My invention relates to rotatable shelf structures and more particularly to such structures for use in household refrigerators.

Rotatable shelves may be provided in household refrigerator cabinets in order to increase the accessibility of the contents thereof. These shelves increase accessibility since through their rotation any portion thereof may be brought to the front of the cabinet for the ready removal of foodstuffs. But even though any portion of the shelves may be reached as a result of their rotation, nonetheless it is desirable that the shelves be easily removable from the cabinet for cleaning or other purposes. Accordingly it is a primary object of my invention to provide a new and improved rotatable shelf structure for use in household refrigerators, in which the shelves may be easily removed from the refrigerator.

It is another object of my invention to provide a new and improved rotatable shelf structure for use in household refrigerators, in which the shelves are all supported on a common vertical shaft but yet may be removed individually from the refrigerator.

A further object of my invention is to provide in a rotatable shelf structure of the type including a vertical supporting shaft and means for effecting vertical adjustment of the shelves along the shaft, an improved arrangement for normally restraining movement of the adjusting means relative to the shaft.

My invention also has as its object the provision of an improved vertically adjustable, rotatable shelf structure which is inexpensive to manufacture and assemble within a refrigerator cabinet.

In carrying my invention into effect I provide a refrigerator cabinet having inner liner which defines a food storage compartment, and within this compartment I mount my new and improved rotatable shelf structure. This shelf structure is particularly adapted for easy removal from the cabinet in that each of the rotatable shelves may be individually removed therefrom. For that purpose the shelf structure includes a main supporting shaft which is formed of a plurality of separate sections detachably secured together and individually rotatable. This shaft is mounted vertically upright in the storage compartment and in accordance with my invention the various rotatable shelves are mounted thereon, each on a separate section. The shelves are thereby individually rotatable within the food storage compartment.

But further in accordance with my invention the means mounting the shaft are such that the various sections may be detached one from another and separately removed from the cabinet. With the shaft sections being individually removable from the cabinet the separate shelves mounted thereon are also individually removable, and thereby as a result of my invention an improved rotatable shaft structure is provided wherein the shelves may be readily removed from the cabinet for cleaning or other purposes.

In rotatable shelf structures it is sometimes desirable that means be included for adjusting the spacing of the shelves and thus when such adjustment is desired in my novel shelf structure I also provide adjusting means for effecting vertical adjustment of the shelves on their respective shaft sections, and in this adjusting means I include a novel arrangement for normally restraining movement of the adjusting means relative to the shaft.

The novel features which I believe to be characteristic of my invention are set forth with particularity in appended claims. The invention itself, however, both as to its organization and mode of operation may be best understood by reference to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a vertical sectional view of a refrigerator including a preferred embodiment of my new and improved rotatable shelf structure;

Fig. 2 is a horizontal sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 2 and partially broken away to show the preferred details of my novel supporting shaft;

Fig. 4 is a fragmentary sectional view taken on the line 4—4 of Fig. 3 and partially broken away to show my improved arrangement for normally restraining motion of the shelf adjusting means relative to the shaft;

Fig. 5 is a fragmentary view, partially in section, showing my preferred manner for supporting the shaft at its upper end;

Fig. 6 is a fragmentary sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a fragmentary sectional view taken on the line 7—7 of Fig. 5; and

Fig. 8 is a fragmentary view showing a preferred manner of mounting the novel means included in my shelf structure for normally holding the shelves in their retracted position within the refrigerator.

Referring now to Figs. 1 and 2, I have illustrated therein a refrigerator cabinet which includes an outer metal wall 1 and an inner metal wall or liner 2, the space between the walls being filled with suitable heat insulating material 3. The walls are formed to provide a door opening 4 at the front of the cabinet, and the space between the walls in the area of the door frame is closed by a breaker strip 5 of suitable heat insulating material. The space 6 defined by the inner liner 2 comprises the food storage compartment of the cabinet, and the door opening 4 of course, provides access to that compartment. The opening 4 may be closed by any suitable insulated door, as for example by the vertically pivoted insulated door 7 which is sealed to the door frame when closed by a compressible gasket 8. The storage compartment is refrigerated or cooled by means of a suitable mechanical refrigerating system (not shown).

Within the storage compartment 6 there is mounted a preferred embodiment of my new and improved rotatable shelf structure. In this preferred embodiment a plurality of rotatable shelves 9 and 10 are supported by means of a vertically extending shaft indicated generally at 11. The shaft 11 is, however, not a single unitary member, but rather by my invention is formed of a plurality of separate sections 12, 13, and 14. As will be more fully explained hereinafter these various shelf sections are detachably and rotatably secured together in order that they may be rotated separately of each other and may also be taken apart and separately removed from the storage compartment. The shaft as a whole is removably mounted vertically upright within the compartment 6 by means which hold the upper and lower sections 12 and 14. More specifically the shaft is mounted by the lowermost section 14 being held by an upstanding member 15 attached to the liner 2 and by the uppermost section 12 being rotatably and releasably secured to a stationary shelf 16. The upstanding member 15 includes a long center bore 16a
which accommodates the lower portion of the shaft section 14, and the length of engagement between the bore 16c and the shaft section 14 is such that the entire shaft is held upright even when the upper mounting of the shaft is released. My preferred means for rotatably and releasably securing the section 12 to the stationary shelf 16 will be more fully described hereinafter.

By reference to Fig. 3 there may be seen my preferred means for detachably and rotatably securing together the shaft sections 12, 13, and 14. As there shown the means for securing together each pair of adjacent sections 12 and 13 include an axially recess 17 formed in the upper end of section 12 and an axial pin 18 protruding from the lower end of section 12. Similarly the means securing together the sections 12 and 13 include an axial recess 17 formed in the upper end of section 13 and an axial pin 18 protruding from the lower end of section 13. In the embodiment illustrated the pins 18 and 20 are each press fitted in suitable recesses provided in the lower ends of their respective sections 12 and 13, but it should be understood that they could also be formed as integral parts of the sections. To secure together the sections 12 and 13 the pin 18 is fitted into the recess 17, and to secure together the sections 13 and 14 the pin 20 is fitted into the recess 19. In other words, when the shaft sections are fitted together the pins provided on the end of one of each pair of adjacent recesses is accommodated by the recess formed in the other of the pair.

In order to provide for rotation of the various sections relative to each other the fit between the recesses 17 and 19 and the pins 18 and 20 respectively accommodated thereby is not a tight one. Rather it is relatively loose. This allows the pins to rotate freely within the recesses and thereby, of course, permits rotation of the shaft sections relative to each other. Further the loose fit allows the pins to be freely withdrawn from the recesses so that the various shaft sections may be detached one from another for separate removal from the food storage compartment.

To provide an easy, relatively frictionless rotation of the individual shaft sections ball bearing means may also be included in the arrangement attaching them together. Thus as shown in Fig. 3 a ball bearing may be positioned at the bottom of each of the recesses 17 and 19. These ball bearings 21 and 22 are of slightly less diameter than the recesses so that they may roll freely but yet remain centered therein. The bases of the pins 18 and 20 rest on the ball bearings when the pins are accommodated by the recesses and thereby the thrust load of the pins is taken up by the ball bearings rather than by the bottoms of the recesses themselves. As a result rolling rather than sliding friction takes place at the bases of the pins upon the rotation of the shaft sections, and thereby a much easier, more friction-free movement is obtained.

As shown in Fig. 1 each of the shelves 9 and 10 is mounted on a separate shaft section in order to be individually rotatable and also so that they may be individually refrigerated from the refrigerator. Specifically the shelf 9 is mounted on the shaft section 12 and the shelf 10 on the shaft section 13. In my preferred embodiment the shelves are both mounted so as to be vertically adjustable on their respective sections and the improved means providing this vertical adjustment may be best seen by reference to Figs. 3 and 4. In my preferred mounting arrangement the sections 12 and 13 of the shaft 11 do not have a truly round configuration, but rather are more or less square having a plurality of flat sides 23 joined by a plurality of rounded corners 24. These rounded corners are provided with a screw thread, but the flat sides are left with a more or less smooth surface. For supporting the shelves 9 and 10 respectively separate collar members 25 and 26 are threaded respectively on the rounded corners of the shaft sections 12 and 13. The shelves 9 and 10 respectively include center hub or sleeve portions 27 and 28 and these hub portions rest on the collar members 25 and 26 respectively. Through this support of the hub portions by the collar members the shelves themselves are maintained in position on the shaft.

The rotation of the shelves is accomplished through the rotation of the shaft sections. To accomplish this result the hubs 27 and 28 are each provided with a center hole or slot through which their respective shaft sections fit, the slot 28a of hub 28 being shown in Fig. 3. These slots are, however, not of a round cross-section but rather are of a square configuration. In other words, the center slots of the hubs have flat sides which engage the flat sides of the shaft when the hubs are placed in position. Thus when a rotating force is applied to either shelf, this force is transmitted to its shaft section through the engagement of these flat sides and thereby the shelf and the shaft section rotate together as a unit.

The vertical adjustment of the shelves along their respective shaft sections is accomplished by means of the aforesaid threaded collar members 25 and 26. By rotating these collar members relative to the shaft, the collar members will move up or down the shaft because of their threaded engagement therewith. Since the hubs 27 and 28 are not secured to their shaft sections, but rather are free to slide up and down along them, therefore this vertical movement of the collar members also results in a vertical movement of the shelves. Thus vertical adjustment of the shelves may be accomplished by simply rotating the supporting collar members 25 and 26 on their respective shaft sections.

Normally, however, it is desirable that the collar members be restrained from movement relative to the shaft. In other words, during the normal operation of the shelves it is desirable that the collar members or adjusting means be restrained from movement relative to their respective shaft sections and thus from vertical change along the shaft. To accomplish this result I have mounted novel motion-restraining means on each of the collar members. The motion restraining means for the collar member 26 may be clearly seen by reference to Fig. 4, it being understood that similar means are provided for the collar member 25.

As shown in Fig. 4 the collar member 26 has a recess 29 provided in the inner peripheral edge thereof. Within this recess there is mounted a locking plunger member 30 having a flat outer face 31, this locking member 30 being biased toward the center shaft section by means of a coil spring 32 also positioned in the recess. Due to this spring bias the outer flat face 31 of member 30 engages the shaft section 13 mounting the collar member 26. Or more exactly it engages a flat face 23 of the shaft section, the particular face 23 engaged depending upon the angular position of the collar member relative to the shaft. This engagement of the locking member 30 with a flat side of the shaft tends to prevent rotation of the collar member 26 with respect to the shaft. However, if a sufficient rotational force is supplied to the collar member the bias of the spring 30 can be overcome so that the collar may rotate relative to the shaft. Unless, however, the housewife desires to adjust the vertical position of the shelf, the collar member will normally remain locked to the shaft due to the engagement of the plunger 30 with a flat side of the shaft. Thus no uncontrolled movement of the collar member will take place upon the usual rotation of the shelf. Rather the shaft sections, the shelf and the collar member will all rotate together during normal use of the shelf structure.

In my preferred embodiment I have also provided means for normally preventing rotation of the shelves themselves unless the housewife should want to move.
them to an outward accessible position. In other words, I have provided means which normally hold the shelves in their retracted position within the refrigerator. As may be best seen in Figs. 1 and 2 this means comprises a long flexible rod 33 which extends vertically along the rear wall of the liner 2. The rod 33 is mounted on a plurality of pins 34 as shown in Fig. 8, extending through apertures 34c in the rear wall of the liner 2 and which are provided with flanged heads 34b on their inner ends. A coil spring 35 is mounted on each of the pins 34 between the liner wall and the rod so that the rod is normally biased outwardly toward the shelves. The flanged heads of the pins 34 extend inwardly toward the shelf members, of course, limit the outward movement of the rod. The shelves 9 and 10 each have small depressions formed in the rear portion of their edges and when the shelves are in their normal position the rod 33 fits into these depressions. Thus as may be seen in Fig. 2 the shelf 10 includes a depression 36 into which the rod 33 fits. This engagement of the rod by the depressions normally prevents the rotation of the shelves. However, when the housewife applies a turning force to any shelf, the locking effect applied by the springs 35 is easily overcome so that the depression of the shelf will move off the rod and the entire shelf will rotate outwardly. The engagement between the rods and the depressions of the shelves is, however, strong enough to prevent movement of the shelves upon slamming of the door 7 or other shaking of the refrigerator.

Preferably, to insure that the rod 33 does not allow wobbling or other movement of the remaining shelves when one shelf is moved outwardly, it is so mounted that it is flexible in one plane only. More exactly the rod is mounted to be flexible in a plane parallel to the sides of the refrigerator cabinet but relatively rigid in a plane parallel to the face or front of the cabinet. To accomplish this result the apertures 34c through which the pins 34 extend are flanged somewhat outwardly so that they serve as guides causing the pins 34 to move in and out in a straight line normal to the rear wall of the liner. This restricts the bending of the rod 33 to the plane parallel to the sides of the cabinet and prevents it from flexing sideways. As a result when a shelf is to be applied to one of the rotating shelves the rod 33 curves or bends toward the rear wall of the liner enough to release that shelf. However it cannot flex enough to either side to allow wobbling of the other shelf or shelves.

As mentioned above my new and improved rotatable shelf structure has the distinct advantage that it may be readily disassembled and removed from the refrigerator. In other words, it has the advantage that each of the shelves 9 and 10 may be removed separately from the refrigerator. To accomplish this result I have, of course, mounted each of the shelves on a separate shaft section,and as will now be explained I have further mounted the shaft itself so that its various sections and thereby the shelves may be removed individually from the refrigerator.

As above mentioned, the upper end of the shaft 11 is mounted by means of a stationary shelf 16 positioned in the top portion of the refrigerator. This upper mounting of the shaft is, however, such that the shaft may be detached from the mounting means. In fact, my preferred detachable mounting may be seen by reference to Figs. 5, 6, and 7.

In order to mount the upper end of the shaft the shelf 16 has mounted thereon a bracket 37. This bracket 37 holds the shelf 16 in place by means of a pin 38 extending downwardly therefrom. The pin 39 fits into a recess 40 provided in the upper end of the topmost shaft section 12, and thereby holds the upper end of the shaft in position. As shown, a ball bearing 41 may be positioned in the bottom of the recess 40 so as to take up any wear and thus prevent any friction between the shaft section and the pin. In other words, the same type of detachable, rotatable connection, is provided between the stationary shelf 16 and the shaft section 12 as between the various shaft sections themselves. Thus, the top shaft section 12 may rotate relative to the shelf and may also be detached therefrom.

To prevent wobbling of the top end of the shaft, it is necessary that the stationary shelf 16 itself be firmly held in position. As shown in Figs. 5 and 7 the shelf 16 is firmly held by means of a plurality of mounting studs to accomplish this result. Specifically, the shelf 16 is held by a plurality of studs 42 which extend through the apertures in the liner 2 and are held in place by clamps 43. At their inner ends, these studs 42 have flanged heads 44, and the depending rear and side edge 45 of the shelf includes slots 46 which fit over the body portions of the studs intermediate the shelf wall and the flanged heads. Preferably, the slots 46 are of the bayonet type so that the ends of the slots are first placed over the studs 42 and then the shelf is rotated slightly to move the studs into the inner ends of the slots. With this bayonet type of mounting, the shelf is prevented both from moving up and down and also from moving sideways. The engagement of the body portions of the studs 42 with the top and bottom edges of the slots 46 prevents a vertical movement and the engagement of the flanged heads 44 of the studs with the depending edge 45 of the shelf surrounding the slot prevents sideways movement of the shelf. Thus the shelf is held firmly in position so that it will not move and cause wobbling of the top edge of the shaft.

To remove the shelf structure from the refrigerator it is only necessary to release the top mounting of the shaft. After that the shelf sections may be detached one from another and removed from the refrigerator. Since the shelves are each mounted on a separate shaft section, they will, of course, be removed individually with the shaft section. In my preferred embodiment, the top mounting of the shaft is released by lifting the stationary shelf upwardly. This pulls the pins 39 out of the recess 40 and thereby completely releases the top end of the shaft. To pull the shelf upwardly it is first rotated slightly so that the pins 42 come out of the bayonet slots 46. Then the stationary shelf may, of course, be lifted upwardly. Thus not only the removal of the rotating shelves from the refrigerator after the release of the shelf but also the release of the shaft itself from its mounting means may be accomplished very simply and easily.

From the above it will be seen that I have provided a new and improved rotatable shelf structure in which the shelves may be removed separately from the refrigerator. By detaching the shaft sections one from another the shelves may be simply and easily lifted from the refrigerator. Since no complicated attaching means are used the shelf structure may then be readily reassembled merely by fitting together the various sections of the vertical shaft. Moreover, when my preferred attaching means are used, efficient bearing means are provided for facilitating the separate rotation of the shaft sections and the shelves mounted thereon. Further, although adjusting means are provided in my preferred embodiment to allow vertical adjustment of the shelves up and down the shaft, the normal rotation of the shelves does not cause such adjustment. As a result of my new and improved locking means incorporated in the adjusting means the shelves are normally restrained from vertical motion along the shaft except when the housewife definitely desires to effect vertical adjustment thereof.

While in accordance with the patent statutes I have described what at present is considered to be the preferred embodiment of my invention it should be obvious to those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:
1. In a refrigerator having a food storage compartment, a rotatable shelf structure removably mounted in said compartment and comprising a threaded shaft formed of a plurality of separate sections, one of each group of adjacent sections having an axial recess in the end thereof and the other of each pair having a pin protruding axially therefrom, with said pin being removably accommodated in said recess thereby to detachably and rotateably secure together said pair of adjacent sections, whereby all of said sections are detachably and rotateably secured together, means releasably mounting said shaft in a vertically upright position in said food storage compartment, a plurality of collar members each rotateably mounted on a separate one of said shaft sections, separate releasable locking means engaging each of said collar members with the shaft section thereof for releasably restraining rotation of said collar members relative to said shaft section, said locking means disengaging when said collar is rotated and a plurality of rotatable shelves each associated with a separate one of said shaft sections thereby to be individually removable therewith from said storage compartment upon the detaching of said shaft sections one from another, said shelves being separately supported on said shaft sections by said collar members threaded thereon and being adjustable along said sections by the rotation of said collar members.

2. The combination of claim 1 wherein said shaft includes a plurality of flat sides and a plurality of rounded corners between said sides with said corners being threaded, and said separate locking means for each collar member includes a movable locking member having a flat face, said locking member being mounted on said collar member, and spring means biasing said locking member against said shaft whereby said flat face of said locking member yieldably engages one of said flat sides of said shaft to normally prevent rotation of said collar member with respect to said shaft except upon a turning force being applied directly to said collar member.

3. In a refrigerator having an inner liner defining a food storage compartment and a stationary shelf removably mounted in the upper portion of said storage compartment, a rotatable shelf structure removably mounted in said storage compartment and comprising a shaft formed of a plurality of separate sections detachably secured together and individually rotatable, a plurality of rotatable shelves each mounted on a separate one of said shaft sections, and means including said stationary shelf releasably mounting said shaft vertically upright in said compartment, said means supporting said shaft at the lower end thereof and said shaft having a member attached to the lower surface thereof adapted to detachably engage the uppermost section of said shaft thereby to hold the upper end of said shaft whereby upon said stationary shelf being moved to detach said member from said uppermost shaft section said shaft sections may be detached one from another and said shelves individually removed therefrom from said compartment.

4. In a refrigerator having a food storage compartment, a rotatable shelf structure removably mounted in said storage compartment and comprising a shaft formed of a plurality of separate sections detachably secured together and individually rotatable, means releasably mounting said shaft vertically upright in said storage compartment, a plurality of collar members each threadably mounted on a separate one of said shaft sections, separate releasable locking means engaging each of said collar members with the shaft section thereof for releasably restraining rotation of said collar members with respect to said shaft sections, said locking means disengaging when said collar is rotated and a plurality of rotatable shelves each associated with a separate one of said shaft sections, said shelves being separately supported on said shaft sections by said collar members threaded thereon and being adjustable along said sections by the rotation of said collar members.

5. The combination of claim 4 wherein said shaft includes a plurality of flat sides and a plurality of rounded corners between said sides with said corners being threaded, and said separate locking means for each collar member includes a movable locking member having a flat face, said locking member being mounted on said collar member, and spring means biasing said locking member against said shaft whereby said flat face of said locking member yieldably engages one of said flat faces of said shaft to normally prevent rotation of said collar member with respect to said shaft except upon a turning force being applied directly to said collar member.

6. In a refrigerator having a food storage compartment, a rotatable shelf structure removably mounted in said storage compartment and comprising a shaft formed of a plurality of sections detachably secured together and individually rotatable, means releasably mounting said shaft vertically upright in said storage compartment, a plurality of collar members each threadably mounted on a separate one of said shaft sections, separate releasable locking means engaging each of said collar members with the shaft section thereof for releasably restraining rotation of said collar members with respect to said shaft sections, said locking means disengaging when said collar is rotated, a plurality of rotatable shelves each associated with a separate one of said shaft sections whereby said collar members rotateably mounted in said compartment, said means supporting said shaft at the lower end thereof and said shaft having a member attached to the lower surface thereof adapted to detachably engage the uppermost section of said shaft thereby to hold the upper end of said shaft whereby upon said stationary shelf being moved to detach said member from said uppermost shaft section said shaft sections may be detached one from another and said shelves individually removed therefrom from said compartment.

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