

Jan. 23, 1945.

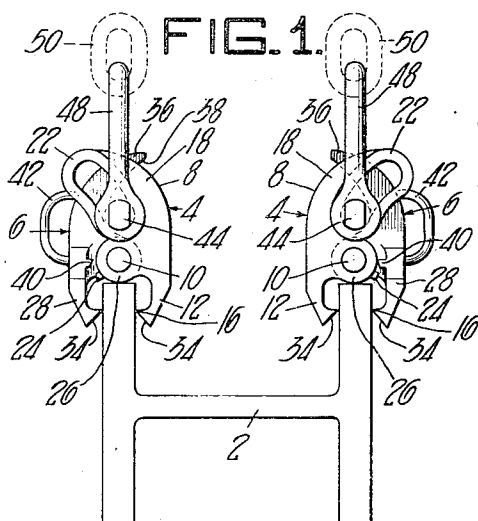
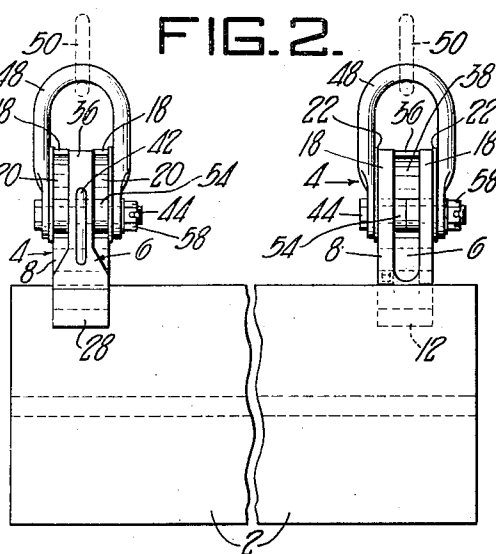
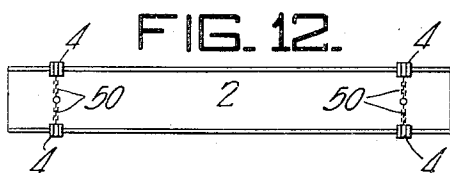
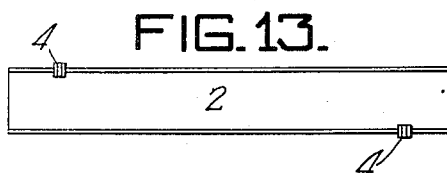
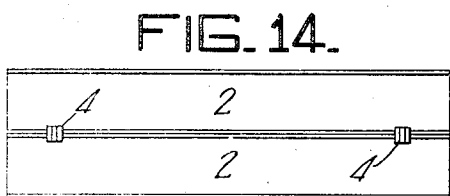
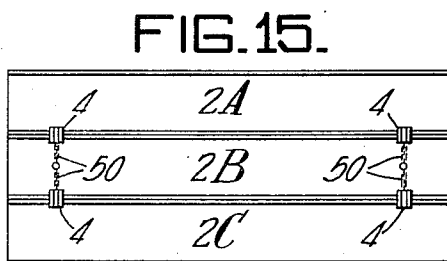
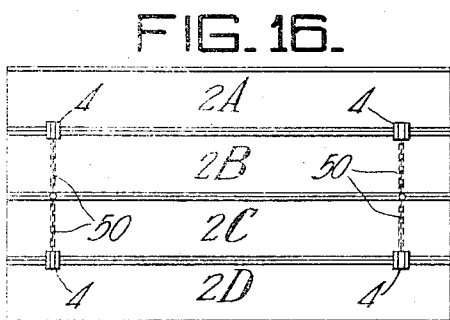
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2,367,766

FINGER LIFTING CLAMP

Filed March 30, 1944

3 Sheets-Sheet 1



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PINGER LIFTING CLAMP

Filed March 30, 1944

3 Sheets-Sheet 2

FIG. 3.

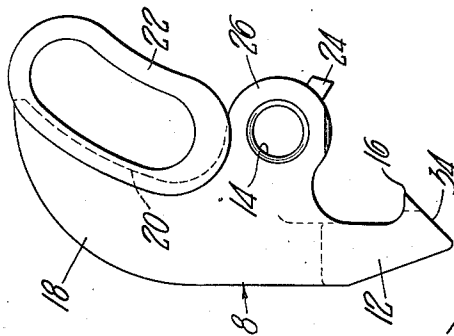


FIG. 4.

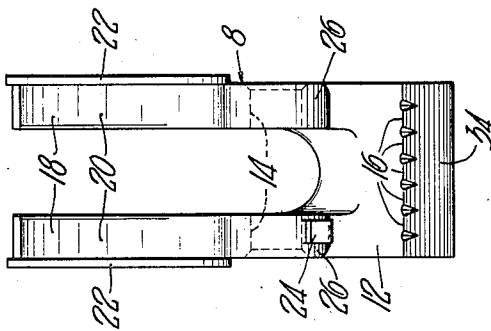


FIG. 6.

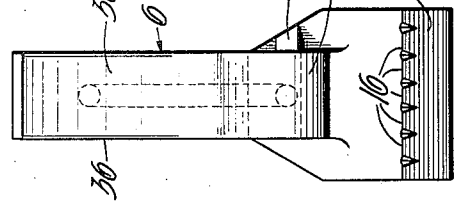


FIG. 5.

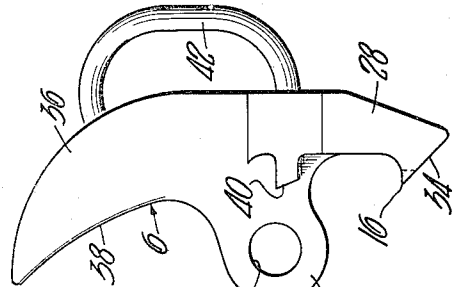
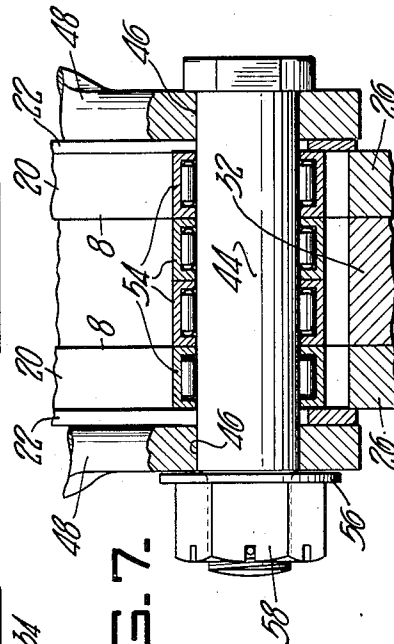


FIG. 7.



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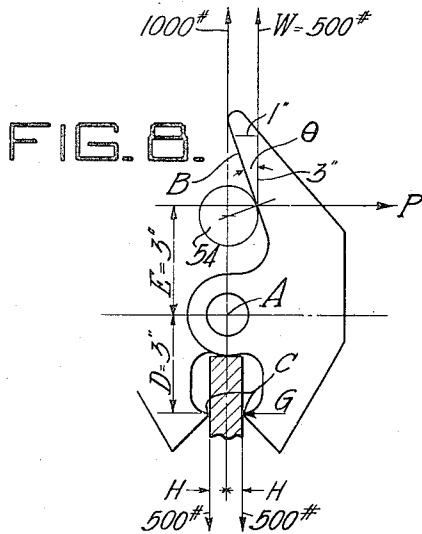
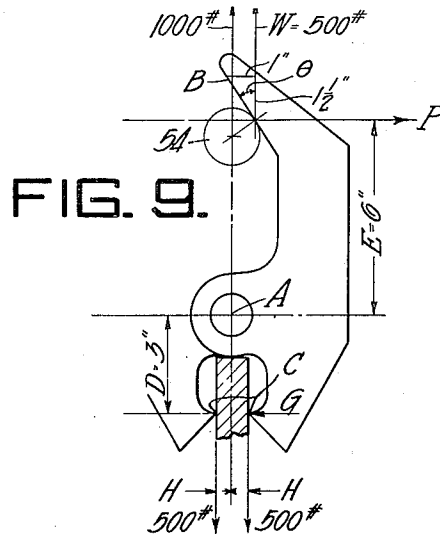
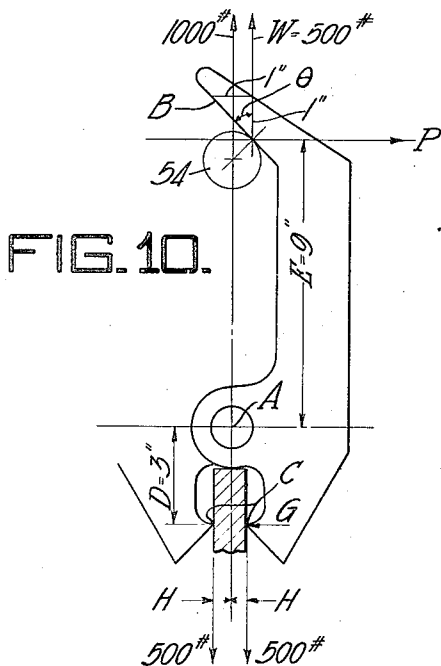
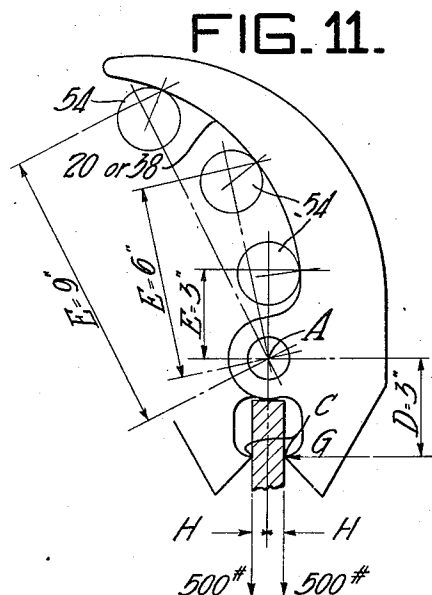
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PINGER LIFTING CLAMP

Filed March 30, 1944

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,367,766

PINCER LIFTING CLAMP

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Application March 30, 1944, Serial No. 528,727

6 Claims. (Cl. 294—116)

This invention relates to a pincer lifting clamp especially adapted for use in lifting H-beams which range in size from 8 to 36 $\frac{3}{4}$ inches with flanges ranging in thickness from $\frac{5}{16}$ inch to 3 $\frac{1}{2}$ inches. The beams vary in length with a maximum of about 100 feet. Previously, in order to handle all of these sections a minimum of six different sized tongs were required and only one beam could be handled with safety at one time. One pair of tongs was suspended from each trolley of a double trolley crane and the operator spotted one trolley over each end of the beam and lowered the tongs until they rested on the beam in closed position. The hooker then pulled the tongs open until their points contacted the outside of the beam flange and the craneman hoisted the beam while the operator held the tongs in position.

With the pincer lifting clamp of the invention only two different sizes are required and from one to four beams can be lifted with safety at one time. The pincers need only be guided into position by the hooker and will open of their own accord. The pincer clamp is about half the weight of the corresponding tongs and is more easily handled by the hooker. The pincer clamp can be disengaged by the craneman without help from the hooker. For these reasons the beams may be handled with greater safety by means of the pincer clamp.

It is an object of this invention to provide a pincer clamp which overcomes the disadvantages of the tongs set forth above.

Another object is to provide a clamp which tends to move to the closed position at all times.

A further object is to provide a clamp that develops a gripping pressure which is always constant relative to the load lifted.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

Figure 1 is an end view of a beam showing the clamps in position;

Figure 2 is a side view of Figure 1;

Figure 3 shows the female pincer arm;

Figure 4 is a side view of Figure 3;

Figure 5 shows the male pincer arm;

Figure 6 is a side view of Figure 5;

Figure 7 shows a detail of the invention;

Figures 8 to 11 show how the pressure surfaces of the clamp are developed;

Figures 12 to 16 are diagrammatic views showing various methods of lifting beams.

Referring more particularly to the drawings, the reference numeral 2 indicates an H-beam which is to be lifted by pincer clamps 4, each of

which consists of a male pincer arm 6 and a female pincer arm 8 which are fastened together by the pin 10. As best shown in Figures 3 and 4, the female pincer arm has a leg 12 extending below the opening 14 for receiving the pin 10, the leg being provided with gripping teeth 16 to better grasp the beam or other object being lifted. A pair of spaced apart legs 18 extend above the opening 14 and are provided with pressure surfaces 20, the construction of which will be explained below. A guide plate 22 is fastened to the outside of each leg 18 in any suitable manner. A stop 24 is arranged on the hub 26 to limit relative movement between the male and female pincer arms.

The male pincer arm 6, as best shown in Figures 5 and 6, has a lower leg 28 which extends below the opening 30 in the hub 32 and is provided with gripping teeth 16 similar to those of the female member 8. The lower part of legs 12 and 28 are provided with opposed wedge surfaces 34 for a purpose which will be explained later. As shown, the gripping faces of the arms are substantially the same width, but if desired, the face of the arm 28 may be made narrower to facilitate removal of the clamp from the beam. Above the opening 30 is a second leg 36 which is provided with a pressure surface 38 having the same curvature as surface 20. A stop 40 is provided on the pincer arm 6 for engagement with the stop 24. To facilitate handling of the clamp when assembled, the male arm is provided with a handle 42.

The assembled pincer arms are carried by a pin 44 which is supported in the openings 46 of the shackle 48 as best shown in Figure 7. Each of the shackles is supported by a chain 50 carried by a crane hook (not shown). The pin 44 carries four roller bearings 54, the outer two contacting the pressure surfaces 20 of the arm 8 and the inner two contacting the pressure surface 38 of the arm 6. A washer 56 bears against one leg of the shackle 48 and it is held in place on the pin 44 by the nut 58.

The development of the bearing surfaces 20 and 38 is shown in Figures 8 to 11. I have found that it requires a pressure of about two to one against load when lifting an average piece of low carbon steel and using a circular pointed bit. When using an edge for contact grip, as shown, a pressure of about three to one is required to prevent the load from slipping from the grip. If steel of a different hardness is lifted, the ratio also varies. The pressure surfaces are so constructed that the grip pressure relative to the load lifted is always substantially constant. In developing

the gripping surfaces 20 or 38, pressure surfaces are determined at a plurality of points and a curve tangent to these surfaces is then drawn. Assuming a gripping force G of three times the weight W to be lifted, the surface is developed as follows:

Let E be the distance of the contact point of the roller 54 from the point A and θ the angle of the incline at that point. The vertical load at this point is equal to W and the horizontal force P equals W cotangent θ . Taking moments about point A, $PE=GD$ or W cotangent

$$\theta \times E = 3WD$$

The distance D is a constant and may be assumed to be 3'', so that E cotangent $\theta = 9$ or cotangent

$$\theta = \frac{9}{E}$$

By using this formula, the slope of the surface B is determined for various distances E from the pivot A.

In Figure 8, E is equal to 3'' and cotangent θ is therefor equal to

$$\frac{9}{3}$$

or 3. When lifting a load of 1000#, there is a vertical load of 500# on each gripping edge and a vertical up-load W of 500# on the pressure surface of each pincer arm. As calculated, the incline is one in three at a distance of 3'' above the pivot point A. If the roller 54 is lifted up at this position, it forces surface B outward one-third of the distance that the roller moves in a vertical direction and the horizontal pressure P exerted by the roller will be three times the vertical load or 1500#. The resultant thrust or gripping force G equals

$$\frac{1500\# \times E}{D} = \frac{1500\# \times 3''}{3''} = 1500\#$$

When E is equal to 6'', as shown in Figure 9, cotangent

$$\theta = \frac{9}{6} = 1\frac{1}{2}$$

With this incline of 1 to 1½ at a distance of 6'' above the pivot point A, the roller 54 if moved upward, forces surface B outward two-thirds of the distance that it moves up and the roller exerts 1½ times as much horizontal pressure as vertical load. With 500# vertical load, 750# horizontal pressure P is obtained and the resulting thrust or gripping force

$$G = \frac{750\# \times 6''}{3''}$$

or 1500#.

In like manner, when distance E equals 9'', cotangent

$$\theta = \frac{9}{9}$$

or 1 and the incline is 1 to 1. The horizontal pressure P and vertical load W are equal and the resultant thrust G equals

$$\frac{500\# \times 9''}{3''} = 1500\#$$

The curve 20 or 38 is then obtained by drawing a curve tangent to the three inclined surfaces B. If desired, the slope may be determined at more than three points and the curve 20 obtained by drawing a curve tangent to all the inclined surfaces B. If the ratio of the gripping force G to the

weight W is changed, for example, to 2 to 1 the procedure is the same, but cotangent θ will equal

$$\frac{6}{E}$$

instead of

$$\frac{9}{E}$$

as in the first example. From the foregoing calculations it is seen that regardless of the position of the roller 54, the relationship between the gripping force and the load W is constant.

In addition to the gripping force G obtained by the action of the rollers wedging the inclined surfaces apart, some additional grip due to the location of pivot point A relative to gripping edge C is obtained. For example, if the material to be lifted in Figures 8 to 11 is 1'' thick, this additional gripping force will be

$$\frac{W \times H}{D} = \frac{500\# \times \frac{1}{2}''}{3''} = 83.3\#$$

(moments about A). The total gripping force when lifting a load of 1000# with a thickness of 1'' equals 1500#+83# or 1583# on each side of the load regardless of the location of the lifting roller. If material 2'' thick with the same weight is gripped, the additional gripping force will be

$$\frac{500\# \times 1''}{3''}$$

or 167.7# and the total gripping force will be 1500#+167# or 1667# on each side of the load.

While the total gripping force varies somewhat with the width of the material being lifted, this variation is but a small percentage of the total gripping force.

The operation of the device is as follows:

The crane-man lowers the clamp toward the beam 2 and the hooker grasps the handle 42 and guides the clamp over the flange of the beam 2. The pivot point A is on the center line of the lifting clamps and the center of gravity of each of the pincer arms is outside this center line so that the weight of each arm causes its gripping edge to always stay in contact with the surface of the load and to approach the gripping edge of the other arm. For lifting relatively thick objects the stops 24 and 40 are provided to limit the movement of the gripping edges toward each other so that their outward movement is not excessive when the hooker guides the clamps into place. As the clamp is guided into place, the wedge shaped surfaces 34 contact the edges of the flange and guide the clamp over the flange. The other clamp is then lowered into place in the same manner and grips the opposite flange at the opposite end of the beam. The crane hooks are raised and the rollers 54 cause the gripping teeth 16 to firmly grip the beam. Since the gripping teeth 16 always stay in contact with the surface of the load, accidental striking of the load from below will not break the contact with the load. When it is desired to disengage the pincers, the beam is lowered and the crane-man by moving the crane hook parallel to the edge of the load tips the clamp over about its hub until the teeth 16 are disengaged from the load. In the larger size clamp the width of the leg 28 of the male arm 6 is made smaller than the width of the leg 12 of the female arm 8, this arrangement being necessary to enable the crane-man to release the pincers from the beam by rolling it on its side. With the smaller size clamp the face of the pincer arms is not so

wide and it can be easily rolled over on its side and released by the crane man.

Figure 12 shows how a single beam is lifted by two clamps 4 at each end of the beam.

Figure 13 shows how a beam can be lifted by two clamps, one gripping one flange at one end of the beam and the other gripping the other flange at the other end of the beam.

Figure 14 discloses how two beams may be lifted with two clamps. The beams are arranged side by side with their flanges in contact and one arm of the clamp 4 contacts the inner surface of each flange. In like manner, another clamp 4 grasps the beams at their other end.

Figure 15 discloses how three beams may be lifted with four clamps. The beams 2A, 2B and 2C are arranged side by side with their flanges in contact and one clamp 4 grips the adjoining flanges of beams 2A and 2B at one end and a second clamp grips the same flanges at the opposite end. A third clamp grasps the adjoining flanges of beams 2B and 2C at one end and the fourth grasps the same flanges at the opposite end.

Figure 16 discloses how four beams may be lifted with four clamps. Beams 2A, 2B, 2C and 2D are arranged side by side with their flanges in contact. Beams 2A and 2B are then grasped by two clamps 4 in the same manner as the two beams of Figure 14. In like manner beams 2C and 2D are grasped by the remaining two clamps.

It will be seen that in each of the methods disclosed above at least two gripping surfaces are in contact with each beam.

While several modifications and adaptations of the invention have been shown and described, it will be apparent that other modifications and adaptations may be made without departing from the scope of the following claims.

I claim:

1. A pincer lifting clamp comprising a male pincer arm having a cam surface thereon, a female pincer arm having cam slots therein provided with cam surfaces, said arms being pivotally connected at a point below said surfaces, a leg on each arm below said pivot point having a gripping surface on its inner side, the center of gravity of each of said arms being substantially outside said pivot connection whereby said gripping surfaces are normally in their innermost position, a wedge surface on each arm extending downwardly and outwardly from the gripping surface to separate the gripping surfaces as the legs are lowered over the article to be gripped, a pin for contacting said surfaces to cause movement of said arms about said pivot connection, and means for supporting said pin.

2. A pincer lifting clamp comprising a male pincer arm having a curved contact surface thereon, a female pincer arm having a similar contact surface, said arms being pivotally connected at a point below said surfaces, a gripping surface on each arm below said pivot connection, a pin for contacting said surfaces to cause movement of said arms about said pivot connection, and means for supporting said pin, said surfaces being shaped in accordance with the formula

$$\frac{W}{G} \cotangent \theta \times E = D$$

where

$$\frac{W}{G}$$

is the ratio of the weight to be lifted to the grip-

ping force, θ is the angle of inclination at a distance E from the pivot point and D is the distance of the gripping surface from the pivot point so that the grip pressure relative to the load lifted is always substantially constant regardless of the thickness of the article being lifted.

3. A pincer lifting clamp comprising a male pincer arm having a cam surface thereon, a female pincer arm having cam slots therein provided with cam surfaces, said arms being pivotally connected at a point below said surfaces, a leg on each arm below said pivot point having a gripping surface on its inner side, the center of gravity of each of said arms being substantially outside said pivot connection whereby said gripping surfaces are normally in their innermost position, a wedge surface on each arm extending downwardly and outwardly from the gripping surface to separate the gripping surfaces as the legs are lowered over the article to be gripped, a pin for contacting said surfaces to cause movement of said arms about said pivot connection and means for supporting said pin, said cam surfaces being so shaped that the grip pressure relative to the load lifted is always substantially constant, regardless of the thickness of the article being lifted.

4. A pincer lifting clamp comprising a shackle, a pin supported by said shackle, a plurality of rollers mounted on said pin, a male pincer arm having a cam surface thereon for contacting one of said rollers, a female pincer arm having cam slots therein provided with cam surfaces for contacting another of said rollers, said arms being pivotally connected at a point below said surfaces, a leg on each arm below said pivot point having a gripping surface on its inner side, the center of gravity of each of said arms being substantially outside said pivot connection whereby said gripping surfaces are normally in their innermost position, and a wedge surface on each arm extending downwardly and outwardly from the gripping surface to separate the gripping surfaces as the legs are lowered over the article to be gripped.

5. A pincer lifting clamp comprising a shackle, a pin supported by said shackle, a plurality of rollers mounted on said pin, a male pincer arm having a surface thereon for contacting one of said rollers, a female pincer arm having a surface thereon for contacting another of said rollers, said arms being pivotally connected at a point below said surfaces, and a gripping surface on each arm below said pivot connection, said surfaces being shaped in accordance with the formula

$$\frac{W}{G} \cotangent \theta \times E = D$$

where

$$\frac{W}{G}$$

is the ratio of the weight to be lifted to the gripping force, θ is the angle of inclination at a distance E from the pivot point and D is the distance of the gripping surface from the pivot point so that the grip pressure relative to the load lifted is always substantially constant regardless of the thickness of the article being lifted.

6. A pincer lifting clamp comprising a shackle, a pin supported by said shackle, a plurality of rollers mounted on said pin, a male pincer arm having a cam surface thereon for contacting one of said rollers, a female pincer arm having cam

slots therein provided with cam surfaces for contacting another of said rollers, said arms being pivotally connected at a point below said surfaces, a leg on each arm below said pivot point having a gripping surface on its inner side, the center of gravity of each of said arms being substantially outside said pivot connection whereby said gripping surfaces are normally in their innermost position, and a wedge surface on each arm extend-

ing downwardly and outwardly from the gripping surface to separate the gripping surfaces as the legs are lowered over the article to be gripped, said surfaces being so shaped that the grip pressure relative to the load lifted is always substantially constant regardless of the thickness of the article being lifted.

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