United States Patent [19]

Hagerty

[11] **3,754,432**

[45] **Aug. 28, 1973**

[54] **FORCE UNIT FOR METAL WORKING**

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[22] Filed: **May 18, 1970**

[21] Appl. No.: **38,406**

[52] **U.S. Cl.** **72/447,** 72/705

[51] **Int. Cl.** **B21d 1/14**

[58] **Field of Search** ..... 72/705, 447; 254/93 R, DIG. 1

[56] **References Cited**

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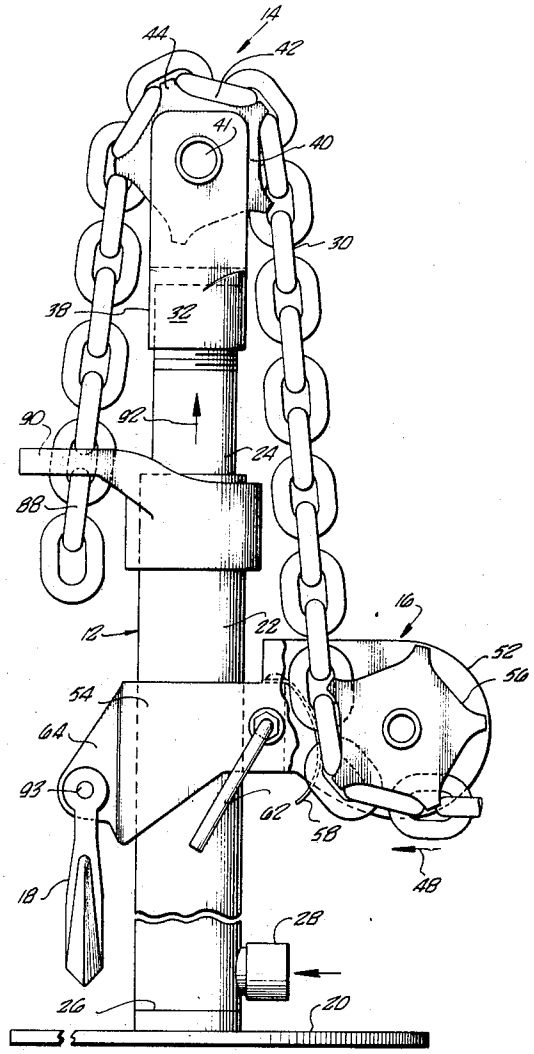
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[57] **ABSTRACT**

A force unit that may be readily employed to develop a pulling force for physically shaping, or molding, a work piece by bending, is disclosed. The force unit includes a power member which is physically moved by a hydraulically operated ram for the purpose of retracting a load chain or cable that is attached at one end to a stabilized work piece to be shaped and at an opposite end to the force unit. The ram is vertically mounted on an appropriate support. A fulcrum pulley is mounted at any vertical position along the length of the ram or a support post to which it may be attached. An anchor is employed to secure the force unit from movement in the direction of the work piece.

22 Claims, 6 Drawing Figures



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2 Sheets-Sheet 1

FIG. 1

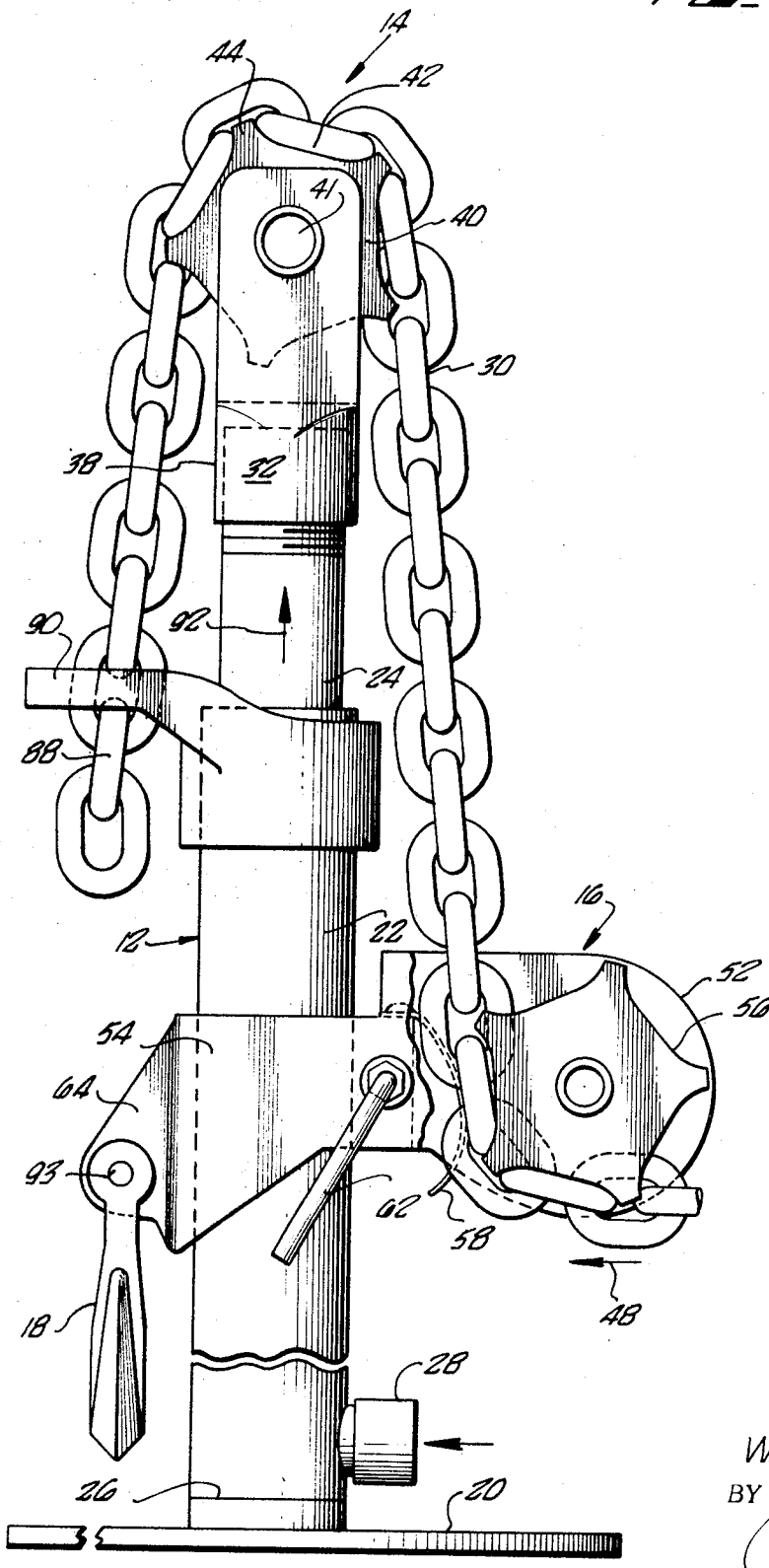
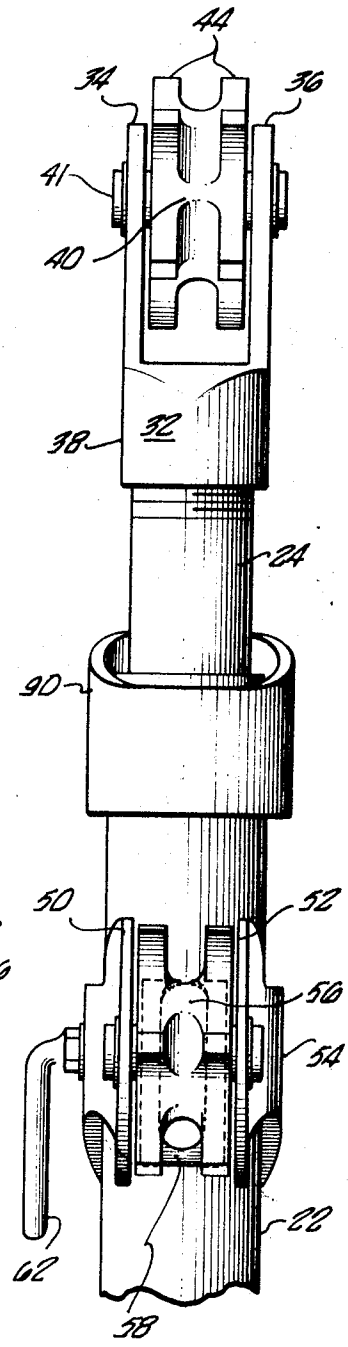


FIG. 2



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FIG 3

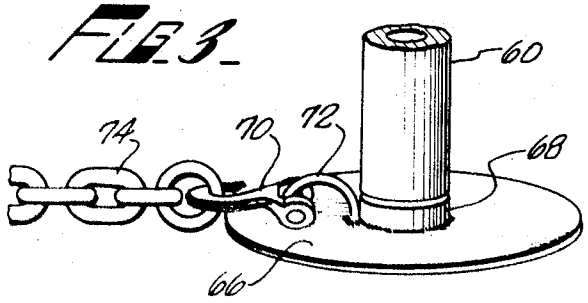
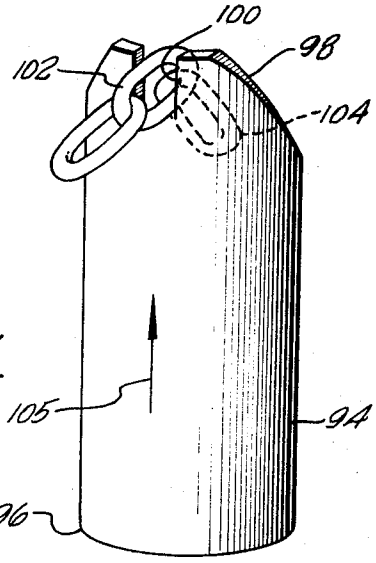


FIG 5



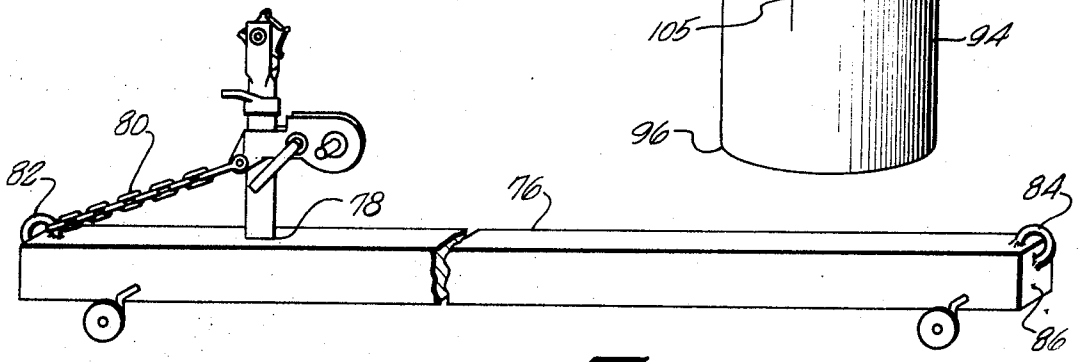


FIG 4

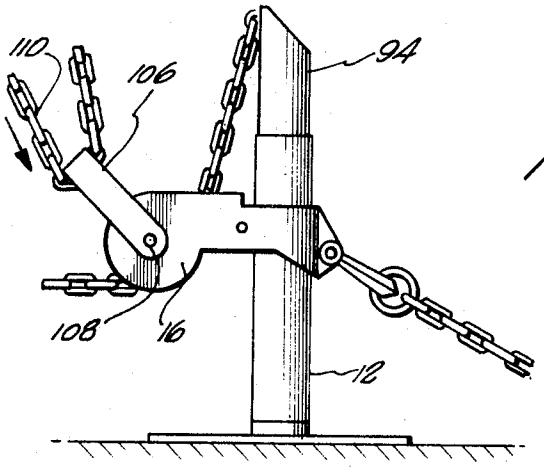


FIG 6

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FORCE UNIT FOR METAL WORKING

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally relates to devices that may be employed to apply a pulling force to a work piece to be shaped or molded. More specifically, the present invention concerns a force unit that serves to develop pulling forces which are typically employed to bend metal work pieces such as portions of a damaged automobile to be restored to an original configuration.

2. Description of the Prior Art

Ordinarily, the repair and/or restoration of damaged automobile bodies involves the application of physical force to deformed portions of the body or frame. Such physical force may be in the form of a pushing force such as may be applied by using a hammer or the like. More typically, however, devices employed in the repair of automobiles exert a pulling force which is applied to one or more selected points of a damaged work piece. The desired bending or shaping is generally accomplished by securing the automobile part in a fixed position relative to the pulling force.

Most of the prior art equipment that is designated to develop such pulling forces is bulky and awkward to use. As a consequence, the repair of automobile bodies is a time consuming and cumbersome process. Exemplary of the prior art equipment in the unit disclosed in the U.S. Pat. to Smith, No. 3,149,660, issued on Sept. 22, 1964, which unit is intended to be situated beneath an automobile and secured thereto at one or more pulling points and at least one retention point. When in operation, physical forces used to accomplish a desired bending are confined to the unit. Otherwise stated, the unit serves to develop both the desired action forces and the necessary reaction forces.

Devices having a design typified by the Smith unit have been found to have several attendant disadvantages. Firstly, the shear size of the unit makes the positioning thereof an awkward task and requires that a fairly large work area be available. Secondly, the use of more than one of the units to provide the oftentimes necessary multiple pulls of different force and/or travel is very inconvenient due to the need to avoid crossing the elongate platform included in a unit. Additionally, because the unit is intended tto provide both the action and reaction forces, the structure must have extreme strength to avoid self-destruction by the ordinary forces involved. Conventionally, these forces may range as high as 10 tons. Needless to say, the requirement for such extreme strength may involve the use of additional amounts of material, which use would contribute additional weight to the unit and may consequently increase manufacturing costs.

Accordingly, it is the intention of the present invention to provide a force unit that is readily potable, that is capable of being easily used in combination with other units, and which is not subject to self-destructive forces as are many prior art devices.

SUMMARY OF THE INVENTION

Briefly described, the present invention involves a force unit that is readily employable to develop pulling forces useful in the repair and/or restoration of metal work pieces such as motor vehicle bodies and frames.

More particularly, the subject force unit includes a hydraulically operated ram having a sleeve that is secured at one end to an appropriate support. A power member is adapted to be vertically extended or retracted by being attached to the piston of the ram. Pulling forces are applied to a work piece by a load chain or cable that is secured to the work piece and to the force unit at the respective ends thereof. A fulcrum pulley, which is secured to either the ram or a support post serves to feed the line from the work piece to the power member. An anchor is provided to restrain movement of the force unit in the direction of the work piece. The anchor and the fulcrum pulley are horizontally positioned with respect to each other such that resultant forces created during the operation of the force unit are substantially directed along the longitudinal axis of the ram.

The many attendant advantages of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description which is to be considered in connection with the accompanying drawings wherein like reference symbols designate like parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram illustrating a partially fragmented side view of a force unit having a load chain positioned in operative engagement, in accordance with the present invention.

FIG. 2 is a schematic diagram illustrating a partially fragmented frontal view of a force unit.

FIG. 3 is an isometric diagram illustrating a perspective view of a flat base employable with the force unit, in accordance with the present invention.

FIG. 4 is an isometric diagram illustrating perspective view of an alternate base employable with the present invention.

FIG. 5 is an isometric diagram illustrating a perspective view of an alternate power member usable with the present invention.

FIG. 6 is a schematic diagram illustrating a partially fragmented side view of a force unit equipped with the alternate power member shown in FIG. 5 and adapted to have a removable collar for enabling secondary pulls to be made.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2 of the drawings, a force unit, in accordance with the present invention, essentially includes a hydraulically operated ram **12**, a power member **14**, a fulcrum pulley **16**, and an anchor member **18**.

The hydraulically operated ram **12** serves as the source of the desired pulling forces. A suitable ram includes an outer cylindrical sleeve **22** and an extensible or telescoping piston **24**. The cylindrical sleeve **22** should be adapted to be securely mounted at a mounting end **26** to a supporting member, such as a base member **20**. An input port **28**, to which an appropriate source of power may be attached, is appropriately mounted on the sleeve **22** and serves to communicate with a hydraulic chamber formed by the sleeve **22**. Any of the conventional sources of hydraulic power, such as a pressurized fluid container, may be employed to power the ram **12** and cause the piston **24** to be extended. A suitable fluid valve (not shown), of a type well known in the prior art, may be employed to con-

trol the application of pressurized fluid to the ram **12** through the input port **28.** An exemplary ram that is suitable for use with the present invention is commercially available as Model RC–159, manufactured by the Blackhawk Manufacturing Company.

The power member **14** serves to forcibly retract a load chain **30,** by being urged upward by movement of the piston **24.** The power member **14** may include a U-shaped yoke **32** having a pair of arms **34** and **36** and a cylindrical body portion **38.** The body portion **38** is adapted to be secured to an end of the piston **24.** Screw threads cut about the inner surface of the body portion **38** and matching a set of screw threads cut about the outer surface of the piston **24,** at the end thereof, may be used to secure the yoke **32** to the ram **12.**

A sprocket wheel **40** is rotatably mounted between the pair of arms **34** snd **36.** A centrally located aperture through which an axle or pin **41** is extended may be employed to mount the wheel **40** on the yoke **32.** As illustrated, the periphery of the sprocket wheel **40** is shaped to have a series of alternating flat portions **42** and pointed portions **44.** The flat portions **42** are adapted to accommodate a link of the chain **30** when laid flat against the periphery of the wheel **40.** The pointed portions **44** are adapted to extend between alternate links of the chain **30** so as to engage the chain **30** as the power member **14** is forced upward by extension of the piston **24.** As shown in FIG. **2,** each of the pointed portions **44** are slotted to accommodate the edge of alternate links of the load chain **30.**

The fulcrum pulley **16** serves to redirect and feed the load chain **30** from a work piece towards the power member **14** as indicated by the arrow **48.** The fulcrum pulley also includes a yoke formed by a pair of arms **50** and **52** and a portion of an O-shaped bracket **54.** A sprocket wheel **56,** that may be identical in design to the sprocket wheel **40,** is rotatably mounted between the arms **50** and **52** which extend from the O-shaped bracket **54.** Each of the arms **50** and **52** may be shaped and sized to extend beyond the periphery of the sprocket wheel **56** for the purpose of guiding the load chain **30** onto the sprockets of the wheel **56** as the chain **30** is retracted in the direction indicated by the arrow **48.** A leaf spring **58** is secured to the bracket **54** between the arms **50** and **52** and serves to bias the individual links of the load chain **30** against the sprocket wheel **56** to prevent disengagement.

The O-shaped bracket **54** is sized to be fit about the cylindrical sleeve **22** of the ram **12** or about a support post **60** (FIG. **3**), which is sized to have an outer diameter equal to the outer diameter of the sleeve **22** and which may be employed to elevate the ram **12** and the elements attached thereto. The support post **60** may be adapted to be secured to the cylindrical sleeve **22** and to the base member **20** in any conventional manner such as by having the respective elements to be joined properly sized and threaded to allow a threaded coupling of the type well known to any person of ordinary skill in the art. For the alternative, any other well known mechanical technique may be used. The O-shaped bracket **54** is adapted to have a gap (not shown), between the arms **50** and **52,** to enable the inner diameter of the bracket **54** to be reduced, by rotation of a threaded tightening bolt **62,** for the purpose of clamping the fulcrum pulley **16** in a desired vertical position. It has been found that clamping the fulcrum pulley **16** in place effectively draws the arms **50** and **52** together. However, such slight inward movement of the arms **50** and **52** does not affect operation of the fulcrum pulley **16** when the bracket **54,** the distance between the arms **50** and **52,** and the thickness of the sprocket wheel **56,** are appropriately sized.

The bracket **54** is designed to have a vertically situated flange **64** extending from an outer surface of the bracket **54** at a position diametrically opposite the arms **50** and **52.** The anchor member **18** is appropriately secured to the flange and serves to restrain the force unit from movement in the direction of the work piece. This may be accomplished by coupling opposite ends of an anchor chain or cable to the anchor member **18** and to a relatively immovable body such as the floor of a work area.

In operation it is ordinarily desirable to attach the force unit to an appropriate support, such as a base plate, for purposes of maintaining the unit in a vertical position. Referring to FIG. **3,** an acceptable base plate **66** may have a flat configuration. An attaching member **68,** having an appropriate configuration, may be centrally located on the base plate **66.**

As shown, a support post **60** may be attached to the base plate **66** for the purpose of elevating a force unit. The vertical support post **60** may be formed as a single cylindrical element of any desired length. In the ordinary use of a force unit for developing pulling forces for the repair of automobiles, a variety of lengths may be required to accommodate an assortment of different pull directions. Accordingly, a number of cylindrical elements may be serially connected to provide a support post **60** of desired height.

An auxiliary anchor **70** may be fastened to the base plate **66** by an appropriate ring **72** for the purpose of providing an additional restraining force for the force unit whenever necessary. As in the case with the anchor member **18,** the anchor **70** may be secured to an immovable independent body by an anchor chain **74** to provide the desired restraining force. It has been found that the additional restraining force provided by the anchor **70** may be useful whenever the force unit is employed to make a downward pull, i.e., the load chain **30** (FIG. **1**), is drawn away from a work piece in a downward direction.

As an alternative to using the flat base plate **66,** a rail **76,** as illustrated by FIG. **4,** may be employed. The ram **12** may again be either directly secured to the rail **76** or through a support post of desired length. A hole **78,** or a suitable attaching member, may be included for this purpose when a rail **76** is used. It may in some instances be desirable to anchor the force unit to the rail **76** instead of to an independent body. In such a case, an anchor chain **80,** or the like, may be used to secure the force unit to the rail **76** by being fastened to a ring or loop **82** which may be provided for this purpose. It is to be noted that the use of the rail **76** enables the force unit to be employed in the fashion of conventional units wherein the rail **76** is also attached to the work piece. A loop **84** at the end **86** of the rail **76** is provided for such conventional attachment.

It is to be understood that as a further alternative to employing either the flat base **66** or the rail **76,** the ram **12** of a force unit may be simply retained in a hole that has been suitably placed in the floor of a work shop.

Considering now the operation of a force unit, with reference to FIGS. **1** and **2,** a load chain **30** is secured at one end thereof to a work piece, such as a portion

of a damaged automobile. After the load chain **30** is engaged with the sprockets of the wheels **56** and **40** of the fulcrum pulley **16** and the power member **14**, respectively, the opposite end **88** of the load chain **30** may be secured to a forked member **90** having a pair of fingers through which the load chain **30** is inserted and retained. Any other suitable means of securing the end **88** of the load chain **30** to the force unit may be employed. For example, the loop **72** on the flat base **66** (FIG. 3) may be employed for this purpose. After the force unit has been anchored, application of pressurized fluid to the ram **12** through the input port **28** will then cause the piston **24** to be moved in an upward direction as indicated by the arrow **92.** Such movement of the piston **24** will force the power member **14** upwards and thereby retract the load chain **30** to develop the desired pulling force. It is to be noted that the axis of the load chain **30**, at the fulcrum pulley **16**, and the connection point **93** of the anchor member **18** are aligned along a horizontal line. Consequently, resultant forces will be generally directed along the axis of the ram **12** and of any support post **60** that may be used. It has been found that when the load chain **30** is making a horizontal pull, only nominal resultant forces are developed. However, when an upward pull is being made, considerable resultant forces are directed downward through the axis of the ram **12.** These forces are naturally directed downward towards a supporting surface such as a floor. A downward pull causes upwardly directed resultant forces to be developed.

It has been found that up to 5 tons of pulling force can be developed by the force unit, illustrated by FIGS. **1** and **2**, when a ram **12** rated at 10 tons force is employed.

In some instances, it may be desirable to utilize the full 10 tons of force available. An alternate power member provided for this purpose, is illustrated by FIGS. **5** and **6.** As shown, an alternate power member **94** may be cylindrical and have a lower end **96** that is adapted to be attached to the piston **24** of the ram **12.** The upper end **98** is adapted to have a slot **100** having a width and depth intended to accommodate a chain link **102,** at the end of the load chain **30,** as shown. A suspended chain link **104** will serve to retain the chain **30** in the slot **100** as the power member **94** is moved in an upward direction as indicated by the arrow **105.** When employed, the power member **94** will serve to move the load chain **30** for a distance exactly equal to the distance through which the piston **24** is moved. By comparison, employment of the power member **14** (FIG. **1**) will cause retraction of a length, of the load chain **30,** equal to twice the distance moved by the piston **24.**

As shown in FIG. **6,** a removable collar **106** may be attached to the fulcrum pulley **16** with a pin **108.** The pin **108** may also serve as the axle mounting the sprocket wheel **56** between the arms **50** and **52** or may be an independent member. When the pin **108** is an independent member, the axle for the sprocket wheel **56** should have an axial bore to accommodate the pin **108.** The collar **106** may serve to conveniently enable secondary pulls to be made with a second load chain **110** that is appropriately powered, such as by a block and tackle. The benefit of using th collar is that the pulling forces may be generally directed through a common point on a force unit.

It should be noted that such secondary pulls normally involve the application of substantially lesser force relative to the primary pull. Consequently, a secondary pull will not upset the force balance of a force unit.

It may now be appreciated that a readily portable and easily employable force unit has been provided by the present invention, which force unit is not subject to extreme self-contained forces that may cause the destruction of a unit if compensating structural strength is not provided.

While a preferred embodiment of the present invention has been described hereinabove, it is intended that all matter contained in the above description and shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense and that all modifications, constructions and arrangements which fall within the scope and spirit of the invention may be made.

What is claimed is:

1. A force unit for applying a pulling force to a work piece through a flexible cable attached thereto, said force unit comprising:

a hydraulically operated ram including a cylindrical sleeve and an extensible piston, said ram being vertically positioned to enable said piston to be extended upwardly along an essentially vertical axis;

a power member operatively connected to said piston to develop said pulling force on said pulling chain by extension of said piston;

a fulcrum pulley secured to said cylindrical sleeve of said ram at a selected position along said vertical axis for directing said flexible cable from said work piece to said power member;

a support post having an elongate cylindrical configuration, said support post serving to elevate said ram, said fulcrum pulley being adapted to be secured at selected positions along said support post;

anchor means for restraining said force unit from movement in the direction of said work piece, said anchor means being connected to a stationary body independent of said work piece; and

support means for maintaining said ram in a vertical position, said support means being independent of any contact or connection with said work piece other than through said flexible cable.

2. The apparatus defined by claim **1** wherein said power member includes:

a yoke having a body portion and a pair of parallel arms extending from said body portion, said body portion being adapted for attachment to said extensible piston; and

a sprocket wheel rotatably mounted between said pair of parallel arms.

3. The apparatus defined by claim **2** further including means positioned on said ram for securing an end of said flexible cable to said force unit.

4. The apparatus defined by claim **1** wherein said power member includes a cylindrical element having a first end adapted for attachment to said extensible piston and a second end having a longitudinal slot for receiving an end of said flexible cable.

5. The apparatus defined by claim **1** wherein said fulcrum pulley includes:

a yoke having a pair of arms;

a sprocket wheel rotatably mounted between said pair of arms;

bracket means for securing said yoke at a selected position along said cylindrical sleeve; and

bias means for urging engagement of said flexible cable with said sprocket wheel, said bias means being secured to said yoke and extending between said pair of arms.

6. The apparatus defined by claim **5** wherein said anchor means includes a coupling device attached to said bracket means at a point diametrically opposite said pair of arms and situated along an essentially horizontal line extending tangentially to a lowermost peripheral point of said sprocket wheel.

7. The apparatus defined by claim **1** wherein said support means comprises a flat plate having a centrally located mounting means for receiving said support post and ram.

8. The apparatus defined by claim **7** wherein said flat plate further includes means for securing said support means to an immovable independent body.

9. The apparatus defined by claim **1** wherein aid support means includes an elongate member having:

means for receiving said support post and ram, and

means situated at one end of said elongate member for enabling an anchor member to be coupled to said support means.

10. The apparatus defined by claim **1** wherein said power member includes:

a power yoke having a body portion and a pair of parallel arms extending from said body portion, said body portion being adapted for attachment to said extensible piston; and

a power sprocket wheel rotatably mounted between said pair of parallel arms included on said power yoke.

11. The apparatus defined by claim **10** further including means positioned on said ram for securing an end of said flexible cable to said force unit.

12. The apparatus defined by claim **6** wherein said power member includes a cylindrical element having a first end adapted for attachment to said extensible piston and a second end having a longitudinal slot for receiving an end of said flexible cable.

13. The apparatus defined by claim **11** wherein said support means comprises a flat plate having a centrally located mounting means for receiving said support post and ram.

14. The apparatus defined by claim **13** wherein said flat plate further includes means for securing said support means to an immovable independent body.

15. The apparatus defined by claim **11** wherein said support means includes an elongate member having:

means for receiving said ram, and

means situated at one end of said elongate member for enabling an anchor member to be coupled to said support means.

16. A force unit for transmitting a pulling force to a work piece via a pulling chain, the force unit comprising:

a hydraulically operated ram having an extensible member and a stationary member forming two ends of the ram, extension of the extensible member operating to separate said two ends along a longitudinal axis of the ram;

a power member secured to said extensible member to be moved and thereby apply a pulling force to said work piece via said pulling chain in response to extension of the extensible member;

a base for supporting the ram in a substantially vertical position atop a supporting surface, said base being operatively connected to said stationary member and aligned along said longitudinal axis, said base being independent of any contact or connection with the work piece other than via the pulling chain;

a cylindrical support post for elevating said ram by being interposed between, and connected, to said base and said stationary member of said ram;

a fulcrum pulley secured to said stationary member of said ram for directing the pulling chain from the work piece to the power member; and

anchor means for anchoring said force unit to said supporting surface to substantially restrain movement of said force unit towards said work piece.

17. The force unit defined by claim **16**, said fulcrum pulley including:

a sprocket wheel; and

yoke means for securing said sprocket wheel to said force unit along said longitudinal axis, said yoke means including a pair of arms between which said sprocket wheel is rotatably mounted, the pulling chain engaging said sprocket wheel to direct said chain from the work piece to the power member.

18. The force unit defined by claim **17**, said fulcrum pulley further including means for urging engagement of said chain with said sprocket wheel.

19. The force unit defined by claim **17**, said anchor means including a coupling device attached to said yoke means at a point along said longitudinal axis and opposite said pair of arms, said anchor means adapted to receive an anchor chain for connection to said supporting surface.

20. The force unit defined by claim **16** further including means positioned on said force unit along said longitudinal axis for securing an end of said pulling chain, said power member including:

a power yoke having a body portion and a pair of upstanding parallel arms extending therefrom, said body portion being adapted for attachment to said extensible member of said ram; and

a power sprocket wheel rotatably mounted between said pair of upstanding arms for receiving said power chain.

21. A force unit for applying a pulling force to a work piece through a flexible cable attached thereto, said force unit comprising:

a hydraulically operated ram including a cylindrical sleeve and an extensible piston, said piston being adapted to be housed by said sleeve and extended therefrom along a longitudinal axis mutual to said sleeve and said piston;

a power pulley operatively connected to an end of said piston to be moved by extension of said piston from said sleeve;

a fulcrum pulley secured to an exterior surface of said sleeve for receiving and directing said flexible cable from said work piece towards said power pulley, said extension of said piston and movement of said power pulley causing said flexible cable to exert a pulling force on a work piece attached to said flexible cable;

cable securing means secured to the exterior surface of said sleeve for securing an end of said flexible cable to the force unit such that resultant force on the power pulley resulting from said pulling force

is directed along the longitudinal axis of the ram;

anchor means for restraining said force unit from movement in the direction of said work piece, said anchor means being a flexible member operatively connected between said sleeve and a stationary body that is independent of said work piece; and

support means for supporting said ram in an upright position, said support means being independent of any contact or connection with said work piece other than through said flexible cable.

22. The force unit defined by claim **21**, said power pulley being aligned along said longitudinal axis of said ram to receive said flexible cable, said power pulley including:

a yoke having a body portion and a pair of parallel arms extending in a direction away from said end of said piston and parallel to said longitudinal axis of said ram, said body portion attached to said end of said piston; and

a sprocket wheel rotatably mounted between said pair of parallel arms, said sprocket wheel engaging said flexible cable to produce said pulling force by the extension of said piston.

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