# United States Patent [19]

**Hickinbotham**

[11] **3,734,312**

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## [54] STEEL BAR STORAGE RACK UNIT AND COOPERATING LIFTING DEVICE


[75] Inventor: **Donald E. Hickinbotham,** Stockton, Calif.

[73] Assignee: **Hickinbotham Bros. Ltd.,** Stockton, Calif.



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[52] **U.S. Cl.** .....**214/16.4 A,** 214/730

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

[58] **Field of Search** .....214/16.4 A, 1 P, 214/730



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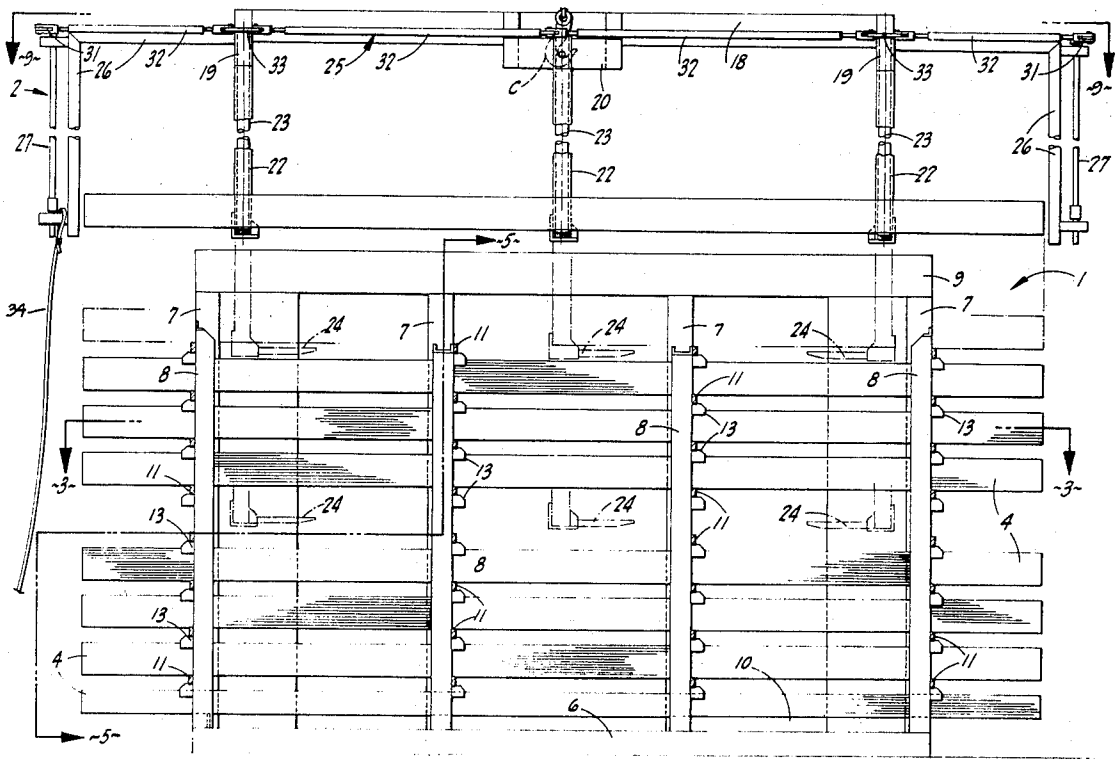
*Primary Examiner*—Robert G. Sheridan
*Assistant Examiner*—R. B. Johnson
*Attorney*—Roger B. Webster



[57] **ABSTRACT**

A pigeon-hole type rack unit having individual racks in vertical stacks, and a cooperating, transitionally suspended lifting device; the racks being adapted for the reception and storage—for wholesale—of relatively small gauge, elongated steel bars in heavy, standard mill bundles of predetermined length; and said rack unit and lifting device being of a construction such that the racks—successively upward from the lowermost one in a given stack thereof—can each be loaded by said device with a bundle of such bars, and thereafter—when desired—any bundle in a rack of such stack, and again by said device, can be lowered to a rack (when empty) therebelow and without removing such bundle, or any others, from the rack unit.


**12 Claims, 12 Drawing Figures**



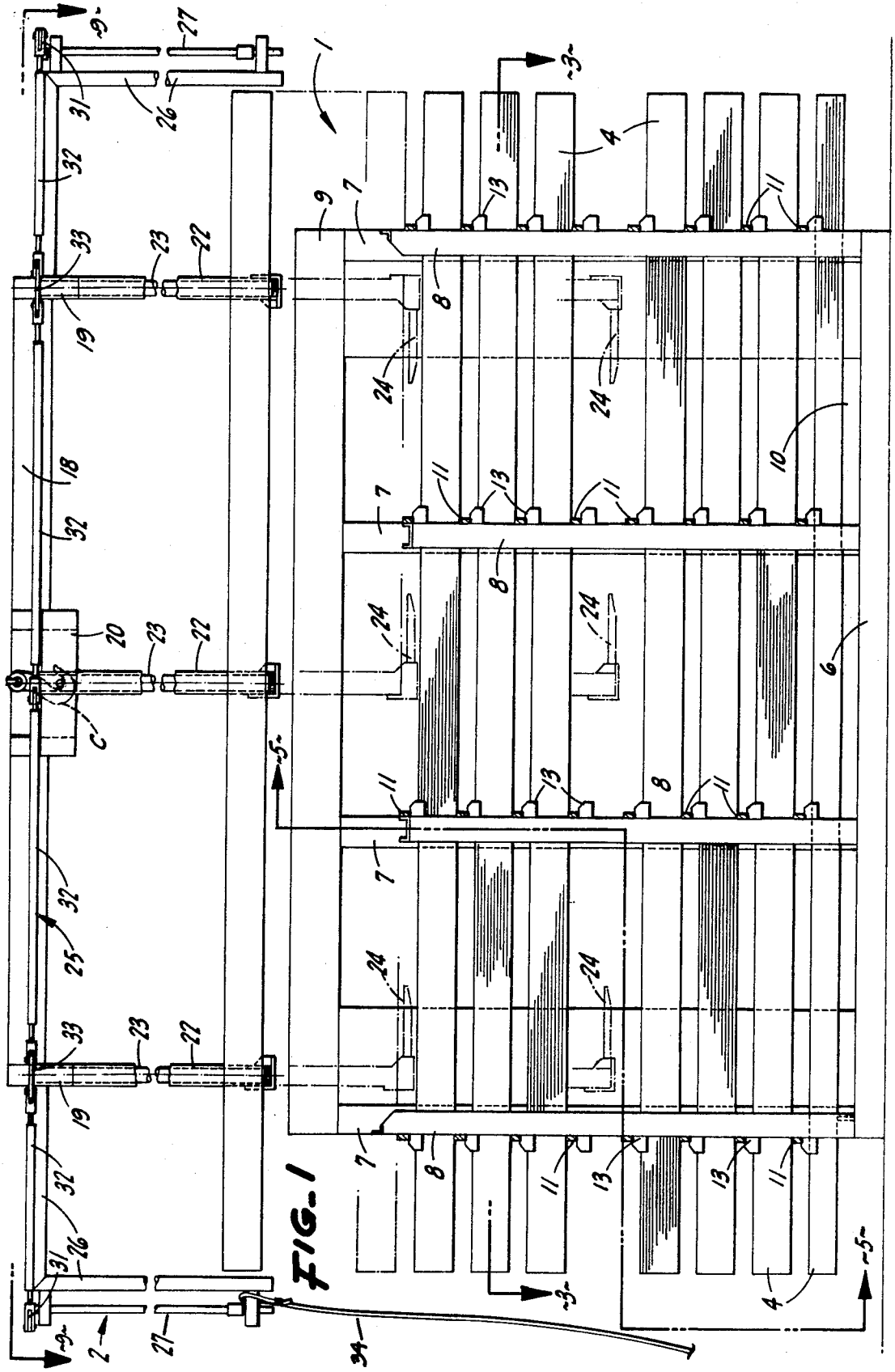



FIG. 1

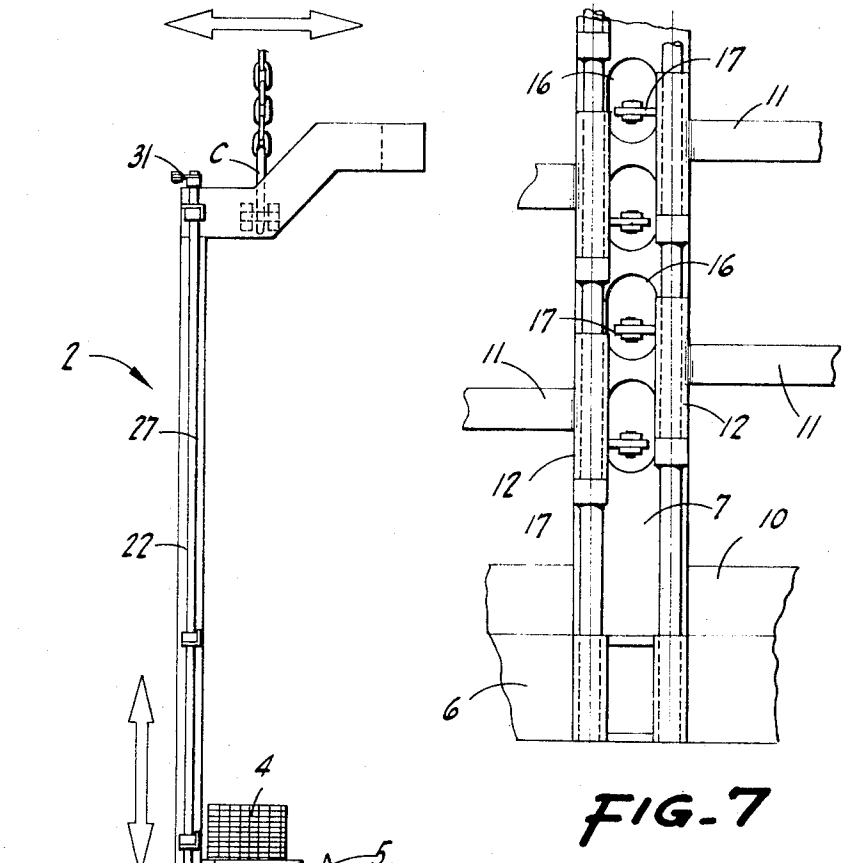

16
17
11
16
17
11
12
11
12
17
7
10
6

FIG-7


31
C
2
27
22
4
24
5
11
3
1
4
11
3
11
11
4
3
8
11
4
11
8
7
10
6

FIG-2

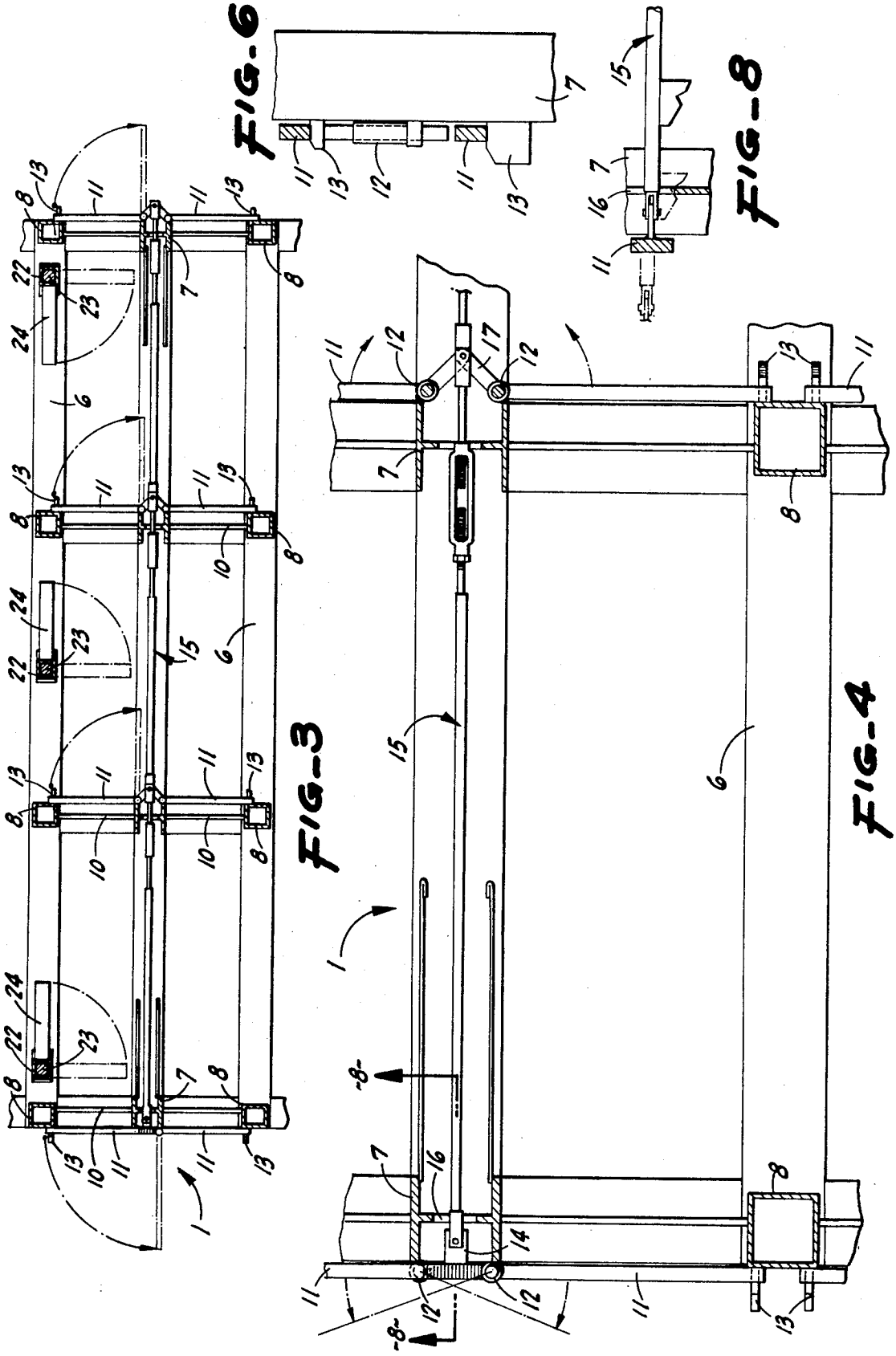

FIG-6
FIG-8
FIG-3
FIG-4

FIG. 5

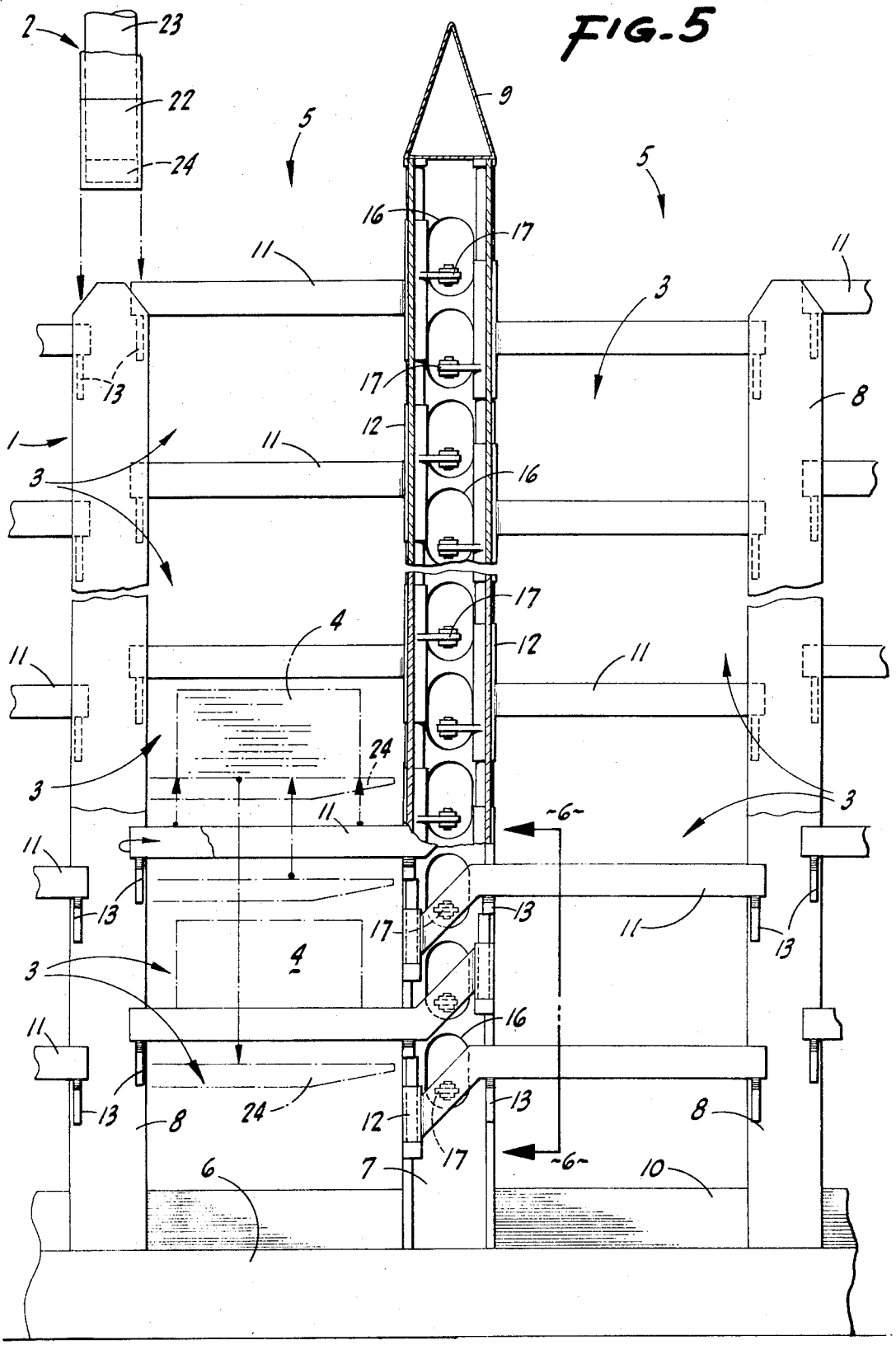


FIG. 9

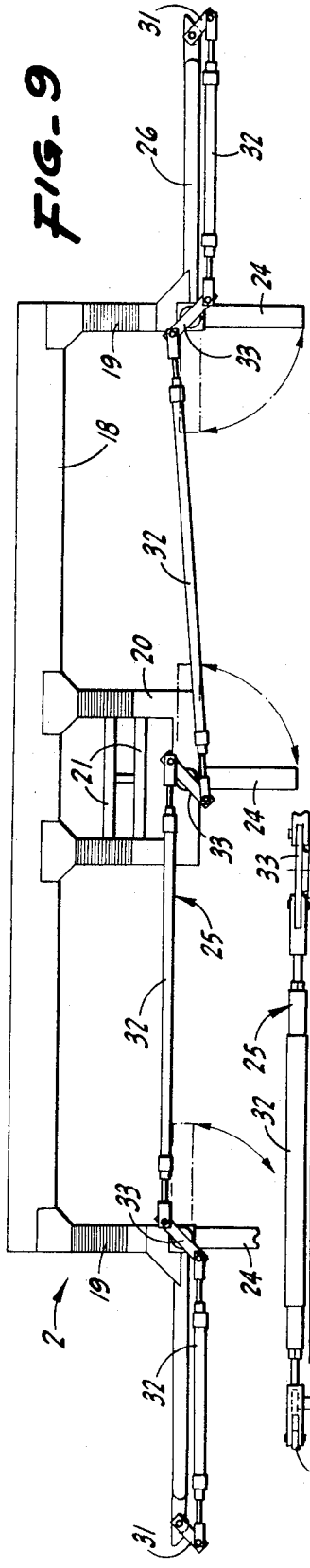



FIG. 12

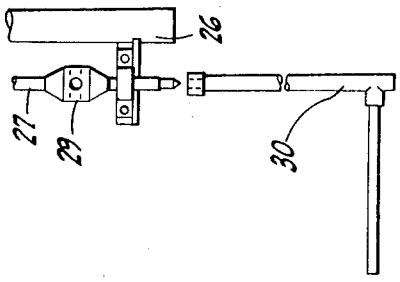



FIG. 11

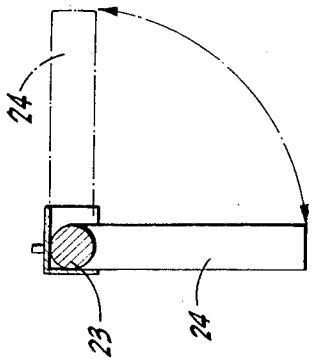
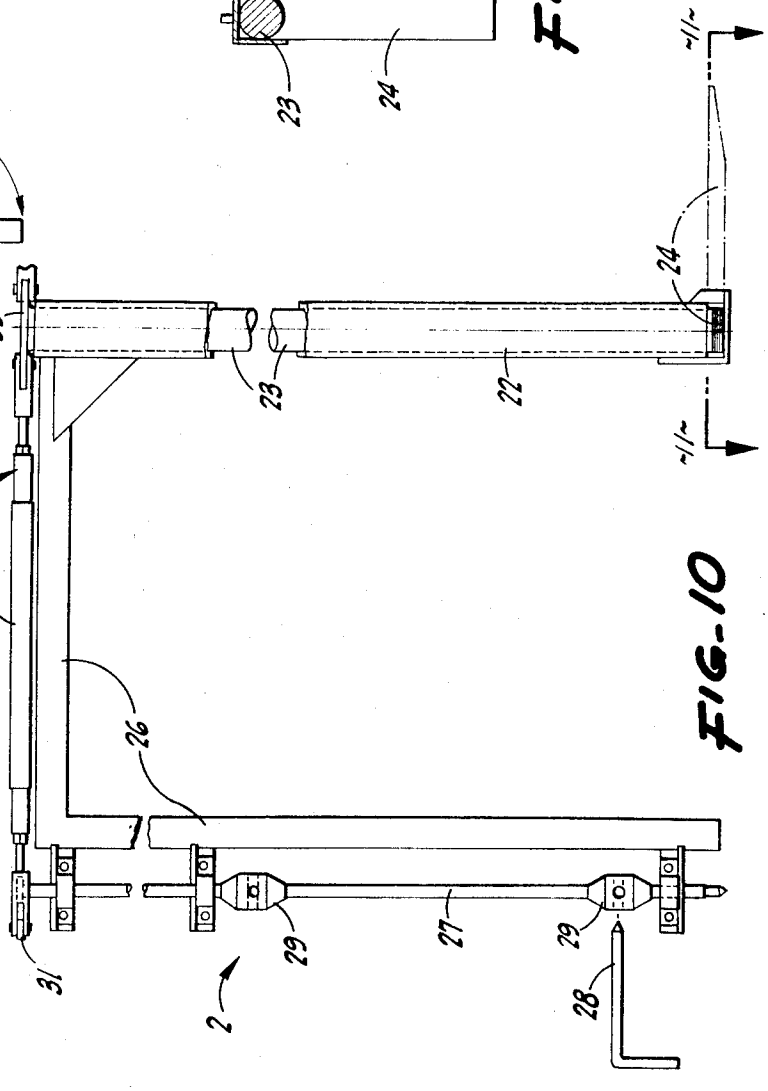



FIG. 10



# STEEL BAR STORAGE RACK UNIT AND COOPERATING LIFTING DEVICE

## BACKGROUND OF THE INVENTION

Heretofore relatively small gauge, elongated steel bars, in heavy, standard mill bundles, have—for storage—been placed in racks by chains, slings, or like equipment suspended from an overhead crane; this having presented a problem in that it was a slow, somewhat hazardous, usually three-man operation. Additionally, if it were desired to subsequently move a bundle of the steel bars from one rack to another, a further problem arose in that it was necessary to manually and individually remove the bars from such one rack and to replace them in the other rack; all of which was a tiresome and time-consuming task. In recognition of these problems, and to overcome them, the present invention was conceived.

## SUMMARY OF THE INVENTION

The present invention provides, as a major object, a pigeon-hole rack unit and a cooperating, transitionally suspended lifting device; the rack unit including racks, in vertical stacks, adapted for the reception and storage—for wholesale—of small gauge, elongated steel bars in heavy, standard mill bundles; said rack unit and lifting device being of a construction, and cooperating in a manner, whereby the racks in a given stack thereof can, by said device and as a one-man operation, each be loaded—progressively upward from the lowermost rack of the stack—with a bundle of such bars. Subsequently, upon any rack becoming empty, the next-above rack-supported bundle can—again by said device—be lowered to such empty rack without removing said bundle (or any others) from the rack unit.

The present invention provides, as a further object, a rack unit and lifting device which is designed for ease and economy of manufacture.

The present invention provides, as a still further object, a practical, reliable, and durable rack unit and lifting device, and one which is exceedingly effective for the purpose for which it is designed.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal side elevation of the rack unit, with the lifting device suspended thereabove.

FIG. 2 is a transverse front end elevation of the rack unit and cooperating lifting device as in FIG. 1; the rack unit being partially broken away but the view showing—in full—one set of side-by-side stacks of the racks.

FIG. 3 is a fragmentary sectional plan view, taken substantially on line 3—3 of FIG. 1, showing such set of side-by-side stacks of the racks including the working parts thereof, together with an illustration of the positions occupied by the forks of the lifting device when cooperating with the rack unit.

FIG. 4 is an enlarged plan view of a portion of the structure shown in FIG. 3.

FIG. 5 is an enlarged transverse vertical elevation, partly in section, showing said set of side-by-side stacks of the racks; the view being taken substantially on line 5—5 of FIG. 1.

FIG. 6 is a fragmentary vertical sectional elevation taken substantially on line 6—6 of FIG. 5.



FIG. 7 is a fragmentary transverse vertical elevation of the rear end of the rack unit; the view being taken substantially on line 7—7 of FIG. 1.

FIG. 8 is a fragmentary horizontal section taken substantially on line 8—8 of FIG. 4.

FIG. 9 is a plan view of the lifting device taken substantially on line 9—9 of FIG. 1.

FIG. 10 is an enlarged fragmentary longitudinal elevation of one end portion of the lifting device.

FIG. 11 is a fragmentary sectional plan view on substantially line 11—11 of FIG. 10.

FIG. 12 is a view showing a fragmentary part of the lifting device as in FIG. 10, shown with a cooperating hand wrench.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now more particularly to the drawings and to the characters of reference marked thereon, the present invention provides a pigeon-hole rack unit, indicated generally at 1, with which a transitionally suspended lifting device, indicated generally at 2, cooperates to initially stock the racks 3 of the rack unit with heavy, standard mill bundles 4 of relatively small gauge, elongated steel bars, and to subsequently lower any selected bundle downwardly from its related rack to an empty one therebelow, and without removing any bundle from the rack unit.

The rack unit 1 includes a multiplicity of sets of side-by-side stacks 5 of the racks 3, but—for the purpose of simplicity and ease of reference—the disclosure is here directed essentially to only one set of such side-by-side stacks.

The herein disclosed set of side-by-side stacks 5 is comprised—on a base 6—of a longitudinal central row of posts 7 which is common to both such stacks. The posts 7 are fixedly secured to and upstand from said base 6. At the outer side of each stack 5, there is a longitudinal row of posts 8 disposed in predetermined spaced relation fixedly secured to said base and extending upwardly therefrom in free standing relation.

While the posts 8 of each row thereof have no connecting members therebetween, a peaked longitudinal header 9 is secured to and spans between the upper ends of all of the central posts 7.

In each stack 5 the sides of the pigeon-hole racks 3 are structurally formed by the posts 7 of the central row and the posts 8 of the related side row. The bottom of the lowermost rack 3 of each stack 5 is defined by fixed cross members 10 spanning between corresponding posts 7 and 8 immediately above base 6. The bottom of each of the remaining racks 3 is comprised of horizontal, bundle-supporting, rack arms 11 normally extending transversely between corresponding posts 7 and 8; such rack arms being hinged, as at 12, at their inner ends to the related posts 7, while the outer ends of said arms bear on rests 13 secured to the related posts 8. As so hingedly mounted, the rack arms 11 are swingable—in an arc of subsubstantially ninety degrees—from their normally transverse position to a lengthwise, out-of-the-way position in the longitudinal plane of the row of posts 7 and hence clear of the space between said row and the row of posts 8. Also, when in transverse position, all but the foremost arms 11 abut forwardly against the related post 8, and which serves as a stop.

With the exception of the ones at the front (i.e., said foremost ones), the individual rack arms 11 are hinged

at the rear of and to the near side to the corresponding posts 7 to swing rearwardly from transverse to lengthwise position; the front rack arms 11 being oppositely hinged to swing forwardly or outwardly from transverse to lengthwise position.

A connecting arrangement is provided to the end that—when one of said front rack arms 11 is manually grasped and pulled forward from transverse to lengthwise position—all of the other arms 11 of the same rack 3 are caused to swing rearwardly from transverse to lengthwise position. See the broken-line representations of the rack arms 11 in FIG. 3. Such connecting arrangement comprises the following:

Each foremost rack arm 11 (of dog-leg form at the inner end) is hinged at the front of and to the far or opposite side of the related post 7, whereby the inner end portion of said rack arm extends across the face of such post; said inner end portion being provided with a rearwardly projecting ear 14 to which an elongated push-pull rod assembly 15 is pivotally connected at its front end. From ear 14 such rod assembly 15 thence extends horizontally rearwardly through the central row of posts 7, and which posts are ported, as at 16, to permit passage of said rod assembly. The rod assembly 15 is pivotally connected, at points in the length thereof, with short radial levers 17 which project at a rearward and inward diagonal from the hinged ends of the rack arms 11. See FIGS. 3 and 4.

Thus, when the foremost rack arm 11 is manually pulled forward, the rod assembly 15 is correspondingly moved, and the levers 17 are pulled forward causing all of the other rack arms 11 to simultaneously swing from transverse to lengthwise position. Conversely, when the foremost rack arm 11 is swung rearwardly to transverse position, the other rack arms 11 are returned to a like position. It will, therefore, be recognized that an operator—standing in front of one of the stacks 5—can, by manipulation of the foremost rack arm 11 of any one of the racks 3 (except the lowermost), simultaneously cause all of the rack arms of such rack to move to lengthwise out-of-the-way position, or to transverse, bundle-supporting position, selectively.

When each stack 5 is to be stocked with bundles 4 of steel bars, all of the swingable rack arms 11 of the stack are first swung to their lengthwise out-of-the-way position. Then, by means of the lifting device 2 (whose structure and operation are hereinafter described in detail), bundles 4 of steel bars are lowered, one at a time, into the said stack; the first bundle being placed on the cross members 10 of the lowermost rack 3. Thereafter, the rack arms 11 of the next-above rack 3 are swung to transverse position and a bundle of steel bars is deposited thereon. This procedure is repeated successively upwardly until all of the racks 3 are stocked with a bundle 4 of steel bars.

The lifting device 2, used to stock each stack 5 as above, and to subsequently re-position the bundles in such stack—both in the particular manner to be later described—comprises the following:

A longitudinal beam 18 forms a part of what may be termed a "counterbalanced frame," and which includes short lateral arms 19 projecting in the same direction from the ends of such beam, and a U-shaped lateral member 20 projecting in the same direction from said beam centrally of its ends; the member 20 having, within its confines, a H-shaped structure 21 adapted to receive the depending hook C of an overhead traveling-type crane (not shown) which is operative to move the lifting device 2 up or down as well as lengthwise and transversely relative to the rack unit 2.

A leg 22 is fixed to and rigidly depends from the outer end of each lateral arm 19, as well as from the central lateral member 20; each such leg providing the mount for a vertical, rotatable shaft 23.

At the lower end thereof, each shaft 23 is fitted with a radial fork 24; such forks being adapted—depending on the rotative positions of shafts 23—to all project lengthwise of the lifting device in the vertical longitudinal plane of legs 22 or to all project laterally from the lower ends of such legs in a direction away from the beam 18. See, for example, FIGS. 1 and 9–11, inclusive. As shown in FIG. 11, the forks, in each of the described positions thereof, abut a side of the corresponding leg as a stop.

When the forks 24 are all in a position extending lengthwise of the lifting device 2, the rearmost fork extends forwardly from the corresponding shaft 23, while the other forks extend rearwardly; this so that in such lengthwise position all of the forks are within the lengthwise extent of said lifting device and do not project endwise therefrom.

A mechanism, indicated generally at 25, is employed at each end of the lifting device to simultaneously, and manually, swing all of the forks 24 from lengthwise to lateral positions or vice versa. As the mechanisms are used only one at a time, and as such mechanisms are identical at each end of the lifting device, a description of one will here suffice.

At each end of the lifting device, an inverted L-shaped extension frame 26 is fixedly secured to and extends longitudinally from the outer end of the corresponding lateral arm 19; such frame, at the outside thereof, having a vertical operating shaft 27 journaled thereon. The shaft 27 is adapted to be reversibly, manually rotated by a pinch bar 28 engaged in one of two socketed, vertically spaced turning heads 29 on shaft 27 (see FIG. 10), or by a wrench 30 engaged on the lower end of such shaft 27 (see FIG. 12).

At the upper end the shaft 27 is fitted with a radial lever 31 which is pivotally connected at its outer end with the adjacent end of a push-pull rod assembly 32 having connection intermediate its ends with double-ended radial levers 33 fixed on the upper ends of the shafts 23.

With part-circle rotation of shaft 27, and the responsive motion of the rod assembly 32, the radial levers are swung in a direction to rotate the shafts 23 through an arc of approximately 90°, and which—depending upon the direction of rotation—swings the forks 24 between lengthwise and lateral positions or vice versa.

In use of the above-described lifting device 2 to load or stock a stack 5 of racks 3 of the rack unit 1, the forks 24 of such lifting device are first swing—by the operating mechanism 25 then corresponding to the front of the rack unit 2—to their laterally projecting positions. The device is then manipulated by the overhead traveling-type crane (from which the device is suspended) to adjacent the point outside the rack unit where a bundle 4 of steel bars rest—as on the floor or a truck bed. The lifting device 2 is thereafter shifted about until the forks engage beneath the bundle, whence it is picked up by the lifting device and transported thereby to a point in clearance relation above the rack unit and substantially longitudinally alined with the stack 5 to be stocked with

bundles 4, and in which stack the rack arms 11 have previously all been swung to their lengthwise, out-of-the-way positions whereby—above the cross members 10—the space between the rows of posts 7 and 8 is unobstructed. A rope 34 is connected to and depends from the lower end of extension frame 26 for manual grasping and for use to aid in locating the lifting device in the desired position above the stack 5 which is to be stocked.

More particularly, the lifting device—extending longitudinally and with a bundle 4 on the laterally projecting forks 24—is positioned so that, upon such device being lowered, the legs 22—which are in predetermined spaced relation for the purpose—occupy positions between and in clearance relation to the posts 8 of one row thereof, and which posts are free-standing without any obstruction therebetween. At the same time that the legs 22 lower between such posts 8, the fork-supported bundle—pre-positioned above the stack 5 to be stocked—is lowered, between the row of posts 7 and said one row of posts 8, into such stack until it is deposited on the bottom, i.e., on the cross members 10, of the lowermost rack 3.

The forks 24 are then swung back to their lengthwise out-of-the-way positions, and the lifting device is withdrawn upwardly from the rack unit and moves away to pick up another bundle in the manner already described.

Nextly, the rack arms 11 of the next-above rack 3 are swung from their lengthwise out-of-the-way position to their transverse position; another bundle 4 then being introduced into the stack—from above and by said lifting device as described—and deposited on the transverse rack arms 11 of said next-above rack 3.

In the above manner, the racks 3 are successively stocked each with a bundle 4 of steel bars—all by operation of the lifting device and with a minimum of manual effort.

After the racks 3 of one of the set of side-by-side stacks 5 have been stocked, the lifting device 2—by merely reversing it and using the operating mechanism 25 at the other end—is employed, by the same steps as above, to stock the other stack 5 of the set thereof. In this case, the legs 22—with each lowering of the lifting device—are disposed between the posts 8 of the other row thereof.

In addition to serving to stock the racks 3 of each set of side-by-side stacks 5, the lifting device also has another important use, as follows:

When a rack 3 of one of the stacks 5 becomes empty, the bundle 4 from the rack immediately thereabove can be lowered into such empty rack by the simple expedient of lowering the lifting device (with the forks in their lengthwise out-of-the-way position) into the stack unit; i.e., lowering the legs 22 into the related row of posts 8 and then swinging the forks 24 out to their lateral position (then offset from adjacent rack arms) and under the bundle 4 to be lowered. This is followed by a slight raising of the lifting device and until the forks engage and lift the bundle a short distance above the transversely extending rack arms 11 which support said bundle to be lowered; such rack arms 11 then being swung to their lengthwise out-of-the-way position. Thence, the lifting device is gradually lowered and until the fork-supported bundle comes to rest and is supported in the rack which previously was empty. See the illustration in FIG. 5.

Further, the above procedure—all accomplished without removal of any bundle from the rack unit—can be successively practiced to correspondingly lower all the bundles, in the stack, above the rack which is empty; the uppermost rack then being the empty one and into which a new bundle 4 may be introduced by the lifting device.

After any such re-positioning of a bundle, the forks 24 are returned to their lengthwise out-of-the-way position so that the lifting device can then be raised in or withdrawn from the rack unit as desired.

In order to prevent possible damage to the rack arms 11, the hinges 12 are—as shown—of a pin and upwardly-slidable sleeve type which permits of limited upward movement of said rack arms 11, from a normal position, should any of such arms be accidentally engaged from below either by a fork-supported bundle 4 or by the forks 24 when the lifting device is in use repositioning a bundle in a stack 5 of racks 3. Each push-pull assembly 15 has sufficient loose play to permit of such limited upward movement of the rack arms 11.

The purpose of hinging, and operating, the rack arms 11 so that all but the foremost ones swing rearwardly to their lengthwise-from-transverse position (on the rests 13 and in stop relation against related posts 8) is to prevent accidental forward swinging of said rack arms and resultant dropping of the supported bundle 4 upon a friction drag being imposed upon such arms by pulling one or more of the steel bars out of the rack unit from the bottom of the bundle.

With respect to the lifting device 2, the purpose of hinging, and operating, the forks 24 so that the foremost and central ones swing rearwardly while the rearmost one swings forwardly from their lateral-to-lengthwise position is not only for compactness but also to permit of unobstructed entry of the legs 22 between the posts 8 when the lifting device is lowered into the rack unit with said forks in such lengthwise position.

Further, the lifting device 2 is constructed and the hook C positioned so that the legs 22 remain vertical and the forks 24 horizontal regardless of whether such lifting device is empty or loaded.

From the foregoing description, it will be readily seen that there has been produced such a rack unit and lifting device as substantially fulfills the objects of the invention, as set forth herein.

While this specification sets forth in detail the present and preferred construction of the rack unit and lifting device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention as defined by the appended claims.

I claim:

1. In combination, a steel bar storage rack unit and a cooperating transitionally suspended lifting device for such bars; the rack unit, which embodies a plurality of longitudinal pigeon-hole racks in a stack, including a pair of upstanding transversely spaced longitudinal structures which define the sides of the racks, a plurality of rack arms normally extending transversely between said structures and defining the steel-bar supporting bottoms of the racks, means mounting the rack arms on one structure for movement between said transverse position and a lengthwise out-of-the-way position clear of the space between said structures, and means to so move the rack arms corresponding to each rack; the lifting device including a longitudinal frame

adapted to be suspended from an overhead traveling-type crane, the frame having a plurality of depending legs spaced apart lengthwise of the frame, forks corresponding to the legs, means mounting the forks on the lower ends of the legs for movement between a lateral steel-bar carrying position and a lengthwise out-of-the-way position, and means to so move the forks; the other structure being formed to receive the legs and forks therein, with the forks in either said lateral position or lengthwise position and movable to the other position without obstruction, upon lowering of the lifting device from a selected point above the rack unit; the forks in said lateral position, and when the legs are in said one structure, extending into the space between said structures.

2. A combination, as in claim 1, in which said one structure is a longitudinal row of spaced posts; the mounting means for the rack arms being hinges secured to the posts of said row.

3. A combination, as in claim 2, in which the hinges are disposed so that the rack arms, when in lengthwise position, lie within the longitudinal vertical plane of said row of posts.

4. A combination, as in claim 2, in which said other structure includes rests upon which the hingedly-mounted rack arms bear at their free ends when in said transverse position.

5. A combination, as in claim 1, in which said means to move the rack arms corresponding to each rack comprises a push-pull rod assembly extending longitudinally of said one structure, a pivotal connection between the adjacent end of the push-pull rod assembly and an outermost one of said rack arms intermediate the ends of the latter, and lever connections between the push-pull rod assembly and the other of said rack arms whereby upon manual movement of said outermost rack arm between transverse position and lengthwise position, such other of the rack arms are simultaneously moved between corresponding positions.

6. A combination, as in claim 5, in which the lever connections are directed so that when said outermost rack arm is moved in one direction, between transverse position and lengthwise position, said other rack arms are moved between corresponding positions but in the opposite direction.

7. A combination, as in claim 6, in which said outermost rack arm is mounted for outward swinging motion between said transverse position and lengthwise position.

8. A combination, as in claim 1, in which said other structure is a row of spaced, free-standing posts having unobstructed space therebetween; the legs and the forks thereon being received between such posts upon said lowering of the lifting device.

9. A combination, as in claim 1, in which said means mounting the forks on the legs comprises vertical shafts journaled on the legs, the forks being secured to the lower ends of such shafts; and said means to move the forks including, with such shafts, a vertical operating shaft journaled in connection with the frame adjacent one end thereof, a push-pull rod assembly extending lengthwise of the frame, a lever connection between the rod assembly and the operating shaft, and other lever connections between the rod assembly and the leg-mounted shafts; such lever connections being directed so that upon rotation of the operating shaft in one direction, the leg-mounted shafts are moved between lateral position and lengthwise position.

10. A combination, as in claim 1, in which said one structure is a longitudinal row of upstanding posts; the means to move the rack arms of each rack including a push-pull rod assembly extending lengthwise of such row of posts; the latter being ported in longitudinal alinement, and the push-pull rod assembly passing through such alined ports.

11. A combination, as in claim 10, in which said means to move the rack arms includes lever connections between the hinged ends thereof and said push-pull rod assembly.

12. In combination, a steel bar storage rack unit and a cooperating transitionally suspended lifting device for such bars; the rack unit, which embodies a plurality of longitudinal pigeon-hole racks in a stack, including a pair of upstanding transversely spaced longitudinal structures which define the sides of the racks, a plurality of rack arms normally extending transversely between said structures and defining the steel-bar supporting bottoms of the racks, means mounting the rack arms on one structure for movement between said transverse position and a lengthwise out-of-the-way position clear of the space between said structures, and means to so move the rack arms corresponding to each rack; the lifting device being adapted to be suspended from an overhead, traveling-type crane and including a frame, longitudinally spaced forks on the frame, the forks being movable between a lateral steel-bar carrying position and a lengthwise out-of-the-way position, and means to so move the forks; the other structure being formed for the reception therein of the forks and a related portion of the frame, with the forks in either said lateral position or lengthwise position and movable to the other position without obstruction, upon lowering of the lifting device from a selected point above the rack unit; the forks in said lateral position, and when said portion of the frame is in said one structure, extending into the space between said structures.

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