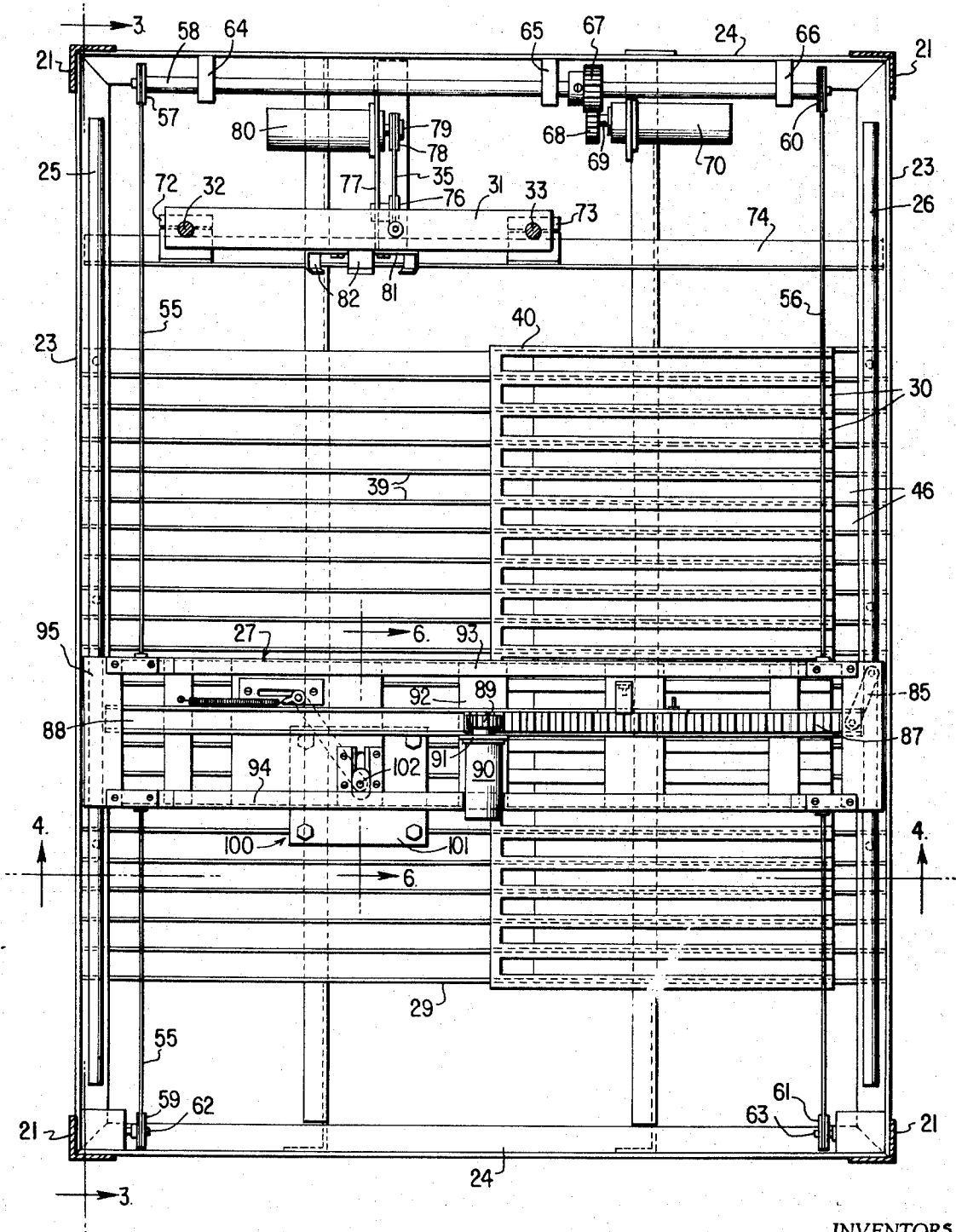


FIG. 2

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FIG. 3

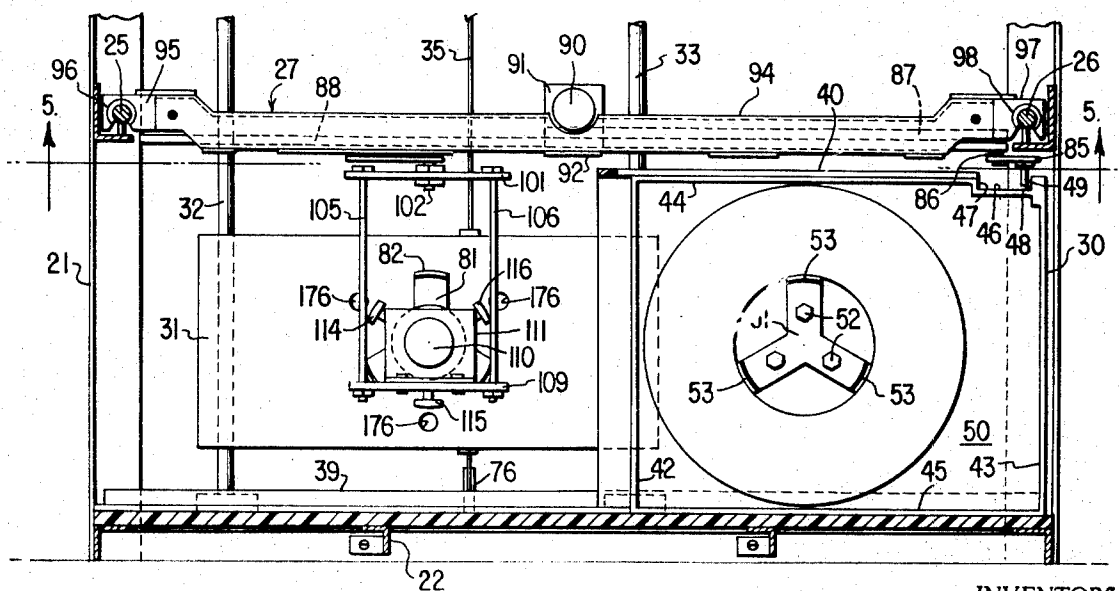
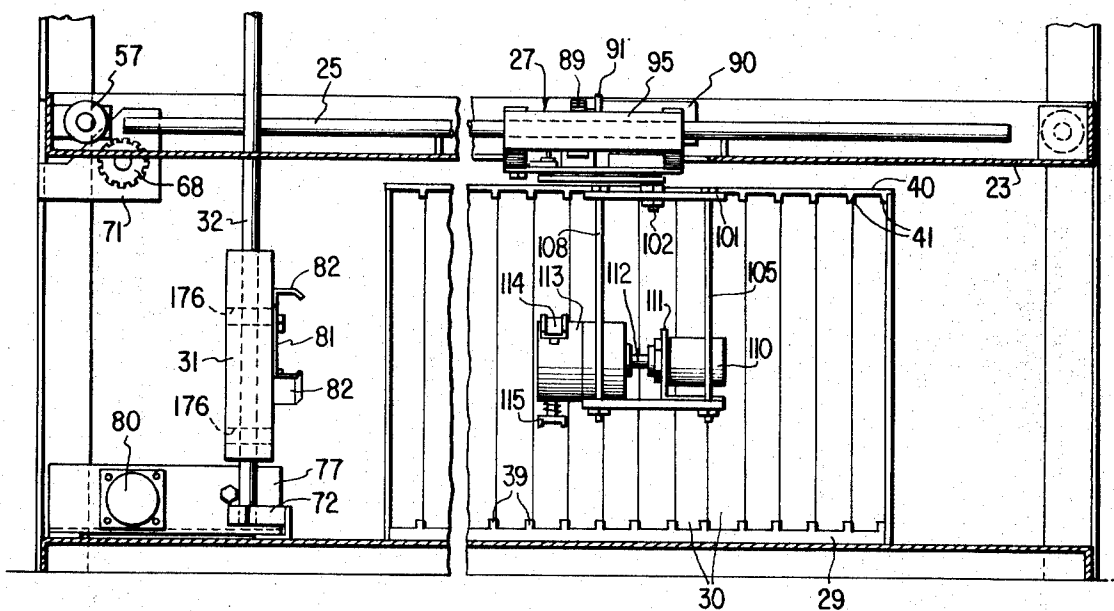


FIG. 4

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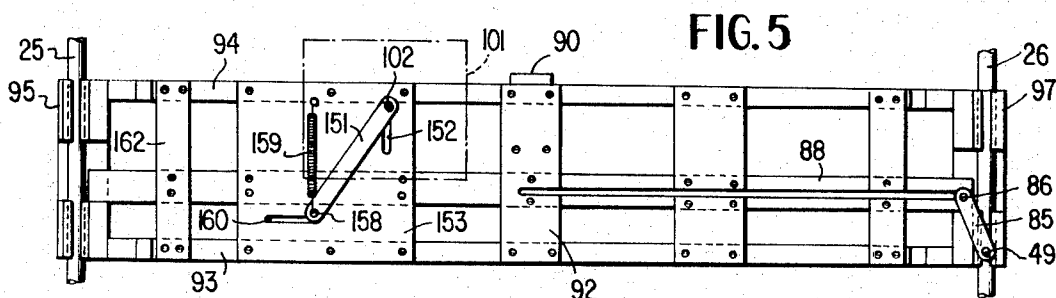


FIG. 5

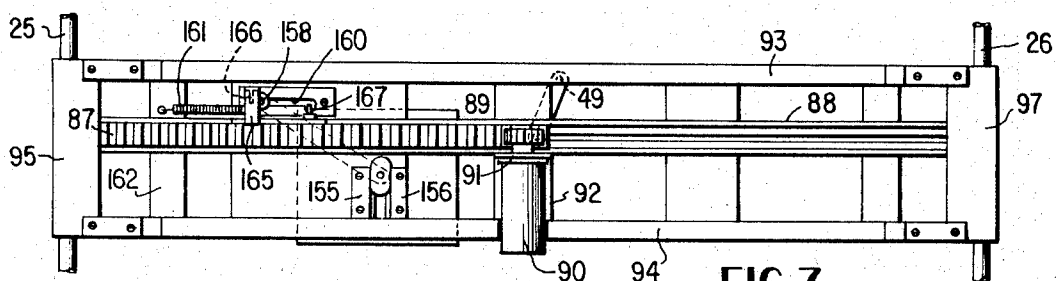


FIG. 7

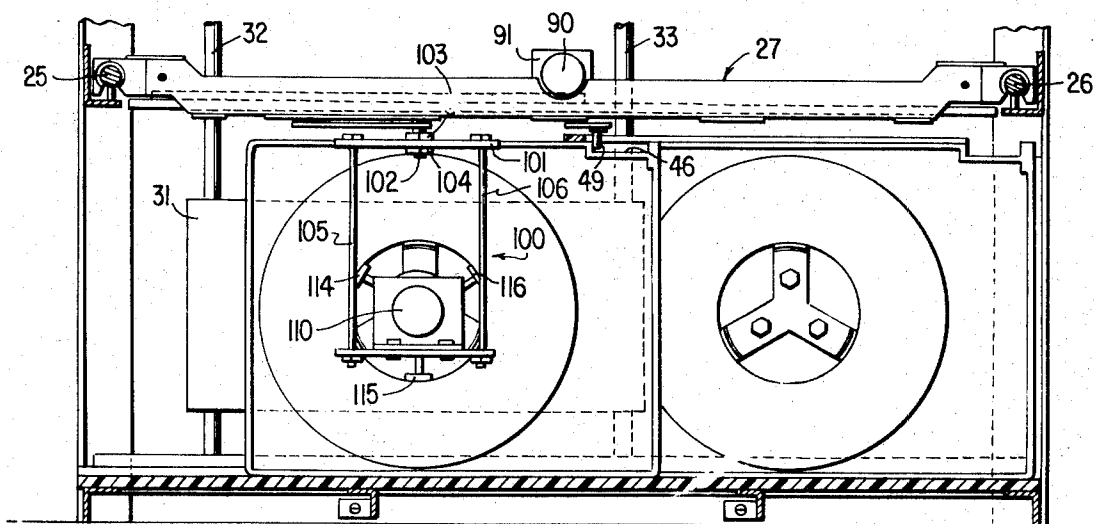


FIG. 8

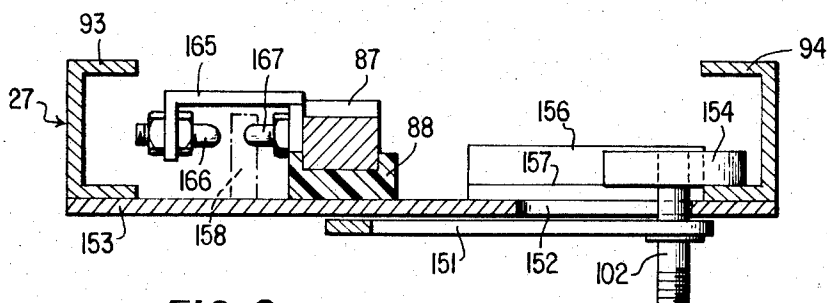


FIG. 6

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FIG. 9

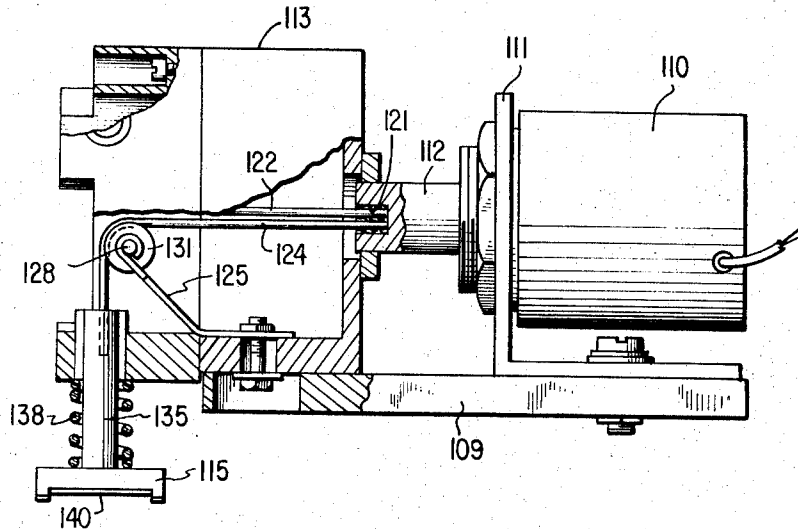


FIG. 10

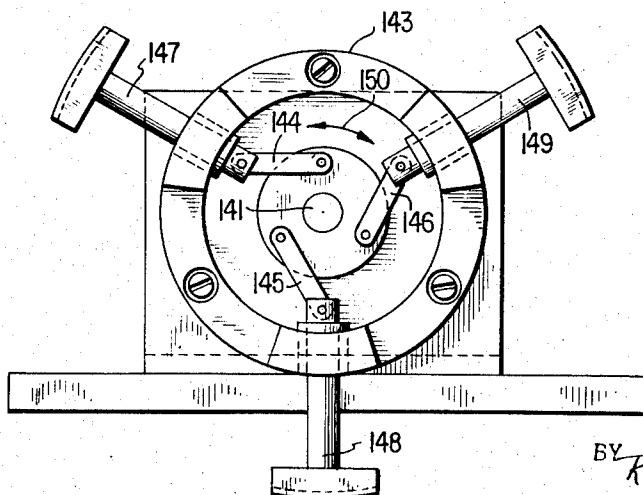
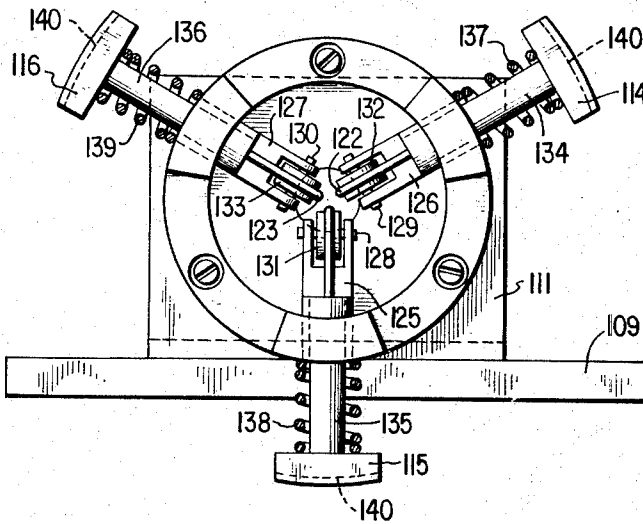


FIG. 11

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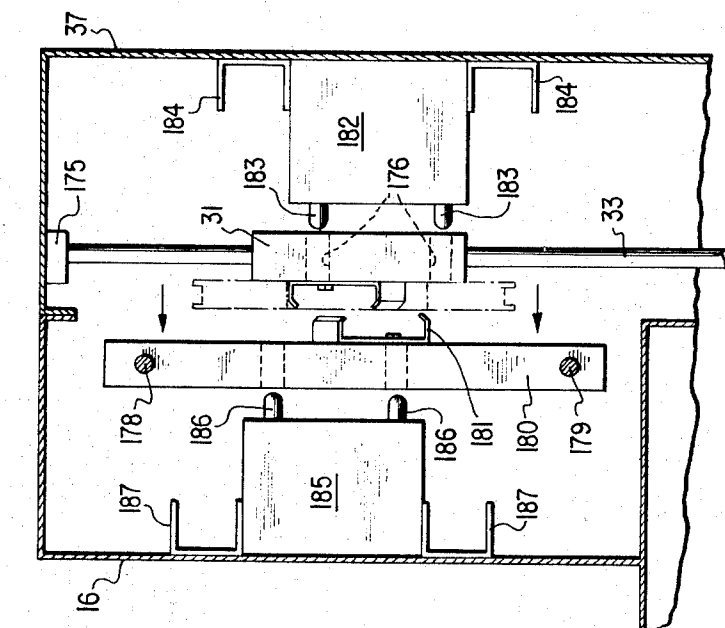


FIG. 13

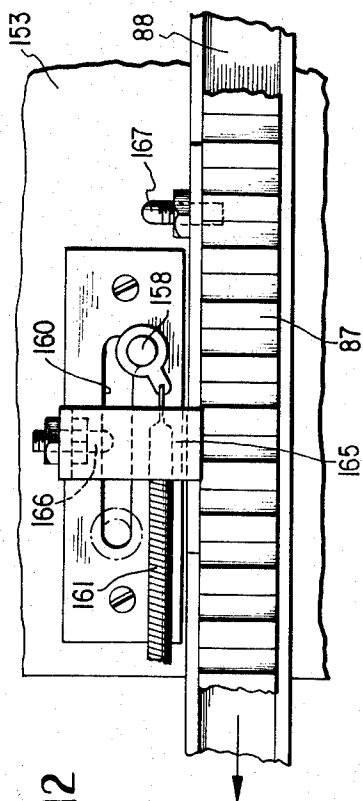


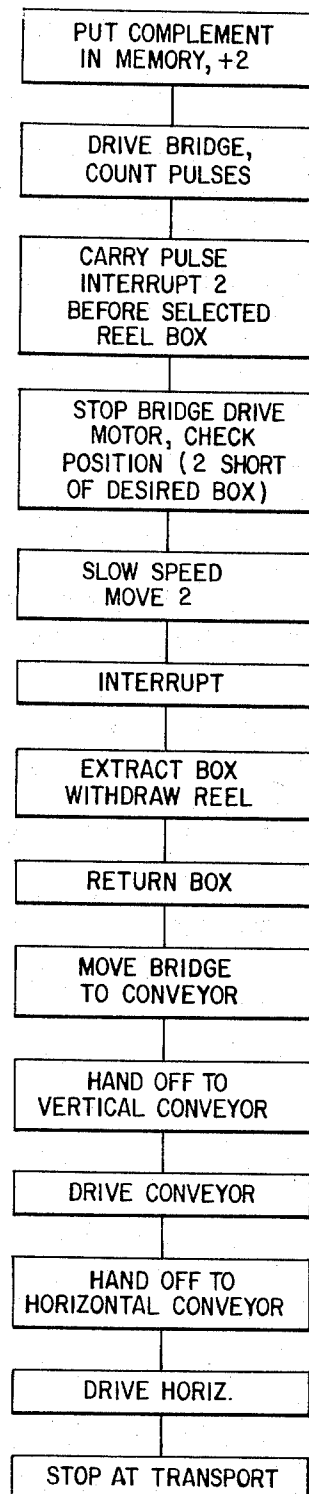
FIG. 14

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FIG. 15



DATA ACCESSING SYSTEM

This invention relates to an apparatus for providing access to data stored on an elongated record medium and, more specifically an apparatus for selecting a desired one of a plurality of reels of stored data and rapidly conveying the selected reel to a tape transport.

In today's computer using facilities, it has become common to amass large libraries of stored data in the form of reels of magnetic tape, microfilm or other elongated webs which are machine readable. Some of these libraries include webs, notably magnetic tape, on which information can be written or corrected and from which information can be read, or data in a form which can be read only. Regardless of the specific recording medium or the read-write capability, a fundamental problem is to locate a specific reel in the library storage facility, transport the reel to a machine capable of reading the data recorded thereon, or writing additional data thereon or correcting previously written data, within a predetermined interval of time.

It has been customary to have an individual manually seek and remove a reel of tape on which information was stored or was to be recorded in the library storage facility, carry it to a device for handling and processing the tape, and place it thereon, the devices for reading or recording on the web being generally known by the generic term "tape transports". However, as processing speeds of these machines have gradually been increased in order to maximize the use of machine time, the length of time required to locate and obtain the desired reel of tape and to manually convey it and place it on the machine became a significant factor in the total operating time to retrieve or store data. Thus, attempts have been made to develop apparatus which would handle tape reels completely, or partially, automatically.

The prior art includes several such attempts, each of which involves equipment of considerable complexity or relatively low speed, or both. Clearly, the attempts to mechanize this operation have contributed improvement over manual loading, but nevertheless contain significant disadvantages.

An object of the present invention is to provide means for high density storage of reels of tape and for automatically selecting, extracting and conveying a desired reel to a tape transport.

Another object is to provide such an apparatus which is further capable of returning the selected reel to its unique storage location.

A further object is to provide a reel storage and retrieval system in which the reels have preselected permanent addresses from which they can be removed and to which they can be returned automatically.

As used herein, the term "tape" is intended to constitute a shorthand notation for any elongated record medium in the nature of a ribbon or web of indefinite length. The term includes, but is not limited to, tape on which information can be magnetically recorded or on which information can be stored by punching or by producing identifiable markings by optical means.

Broadly described, the invention includes one or more storage cabinets or bins, at least half of each bin being utilized for high density storage. Each bin is provided with a movable bridge which is capable of traversing the storage compartment, stopping at a posi-

tion adjacent a selected reel, extracting the reel, carrying it to a conveyor and transferring it to the conveyor for movement to a position adjacent the tape transport. The reel can then be manually removed from the conveyor and placed on the transport, or further conveyor means can be used to place it on the transport without manual intervention.

In order that the manner in which the foregoing and other objects are attained in accordance with the invention can be understood in detail, a particularly advantageous embodiment thereof will be described with reference to the accompanying drawings, which form a part of this specification, and wherein:

FIG. 1 is a perspective view of a computer system incorporating the present invention;

FIG. 2 is a plan view of one storage and retrieval unit in accordance with the invention;

FIG. 3 is a front elevation of the storage and retrieval unit of FIG. 2;

FIG. 4 is a section of the storage and retrieval unit along lines 4-4 of FIG. 2;

FIG. 5 is a bottom view of the bridge structure of the storage and retrieval unit;

FIG. 6 is a detail of the bridge structure of FIG. 5;

FIG. 7 is a plan view of the bridge structure of FIG. 5;

FIG. 8 is an end view of the storage and retrieval unit shown in FIGS. 2-4;

FIG. 9 is a side elevation showing the details of a reel gripping apparatus carried by the bridge structure of FIGS. 5 and 7;

FIG. 10 is an end view of the structure of FIG. 9;

FIG. 11 is an end view of an alternative embodiment of the reel gripping structure of FIGS. 9 and 10;

FIG. 12 is a detail of a portion of FIG. 7;

FIG. 13 is an elevation of the reel transfer mechanism;

FIG. 14 is a block diagram of the control circuit; and

FIG. 15 is a functional flow diagram showing the operation of the system.

FIG. 1 shows a general arrangement of a tape reel retrieval system in accordance with the invention, the object of the system being to select a specific desired reel of tape and bring it to a point immediately adjacent a tape transport 15 of conventional design. The selected reel is conveyed to the transport, or returned from the transport to its storage point, in a horizontal conveyor channel or conduit 16 which has an opening 17 immediately above the transport. A typical reel 18 which has been conveyed to the transport for use, or which has been placed by an operator on the conveyor for return to the storage unit, is shown in opening 17. A "waiting point" can also be provided at which a reel 19 can be placed when it is about to be returned to the storage point, if the conveyor happens to be in use.

Horizontal conveyor 16 extends across the top of a plurality of storage units or bins 20. Each unit 20 constitutes an essentially independent structure which can be used alone if the library to be stored is relatively small, or which can be joined to any number of like units by making a minor modification to the conveyor system. As shown in FIG. 1, each individual unit is supported by the contained within an external rectangular frame including corner posts 21, a rectangular floor frame 22 and an upper frame including side rails 23 and end rails 24. Two rods 25 and 26 extend along sides

rails 23 to constitute a guide and bearing surface to support a bridge assembly indicated generally at 27. Bridge 27 is designed, as will be described hereinafter, to traverse the length of unit 20 by riding on rails 25 and 26 in the directions indicated by double-headed arrow 28.

The lower frame structure 22 supports a floor 29 which, in turn, supports a plurality of reel boxes 30 which contain reels of tape. Each reel box is essentially identical to every other reel box except that it has a unique location and is intended to contain a specific unique reel. Means is provided, as will be described, to identify a specific box, stop the bridge 27 adjacent that box, extract the box, remove the reel therefrom, return the box to its location, and then transport the reel, by moving the bridge, toward a vertical conveyor structure including a reel carrier 31 which is guided by vertical rods or rails 32 and 33. Vertical reel carrier 31 is shown supporting a reel 34 and is movable, as by a drive wire 35, in the directions indicated by double-headed arrow 36. Carrier 31 transports the reel upwardly into an upper extension 37 on the top unit of the stack, at which point the reel is transferred to a horizontal conveyor contained within conduit 16. The horizontal conveyor, which is movable in the directions indicated by double-headed arrow 38, transports the reel to the position shown by reel 18.

It will be recognized that the conveyor within channel 16 can serve a plurality of stacks of individual stored units 20 and that each such stack is served by a vertical conveyor including a carrier such as carrier 31. It will be further recognized that the horizontal conveyor can serve more than one tape transport, and that conduit 16 can be extended beyond transport 15 to other units if desired for a particular installation.

The details of one bin storage unit can be more clearly understood by referring to FIGS. 2-11. In FIG. 2, unit 20 is shown in plan view with bridge assembly 27 disposed in a position to extract one reel box from its normal storage location. It will be seen, viewing FIGS. 2-4, together, all of which show the apparatus with the bridge in the same location, that the individual reel boxes 30 rest on floor 29 between upstanding ridges 39 which are formed as part of the floor. Thus, the boxes are separate and guided by the floor ridges and can move across the floor parallel to the ridges freely. Also, a "roof" member 40 is provided with depending ridges 41 which are parallel with and directly above parallel ridges 39 to support and guide the upper ends of boxes 30.

The shape of an individual box can best be seen in FIG. 4 in which it can be seen that the box is substantially rectangular having front, back, top and bottom walls 42-45, respectively, with the top wall 44 having a downwardly extending recess 46 which has a front surface 47 and a back surface 48 against which a drive pin can operate to move the box across the interior of the unit. Slots 46 can be seen in plan view in FIG. 2. When dealing with tape reels of the usual commercial diameter, approximately 10 inches, the width of slot 46 between surfaces 47 and 48 is approximately 1 inch. A pin 49 is carried by the bridge structure and depends into slots 46 as the bridge traverses the length of the unit.

Walls 42-45 are joined on one side of the box by a vertical wall 50 which is perpendicular to the axis of a reel and which supports a Y-shaped reel gripping member 51 which is attached to wall 50 by suitable fasteners 52 such as rivets or bolts and nuts. The gripping member 51 includes three spring fingers 53 which protrude perpendicularly from wall 50 and which are dimensioned to fit within the central opening of a tape reel. The end of each member 53 is slightly tapered or bent inwardly to permit the reel to be forced over the three fingers which resiliently bend inwardly slightly but which provide sufficient radial outward force to solidly retain the reel within the box. Spring fingers 53 can be made from any suitable resilient material, including a spring brass or bronze, or a plastic having adequate strength and resiliency characteristics.

It will be recognized that the wall of the box opposite and parallel to wall 50 is absent so that reels can be inserted into or withdrawn from the box without the necessity of opening a lid. When the boxes are all in their normal storage locations, as shown in FIG. 2, the wall 50 of one box closes the open side of the adjacent box to minimize entry of dust or the like. Also, resilient strips can be placed around the exposed edges of walls 42-45 so that when one box is placed next to the other an effective dust seal is created.

Turning now to the bridge structure, it will be seen that the bridge can be caused to traverse the length of the storage unit by the action of bridge drive wires 55 and 56, one end of each wire being attached to one side of the bridge and the other end of each wire being attached to the other side of the bridge. Wire 55 extends from the bridge and passes around a pulley 57 which is firmly pinned to a drive shaft 58 at the conveyor end of the unit. The wire then extends the full length of the unit and passes around a pulley 59 and returns to the other side of the bridge. Similarly, wire 56 is connected to the bridge, passes around a pulley 60, which is also firmly attached to shaft 58, after which the wire extends the full length of the unit beneath the bridge, passes around a pulley 61 and returns to the other side of the bridge. Pulleys 59 and 61 are mounted for free rotation about axles 62 and 63 which are connected to the frame of the unit.

Drive shaft 58 is journaled for rotation in bearing supports 64, 65 and 66 which are attached to end frame member 24. A spur gear 67 is firmly attached to shaft 58 and meshes with a spur gear 68 which is attached to the drive shaft 69 of a bidirectional electric motor 70. Motor 70 is mounted in a flange 71 which is attached to end frame member 24. Rotation of motor 70 drives shaft 58 through gears 67 and 68, causing pulleys 57 and 60 to rotate, thereby exerting force on wires 55 and 56 and moving the bridge assembly longitudinally in the unit.

A somewhat similar drive structure is provided for the vertical reel carrier 31 which rides on vertical rods 32 and 33. In FIG. 2 the unit is shown as though it were the bottom unit in a stack or the only unit used, the lower ends of rods 32 and 33 being clamped in brackets 72 and 73 which are welded or otherwise firmly attached to cross brace 74 which is part of rectangular floor frame 22. A drive wire 35 is connected to the lower end of reel carrier 31 and passes around a pulley 76 which is journaled for rotation about an axle which

is connected to longitudinal brace 77. The wire then passes around a pulley 78 which is connected to the drive shaft 79 of a bidirectional electric motor 80 which is also attached to longitudinal brace 77. The wire then passes upwardly around similar pulleys at the upper end of the unit and returns to be connected to the upper end of vertical reel carrier 31.

It will be observed that reel carrier 31 is provided with a Y-shaped reel gripping member 81 which has protruding spring fingers 82 and is substantially identical with the reel gripping member provided on the interior of each reel box. It will be observed also that one of spring fingers 53 on the interior of the reel box is disposed directly above the axis of the reel and that one of fingers 82 is similarly disposed directly above the reel axis, and that the radially outwardly extending arm portions of the gripping member are separated at their center lines by angles of 120°.

Turning now to the bridge structure, it will be seen that pin 49 is attached to a point near one end of a small horizontal plate 85 which is attached at its other end to a pin 86. Pin 86 is firmly connected to a rack 87, the lower side of which is smooth and the upper surface of which is provided with gear teeth. Rack 87 lies in a slotted channel 88 and is freely movable lengthwise in the slot, or perpendicular to the direction of motion of the bridge, which motion, for purposes of reference, is parallel to the axes of all reels. A spur gear 89 meshes with the teeth on rack 87, rotation of gear 89 being used to drive the rack in its longitudinal direction. Gear 89 is pinned to the shaft of a bidirectional motor 90 which is mounted on and carried by the bridge assembly. Specifically, the motor is mounted through a flange 91 which is attached to a cross brace 92 extending between main side rails 93 and 94 of the bridge structure. One end of each of side rails 93 and 94 is connected to a bearing housing 95 which contains bearings 96 to provide low friction contact with rod 25. At the other end, a similar bearing housing 97 houses bearings 98 which ride on rail 26, housing 97 being connected to the other ends of side rails 93 and 94.

It will be observed that plate 85 extends slightly outwardly from the end of rack 87 and also extends toward the conveyor end of the unit. As previously mentioned, pin 49 depends into slot 46 so that motion of rack 87 carries with it plate 85 and pin 49. After approximately 1 inch of motion of rack 87, pin 49 comes in contact with side 47 of slot 46, as seen in FIG. 8, causing one reel box to slide across floor 29 in the slot formed by ridges 39. The motion of rack 87 to extract the box is controlled by the energization of bidirectional motor 90, the rack being moved until the reel contained within the box is in position to be transported along the unit.

The mechanism for removing the reel from the box will be described. As will be seen in FIGS. 3, 4 and 8, a reel gripping and extracting mechanism indicated generally at 100 depends from bridge 27. Mechanism 100 includes an upper plate 101 which has a centrally located hole through which a threaded shaft 102 extends. Internally threaded nuts 103 and 104 hold plate 101 in the proper vertical position on shaft 102. The apparatus to which shaft 102 is connected on the bridge will be discussed hereinafter.

Four corner plates 105, 106, 107 and 108 depend from the corners of plate 101 and support a lower plate 109. A solenoid 110 is mounted in an L-shaped bracket 111 which is attached to the lower plate, the solenoid being mounted so that its axis is parallel with the axes of the reels in the bin. Also, the axis of the solenoid lies in a horizontal plane which also contains the axes of the reels stored in the boxes in the bin. An output shaft 112 of the solenoid passes through one end of a cylindrical gripper mechanism housing 113 which rests on plate 109 and the front portion of which protrudes forwardly from the plate, the direction "forward" being used in this context to refer to the direction of the bridge when it is moving toward vertical carrier 31. The forward portion of housing 113 includes three openings spaced 120° apart through which three gripper feet 114, 115 and 116 protrude radially.

The details of the gripping mechanism can be more clearly seen in FIGS. 9 and 10 in which it will be seen that shaft 112 of solenoid 110 extends through an opening 120 in housing 113, shaft 112 having an opening 121 in the end thereof to receive and grip three cables 122, 123 and 124. The interior of the housing is provided with three brackets 125, 126 and 127 which are spaced 120° apart and attached to the interior surface of the housing. Each bracket extends forwardly from its attachment point and radially inwardly at about a 45° angle, each bracket terminating in a loop for retaining an axle. The three axles 128, 129 and 130 rotatably support three pulley wheels 131, 132 and 133 over which the cables pass from the end of shaft 112. The other end of each cable is attached to one of shafts 134, 135 and 136 which pass through the radial circularly spaced openings in the housing and are connected to the gripper feet 114, 115 and 116, respectively. Coil compression springs 137, 138 and 139 surround shafts 134, 135 and 136, respectively, and tend to press the gripper feet outwardly.

In the embodiment shown in FIGS. 9 and 10, solenoid 110 is designed so that when it is deenergized shaft 112 is retracted to its fully retracted position within the solenoid housing. When energized, solenoid 112 extends, tending to permit slack in cables 122-124 and permitting compression springs 137-139 to urge gripper feet 114-116 radially outwardly. The structure is inserted within the central opening of a tape reel before the solenoid is energized so that the gripper feet lie in the plane of the reel. When the solenoid is energized the feet will extend outwardly, firmly gripping the reel opening. It will be observed that shaft 135 and gripper foot 115 extend downwardly from the axis of the gripper mechanism and, as previously described, with respect to the reel axis. Thus, with the other feet spaced 120° from foot 115, it will be seen that the feet are angularly spaced from the reel gripping members on the interior of each reel housing box and from the gripping member on vertical conveyor 31. These members thus interdigitate and can all exist within a given reel at any time. It will be observed further, as shown in FIG. 9, that the outward surface of each gripper foot includes a radially inwardly extending U-shaped indentation 140 the interior of which is designed to be equal to or slightly larger than the axial dimension of the central opening of a reel. Thus, the gripping action does not relay entirely upon friction but provides a positive grip

so that relative motion of the gripping mechanism and the housing box will cause the reel to be extracted from the box positively.

An alternative embodiment to the apparatus shown in FIGS. 9 and 10 is shown in FIG. 11 wherein the solenoid is a rotary solenoid having an output shaft 141 which protrudes into the gripper mechanism housing 143 and is firmly attached to a disc 142. One end of each of three lengths 144, 145 and 146 is pivotally connected to a point on the disc, the three connection points being spaced 120° apart. The other end of each link is connected to the inner end of three shafts 147, 148 and 149, the outer ends of which are connected to the gripper feet. Rotary motion of the solenoid causes the disc to move in directions shown by double-headed arrow 150, causing the shafts and gripper feet to move radially inwardly or outwardly.

The mechanism for causing the reel gripping mechanism to move axially, with respect to the reel, for the purpose of inserting the gripper feet into the reel opening and extracting the reel from the box will now be described. Shaft 102, which supports the reel gripping and extracting mechanism, extends upwardly, as shown in FIG. 6, through one end of a link 151 and through an elongated slot 152 in a rectangular plate 153 which extends between side members 93 and 94 of the bridge structure. The upper end of shaft 102 is fastened in a lozenge-shaped slide member 154 which is capable of sliding, in a direction parallel to the reel axes, between two guide members 155 and 156. As seen in FIG. 6, guide member 156 is an L-shaped structure having a lower shoulder 157 which prevents downward movement of slide 154 and a vertically inwardly facing surface which prevent lateral movement of the slide member. The other end of link 151 carries a pin 158 (FIG. 5) which protrudes downwardly below the link far enough to permit attachment of one end of a coil spring 159, the other end of which is fixed to plate 153. Pin 158 extends upwardly through an elongated slot 160 in plate 153, slot 160 having long sides which are parallel to side members 93 and 94. As seen in FIG. 7, the end of slot 160 which is closest to motor 90, includes an offset portion into which pin 158 is urged by spring 159. An additional coil spring 161 is connected between the upper end of pin 158 and a cross brace 162 which extends between side members 93 and 94. Spring 161 tends to urge pin 158 toward bearing carrier 95 at the left-hand end of the bridge structure as shown in FIGS. 5 and 7. However, so long as pin 158 is in the offset portion of slot 160 and is retained therein by the action of spring 159, spring 161 is ineffective to cause the pin to move to the other end of the slot (FIG. 12).

It will be observed that if pin 158 is moved forwardly, out of the offset portion of slot 160 and against the action of spring 159, spring 161 causes the pin to move to the other end of the slot, carrying with it shaft 102 and slide member 154. Slide 154 is limited to motion parallel to the axes of the reels by guides 155 and 156. This also limits motion of shaft 102 to that direction so that the shaft and the reel gripping and extracting mechanism carried by the shaft moves forwardly the length of slot 152. Thus, if a reel is in the position shown in FIG. 8 and pin 158 is removed from the offset portion of slot 160 as described, the reel gripping feet

are moved into the central opening in the reel and are in position to grip the reel as described above.

The means for moving pin 158 out of the offset portion of the slot and for returning it to that offset portion are carried by rack 87. Referring again to FIG. 6, rack 87 carries a downwardly opening U-shaped bracket member 165, the outer end of which supports an inwardly protruding pin 166. A pin 167, which lies in the same horizontal plane as pin 166, protrudes forwardly from rack 87, the vertical planes in which pins 166 and 167 lie being spaced apart a distance of approximately 1 inch.

The operation of this part of the mechanism begins with slide member 154 in the position shown in FIG. 6 and with link 151 as shown in FIG. 5, this being the withdrawn position of the reel gripping and extracting mechanism. As rack 87 is moved along channel 88 in the direction to remove a reel from its storage location, pin 49 engages surface 47 of slot 46 and moves the box into the access area. The motion proceeds uninterrupted, pin 166 being designed to pass pin 158 when pin 158 is in the offset portion of slot 160. However, when pin 167 is carried by the rack to the position occupied by pin 158, pin 158 is caused, by a camming action against the walls of slot 160, to move forwardly in the slot out of the offset portion. At that time spring 161 causes pin 158 to move suddenly to the other end of the slot, as previously described, causing slide member 154 and shaft 102 and the reel gripping and extracting mechanism carried thereby to suddenly move forward. At this point, microswitches, omitted from the drawings for clarity, deenergize motor 90 causing the motion of the rack to stop. Solenoid 110 is then actuated, causing the gripping feet to grip the interior opening of the reel. Motor 90 is then energized to move in the opposite direction, initiating motion of rack 87 in its opposite direction causing pin 166 to now come in contact with pin 158 to return it toward the offset portion of slot 160. While pin 158 is being caused to travel the length of slot 160 the reel gripping and extracting mechanism is still in its forward position and the reel has not yet been extracted from its box. However, the box does not move because pin 49 must travel the length of slot 46 before it comes in contact with surface 48, at which time the first motion of the box will take place. The lengths of slots 160 and 46 are dimensioned so that the offset portion of slot 160 will be reached by pin 158 before pin 49 contacts surface 48. Motion of pin 158 to the other end of the slot causes slide member 154 and shaft 102 to return to its rear position, moving the reel gripping and extracting mechanism slowly to the rear and slowly extracting the reel from the box. It should be recognized that this "slow" motion actually takes place in a very short period of time, but is a slow motion when compared with the sudden or snap motion of the reel gripping mechanism in its forward motion.

As soon as the reel has been extracted from the box, pin 158 has been returned to the offset portion of slot 160 and is retained therein by spring 159, rack 87 is free to travel the rest of the length of its motion, permitting pin 49 to act against surface 48 and return the empty box to its storage location.

In the next step of the operation motor 70 is energized, causing rotation of shaft 58 and causing wires 55

and 56 to pull bridge 27 the length of the bin structure until the reel gripping and extracting mechanism approaches vertical conveyor 31. As previously described, the gripping fingers on member 31 are disposed just like the members on the interior of each reel housing box so that the gripping feet carried by the bridge interdigitate with those fingers. Thus, the bridge can simply be run to the end of the box until the reel is forced over fingers 82, at which time solenoid 110 can be energized and the bridge can be withdrawn in toto, extracting feet 114-116 from the interior of the reel. It is unnecessary, at that point, to operate the bridge, although this full cycle of rack motion can be gone through if desired. It may be desirable to design the apparatus to do so, in view of the relatively simple operation thereof and in view of the simplified circuitry required.

FIG. 13 shows means for transferring the reel from the vertical conveyor to the horizontal conveyor in the process of providing a reel to a transport, and the means for transferring from the horizontal to the vertical conveyor in returning the reel to its normal storage location. As will be seen, the vertical conveyor extends upwardly into the upper extension 37 at the rear of the stack of storage bins. Using identifying numerals similar to those previously used, the vertical reel carrier is identified as 31 with this carrier being guided by vertical rods 32 and 33. It will be noted that the upper ends of the rods are securely attached in a block 175 at the upper end of housing 37. A cable and pulley system, similar to that described with reference to the bridge drive structure, is provided for moving the reel carrier vertically, but this is not shown in FIG. 13 for simplicity. As seen in FIGS. 3, 4 and 13, reel carrier 31 is provided with three openings 176 which are spaced 120° apart and which are angularly disposed midway between radially outwardly extending legs of the reel gripping device supported by carrier 31. The openings are radially outwardly spaced from the circle in which the reel gripping arms 82 lie and, when a reel of tape is on the carrier, are hidden thereby. When a reel of tape is to be transferred from the vertical conveyor to the horizontal conveyor, carrier 31 is moved to a predetermined uppermost position and stopped. The predetermined uppermost position is that which lies between two horizontally extending rods 178 and 179 which support and guide a horizontal reel carrier 180. Carrier 180 is substantially identical to carrier 31 and is provided with a reel gripper 181 having outwardly extending resilient fingers to grip a reel. On the horizontal carrier, the fingers are disposed to interdigitate with those on carrier 31. In the predetermined position, reel carrier 31 is adjacent a solenoid structure 182 which includes outwardly projecting solenoid plunger rods 183 which, in the predetermined position, are aligned with openings 176. Solenoid structure 182 is carried by brackets 184 which support the structure from the wall of housing 37.

In similar manner, a solenoid structure 185 is positioned adjacent carrier 180 in the transfer position, solenoid structure 185 having outwardly projecting plungers 186, the structure being supported by brackets 187 within conduit 16.

When a reel is to be transferred from the vertical to the horizontal conveyor, the two carriers 31 and 180

are brought to their aligned predetermined positions and solenoid 182 is actuated, causing the plungers to pass through openings 176 and push the reel from the vertical to the horizontal conveyor. The horizontal conveyor then carries the reel to the desired position adjacent a reel transport, the carrier being driven by a wire drive similar to that described with reference to carrier 31.

It will be apparent that when a reel is to be returned to its storage position and is to be transferred from the horizontal to the vertical conveyor, solenoid 185 is actuated when the two carriers are in their interdigitating positions, pressing the reel from the horizontal to the vertical conveyor, after which the vertical conveyor returns the reel to the appropriate bin and transfers it to the reel structure which then returns it to its "home" box and to its normal storage position.

FIG. 14 shows a simplified block diagram of the circuitry for controlling the various functions of the apparatus as described above. Each of the reel storage boxes 30 is provided with a highly reflective patch on the upper surface thereof, the patch being of relatively narrow width. The bridge structure carries with it a light source 190 which directs light toward the upper surface of the boxes, which light is reflected from the reflective patches. A photo-detector 191 receives the pulses of light which are reflected as the bridge passes over the boxes, one pulse per box. The electrical signal from the photodetector 191 is connected to amplifier means 192 which functions to amplify and "sharpen" each pulse, producing one pulse per box. The pulses emanating from unit 152 are connected to a counter 193 which counts the received pulses.

Before operating the apparatus a desired box is selected by number and the complement of the count is entered in a memory 194. Thus, if there are twenty boxes in a specific bin and box 11 counting from the end opposite the conveyor is desired, then the complement of 10, or 9, is entered in computer 194. The count is provided by the memory to the counter with the addition of two counts, so that 11 is supplied to the counter by the memory. Then, as counter 193 counts pulses from unit 192, 20 being a full count, a carry pulse is provided when the bridge has passed nine boxes, two short of the desired box. A carry pulse is then supplied on a conductor 195 to an interrupt circuit 196. The interrupt circuit terminates the action of the bridge drive motor 90 through motor control 197. That unit stops motion of the bridge at which time the interrupt circuit checks to see that the memory and the counter have correlated with the desired input. Then, the motor is activated to move the bridge for two more pulses, at which time the bridge is at the desired box. Then, the reel is extracted and delivered to the transport. The entire sequence can be overseen by a sequence control unit 197 and vertical and horizontal conveyor drive units 198 and 199.

FIG. 15 shows the sequence of events in flow diagram form, beginning with the placing of the complement of the desired count in the memory plus two counts. The bridge is driven and pulses are counted as previously described. A carry pulse at full count interrupts motor operation two counts before the selected reel box is arrived at, stopping the bridge drive motor and checking position two short of the desired box. The

bridge is then moved at a slow motor speed for two pulses, or two boxes, at which time motor operation is again interrupted. The proper box is extracted and the reel is withdrawn from the box in accordance with the operation previously described. The box is then returned and the bridge is moved toward vertical conveyor 31. When the bridge reaches the conveyor, the reel is handed off to the vertical conveyor and the conveyor is driven vertically to the predetermined position at which point the reel is handed off to the horizontal conveyor. The horizontal conveyor is then driven to deliver the reel to the desired transport.

While certain advantageous embodiments have been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. A data accessing system comprising the combination of

a frame;

means for supporting a plurality of tape reels in side-by-side relationship in said frame,

said means for supporting comprising

a plurality of reel storage boxes each dimensioned to hold one reel,

each of said boxes having

an open side through which a reel can be removed in a direction parallel to the axis of the reel,

a wall perpendicular to the axis of the reel when a reel is stored therein, and

a plurality of spring fingers, protruding into the interior of the box from said wall to engage the central opening of the reel;

means for extracting a selected one of said plurality of tape reels from its relationship with the remaining reels;

means for transporting said selected reel to a location near one end of said frame;

means for conveying said selected reel from within said frame to a point of use outside of said frame; and

means, carried by said means for transporting, for transferring said selected reel from said means for supporting to said means for transporting and from said means for transporting to said means for conveying.

2. Apparatus according to claim 1 wherein

said means for supporting a plurality of reels further comprises

a floor panel for supporting said plurality of reel storage boxes, said panel having

a plurality of upstanding spaced parallel ribs defining elongated recesses in which said boxes can slide in direction perpendicular to the axes of the reels supported thereby,

each of said recesses being at least twice as long as the diameter of a reel, the normal storage location for said boxes being at one end of the recesses;

and wherein said means for extracting one of said plurality of reels includes

means for sliding the box containing the selected reel from the normal storage location along the recess

to a location at which the reel can be moved axially without interfering with the remaining reels.

3. Apparatus according to claim 1 wherein

said means for extracting a selected one of said reels includes

means for moving one of said reel boxes in a direction perpendicular to the reel axis from a normal storage location to a second location and for returning the box to its normal location.

4. Apparatus according to claim 3 wherein

said means for transferring said selected reel includes a plurality of radially extendible and retractable fingers;

means for carrying said fingers in a plane perpendicular to the axis of a reel,

said fingers being angularly disposed in interengaging relationship with said plurality of spring fingers in said reel boxes.

5. A data accessing system comprising the combination of a frame;

means for supporting a plurality of tape reels in side-by-side relationship in said frame;

means for extracting a selected one of said plurality of tape reels from its relationship with the remaining reels;

means for transporting said selected reel to a location near one end of said frame;

means for conveying said selected reel from within said frame to a point of use outside of said frame; and

means, carried by said means for transporting, for transferring said selected reel from said means for supporting to said means for transporting and from said means for transporting to said means for conveying,

said means for transferring a selected reel including a plurality of radially extendible and retractable fingers; and

means for carrying said fingers in a plane perpendicular to the axis of a reel and in equiangular disposed relationship.

6. A data accessing system comprising the combination of

a frame;

means for supporting a plurality of tape reels in side-by-side relationship in said frame;

means for extracting a selected one of said plurality of tape reels from its relationship with the remaining reels;

means for transporting said selected reel to a location near one end of said frame, said means for transporting including

bridge means for traversing said frame along said plurality of tape reels and for supporting said means for extracting

guide means mounted on said frame for supporting and guiding said bridge means; and

a motor for moving said bridge means along said guide means,

means for conveying said selected reel from within said frame to a point of use outside of said frame; and

means, carried by said means for transporting, for transferring said selected reel from said means for

supporting to said means for transporting and from said means for transporting to said means for conveying.

7. Apparatus according to claim 6 wherein said motor is an electric motor.

8. A data accessing system comprising the combination of

a frame;

means for supporting a plurality of tape reels in side-by-side relationship in said frame;

means for extracting a selected one of said plurality of tape reels from its relationship with the remaining reels;

means for transporting said selected reel to a location near one end of said frame;

means for conveying said selected reel from within said frame to a point of use outside of said frame, said means for conveying including

a pair of parallel guide rails extending from within said frame to a point external of said frame;

a reel carrier journaled for movement along said guide rails;

a plurality of spring fingers protruding from said reel carrier to support and grip a reel;

a motor to drive said reel carrier; and mechanical means interconnecting said motor and said reel carrier; and

means, carried by said means for transporting, for transferring said selected reel from said means for supporting to said means for transporting and from said means for transporting to said means for conveying.

9. A tape reel retrieval system comprising a plurality of tape bin assemblies each including

a frame;

means for supporting a plurality of tape reels in side-by-side relationship in said frame;

means for extracting a selected one of said plurality of tape reels from its relationship with the remaining reels;

means for transporting said selected reel to a location near one end of said frame; and

means, carried by said means for transporting, for transferring said selected reel means for supporting to said means for transporting, and from said means for transporting;

said system further comprising means for receiving a reel from said means for transporting and for conveying the reel selected from one of said bin assemblies to a point external of said plurality of bin assemblies, said means for receiving a reel from said means for transporting and for conveying the reel selected including

two parallel guide rails extending along ends of said plurality of tape bin assemblies;

a reel carrier movable along said guide rails;

a plurality of spring fingers protruding from said reel carrier to support and grip a reel; and

means for driving said reel carrier.

10. A tape reel retrieval system comprising the combination of a frame;

means for supporting a plurality of tape reels in side-by-side relationship in said frame;

means for extracting a selected one of said plurality of tape reels from its relationship with the remaining reels;

means for transporting said selected reel to a location near one end of said frame, said means for transporting including

bridge means for traversing said frame along said plurality of tape reels and for supporting said means for extracting;

guide means mounted on said frame for supporting and guiding said bridge means; and

drive means for moving said bridge means along said guide means,

means at one end of said frame for receiving said selected reel and for making said reel available for use outside said frame; and

means, carried by said means for transporting, for transferring said selected reel from said means for supporting to said means for transporting and from said means for transporting to said means for receiving at one end of said frame.

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