

Feb. 3, 1959

R. D. COOPER
BOOK STORAGE APPARATUS

2,872,048

Filed May 18, 1955

4 Sheets-Sheet 1

Fig. 2.

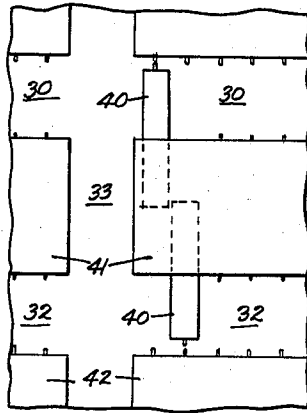
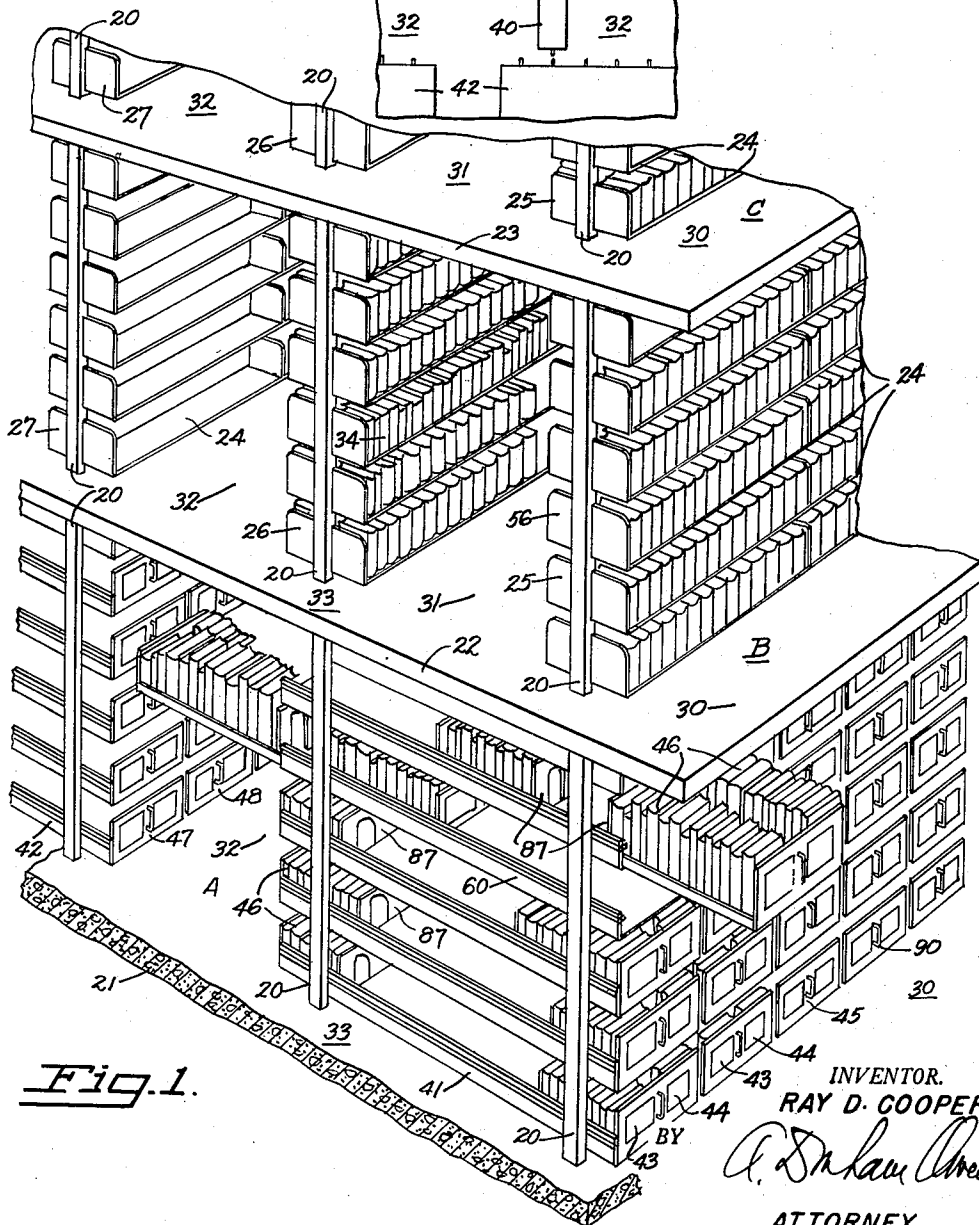


Fig. 1.

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Fig. 3.

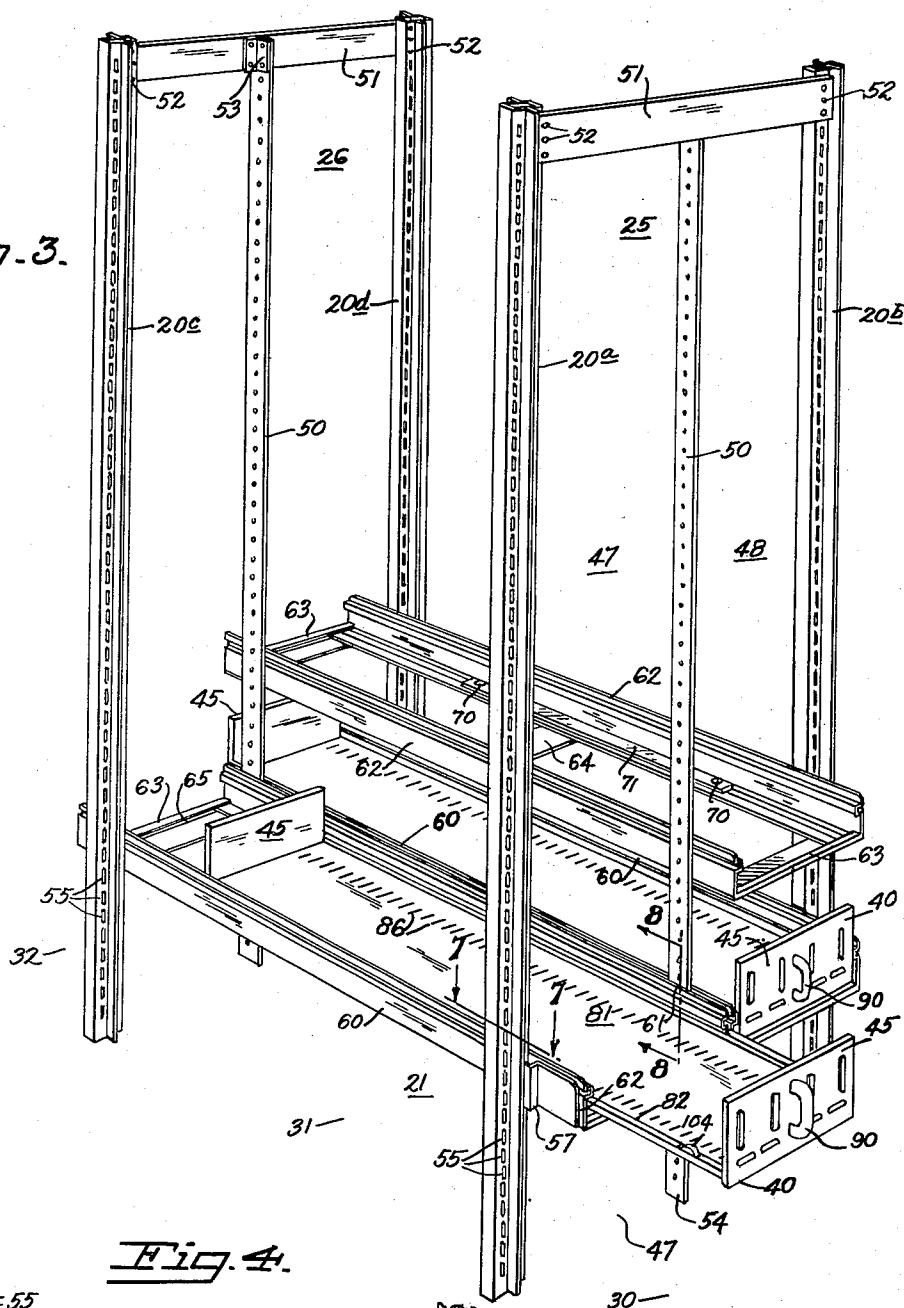
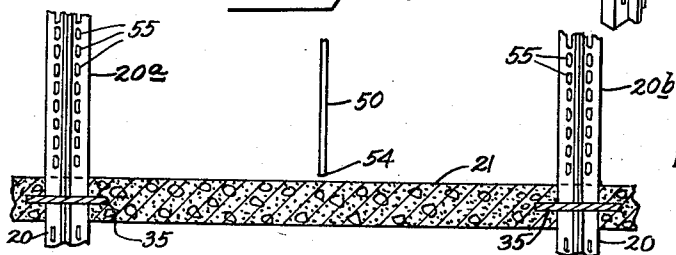


Fig. 4.



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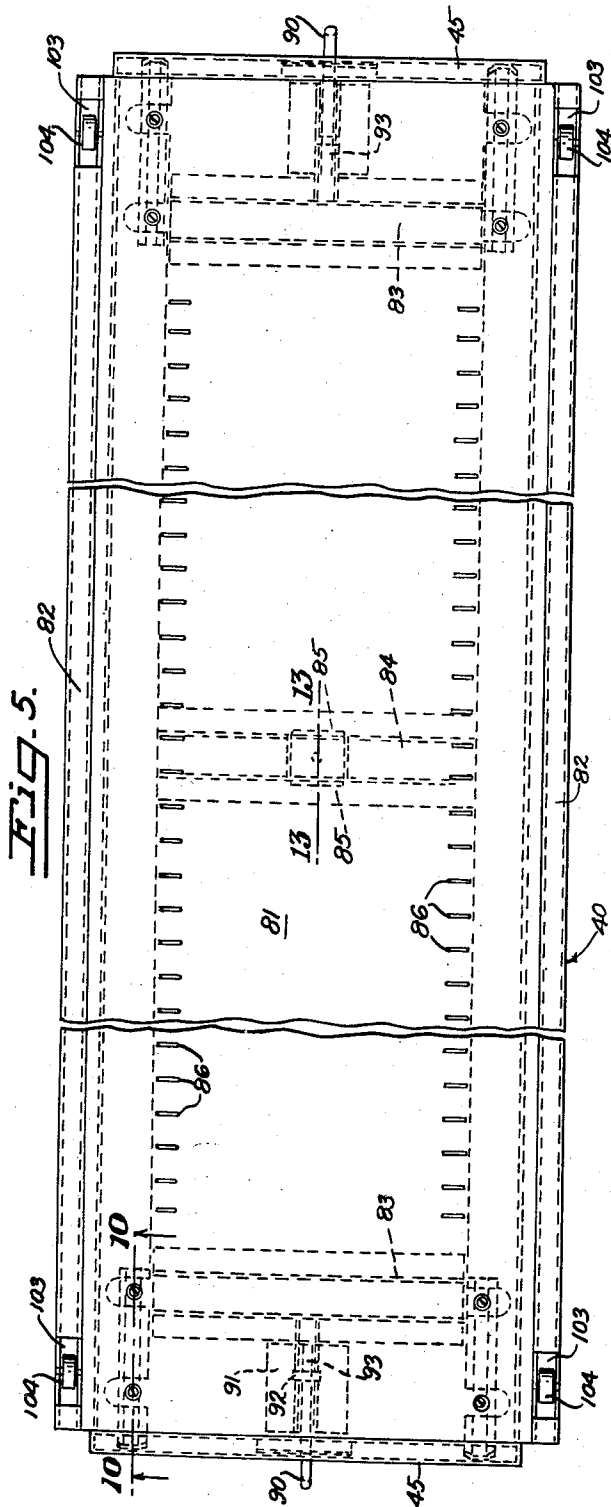
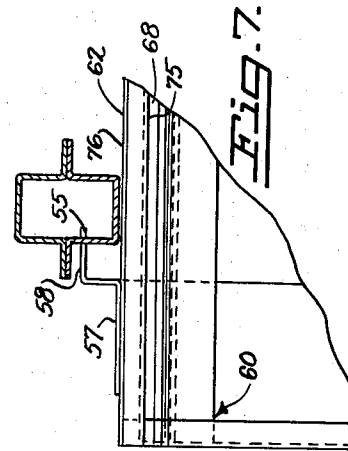
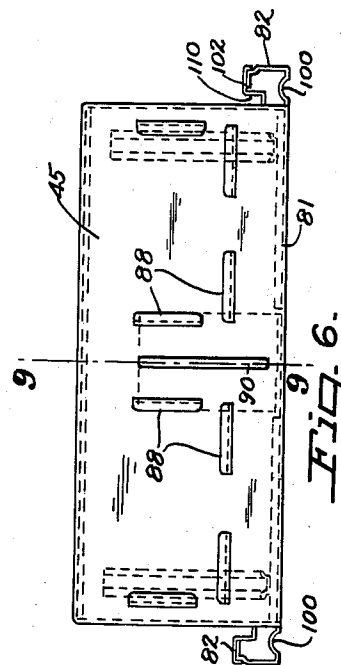
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4 Sheets-Sheet 3



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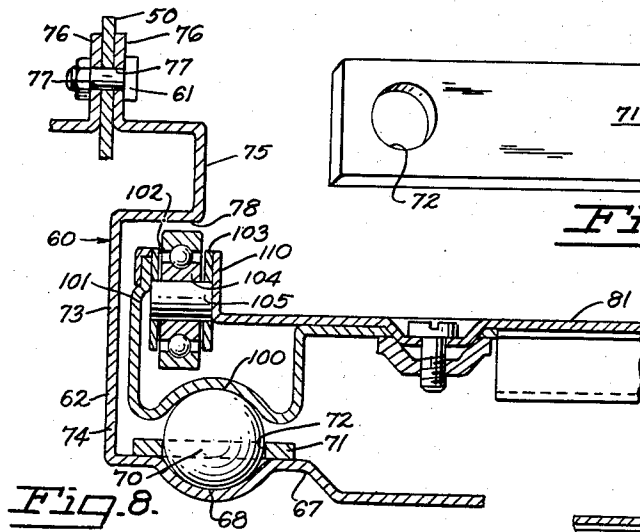
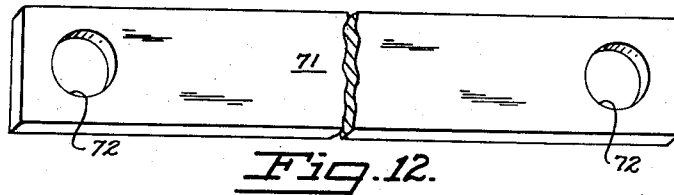
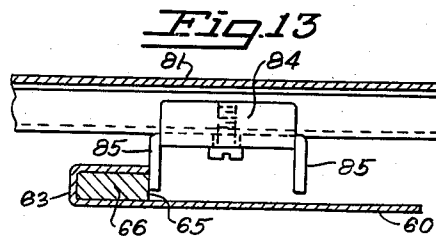
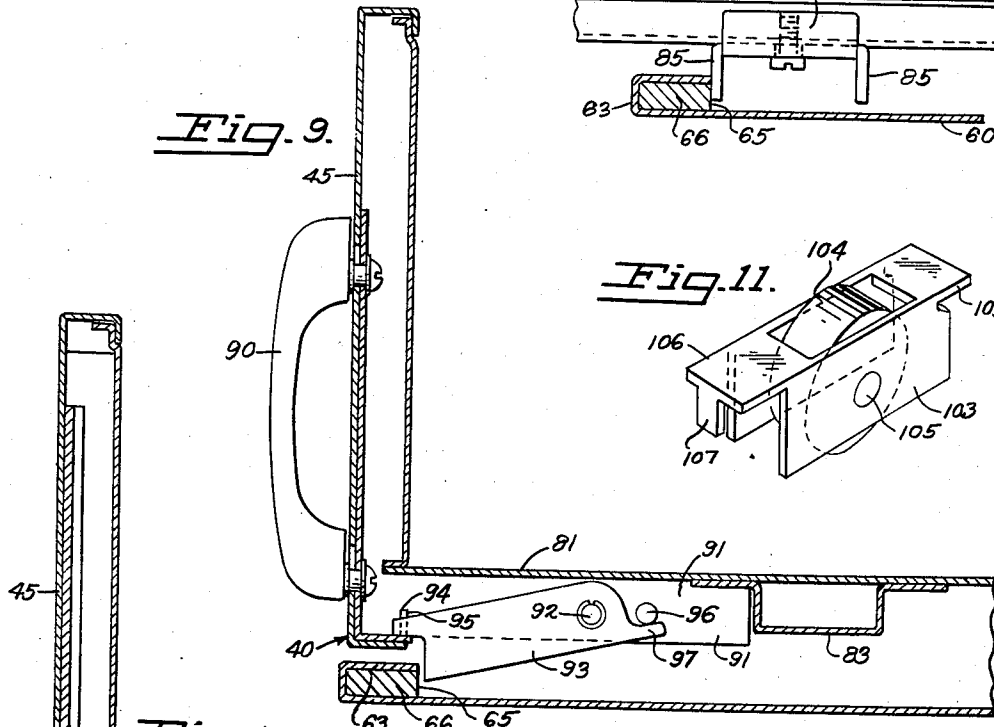
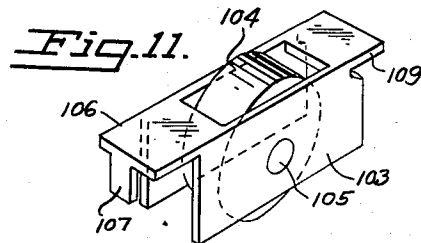
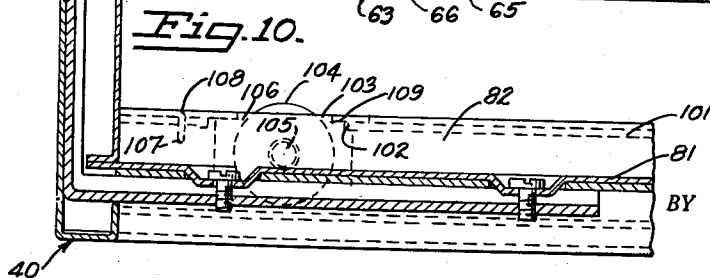
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4 Sheets-Sheet 4



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2,872,048

BOOK STORAGE APPARATUS

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Application May 18, 1955, Serial No. 509,232

9 Claims. (Cl. 211—143)

This invention relates to an improved book-storage arrangement. More particularly, it relates to a construction in which a novel type of rolling drawer is used in the storage of books, in place of stationary book shelves. This application is a continuation-in-part of my application, Serial No. 248,087, filed September 24, 1951, now abandoned.

This invention solves the problem that practically every expanding library is faced with sooner or later—the need for more book storage space than conventional storage arrangements are able to supply. Since floor area and building volume are not readily enlarged and often cannot be enlarged at all, space must be gained by a reconstitution of the storage facilities themselves. The problem has existed for a long time, and many attempts have been made to meet it, but heretofore none of these attempts proved satisfactory.

One of the principal objects of this invention is to provide a novel arrangement enabling the storage of many more books in the same floor area and same total volume of stack space than was possible with the shelving heretofore in use. In fact, my invention makes it possible to store about twice as many books in a given amount of room as could be stored heretofore.

Another object of the invention is to achieve this remarkable increase in storage capacity without having to reconstruct the library building, or even the stacks. The problems which must be met in achieving this second object are less known and less obvious than the problems encountered in achieving the first object. They may be better understood after a brief consideration of the two general types of library shelving: free-standing shelving and multi-tier construction. The base of free-standing shelving rests on the floor; the shelving can be moved from place to place, because it forms no part of the supporting structure for the floors above. The load of books on free-standing shelves is supported by the floor, with the aid of the building frame. While free-standing shelving is quite practical for small libraries and low buildings, it has not proved practical for large libraries, partly because it has entailed expensive construction, including very strong floors, due to the tremendous load that the floors and floor beams must support.

To meet the load problem, most large libraries have adopted what is known as multi-tier bookstack construction. In multi-tier construction the columns only of each tier support the full load of the shelving and books for their tier; equally important, the columns of each tier are in line with the columns of the tiers above and below, and so carry the load of the floors above, as well as that of the books and bookstacks. While the columns may be continuous, extending through the floors and several stories high, this is not the way they are normally constructed. Instead, the steel columns of each tier are embedded in the concrete of their deck floor and extend up in supporting engagement with the ceiling. Consequently, the column above transmits its pressures through the floor to the column directly below. This relatively

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inexpensive construction accomplishes the desired result: namely, support by the columns of practically the entire load and transmission of that load down to the base or foundation of the building. The deck floors support only foot traffic and other comparatively light loads; therefore the floors can be made relatively inexpensively, the tremendous weight of the books being carried directly on the steel columns. Since the columns for multi-tier book stacks are embedded in the floor, they cannot be moved from place to place, and a problem that must be met in extending the storage capacity of existing libraries is to provide a structure that (1) uses the multi-tier columns to support the added loads and (2) does not place any additional load on the floors.

The present invention solves this problem by using the columns already in place as the sole support for the load of books. In fact, the book drawers and associated parts may be removed from one group of columns and reinstalled on other columns in the bookstack area, and shelves may be re-installed on the columns in the areas vacated by the drawers.

Thus, another object of the invention is to provide a drawer-type of storage construction that is interchangeable, for most applications, with standard shelving.

It should not be thought, however, that the present invention is applicable only to multi-tier construction, for it can be used with free-standing columns. Nor should it be thought that its use is confined only to replacement of existing stacks; it is equally useful in new installations for providing more storage space per building volume.

It will be helpful in considering this invention to define some of the terminology employed in library engineering. A series of shelves supported by a series of columns along substantially a single vertical plane is called a range or a storage range. Each storage range is separated from the next storage range by a range aisle, that gives access to the books on the shelves on both sides of the aisle. Perpendicular to a series of range aisles is one or more end aisle or cross aisle, or both, providing access to each of the range aisles.

The present invention is characterized by the use of a novel type of sliding drawer mounted for movement parallel to the cross aisles. All the drawers are supported by the original columns, and each range of drawers occupies the space formerly taken by two storage ranges of shelves and the range aisle in between. In other words, instead of the range aisles alternating with the column ranges, there are two column ranges for each range aisle, with the drawers extending across each group of two column ranges.

In this invention, each drawer extends the full width of the drawer range and is adapted to be pulled halfway out from each side; i. e., from each of the two range aisles on each side of the drawer range, to give access to one-half of the books from one range aisle and one-half of the books from the other range aisle. This structure helps to achieve another object of the invention, which is to give effortless trouble-free operation of the drawers. Such a drawer may, and often does, hold 250 pounds of books, yet by using the principles of my invention, the drawer can be opened and closed easily and quietly with less than a three-pound pull. I also provide novel latch means for preventing the drawers from overrunning their course when they are closed, so that they do not slide out into the other range aisle.

While some of the main problems have mentioned and some of the principal objects have been specified, the invention solves many other problems and achieves other objects. For example, the spacing of the height of the drawers relative to each other is fully adjustable to the various sizes of books. Also, there are means for pre-

venting the drawers from tipping forward and from binding when they are drawn out. Still other objects and advantages will appear from the following detailed description.

In the drawings:

Fig. 1 is a view in perspective somewhat diagrammatic in nature, showing a portion of a multi-tier library stack having one level constructed according to the principles of the present invention and standard book shelving installed on two other levels, illustrating how the present invention adapts itself to existing installations and is convertible with standard shelving.

Fig. 2 is a plan view of a tier of bookstacks constructed according to the present invention.

Fig. 3 is a perspective view showing the installation of one tier of drawers between two pairs of columns, with most of the drawers removed in order to show the construction better.

Fig. 4 is a fragmentary view in elevation of the bottom end of the tier of Fig. 3.

Fig. 5 is a top plan view of a single drawer, broken in two places between the center and its ends to conserve space.

Fig. 6 is a view in end elevation of the drawer of Fig. 5.

Fig. 7 is a fragmentary enlarged plan view partly in section taken along the line 7—7 in Fig. 3.

Fig. 8 is an enlarged fragmentary view in section taken along the line 8—8 in Fig. 3.

Fig. 9 is an enlarged view in section taken along the line 9—9 in Fig. 6.

Fig. 10 is an enlarged view in section along the line 10—10 in Fig. 5.

Fig. 11 is an enlarged view in perspective of the roller assembly.

Fig. 12 is a perspective view of the ball spacer, broken in the middle to conserve space.

Fig. 13 is a view in section taken along the line 13—13 in Fig. 5 with a portion of the carriage shown also, the drawer being in its fully extended position.

Figs. 1 and 2 show a portion of a library provided with multi-tier book-stacks. On each level a plurality of columns 20 are disposed in ranges and extend from the floor to the ceiling of each tier. The lower ends of the columns 20 for the bottom tier A are embedded in or secured to a floor 21, and their upper ends are embedded in and support a ceiling 22, which is also the floor of the next tier B. There, the columns 20 are embedded in their floor 22 and are embedded in and support the ceiling 23, which is the floor of tier C above. Each column 20 of each upper tier is directly in line with a column 20 of the tier below, so that so far as the resolution of forces is concerned, the columns 20 give the same result as a continuous column (Cf. Fig. 4).

In the conventional bookstack on tier B, the columns 20 support double-faced shelves 24, which provide a series of ranges 25, 26, and 27, etc., with range aisles 30, 31, and 32, etc., alternating between the ranges. Access to the range aisles 30, 31, and 32 is gained from a cross aisle 33. Note that the shelves 24 hold only two rows of books 34, one on each side, and that only two rows are accessible from each range aisle 30, 31, and 32.

The drawer-type storage arrangement of the present invention is shown on tier A. It utilizes exactly the same arrangement of columns 20, but drawers 40 span what had been every other range aisle 31, the drawers being arranged in ranges 41, 42 and leaving half as many range aisles 30 and 32. Each drawer 40 is so constructed that it can be opened from both sides, i. e., from either of the two range aisles 30 and 32 between which it lies. Each drawer 40 opens only half way into any one range aisle 30 or 32, since the books 34 on the other half of the drawer 40 are accessible from the other range aisle 32 or 30. It should now be apparent how the present invention doubles the storage capacity of the illustrated stacks.

Use of the book drawers 40 is no more difficult than

use of the shelves 24. The user locates the proper drawer 40, using the index cards 43 and 44 on the front face 45 of each drawer 40 to help him. If the book he wants is indexed on a left-hand card 43, he stands on the left side of the drawer 40 when he opens it; if the book is indexed on a right hand drawer 44, he stands on the right side. When he pulls out the drawer 40, he immediately has before him the row 46 of books which includes the one he desires. When he withdraws that book and closes the drawer 40, a latch mechanism 93 (described below) automatically catches, and another latch 93 at the opposite end of the drawer 40 prevents the drawer from running beyond its closed position into the other range aisle.

With the foregoing explanation of the broad idea of the present invention in mind, we can now pass to a detailed exposition of my preferred construction, referring first to Fig. 3. Four columns are shown, two columns 20a, and 20b are in one column range 25, and two columns 20c and 20d are in another column range 26. The drawers 40 span what would be a range aisle 31 in shelving construction, and access to them is had from the range aisles 30 and 32. In multi-tier construction, columns (e. g., 20a and 20b) are normally spaced approximately 3 feet apart in the same range, and approximately 5 feet separates the column ranges 25 and 26. The 3-foot width means that it is advisable to install two tiers 47 and 48 of drawers 40 between successive columns 20a and 20b or 20c and 20d of the same range, and this is to be done, it will be remembered, without installing any new columns or other members that would place any load on the floor 21, which, it will be assumed, has been constructed to support only foot traffic and relatively light weights. The separation and central support of parallel tiers 47 and 48 is provided by a free-floating center support 50 suspended from a beam 51, which in turn is attached to and supported by the columns 20. For example, the beam 51 may be attached to the columns 20 by suitable screws 52, and the center support 50 may be secured to the beam 51 by a bracket 53 which is bolted to both the beam 51 and the center support 50. The two center supports 50 are parallel to the columns, and the lower ends 54 float freely about ¼" above the deck floor 21 (see Fig. 4), while the columns 20 are imbedded in the concrete floor 21 and rest on broad footing plates of suitable size if they are on the bottom level; otherwise, bearing plates 35 are provided between the upper columns and the columns immediately below.

The columns 20 are normally provided with perforations 55 for the reception of adjustable brackets 56 which in turn support the shelves 24 (Fig. 1). This is taken advantage of by utilizing a similar bracket 57 with detents 58 which fit into the column slots 55 and support one side of each drawer carriage 60 (Fig. 7). The opposite (inside) side of each carriage 60 is secured by bolts 61 or by a clip to the center support 50. When two drawers 40 of each tier 47, 48 are on the same level, as is usually the case, the same bolt will support the center-ward side of the two carriages 60 on the center support 50.

The carriages 60 themselves comprise two parallel side members 62, 62 extending lengthwise across what was the range aisle 31 and braced by a transverse member 63 at each end and a transverse member 64 at the center. The end transverse members 63 are provided with an up-turned flange portion 65, preferably strengthened by a bar member 66 as shown in Figs. 9 and 13, which serves as a strike plate to limit the drawer extension in a manner to be described.

Fig. 8 shows one of the side members 62 in section. Since the two side members 62 are identical, the description of one applies to the other. Generally speaking, the side member 62 is L-shaped. The generally horizontal bottom flange 67 incorporates a concave linear portion 68 which serves as a race for a pair of balls 70, 70, the balls being spaced apart by a spacer element 71 (Fig. 12) having two openings 72, 72 therethrough adjacent each

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end, the openings 72 being somewhat larger but not greatly larger than the balls 70. The remainder of the horizontal flange 67 is provided principally for strength purposes and may be flat along its entire length.

The vertical flange 73 of the carriage side member 62 has a lower vertical portion 74 that meets the horizontal flange 67, an inset channel-shaped portion 75, and a short vertical portion 76 above the channel 75 and substantially in line with the longer vertical portion 74. The upper portion 76 of the centerward member 62 may be provided with an opening 77 to receive the clip or bolt 61. The outward member 62 may be spot welded or bolted to its bracket 57. The inset channel 75 gives the pan 60 additional strength, and its lower surface 78 provides a race for a roller bearing 104, which will be described subsequently.

Each tray or drawer 40 (Figs. 5, 6, 8, 9 and 10) generally comprises a flat floor portion 81, a pair of formed side edge portions 82, and a pair of front wall or face portions 45 used at each end. Three transverse reinforcing members are preferably provided, one member 83 adjacent each end (which may comprise simply a channel member with outwardly extending flanges spot welded to the floor 81 of the tray 40) and a similar central member 84. However, the central reinforcing member 84 not only includes another channel whose out-turned flanges are spot welded to the floor 81, but also preferably includes a stop member or strike 85, which may comprise a member bolted to the reinforcing channel 84 and having a pair of upwardly extending flanges adapted to embrace the channel and a pair of downwardly extending strike members (Fig. 13). Such a strike 85 may be less than 2" long with the downwardly extending flanges approximately $\frac{1}{2}$ " long. The downwardly extended flanges of this strike 85 are adapted to engage the forward flange or strike 65 of the pan 60 to prevent outward movement of the drawer 40 beyond that point, and thereby limit the drawer's movement in either direction to approximately one-half its length before the stop member 85 comes into engagement with the strike flange 65. This helps to prevent the drawer 40 from one range from coming into contact with and scraping the drawers 40 in the next range, as well as preventing movement into an opposite range where a drawer 40 has been pulled out in the same direction.

The floor 81 of each tray 40 may be provided with two rows of slots 86, adapted to receive and lock therein suitable book-end brackets 87, each of which has detents that engage in the slots 86. Obviously each book-end 87 is adjustable along the length of the tray 81 because it can be inserted wherever there are slots 86.

The two ends 45 of each tray are identical; so the consideration of one, as shown in Figs. 6, 9 and 10, will suffice. The actual vertical head 45 may be hollow and may be made from sheet metal bent and welded together with connecting portions thereof bolted (as shown in Fig. 10) or welded to the tray floor 81. The forward face is perforated and formed to provide bent-out catches 88 (Fig. 6) to hold a pair of index cards 43, 44, for there are two rows 56 of books in each tray 40.

Between the index cards 43, 44 is a handle 90 which not only aids in pulling the drawer 40 out, but serves also as a latch release, as shown in Fig. 9, being mounted in slots for vertical movement relative to the face 45. A bracket 91 holds a journal pin 92 on which a latch bar 93 is pivoted. Normally, when the drawer 40 is in place, this latch bar 93 is locked against the bottom flange 65. The latch bar 93 is provided with a forwardly projecting end 94 which is attached to a handle portion 95 and is adapted to be moved upwardly when the handle 90 is lifted, thereby raising the latch bar 93 above the strike plate 65 and then permitting the drawer 40 to be withdrawn. A bolt or pin 96 may also be provided to limit the action of the rear end 97 of the latch bar 93.

The sides 82 of the tray 40 are provided with a longitudinally extending portion whose bottom surface 100 (see

Fig. 8) is concave upwardly and is adapted to serve as the upper half of the race for the balls 70. This means that the race 100 slides on the balls 70 while the balls slide in the pan race 68, so that the drawer 40 moves at twice the speed at which the balls 70 move. By using the ball spacer 71 heretofore described, the balls 70 are self-locating; that is, when first installed, their position is not critical for as soon as the drawer 40 has been opened once from each end, the end of the spacer 71 will come against the strike 65 of the drawer 45 to which it was closer, and from then on the balls 70 are properly positioned.

The side portion 82 is also provided with an upwardly extending inverted channel portion 101. The upper surface of the channel 101 is provided with a receptacle 102 in which a thrust bearing bracket 103 (Fig. 11) is inserted along with its roller bearing 104. The bearing 104 is preferably mounted on a stub axle 105 in the bearing bracket 103, and arranged so that a small portion of its surface extends above the upper surface of the bracket 103, as shown in Figs. 8, 10, and 11. The bracket 103 is provided with a forwardly extending portion 106 having a downwardly projecting detent 107 adapted to engage in a notch 108 in the upper surface of the hollow side edge 82, while the rear portion 109 of the bearing bracket 103 rests on a shelf of the side edge 82. Initially, the roller bearing 104 does not engage the flat race 78 of the carriage, but when a drawer 40 heavily loaded with books is pulled out and begins to tip away from its rear ball bearing 70, the thrust roller bearing 104 then does engage the race 78 and rolls on it. This prevents any binding and makes certain that it will take no more pressure to move the drawer 40 backward and forward when it is well extended than when it is first moved. It will be noted that these thrust rollers 104 are spaced closely adjacent the ends of the tray 40, so that even when a drawer 40 is fully withdrawn in either direction, the roller 104 moves no farther than one-half way across the carriage 60. This location also helps to minimize both tipping and binding, making it easy to operate the drawer. Thus this drawer has a distinct advantage over drawers extending only half-way across the drawer-range.

Furthermore, it will be noted that the latch bar 93 on each drawer head 45 prevents the drawer 40 from moving out at the opposite end when the drawer 40 is given a push to return it to its original position. In other words, if such a drawer 40 is pushed, it runs until the latch bar 93 engages its strike plate 65 and then stops. At that point the latch bar 93 at the end that was out falls behind its strike plate 65, and the drawer 40 is locked against movement in either direction.

The inside side flange 110 (Fig. 8) serves as a book stop, to prevent the books from creeping too far to the side while the drawer is being operated. This structure prevents the bindings from coming against the flange 75 and becoming damaged.

In operation, then, anyone using the bookstacks first finds from the library card index the proper decimal number and locates that number on the index card 43 or 44 of one of the drawer faces 45. He then begins to open the drawer 40 and as it opens, takes his position at the same side as that of the index card in which he is interested.

To open the drawer 40 he releases the latch bar 93 simply by lifting the handle 90, and then he can pull the handle toward him. Due to the ball and roller bearing construction, tests have proved that even a fully loaded drawer 40 containing 250 pounds of books can be moved out by a three-pound force. When the drawer 40 is withdrawn, one-half of its contents extend out to the range aisle 30 and of these, one-half of the books (or one-quarter of all the books) are accessible to the user. He locates the books he needs, removes them, and then returns the drawer to its place, the drawer automatically latching.

While the invention has been described in connection with multi-tier book shelves, it will be obvious that it can be used equally well with free-standing shelves by spacing ranges of suitable vertical support members or by having a free-standing unit constructed. In such an event, the central support member 50 need not lie above the ground or floor level, although it may. It will be apparent from the description and from Figs. 1 and 2 that this invention makes it possible to interchange drawer-type ranges freely with shelf-type ranges since there is no difference in the support.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

I claim:

1. In a library book storage arrangement, two adjacent pairs of columns connected adjacent their upper ends in one direction by horizontal load transmitting hanger beams, a vertical support member freely depending from each of said beams intermediate the ends thereof and terminating free of a subjacent floor, a vertical spaced series of drawer carriages each extending normal to said load transmitting hanger beams between said adjacent pairs of columns, and each said carriage being connected adjacent its opposite ends to columns of said adjacent pair of columns and to said vertical support members for support thereof solely by said columns.

2. The library book storage arrangement as defined in claim 1, in which there are two vertical spaced series of rectangular drawer carriages disposed side-by-side between said adjacent pairs of columns and substantially filling the space therebetween, and each of said carriages of said two vertical spaced series of carriages being connected adjacent its opposite ends and at one side thereof to columns of said pairs of columns and at its opposite side to said vertical support member therebetween, for support thereof solely by said columns.

3. The library book storage arrangement as defined in claim 2, in which each of said side-by-side carriages of said two vertical spaced series of carriages are in mutual supporting relationship at one side thereof and connected to said vertical support therebetween, and the opposite side of each said carriage is connected adjacent its ends to said columns for support thereof solely from said columns.

4. The library book storage arrangement as set forth in claim 1, in which each of said drawer carriages comprises two laterally spaced side carriage rails extending normal to said hanger beams and connected adjacent their opposite ends to columns of said adjacent pairs of columns and to said vertical support members, drawers slidably mounted in each said carriage between the side rails thereof and being coextensive therewith, and latch means to limit longitudinal sliding of said drawers in said carriage rails, whereby the entire weight of said drawer carriages and drawers is transmitted to said columns by the aid of said depending support members and load transmitting hanger beams.

5. The structure as defined in claim 1, in which a drawer is slidably mounted in each of said drawer carriages for limited movement out from opposite ends thereof, said carriage and said drawer each having a pair of parallel ball races ending in the direction in which said drawer slides, the races on said carriage lying directly below those on said drawer, and, between each race, a pair of balls and a rigid spacer member with a pair of openings therethrough barely larger in diameter than said balls and spaced apart approximately half the length of said drawer.

6. The structure of claim 5 wherein each drawer has side edges provided with roller bearing means adjacent each end of said drawer for engagement of its upper surface with a lower surface of a projecting upper portion of said carriage to prevent said drawer from tipping any substantial amount as it is pulled out either end of said carriage.

7. The structure as defined in claim 1 in which a strike plate is mounted at each end of said drawer carriages, a drawer slidably mounted in each of said drawer carriages and having at each end a releasable latch and at the center a stop means, said latches being adapted to engage said strike plates when said drawer is closed and said stop means being adapted to engage one said strike plate at each extremity of the drawer's travel to prevent withdrawal of more than one-half of each said drawer.

8. The structure defined in claim 7 wherein each drawer has a face plate at each end and each face plate is slotted to receive a handle adapted to move vertically in the slots and connected to the latch at that end of the drawer for releasing it and permitting withdrawal of the drawers.

9. The structure as defined in claim 7 wherein there is a ball-race rolling connection between the lower surface of each said drawer and its said carriage and wherein there is a roller bearing on the upper surface on each end of said side of said drawer, normally not in contact with said carriage, but adapted to engage the lower surface of a projecting portion of said carriage when said drawer tips forward a slight amount, whereby binding is avoided.

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