

Sept. 16, 1958

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2,852,300

POSITIVE GRIP LIFTING CLAMP WITH DIRECT HAND LOCK

Filed April 7, 1954

2 Sheets-Sheet 1

FIG. 1

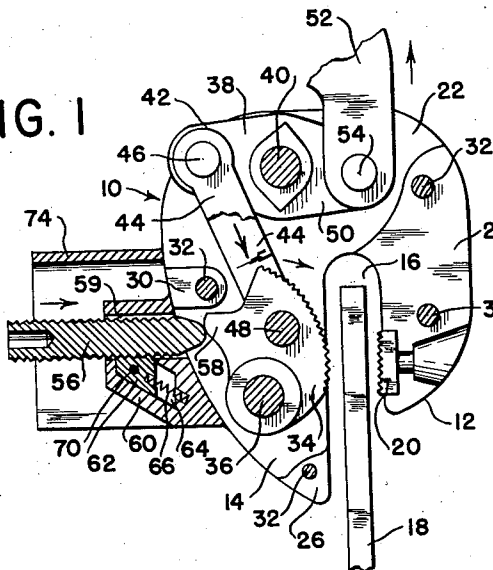


FIG. 4

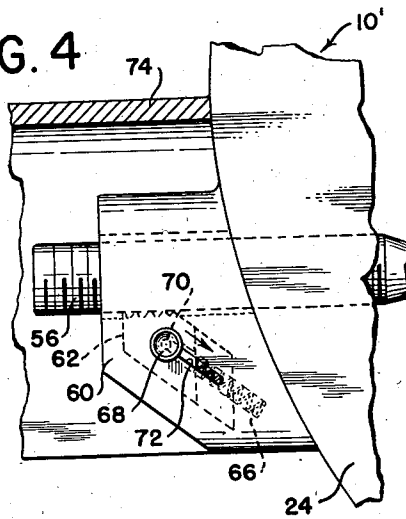


FIG. 3

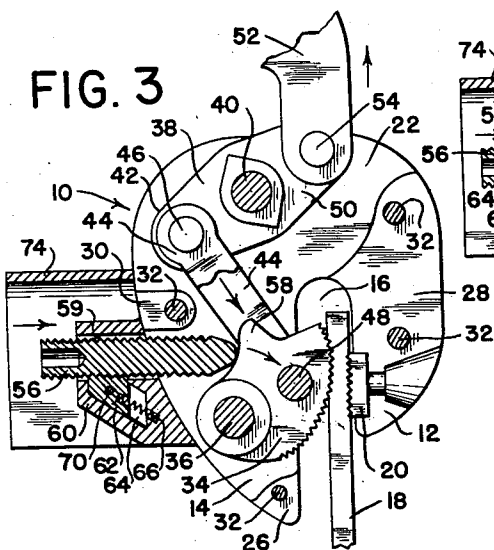
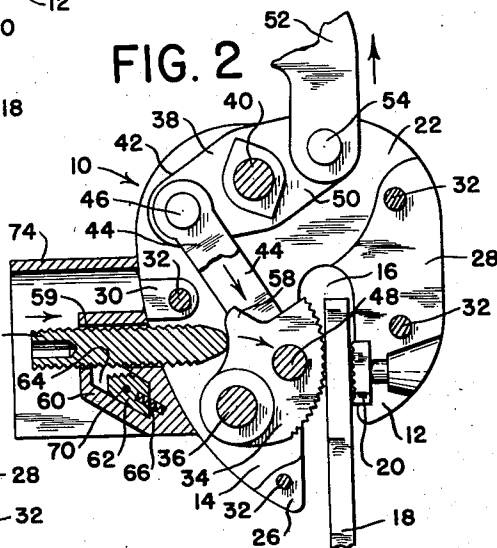


FIG. 2



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2 Sheets-Sheet 2

FIG. 7

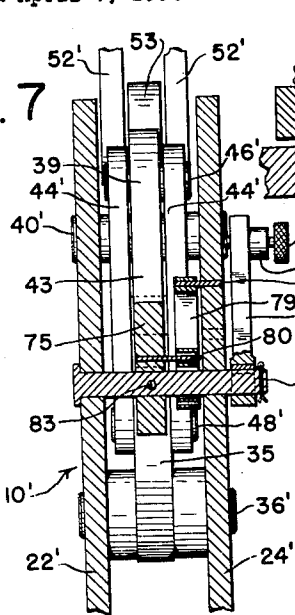


FIG. 9

FIG. 5

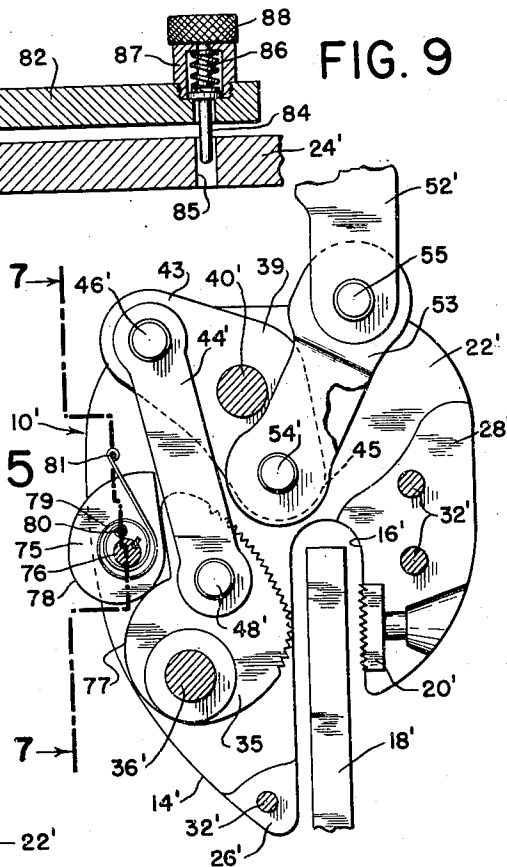


FIG. 6

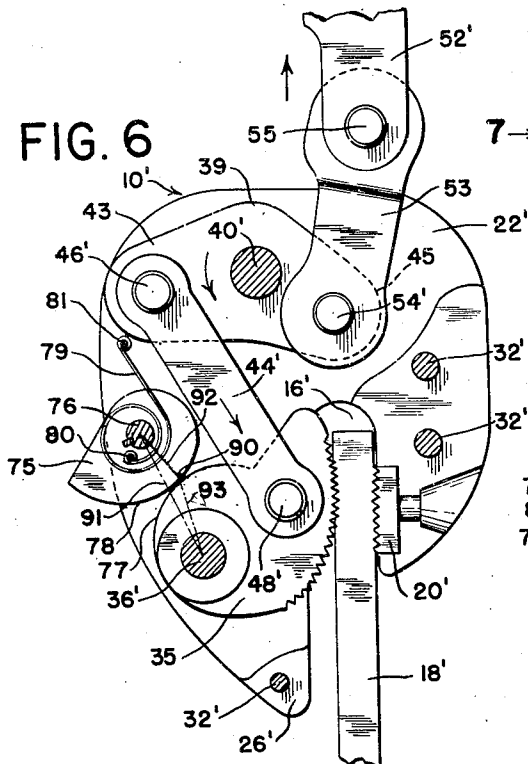
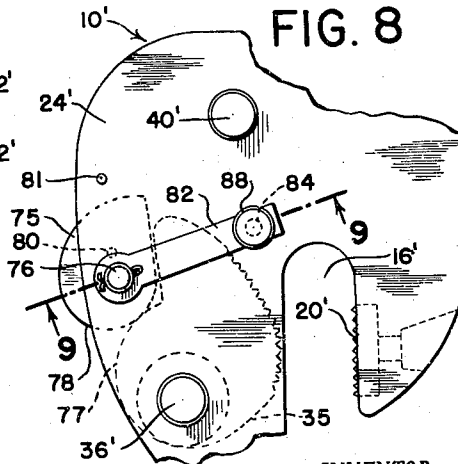


FIG. 8



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POSITIVE GRIP LIFTING CLAMP WITH DIRECT HAND LOCK

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Application April 7, 1954, Serial No. 421,647

7 Claims. (Cl. 294—104)

This invention relates to improvements in lifting clamps of the type used for gripping or lifting steel plates or other heavy articles presenting a relatively thin edge adapted to be received into the clamp, and more particularly to such a clamp having a directly operating hand-operated locking means and adapted to grip and lift hard steel plates.

The lifting clamp of the present invention is an improvement on the lifting clamps disclosed in my Patent No. 2,393,101, granted January 15, 1946, and my pending application Serial No. 278,864, filed March 27, 1952, now Patent No. 2,676,838, granted April 27, 1954.

In my pending application I have disclosed a plate lifting clamp which is adapted to effect a substantially tight grip on ordinary steel plates when the lift or pull is vertical, horizontal or at any angle in between. However, it has been found that when it is necessary to lift hard steel plates, such as heat treated armor plates or alloy or stainless steel plates which have a smooth surface, it is difficult to make the gripping cam of the lifting clamp penetrate the sheet to be lifted sufficiently to get a good grip, especially at the start of the lifting operation. In this connection it has been found that, if the cam teeth do not penetrate the plate somewhat, it is impossible to get the clamp to function, since no load is applied on the lifting shackle of the clamp. Furthermore, it has been found that the penetrating force must be great enough at the start of the lifting operation, and upon a small contacting surface in order to cause the cam teeth to penetrate the plate.

The primary object, therefore, of the present invention is to provide an improved lifting clamp which includes a locking mechanism for positively forcing and holding the cam of the lifting clamp in locking engagement with the plate to be lifted.

A further object of the invention is to provide a lifting clamp for hard steel plates which includes means for forcing the teeth of the gripping cam into the plate to be lifted, thereby avoiding damage and accidents caused by the clamp having slipped off the plate.

According to the invention, the improved lifting clamp includes a structure generally similar to that disclosed in my pending application and provided with hand-operable means acting directly on the gripping cam of the clamp for forcing its teeth into the surface of the plate to be lifted, thereby providing a positive grip.

According to a preferred construction, the improved clamp incorporates a novel locking mechanism in which the back portion of the gripping cam to be clamped is formed with a cam surface having a predetermined pitch or grade to provide one element of the locking mechanism, the other element of the mechanism including a locking cam device having a cam surface adapted to act upon the back cam surface of the gripping cam to force some of the teeth of the gripping cam into the surface of the plate to be lifted. In this construction the cam surfaces of the locking and gripping cams are so shaped relative to each other that a positive lock is applied to the gripping cam which cannot be released by any pres-

sure applied backwardly to the plate gripping cam. According to this preferred construction, the locking or auxiliary cam is provided with a grade or pitch which is about one-half that of the back cam surface of the gripping cam, and the point of tangency and engagement of the cam surfaces is located inside of a straight line between the centers of rotation of the cams.

In a modified form of clamp construction, the means for positively forcing the gripping cam against the plate to be lifted and locking it in that position comprises a special lug on the back portion of the gripping cam and a cooperating readily releasable screw in line with the back of the cam adapted to engage the lug on the gripping cam and force its gripping surface into contact with the plate to be lifted.

The invention includes other objects, features and advantages, which are described more in detail hereinafter in connection with the two embodiments of the lifting clamp, as shown in the accompanying drawings forming a part of this application.

In the drawings:

Fig. 1 is an elevational view partly in section of a lifting clamp in disengaged position embodying the features of the present invention shown with one of the side plates of the clamp removed;

Figs. 2 and 3 are views similar to that of Fig. 1, respectively showing the position of the gripping cam and other parts as they are being moved into locking position, and in locking position, respectively;

Fig. 4 is an enlarged detailed view, partly in section, of the locking screw mechanism comprising a part of the lifting clamp shown in Figs. 1 to 3;

Figs. 5 and 6 are views similar to those of Figs. 1 and 3 illustrating the preferred embodiment of the invention in which a locking or auxiliary cam is used in cooperation with the gripping cam of the lifting clamp, Fig. 5 showing the gripping cam in disengaged position, while Fig. 6 shows the gripping cam in engaged position locked onto a plate to be lifted;

Fig. 7 is a vertical sectional view of the lifting clamp shown in Figs. 5 and 6, taken on the line 7—7 of Fig. 5;

Fig. 8 is a broken side elevational view of the lifting clamp shown in Figs. 5 to 7 showing the position of the hand-operated lever when the cams are in disengaged position; and

Fig. 9 is a broken sectional view taken on the line 9—9 of Fig. 8.

Referring to Figs. 1, 2 and 3 of the drawings, the improved plate lifting clamp shown therein comprises a clamp body 10 having a short leg or jaw 12 and a long leg or jaw 14, spaced and facing each other to provide a slot 16 for receiving a plate 18 to be gripped and lifted by the clamp. The short jaw 12 is provided with a serrated gripping pad 20 extending slightly into the slot 16 and facing the longer leg or jaw 14.

The body 10 of the clamp includes a pair of spaced side plates 22 and 24, which are held in spaced relation by spacing blocks 26, 28 and 30 and riveted together by means of rivets 32. The spacing blocks 26 and 28 may have a thickness equal to the space between the plates or may have a thickness of only half the distance between the plates, the separate halves being integral respectively with the plates 22 and 24, so that they engage each other when the plates are riveted together. The spacer 30 serves as a stop for the gripping cam of the clamp.

The longer jaw 14 includes and houses a gripping cam 34, the lower portion of which is pivoted on a pivot pin 36 located in the lower portion of the jaw 14. The cam 34 includes an enlarged hub portion mounted between the side plates 22 and 24, while the pin 36 is of the cotter pin type held in the body of the clamp by a cotter pin, not shown.

The leverage mechanism for actuating the serrated cam 34 into and away from gripping engagement with the plate 18 includes a radius link 38 mounted between the side plates 22 and 24 in the upper portion of the clamp body and pivoted therein on a pivot pin 40 held in place by a cotter pin, not shown. The outer arm 42 of the radius link is provided with an end portion having the same thickness as the cam 34, this arm being connected to the cam by a pair of connecting links 44, respectively arranged on opposite sides of the arm 42 and gripping cam 34 and being pivoted thereto by pivot pins 46 and 48, respectively, the edges of each of which may be peened over into a counterbore to hold them against axial movement.

The other arm 50 of the radius link 38 is pivoted to the inner end of a forked connecting-lifting shackle 52 by means of a pin 54 held in place in the same way as pin 46. The lifting-connecting shackle 52 may include a lifting ring adapted to receive a hook normally carried by a lifting crane or other lifting apparatus.

Most, if not all, parts of the clamp are of heavy forged steel and the leverage and lifting elements of the clamp are arranged so that they readily fit within the side walls 22 and 24. For example, the cam 34 has a relatively large hub which fits between the plates 22 and 24, while the web of the cam is engaged on opposite sides between links 44, which also engage the opposite sides of the radius link arm 42. The radius link 38 includes a thick hub section integral with its ends which fits between the side plates 22 and 24, while the forked end of the lifting shackle 52 fits between the side plates 22 and 24, as they span the end 50.

According to the modified form of the invention shown in Figs. 1 to 4 of the drawings, the means for positively locking the clamp onto the plate or other object to be lifted comprises a screw 56 to be applied against a projecting lug 58 provided on the back of the cam 34. The lug 58 is the same thickness as the cam proper and is provided with a back contact surface arranged at approximately 90° to the axis of the screw 56 when the cam is in a number of different gripping positions. The shaping of the back of the lug in this way avoids any binding action with the screw and the bending of the screw when pressure is applied.

The screw 56 is advantageously an Allen type screw having a somewhat tapered and rounded point for engaging the lug 58 and is mounted in a bore 59 of a housing 60 located at the back of the clamp. The housing 60 may be welded to the clamp plates 22 and 24 or be integral with these plates in such a manner that it comprises a sturdy block-like structure located with the bore for the screw 56 somewhat above the pivot pin 36 for the cam 34, so that the screw will be able to apply a considerable leverage pressure against the cam and rotate it clockwise toward the plate to be engaged. The bore 59 in the housing 60 is smooth and extends at right angles to the slot 16 of the clamp and in alignment with the cam 34.

A movable wedge-shaped quick releasing semi-nut 62 is mounted in the lower portion of the housing 60, and its upper surface is provided with threads engageable by the threads of the screw 56. The semi-nut 62 is a block-like structure slidable toward and away from the screw 56 in a passageway 64 inclined with respect to the axis of the screw. A compression spring 66, the ends of which are respectively engaged in holes in the housing 60 and semi-nut 62 biases the semi-nut toward its upward position where its threads engage the threads of the screw 56.

The semi-nut 62 is retractable manually by means of buttons 68 (Fig. 4) arranged on opposite sides of the housing 60 and respectively carried on the ends of a pin 70 extending through slots 72 in the opposite sides of the housing, and through the body of the semi-nut 62. A guard 74 to protect the screw and housing from dam-

age is advantageously secured to the body of the clamp 10 and extends around the sides and upper part of the housing 60 and screw 56 in spaced relation to the housing so that an operator may readily actuate the buttons 68 to release the screw 56.

In the operation of the clamp shown in Figs. 1 to 4 for gripping the plate 18, the operator first presses the buttons 68 toward the body of the clamp against the action of the spring 66 to disengage the nut 62 from the screw 56, as in Fig. 2. This is accomplished by one hand, while the operator with the other hand presses the clamp shackle 52 toward the body of the clamp causing the cam to pivot counterclockwise and push the screw 56 back into the position shown in Fig. 1 of the drawings. Now when the slot 16 of the clamp extends over the plate 18, the buttons 68 are released and the semi-nut 62 engages the screw 56, as in Fig. 1. The shackle 52 is now pulled out in the usual manner in the direction of the arrow causing the cam 34 to move away from the screw 56 and engage the plate 18, as in Fig. 2. At this point the screw 56 is pressed inwardly by hand until its inner end engages the back of the cam 34. As the screw 56 is pushed inwardly toward the cam 34, and during its inward movement, since its thread is engaged with the thread of the semi-nut 62, it forces the semi-nut 62 to travel along the passageway 64, and because the bore 59 and passageway 64 diverge, the semi-nut 62 and the screw 56 separate, or their threads disengage until the top of the thread of the screw 56 passes over the thread of the semi-nut. As the screw 56 is pushed inwardly to the position shown in Fig. 2, its point engages the lug 58 at the back of the cam 34 and, as soon as the forward movement of the screw 56 is arrested, the spring 66 slips the semi-nut 62 up along the passageway 64 to engage its thread with the thread of the screw 56. An Allen wrench, which may be clipped to the body of the clamp for convenience, is then applied to the Allen screw 56 forcing the screw against the lug 58, which in turn forces some of the teeth of the cam 34 into the plate 18, before the plate is lifted. The sharp edges on the face of the gripping pad 20 also enter the surface of the plate to some extent. Fig. 3 shows the clamp in this position with the teeth of the cam 34 pressed into the plate.

With the clamp firmly gripped onto the plate, it may be safely lifted to the desired point and laid down again. In order to release the clamp from the plate, it is necessary to again use the Allen wrench to give the screw 56 about 1½ to 2 turns backwards to release the tension and also to allow play between the threads of the screw and nut. The operator then presses inwardly and downwardly on the buttons 68 to completely release the screw which is readily pushed back by the cam when an inward pressure is applied to the shackle 52. In this operation it is not necessary to rotate the screw except for the first 1½ to 2 revolutions sufficient to release the semi-nut 62.

The preferred form of locking clamp according to the invention is shown in Figs. 5 to 9 in which the body of the clamp is of the same general form as that shown in Figs. 1 to 4 and in which like parts have been given the same numbers followed by a prime. As shown in Figs. 5 and 6, a bell crank 39 is used in place of the radius link 38 with its outer arm 43 pivoted to the links 44'. The bell crank 39 is arranged with its inside angle facing generally toward the cam 35 which does not include a lug 58 as in Fig. 1 but is provided with a back cam surface used in cooperation with the locking mechanism shown in Figs. 5 to 9.

The inner arm 45 of the bell crank 39 extends into the forked end of a lifting link 53 and is pivoted thereto by the pivot pin 54'. The outer end of the link 53 in turn extends into the fork of a lifting shackle 52' and is pivoted thereto by a pivot pin 55, which may be held in place in the same manner as the pivot pins 46, 48 and 54. The use of the bell crank 39 in place of a

5

straight radius link, such as 38, provides a construction in which the angle of pull by the lifting shackle 52 may be applied in various directions without acting on the leverage mechanism to in any way tend to release the cam 35 from its grip on the plate 18'. Assuming, for example, that the pull on the shackle 52' is at an angle of 90° to the right with respect to the slot 16', the arm 45 of the bell crank is so far into the body of the clamp that there would be no possibility of the clamp being released from the plate 18'.

According to the preferred construction shown in Figs. 5 to 9, the improved locking mechanism for the clamp comprises an auxiliary cam 75 mounted in the back portion of the body of the clamp and keyed to a pin 76 in alignment with and somewhat above and in back of the major portion of a gripping cam 35. The cams 35 and 75 are respectively involuted cams or are provided with involuted engaging edge cam surfaces 77 and 78. The involuted surface 78 of the cam 75 has a grade or pitch which is about one-half that of the involuted surface 77 of the gripping cam 35. The term "grade" or "pitch" means the angle in excess of ninety degrees which is formed by two intersecting lines, one through the center of rotation of the cam at the point where the other is tangent to the surface of the cam. This arrangement of the locking cam 75 is such that, when it is rotated to firmly engage the surface 77, a positive lock on the cam 35 is provided, which is not dependent in any way upon the action of a spring or upon the holding of the auxiliary cam by hand. After the cam 75 is moved into locking engagement with the cam 35 as in Fig. 6 it cannot be released by a backward pressure on the cam 35 even though not held by a spring or by hand. The secret of this locking action is the relative pitches of the two involuted cam surfaces 77 and 78 or the fact that in the relationship shown in Fig. 6 the sum of the distances represented by the lines 92 and 93, respectively extending from the centers of rotation of the cams 75 and 35, to the point of common tangency and contact 90 of the cam surfaces, is greater than the distance represented by the straight line 91 extending between said centers of rotation.

On rotating cam 75 clockwise, because of the fact that the distance from point 90 to the center of rotation of cam 75 is longer than the radial distance at any point on the cam surface 78 to the right of that line, a space for disengaging of the two cam surfaces will occur and therefore allow cam 35 to rotate counter-clockwise. In attempting to move cam 35 counter-clockwise without first moving cam 75 clockwise when it is engaged with cam 75, an infinitesimal action is started in spite of the fact that the sum of the two radial distances 92 and 93 to point 90 is longer than a direct line between the center points of rotation. This is due to slight strains of material under stress. However, the rolling cannot continue except an infinitesimal amount because the sum of the two radial distances when cam 75 rolls counter-clockwise progressively increases, causing increasing strains and stresses until there is a balance of forces and equilibrium results. The reason the sum of the two radial distances increases in this instance is because the pitch or grade on cam 75 is less than on cam 35.

The auxiliary cam 75 is provided with a biasing spring 79 of the clock spring type arranged on one side surface of the cam and having one end fixed thereto by means of a pin 80, the other end of the spring being fixed to the inside of the body of the clamp by means of a pin 81. The spring 79 biases the cam in a counterclockwise direction so that when released, it follows the rotation of the gripping cam 35 in a clockwise direction and prevents the reverse rotation of the latter.

A handle 82 is provided on the outside of the body of the clamp for rotating the auxiliary cam 75, this handle being fixed to the pin 76, for example, by a key as shown in Fig. 9. The pin 76 extends through the

6

body plates 22' and 24'. The cam 75 is fixed against lateral displacement on the pin or shaft 76 by a pin 83. The handle is retained in place by a cotter pin, as shown in Figs. 7 and 8. When the auxiliary cam 75 is in its unlocked or released position, as shown in Figs. 5 and 8, the handle 82 is in the position shown in Fig. 8 and is latched to the body of the clamp by means of a pin 84 (Fig. 9) engaging in a hole 85 in the body plate 24'. The pin 84 is carried by the outer end of the arm and biased to engaging position by means of a spring 86 mounted in a casing 87 threaded into the arm 82. A knurled button 88 on the outer end of the pin 84 permits the ready release of the arm 82 so that it may be swung upwardly either by the action of the spring 79 or by the hand of the operator. When the pin 84 is not engaged in the hole 85, as in Figs. 8 and 9, the inner end of the pin rides on the outer surface of the body plate 24' in the manner shown in Fig. 7.

The operation of the clamp shown in Figs. 5 to 9 during the attachment of the clamp to a plate follows a sequence similar to that described above in connection with Figs. 1 to 4, Fig. 5 showing the gripping cam 35 in released position and cam 75 held in its disengaged position. Now as the lifting shackle 52' is pulled up, the cam 35 is rotated in a clockwise direction to move its teeth into engagement with the plate 18'. At the same time the handle 82 is released so that the cam 75 rotates in a counterclockwise direction with the surface 78 following the surface 77. When the plate 18' is firmly held between the teeth of the cam 35 and the gripping pad 20', the operator pulls back and downwardly on the handle 82 to apply pressure on the cam surface 77 by the cam surface 78, thereby forcing the teeth of the cam 35 into the surface of the plate 18'. At the same time the teeth on the pad 20' will engage somewhat into the surface of the plate 18' so that the clamp is firmly locked onto the plate.

As the involuted surface 78 is moved against the involuted surface 77, the former slips slightly on the latter and creates a mechanical advantage or leverage for pressing the teeth of the gripping cam forward against and into the surface of the plate 18'. The cam 35 is locked against the plate 18' by the locking mechanism because the point of tangency or of engagement 90 of the two cam surfaces is on the inside of the straight line 91 extending between the axes of rotation of the cams.

After the plate 18' has been moved to the desired location, the clamp is released by operating the handle 82 to rotate the auxiliary cam 75 in a clockwise direction. In this operation there must be some slippage between surfaces 78 and 77, and the surface 78 must be moved twice as fast as the surface 77 if the cam 35 is rotated counterclockwise during the release of the cam 75. The only way the cam 35 can be released is to first rotate the auxiliary cam 75 clockwise since it is jammed and wedged in against the surface 77 when the plate 18' is ready to be lifted, as shown in Fig. 6. If an attempt is made to force the cam 35 outwardly first, further jamming occurs, because the sum of the lengths of the straight lines 92 and 93 is greater than the length of the line 91, and a wedging or toggle-like locking action takes place applying pressure on the pins 36' and 76, as explained above.

The improved clamp structures of the present invention are particularly adapted for lifting hard steel plates, such as heat-treated armor plates, alloy plates or stainless steel plates, which have smooth hard surfaces, and which are difficult if not impossible to penetrate by the gripping cam of ordinary types of clamps, especially at the start of a lifting operation. If the gripping cam of the clamp does not penetrate the plate somewhat, it is impossible to get the cam to function, since until the plate is gripped and held substantially, no load is applied on the shackle. However, with the improved constructions of the present invention, a hand operated means is provided which acts in series with the gripping cam of the

clamp and the lifting shackle to effect a positive safe grip. The penetrating force must be great enough at the start of the lifting operation and upon a small contacting surface in order to cause penetration. With the hand operated screw and auxiliary cam arrangements of the present invention operating in conjunction with the lever-actuated gripping cam to cause pressure at a single point of contacts, penetration sufficient to prevent slipping on thin hard surfaces can be accomplished. If the hand screw, for example, and the cam were not operated in series with each other, but separately engaged the plates side by side, the forces would be dissipated over the two points of contact and penetration would not be effectively accomplished. The engagement of a plate at two separate points by a clamp is not practical or effective, because swiveling or swinging of the plate on one gripping point will hold, but such swinging or swiveling on two gripping points breaks them loose alternately.

A clamp constructed according to the invention is much safer than previously known clamps, and in addition to having a greater initial gripping pressure, it is also locked in closed position on the plate and can only be released by a hand operation, such as using a wrench to unscrew the Allen screw for one or two turns. In the construction shown in Figs. 1 to 4, there is no possibility of the wedged semi-nut being released prior to using the Allen wrench, since it is locked in place by the screw and is wholly independent of a spring to hold it in place. The gripping cam cannot come off the plate in normal usage until the pressure of the Allen screw is released. This is not true of ordinary screw clamps without a cam or of clamps provided with gripping cams without a cooperating screw operating directly in series with the cam. A screw or C clamp when lifted with a crane can always be pulled off of any plate when the plate is sufficiently heavy or loaded down. There is usually no permanent distortion of the clamp because the frame springs out under load and springs back when it is released, regardless of how strong the frame is. My clamp on hard steel plates may be given the initial pressure by the locking screw or locking cam to start penetration of plate surface and the cam follows up (from the further force brought about by the pulling of the shackle 52) the loosening that may be caused by any stretching of the frame or looseness of the lock caused by further penetration of the cam. This pyramids up and as further pulling is exerted you get proportionately more gripping. Regardless of the stretching of the body of the clamp the gripping pressure keeps on mounting as the cams follow up and never release (as a C clamp does not follow up) until the clamp is destroyed or the plate is pulled apart. Ordinary clamps with gripping cams can be released on smooth hard plates like polished armor plate or some stainless steels. The cam will not get penetration for the initial gripping which is necessary to activate the force of the crane hook on the lifting shackle. Unless the cam has a penetrating force sufficient to prevent slipping at the very start of lifting, it will come off the plate. Clamps made according to the invention are provided with means for forcing some of the teeth of the gripping cam into the surface of the plate sufficiently to hold until the lifting pressure is applied to the cam by the lifting shackle. The lifting shackle increases the pressure and wedging action of the gripping cam and may even deepen the indentations in the plate so that the grip is made even more secure.

The improved clamp structures of the present invention maintain a continuous positive grip on the plate being lifted so that even if the plate were let down to rest on its edge, there would be no release of the clamp mechanism and the operator could pick up the plate again and know that it would be perfectly safe. On the other hand, clamps provided only with a gripping cam might release their grip if a plate is rested on its edge and al-

lowed to tilt over. When the operator again tries to lift the plate, he may find that the clamp had released its grip and would slip off the plate causing damage or injury.

In the use of lifting clamps of the type under consideration, the confidence of the operator and plate handlers is very important. The positive locking grip of the improved clamp construction gives such operators and plate handlers positive confidence in their own safety, since the gripping cam is mechanically locked by a hand operated mechanism and not dependent upon any spring locking or even on the pull of the lifting crane. Furthermore, the plate handlers know that, in order to release the clamp, they must use a wrench or operate a hand lever. This confidence is of great importance because for unknown reasons, plates have occasionally become disengaged and fallen when being handled by previously known types of clamps.

The improved clamp of the present invention may be used for handling other heavy objects than simply plates, and a single clamp, for example, can be effectively used to replace two of the previously known cam type clamps used by millwrights to grab on the bottom of I beams. Where two clamps are thus used, they are placed respectively on opposite sides. This operation can be very effectively accomplished with a single clamp of the type disclosed herein and with a much greater degree of safety. Furthermore, a clamp constructed according to the present invention will safely grab and lift tapered plates or articles having tapered edges where they could not possibly be handled by prior clamps with gripping cams. The clamp of the present invention can be effectively used for lifting assembled parts where the edges are not horizontal, whereas prior known clamps would readily slip from such edges.

What I claim is:

1. In a lifting clamp of the type including a body having spaced opposed depending portions providing a downwardly extending slot when the clamp is in vertical lifting position said slot being adapted for receiving a plate or other article to be lifted, a gripping means on one of said depending portions facing the other depending portion across said slot, a gripping cam having a serrated arcuate article-gripping surface and pivoted in said other depending portion adjacent said slot with its gripping surface facing toward the gripping means, and a leverage mechanism pivoted in the upper portion of said body and connected to said gripping cam for applying a gripping pressure to the gripping cam when a lifting pull is applied to the free end of said leverage mechanism the improvement in which the gripping cam opposite its gripping surface includes a convex arcuate cam surface having a predetermined pitch, a rotatable locking cam carried by the body of the clamp and located adjacent to the arcuate cam surface of the gripping cam, and means for manually rotating the locking cam to apply pressure on the gripping cam and for releasing the locking cam, said locking cam having a convex cam surface contacting the convex cam surface of the gripping cam and acting to hold the locking cam in its rotated locking position, the locking cam surface acting on the convex cam surface of the gripping cam to rock the gripping cam on its pivot and to force its teeth into the surface of the article to be lifted, thereby providing a positive grip on the article to be lifted and preventing slipping of the clamp in the lifting of hard surfaced articles.

2. A lifting clamp as claimed in claim 1, including spring means carried by the body of the clamp and acting on the locking cam for rotating and biasing the locking cam into locking engagement with the gripping cam.

3. A lifting clamp as claimed in claim 1, in which the means for rotating the locking cam include a pivot pin on which the locking cam is fixed, said pivot pin extending into the body of the clamp, a handle fixed

to said pivot pin outside of the body of the clamp for rotating the pivot pin and locking cam, and means for latching the handle in a position in which the locking cam is in its raised position with respect to the gripping cam.

4. A lifting clamp as claimed in claim 1 in which the locking cam is pivoted in the body of the clamp in alignment with the gripping cam, the cam surface of the locking cam being involuted and engaging the cam surface of the gripping cam at a point on that side of a straight line extending through the axes of rotation of the cams which lies in the direction of movement of the cam surface of the locking cam when the locking cam is rotated in a direction to force its cam surface into engagement with the gripping cam whereby the sum of the distances from the axes of rotation of the cams to the point of contact of the cams is greater than the straight line distance between said axes of rotation.

5. A lifting clamp as defined in claim 4 in which the locking cam is pivoted in the body of the clamp above the gripping cam.

6. In a lifting clamp of the type including a body having spaced opposed depending portions providing a downwardly extending slot when the clamp is in vertical lifting position said slot being adapted for receiving a plate or other article to be lifted, a gripping means on one of said depending portions facing the other depending portion across said slot, a gripping cam having a serrated arcuate article-gripping surface and pivoted in said other depending portion with its gripping surface facing toward the gripping means, and a leverage mechanism pivoted in the upper portion of said body and connected to said gripping cam for applying a gripping pressure to the gripping cam when a lifting pull is applied to said lifting mechanism, the improvement in which the gripping cam includes an involuted cam surface opposite its gripping surface having a predetermined pitch, an actuating cam pivoted to the body of the clamp in alignment with and adjacent to the gripping cam for engaging and rotating the gripping cam on its pivot and cooperating with the leverage mechanism to force the teeth of the gripping cam into firm engagement with the surface of the article to be lifted, thereby providing a positive grip on the article to be lifted and preventing slipping of the clamp in the lifting of hard surfaced articles, said actuating cam having an involuted cam surface of less pitch than that of the gripping cam, and hand operable means for rotating the actuating cam to force its involuted cam surface against the involuted cam surface of the gripping cam.

7. In a lifting clamp of the type including a body having spaced opposed depending portions providing a downwardly extending slot when the clamp is in vertical lifting position said slot being adapted for receiving a plate or other article to be lifted, a gripping means on one of said depending portions facing the other depending portion across said slot, a gripping cam having a serrated arcuate article-gripping surface and pivoted in said other depending portion adjacent said slot with its gripping surface facing toward the gripping means, and a leverage mechanism pivoted in the upper portion of said body and connected to said gripping cam for applying a gripping pressure to the gripping cam when a lifting pull is applied to said leverage mechanism, the improvement in which the gripping cam opposite its gripping surface includes an involuted arcuate cam surface having a predetermined pitch, and a rotatable locking cam pivoted in the body of the clamp and located adjacent to the involuted arcuate cam surface of the gripping cam, and manually-operable means for rotating the locking cam to apply pressure on the gripping cam, said locking cam having an involuted cam surface contacting the involuted cam surface of the gripping cam the pitch of which is about one-half that of the involuted cam surface of the gripping cam, whereby the locking cam is held in its rotated locking position, the locking cam when rotated in the locking direction acting on the gripping cam to rock the gripping cam on its pivot end to force its teeth into the surface of the article to be lifted, thereby providing a positive grip on the article to be lifted and preventing slipping of the clamp in the lifting of hard surfaced articles.

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