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2,742,316

CLAMPS WITH CAMBERED GRAB ARMS

Filed Dec. 29, 1952

2 Sheets-Sheet 1

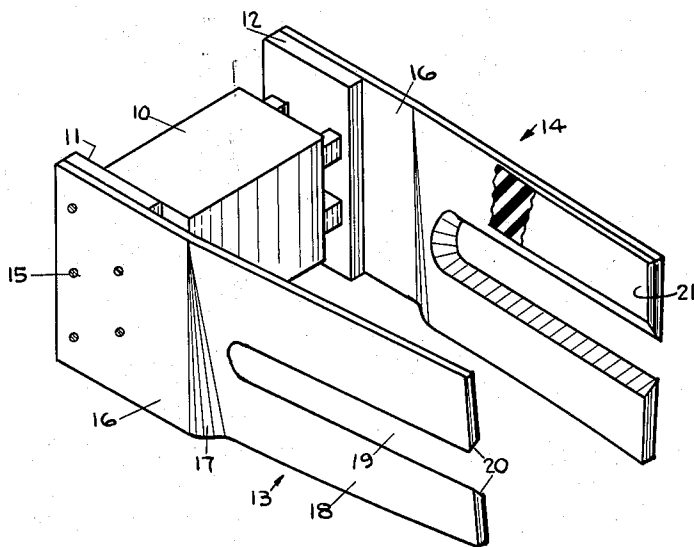


Fig. 1

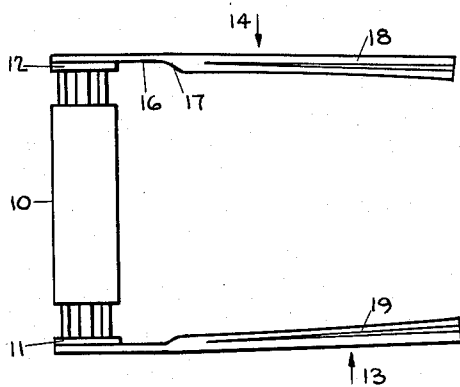


Fig. 2

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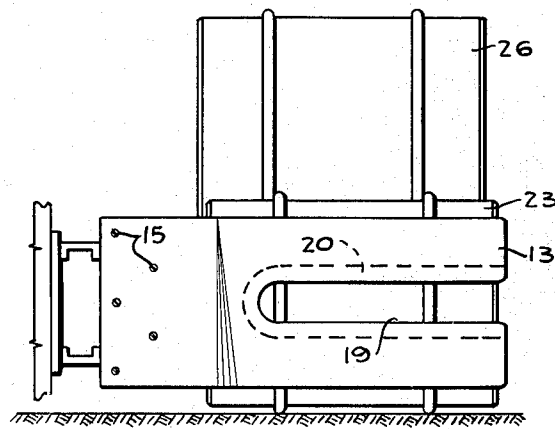


Fig. 3

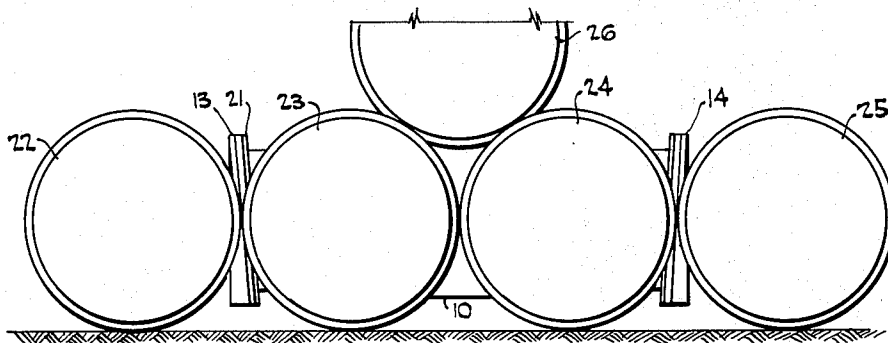


Fig. 4

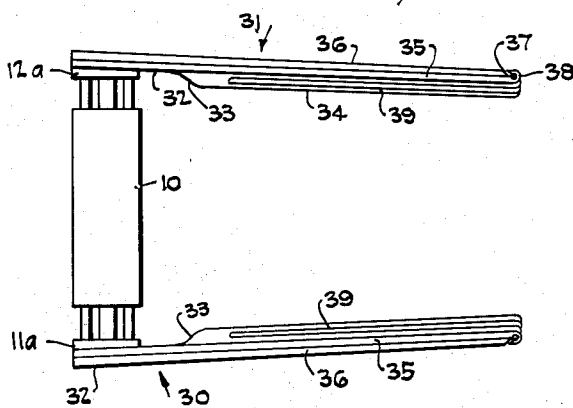


Fig. 5

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2,742,316

CLAMPS WITH CAMBERED GRAB ARMS

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Application December 29, 1952, Serial No. 328,303

5 Claims. (Cl. 294—99)

This invention relates to clamps having a pair of grab arms that extend forwardly in spaced relation from a pair of supporting, relatively movable brackets such as are used, for example, in industrial lift trucks having side-shifting clamps. More particularly, the invention relates to clamps having pre-set arms adapted for handling cylindrical drums and the like with the drum axis parallel to the longitudinal directions of the arms; however, such clamps may also be used to clamp objects of other outlines or in other positions, e.g., boxes with flat faces or drums with their axes vertical or transverse to the arms.

For convenience, the invention will be described with reference to specific embodiments applicable to an industrial lift truck having side-shifting clamp brackets and grab arms that extend substantially horizontally forwardly from the clamp brackets and have generally vertical, opposed article-engaging faces. The choice of such an embodiment is however, arbitrary and it should be understood that the improved grab arms and clamp may be used in other positions or inclinations and need not be used on side-shifting clamps. It is, therefore, evident that such expressions as "horizontal" and "vertical" are used in the description and claims to indicate relative dispositions of parts of the clamp shown on the appended drawing and are not restrictive of the directions of the parts of the clamp in actual use.

It is an object of this invention to provide a clamp and grab arms suitable for use in clamps wherein at least the front parts of the clamps have camber, i.e., are downwardly convergent, for engaging and sustaining cylindrical objects such as drums with the drum axes parallel to the lengths of the arms. Ancillary thereto, it is an object to provide a clamp adapted to clamping a plurality of such drums in side-by-side relation.

A further object is to provide a clamp wherein the arms are flexible and converged both downwardly and toward the front, whereby the clamp is adapted also to engaging parallel faces of objects such as boxes, etc.

Still a further object is to provide a clamp of the type indicated having improved grab arms provided with camber and adapted to sustain one drum or a plurality of drums side-by-side, wherein the arms are made sufficiently thin to enter close places.

In summary, according to the instant invention, the grab arm is made of one or more metal plates that are supported at their rear ends to laterally movable clamp brackets and extend forwardly therefrom in generally vertical and parallel relation, at least the front parts thereof having a small camber such that the intersections of the arms with a transverse vertical plane converge toward the bottom. At least one arm advantageously has a longitudinal slot, open to the front, and extending back for a major portion of the length of the cambered part for receiving the laterally protruding parts of objects to be clamped, a slot being preferably provided in each arm.

According to a further feature of the invention the arm has a substantially flat, flexible rear portion that is

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mounted vertically on the clamp bracket and the forward part is inclined to the vertical, i.e., it lies in a plane inclined with respect to the rear part about the longitudinal axis of the arm; this shape of the arm may also be described by stating that the plate has a twist- or helix-like buckle between the rear and forward parts. Moreover, it is preferred to have at least the forward part of the arm converged toward the opposite arm. This convergence may extend all the way to the rear of the arm; however, the rear part of the arm may be substantially parallel to the opposite arm and only the front, cambered part may be converged forwardly toward the other arm. It is evident that it is strictly only necessary that one of the arms be given such a construction, and the other arm may be flat and vertical throughout; however, in the preferred embodiment to be described the clamp is symmetrical about the vertical longitudinal central plane.

The invention will be described in detail with reference to the accompanying drawing forming a part of this specification and illustrating two preferred embodiments wherein:

Figure 1 is an isometric view of a clamp according to the invention;

Figure 2 is a plan view of the clamp;

Figure 3 is a side elevation of the clamp used to clamp a plurality of drums;

Figure 4 is a front view of the clamp according to Figure 3; and

Figure 5 is a plan view of a modified construction.

Referring to the drawings in detail, 10 is a supporting bracket forming a housing for the laterally slidable clamp brackets 11 and 12 and adapted to be mounted on an elevator of an industrial lift truck, etc., e.g., as shown in my copending patent applications, Serial No. 328,301 and Serial No. 328,302, both filed concurrently herewith. As more particularly shown in both of the said applications, the slidable clamp brackets are in slidable engagement with the bracket 10 so as to resist relative angular motion between the parts, such as outward rotation of the forward parts of the slidable brackets due to engagement of the clamp with a load or downward rotation of the forward parts due to the weight of the load. The bracket 10 further contains suitable clamp-actuating motors of any desired type for translating the brackets laterally; such motors may, for example, include double-acting hydraulic cylinder-piston assemblies, not shown. The specific construction of the clamp brackets and their mounting on the industrial truck or elevator, as well as the actuating motor and control elements therefor are all known and form no part of the invention; further description thereof is therefore, unnecessary herein.

Each clamp bracket carries a grab arm 13 or 14, rigidly secured to the lateral ends thereof, e.g., by screws 15. Each grab arm is made of a single resilient metal plate that has a flat, vertical rear part 16. The rear part is advantageously perpendicular to a transverse line joining the two arms, i.e., the rear parts 16 of the two arms are parallel. Each arm further has a helix-like buckle or twist 17 intermediate the rear part 16 and the front part 18, which is thereby inclined to the vertical, i.e., inclined with respect to the plane of the rear part about a longitudinal axis of the arm. As a result of this inclination the front parts of the arms have a camber, i.e., the intersections of the arms with a transverse vertical plane are downwardly convergent. This camber at the front is best seen in Figure 4 and is typically between about 1° and 6° (e.g., each arm is inclined to the vertical by half of these angles) particularly when the clamp is intended for clamping objects with flat ends or drums standing on end; when the clamp is intended only for use in the manner indicated in Figures 2—4, a somewhat greater camber

may be employed. The camber advantageously increases toward the front from the buckle 17, as shown, whereby the arms are progressively twisted and are helicoidal surfaces. By thus increasing the camber toward the front the stress on the arms near the clamp brackets when lifting a load is greatly reduced. Moreover, at least the front parts of the arms are made laterally convergent toward the front. In the embodiment illustrated, wherein the upper edges of the arms are substantially straight, lateral convergence begins at the buckle 17 and is uniform at the top, typically between 1° and 6°; the convergence of the lower edges increases toward the front. However, the convergence of the top edges may be increased toward the front. The buckle 17 may in some cases be very slight or be omitted, particularly when a strong twist is employed.

Each arm has a horizontal slot 19, open to the front, and extending back from the front of the arm a distance in accordance with the intended use, normally at least a major portion of the length of the front part of the arm, e. g., for three-quarters of the length as shown. This slot serves the dual purpose of (1) facilitating insertion of the grab arm into a gap between a wall and a stack of drums or between two stacks of drums that have no clearance between rolling hoops, both when the drums are standing on end or with their axes horizontal, and (2) providing added security in supporting the load in that the rolling hoops or convexly curved parts or other protuberances on the clamped object can project outwardly into the slot to receive vertical support. The vertical height of the slot should not be made greater than necessary to achieve these purposes because the grab arm is made as thin as possible to afford flexibility thereto and to facilitate entry into close clearances and the parts of the arms above and below the slot should be sufficient to permit the arms to perform their clamping and load-sustaining function without buckling or permanent deformation. In general, it is preferred that, at about the midpoint of the slot, the height of the slot be only a minor part of the height of the arm, advantageously not greater than the height of the part of the arm above the slot or the part below the slot. The edges of the slot 19 are advantageously beveled on the sides toward the opposite arm, as indicated at 20, to conform approximately to the outline of a drum or keg, thereby better adapting the clamp to picking up such objects when their axis is parallel to the longitudinal axis of the clamp without damage to the objects.

The grab arms may, if desired, be covered with a suitable material 21 having a high coefficient of friction, such as rubber facing, expanded metal, mesh, or a combination of these or similar materials. This facing is partly broken away in Figure 1 and omitted from Figure 2 for clarity.

The clamp may be used, for example, as shown in Figures 3 and 4, wherein 22-25 are four touching drums resting on the ground and 26 is a drum resting on drums 23 and 24. To pick up the center three drums the clamp is positioned opposite the ends of the drums with the grab arms opposite the appropriate intervals, and at a height to bring the slot 19 to the level of the points of contact between the drums 22 and 23, and between the drums 24 and 25. The clamp is then inserted forwardly into the gaps between the drums above and below the points of contact. When the clamp is closed the drums 23 and 24 are clamped together, the forward ends of the arms becoming flexed outwardly until they both approach or attain shapes that are perpendicular to a transverse vertical plane, i. e., they lose their convergence. They may also lose some or most of their camber. The rolling hoops project outward through the slots 19, into engagement with the bevels 20. These slots and the camber jointly contribute to the stability of the clamping action.

When the arms are clamped to the load as described above the lateral bending moment is greatest at the rear parts 16 of the arms. Since these parts are vertical, they are well adapted to flex outwardly, and only a minor amount of lateral flexure occurs in the front parts 18. While this construction is particularly preferred, it should be noted that it is also possible to continue the camber all the way to the rear, as shown in the above-mentioned compending applications.

The arms can also engage the parallel, flat ends of objects such as boxes; in this case the front parts of the arms are flexed laterally outwardly and also torsionally so as to reduce the camber. The helicoidal shape of the arms becomes less pronounced or is eliminated.

The details of the construction may be modified and certain changes are shown in Figure 5, it being understood that they may be applied severally or in combination to the prior embodiment. Each of the arms 30 and 31 is similarly provided with a vertical rear part 32, a buckle 33 and a flat front cambered part 34. However, in this embodiment the buckle 33 does not provide for a change in the lateral convergence of the arms, but the arms converge laterally continuously from the rear to the front, the brackets 11a and 12a having their outer faces convergent toward the front. Further, the arms are of laminar construction, each arm comprising a plurality of plates, such as an inner plate 35 and an outer plate 36, shaped to lie in engagement with one another throughout their lengths, thereby affording greater flexibility to the arms. The rear ends of these arms are fixed together and to the bracket 11a or 12a by suitable means, such as the screws 15 shown in Figure 3, and the front parts of the several plates are free to slide relatively to each other longitudinally as the arms are flexed laterally. The arms are helicoidal only at the buckles 33 and the parts to the front thereof may be flat, as shown, to facilitate manufacture and relative sliding between the laminations, but may be twisted progressively throughout the front parts as described for the first embodiment. The front parts of the plates of the same arm may be secured against separation by any suitable means, e. g., by providing a vertical bevel along the front edge of the outer plate 36, as shown at 37, and by both beveling and bending the front edge of the inner plate 35 over the bevel 37, as shown at 38. This secures the plates while permitting relative longitudinal movement. According to a further feature, the lateral flexibility of the arms is increased toward the front by reducing the cross sectional area of the arm toward the front and thereby reducing the moment of inertia of the cross section of the arm about a substantially vertical axis lying in the arm. This is effected by tapering the outer plates 36 toward the front, as shown. These arms are provided with longitudinal slots 39 which may be shaped and beveled as described above for the slots 19, and covered with a suitable material having a high coefficient of friction, such as the material 21, not shown in Figure 5. It may be further noted that although the plates are shown to be relatively slidable, they may be secured together at a plurality of points and pre-stressed in the manner described in the aforesaid compending application, Serial No. 328,301.

I claim as my invention:

1. A clamp for use with lift trucks comprising a support structure, a pair of clamp brackets mounted on said support structure for relative lateral translatable motion, means for translating said brackets relatively to each other and a laterally flexible plate shaped grab arm extending forwardly from each bracket and fixed thereto for transmitting lateral and vertical cantilever stresses, said grab arms having substantially vertical rear parts and the front parts thereof being inclined slightly with respect to the vertical so that the front parts of the arms converge towards each other at the bottom.

2. A clamp according to claim 1 wherein each of said

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arms has a longitudinal slot open to the front extending back through a major portion of the length of said front part for receiving laterally protruding parts of objects to be clamped.

3. A clamp for use with lift trucks comprising a support structure, a pair of clamp brackets mounted for relative lateral translatable motion, means for translating said brackets relatively to each other and a laterally flexible plate shaped grab arm extending forwardly from each bracket and fixed thereto for transmitting lateral and vertical cantilever stresses, said grab arms having substantially vertical rear parts and the front parts thereof being inclined slightly with respect to the vertical so that the front part of the arms converge toward the bottom and said front parts being further converged laterally toward the front.

4. A clamp comprising a support structure, a pair of clamp brackets mounted on said support structure for relative lateral translatable motion, means for translating said brackets relatively to each other and a laterally flexible plate shaped grab arm extending forwardly from each bracket and fixed thereto for transmitting lateral and vertical cantilever stresses, said grab arms having substantially vertical rear parts and the front parts thereof being inclined slightly with respect to the vertical so that the front parts of the arms converge toward the bottom and said front parts being further converged laterally toward the front, each of said arms having a longitudinal slot, open to the front, extending back through a major

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portion of the length of said front part for receiving laterally protruding parts of objects to be clamped.

5. A clamp comprising a support structure, a pair of clamp brackets mounted on said support structure for relative lateral translatable motion, means for translating said brackets relatively to each other and a laterally flexible grab arm extending forwardly from each bracket and fixed thereto for transmitting lateral and vertical cantilever stresses, said grab arms having substantially parallel and vertical rear parts and the front parts thereof being substantially helicoidal in opposite directions so as to be converged toward the bottom, the convergence increasing progressively toward the front, the front ends of the arms converging toward the bottom at an angle between about 1° and 6° , said front parts of the arms being further converged laterally toward the front, each of said arms having a longitudinal slot, open to the front, extending back through a major portion of the length of said front part for receiving laterally protruding parts of objects to be clamped.

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