The present invention relates to improvements in lifting clamps and more particularly to an improved lifting clamp especially adapted for lifting and handling heavy steel members of the type of I and H beams, or steel members having a surface between spaced longitudinally-extending edge flanges, the latter of which are adapted to be engaged by grab means carried by the clamp.

Lifting clamps are known which includes a body connected to a lifting shackle by means of a linkage parallelogram, opposite sides of which carry grab hooks for engaging the flanges of an I beam, for example.

In the operation of clamps of this type, the grab hooks are not sufficiently free but are actuated by a lever so that on occasions difficulties are encountered in attaching the clamp to the flanges of the beam. Furthermore, when lifting begins, the body is forced onto the surface of the beam in such a manner and position that slippage of the clamp is likely if the beam should tilt to a substantially upright position. Other disadvantages are also encountered with known clamps specifically designed for handling beams of the type of I and H beams.

The primary object, therefore, of the present invention is to provide a clamp construction of the type referred to which will avoid the difficulties encountered with known types of clamps used for lifting I and H beams.

The improved clamp according to the present invention for lifting heavy metal members of the type of I and H beams and the like having a surface between spaced longitudinally-extending edge flanges, in general, includes a frame, a pair of grab means adapted to respectively engage the edge flanges of a heavy steel member to be lifted when the clamp is moved to a position adjacent the surface between the flanges. The improved clamp also includes a lifting shackle interconnected with the frame by means of a leverage mechanism described more in detail hereinafter, a lifting connection between the lifting shackle and the grab means, and, importantly, means included in said leverage mechanism for applying pressure to the surface of the member to be lifted when a lifting force is applied through the lifting shackle to the leverage mechanism, the frame, the grab means and the member to be lifted.

In the preferred construction the pressure-applying means comprises a pair of gripping members located respectively at the ends of the frame and actuated by the leverage mechanism so that in cooperation with the grab means the member to be lifted is gripped firmly and cannot slip out of the clamp regardless of the angular position of the member. The clamp preferably includes means permitting automatic application of the clamp to the member to be lifted, and other features described in more detail in connection with a preferred embodiment of the clamp illustrated in the accompanying drawings.

In the drawings:

FIG. 1 is an elevational view from one side of the clamp according to the invention showing the clamp with the leverage arms and the projecting parts of the frame in assembled position, and showing the clamp with the grab hooks in an engaging position of the flanges of an I beam to be lifted by the clamp, but with the leverage mechanism in a locked open position just prior to automatic releasing of lever arms for engagement on top of the I beam;

FIG. 2 is an elevational view similar to that of FIG. 1, showing the clamp in lifting position with respect to the I beam;

FIG. 3 is a sectional view taken on the line 3-3 of FIG. 2 with parts broken away;

FIG. 4 is a view looking down on the clamp as shown in FIGS. 2 and 3.

FIG. 5 is a detail sectional view of a portion of one of the grab hooks taken on the line 5-5 of FIG. 3. In general, the improved clamp comprises a channel-shaped steel frame 10 having side walls 12 and a bottom wall 14 joining the side walls 12. The sides of each carry a grab hook 16 while a lifting shackle 18 is attached to a leverage mechanism 20 which is partly mounted between the side walls 12 of the frame 10 and attached thereto by a transverse steel pin or bolt 21 extending through the side walls 12. The leverage mechanism includes levers 22, 22' located opposite the respective ends of the frame, shown best in FIGS. 1 and 2, each including a downwardly projecting arm 24, 24' carrying a shoo 26, 26' for engaging and applying pressure to the surface 28 of a member to be lifted such as the upper surface of an I-beam 30 shown in the drawings.

Each of the pair of grab hooks 16 includes similar spaced steel hook-shaped members 32 welded to an intervening spacer web 34. The upper ends of the side members 32 are each pivotally mounted between flanges 36 welded to the side walls 12 of the frame 10 so that the hooks 16 hang freely from the frame. The four flanges 36 on each side of the frame are bridged by a plate 37 welded to each and to the body or frame 10 so that the structure is braced and the up-swing of the hook 16 is limited. However, the outer lower parts of the hooks 16 are provided with rollers 38 adapted to engage the surface of the beam to be lifted so that the hooks 16 roll outwardly as the clamp is lowered and finally move off the surface of the opposite sides of the beam. The rollers are located at the base of the hooks per se which extend inwardly as shown and each includes a pair of spaced toothed pads 40 as shown in FIGS. 3 and 5, carried by a replaceable bridge member 42 riveted to web 34.

The pads 40 of each pair rest on the upper edges of the members 32, face upwardly and engage the underside of the flanges of the beam 30 as shown in FIGS. 3 and 5. The teeth which project from the surfaces of the pads imbed into the steel beam and prevent slippage when the beam is gripped by the clamp and lifted. The roller units as seen in FIGS. 1 to 5 each includes two hardened steel rollers 38 on a bolt 44, spaced from the members 32 by washers and from each other by a spacer tube 46.

The leverage mechanism 20 for applying the lifting force of the lifting shackle 18 to the upper surface of the beam 30 by the shoo 26, 26' at points spaced from the respective ends of the frame 10 includes the levers 22, 22' and their projecting legs 24, 24' opposite the ends of the frame, and four levers which are of lattice construction, two of which are connected at spaced points to each of the levers 22, 22'. The four levers comprise two similar upper levers 48, 48' and two similar lower levers 50, 51' each comprising two similar spaced steel plate members (FIGS. 3 and 4) having the contours shown in FIGS. 1 and 2. The levers 50, 51' are fulcrumed on the fixed pin or bolt 21 extending through the side walls 12 of the frame with their steel plates alternating and their longer legs extending outwardly in opposite open ends of the frame. The upper levers 48, 48' are fulcrumed respectively to the ends of the short legs of the levers 50, 51' on pins 52 with their longer legs extending outwardly in opposite directions. The ends of the short legs of both of the levers 48, 48' are connected together by a bolt 54 to which the lifting shackle 18 is connected. The levers 22, 22' are respectively fulcrumed on pivot pins 56 at the projecting ends of the longer legs of the
levers 50, 59', while the ends of the shorter legs of the levers 22, 22' are respectively connected to the adjacent ends of the longer legs of the levers 48, 48' by pivot pins 58.

The two sides of the leverage mechanism are comprised of similar levers and reference will be made to the planes defining the levers 22, 22' 48, 48' and 50, 59, as shown in FIGS. 3 and 4. The lever 22, 22' and a pair of spaced similar plates 23, 23', the lever 48 comprises two similar spaced plates 49, 49' while the lever 50 comprises a pair of spaced similar plates 51, 51'. The lever 22' comprises a pair of spaced similar plates 25, 25', the lever 48' comprises two similar spaced plates 53, 53', while the lever 50' comprises a pair of spaced similar plates 55, 55'. The side plates of the levers 22, 22' alternate with the plates of the levers 48, 48' on the pins 58 and with the side plates of levers 50, 50' on the pins 56. The pairs of plates 49, 49' and 53, 53' are located respectively above the pairs of plates 51, 51' and 55, 55'.

The six levers of the leverage mechanism 20, three at each end of the frame, comprise six short legs including the upper legs of the levers 22, 22' and four long legs of the levers 48, 48', 50, 50'. As shown in FIG. 3, the plates 49, 49' of the lever 48 alternate with the corresponding plates 53, 53' of the lever 48' on the pin 54. In a similar manner, the plates 51, 51' of the lever 50 alternate with the corresponding plates 55, 55' of the lever 50' on the bolt 21 as shown in FIG. 3. The arrangement is such that the plates of the lever 48' are located respectively directly above the plates of the lever 50'.

The clamp is provided with means for holding the leverage mechanism 20 in retracted position, as shown in FIG. 1, with the bottoms of the shoes 26, 26' above the bottom of the frame 10, and with a trigger release so that the clamp can be applied to a beam automatically by a crane operator. In the illustrated embodiment as shown in FIGS. 1, 2 and 3, the plate 51 of the lever 50 and the adjacent plate 55 of the lever 50' are each provided with a bottom catch 60 which together form a notch below the bolt 21 when the leverage mechanism is in the position shown in FIG. 1. In this position, the catches 60 on adjacent plates 51 and 55 of the levers 50, 50' engage opposite sides of a trigger bar 62 pivoted on a pin 64 and biased toward the bottoms of the plates 51 and 55 by a spring 66. A trigger release pin 68 is mounted for reciprocation in the bottom wall 14 of the frame 10 and is retained therein in operative position by a pin 70.

When the clamp is to be applied to a beam, such as the I-beam 30, the leverage mechanism 20 is in the retracted position shown in FIG. 1, and the grab hooks 16 hang down freely from the sides of the clamp with the facing parts 42 in engagement with each other. As the clamp is lowered toward the upper surface of the beam, the rollers 38 of the grab hooks 16 engage the surface of the I-beam, roll apart and direct the hooks outwardly so that they eventually drop over the opposite flanges of the beam. This would be the position shown in FIG. 1, which is just prior to the release of the leverage mechanism, which is accomplished after the release pin 68 engages the surface 28 as the clamp moves downwardly so that the trigger bar 62 is disengaged from the catches 60. As soon as this happens, the shoes 26, 26' drop onto the surface 28 of the beam 30.

When the shoes 26, 26' drop onto the surface of the plate 30, the operator knows that the leverage mechanism has been released and he, therefore, applies a lifting force, for example by means of a crane, cable and hook attachment to the lifting shackle 18 thereby actuating the leverage mechanism and the shoes 26, 26' to the positions shown in FIG. 2. Since the leverage mechanism 20 is connected to the frame 10 by the bolt 21, the frame is lifted away from the I-beam 30, the grab hooks 16 are pulled up so that the gripping pads 40 engage under the flanges of the I-beam 30 as shown in FIG. 3, and the shoes 26, 26' are forced downwardly against the surface 28 of the beam 30.

It will be noted that the entire lifting force, sufficient to lift the I-beam, is applied through the lifting shackle to the levers 48, 48' fulcrumed respectively to the short legs of the levers 22, 22' and 50, 50' in turn fulcrumed on the bolt 21. A down force is, therefore, applied to the shoe 26 through the lever 22 by the long legs of the levers 48 and 50. A similar force is applied to the shoe 26' through the lever 22' by the long legs of the levers 48' and 50'.

As a result of the foregoing, an enormous gripping pressure is applied to opposite sides of the upper part of the I-beam which may exceed the weight of the beam itself. It will be apparent that the grab hooks 16 not only carry the weight of the beam but also the additional pressure or weight applied by the shoes 26 and 26'. Furthermore, the gripping effect of the clamp is distributed to four widely spaced points, two by the grab hooks 16 and two by the shoes 26, 26'. The wide spacing of the four points prevents the rocking of the clamp on the beam even if the beam should be lifted from an off-center point, and the clamp would swing to a substantially vertical position when lifted.

The heavy beam 30, as shown in FIG. 3, for example, is nearly as wide, and the top portion is nearly as thick as the particular sized clamp illustrated will take. It is apparent that when the particular clamp is applied to beams with narrower tops or thinner webs, the frame of the clamp will move to a higher position with respect to the beam when a lifting force is applied to the lifting shackle. At the same time the shoes 26, 26' will engage the beam at points farther from the frame than those shown in FIG. 2, because of the angular shape of the levers 22, 22' and the fact that as the pins 52 are moved upwardly and inwardly as the levers 22, 22' are rocked on the fulcrum pins 56. The shoes 26, 26' have arcuate-shaped bottoms so that they engage the surface of any sized beam with a firm engagement concentrated in a relatively small area. The curved bottoms of the shoes 26 and 26' provide a firm engagement at any angle which can be assumed by the legs 24, 24' and they may be toothed like the pads 40.

All six levers of the system 20 are wide angle bell crank levers, and the longer legs of the levers 48, 48'; 50, 50' are shaped to fit together in the manner shown in FIG. 1 when the leverage mechanism is retracted and locked to that position by the bar 62. The wide angle bell crank shape of the levers 48, 48'; 50, 50' provides a compact arrangement for the intercoupling of the short legs of these levers and the fulcrumming of the levers in a compact arrangement. The levers 22, 22' are shaped and fulcrumed on the pin 56 so that as the leverage mechanism 20 is expanded the shoes 26, 26' swing outwardly relative to the frame 10, and thereby the upper pad 26 which has the greater gripping pressure would move in opposition to the lifting of the beam.

The lifting force applied to the lifting shackle 18 in lifting a beam is transmitted through the leverage mechanism to the bolt 21 and the frame 10 to the grab hooks 16 which are advantageously pivoted to the respective sides 12 of the frame at the level of the bolt 21 as shown, for example, in FIGS. 1 and 2. This provides an almost direct line of pull on the opposite sides of the frame at the position of the bolt, which is fastened tightly to the frame by means of nuts. It is understood that the frame may be constructed in other ways if the grab hooks are pivoted to a substantially rigid structure adjacent to bolt 21, so that the grab hooks 16 are brought into operative position directly opposite each other.

When a beam such as the beam 30 has been lifted and let down in the desired position, a logical way to release the clamp is to lift up both grab hooks 16 and turn the
entire clamp through an angle of about 90° allowing the grab hook 16 to rest on top of the beam. In this position of the clamp, the shoes 26 are then lifted until they are latched up by the bar 62, following which the crane operator can lift the clamp off the beam and without help grab another beam automatically. A known type of means may be provided so that the crane operator is able to unhook the grab hooks from a remote position.

While the preferred construction of the clamp according to the invention has been illustrated and described in considerable detail, it is to be understood that certain variations in shape and structure may be made without departing from the spirit and scope of the invention as defined by the accompanying claims.

1. A clamp for lifting heavy metal members of the type of I and H beams and the like having a surface between spaced longitudinally-extending edge flanges, said clamp comprising a frame having spaced side members, a pair of grab means adapted to be placed respectively in engagement with said edge flanges of the member to be lifted when the clamp is moved to a position adjacent said surface, a lifting shackle, a leverage mechanism connected between said lifting shackle and frame, a lifting connection between the lifting shackle and grab means, a bolt extending transversely through the member of the frame member, said frame member including a lever fulcrummed on said bolt between said side members, said lever having a leg extending from the frame, means carried on the projecting end of said leg for engaging and applying pressure to said surface of said heavy metal member when a lifting force is applied through the lifting shackle to the leverage mechanism, the frame, the grab means and the member to be lifted, a second lever the end of one leg of which is connected to the shackle and the other leg of which extends from the frame generally parallel to said leg of the first-mentioned lever and connected to said means for engaging and applying pressure to said surface of said heavy metal member.

2. A clamp as claimed in claim 1, in which said means for engaging and applying pressure comprises a lever fulcrummed to the end of the leg of said first-mentioned lever and having a leg extending therefrom and connected to said leg the end of which is connected to the shackle, said lever fulcrummed to the end of the leg of the first-mentioned lever including a leg extending therefrom for engagement with said surface.

3. A clamp as claimed in claim 2, in which each lever comprises a pair of similar spaced steel plates.

4. A clamp for lifting heavy metal members of the type of I and H beams and the like having a surface between spaced longitudinally-extending edge flanges, said clamp comprising a frame having spaced side members, a pair of grab means adapted to be placed respectively in engagement with said edge flanges of the member to be lifted when the clamp is moved to a position adjacent said surface, a lifting shackle, a leverage mechanism connected between said lifting shackle and frame, a lifting connection between the lifting shackle and grab means, said frame member including a lever fulcrummed on said bolt between said side members, said lever having a leg extending from the frame, means carried on the projecting end of said leg for engaging and applying pressure to the surface of the beam member when a lifting force is applied through the lifting shackle to the leverage mechanism, the frame, the grab means and the member to be lifted, second pair of levers respectively fulcrummed to the ends of said first-mentioned levers on their ends opposite said legs and having legs extending from the frame respectively generally parallel to the extending legs of the first-mentioned levers with their respective ends connected to said means for engaging the surface of said beam member, the arrangement being such that each of said second pair of levers is fulcrummed to one of said first-mentioned levers while its extending leg is generally parallel to the other of said first-mentioned levers.

5. A clamp as claimed in claim 4, in which each second lever includes a leg connected to the lifting shackle.

6. A clamp as claimed in claim 4, in which each of said means for engaging the surface of the beam member comprises a gripping lever fulcrummed to the end of the extending leg of each of the first-mentioned levers and includes a leg extending therefrom and connected to the end of the extending leg of the adjacent second lever, said gripping lever having a leg with a free end extending from its fulcrum for engaging the surface of the beam member when lifted.

7. A clamp as claimed in claim 6, in which each lever comprises a pair of spaced steel plates, the plates of the pair of first-mentioned levers alternating with each other on the bolt extending through the sides of the frame, and the plates of said second pair of levers alternating with each other on a common pin connected to the shackle.

8. A clamp for lifting heavy metal members of the type of I and H beams and the like having a surface between spaced longitudinally-extending edge flanges, said clamp comprising a frame having spaced side walls, a pair of grab means adapted to be placed respectively in engagement with said edge flanges of the member to be lifted when the clamp is moved to a position adjacent said surface, a lifting shackle, a leverage mechanism connected between said lifting shackle and frame, a lifting connection between the lifting shackle and grab means, means for engaging and applying pressure to said surface of said member to be lifted when a lifting force is applied through the lifting shackle to the leverage mechanism, the frame, the grab means and the member to be lifted, a bolt extending transversely through said side walls, and in which said leverage mechanism includes a first pair of levers fulcrummed on said bolt between said side walls having legs extending laterally in opposite directions from the frame, said levers also including upwardly-extending legs from the position of said bolt, a second pair of levers respectively fulcrummed on the upwardly-extending legs of said first pair of levers, the levers of said second pair including upwardly-extending legs connected together at their ends and to the lifting shackle, said levers of the second pair each including a leg extending from its fulcrum on one of said first pair of levers laterally above the extending leg of the other lever of the first pair and generally parallel thereto, the means for engaging and applying pressure to said surface of the beam member comprising a pair of gripping levers respectively fulcrummed to the ends of the laterally-extending legs of the first pair of levers and including a leg extending from said fulcrum to and connected to the adjacent end of the laterally-extending adjacent leg of the second pair of levers, each gripping lever including a leg extending downwardly from its fulcrum.

9. A clamp as claimed in claim 8, in which the upwardly-extending legs of the first and second pairs of levers are of equal length.

10. A clamp as claimed in claim 8, in which the leverage mechanism is operable from a collapsed position to an expanded position when a lifting force is applied thereto and pressure is applied to the beam to be lifted, means for latching the leverage mechanism in its collapsed position when the clamp is out of engagement with a beam, and means engageable with the beam to be lifted during the application of the clamp thereto for releasing the latch means.

11. A clamp as claimed in claim 10, in which the latch means includes a bar means for preventing pivot-
ing the beam comprises a pin projecting downwardly from the frame.

12. A clamp for lifting heavy metal members of the type of I and H beams and the like having a surface between spaced longitudinally-extending edge flanges, said clamp comprising a frame having spaced side members, a pair of grab means adapted to be placed respectively in engagement with said edge flanges of the member to be lifted when the clamp is moved to a position adjacent said surface, a lifting shackle, a leverage mechanism connected between said lifting shackle and frame, a lifting connection between the lifting shackle and grab means, a bolt extending transversely through the side members of the frame, said leverage mechanism including a lever fulcrumed on said bolt between said side members, said lever having a leg extending from the frame, means carried on the projecting end of said leg for engaging and applying pressure to said surface of said heavy metal member when a lifting force is applied through the lifting shackle to the leverage mechanism, the frame, the grab means and the member to be lifted, said frame comprising a bottom wall integral with said side members, a latch means in the frame and associated with said lever for retaining the lever in a retracted position when the clamp is out of engagement with a beam, and means engageable with the surface of the beam to be lifted as the clamp is moved adjacent thereto for releasing the latch means and the lever.

13. A clamp as claimed in claim 12, in which the latch means includes a catch on the lever and a pivoted bar engageable with the catch.

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