

July 11, 1939.

E. M. PFAUSER

2,165,504

PORTABLE HYDRAULIC METAL STRAIGHTENING MACHINE

Filed April 4, 1936

10 Sheets-Sheet 1

Fig. 1.

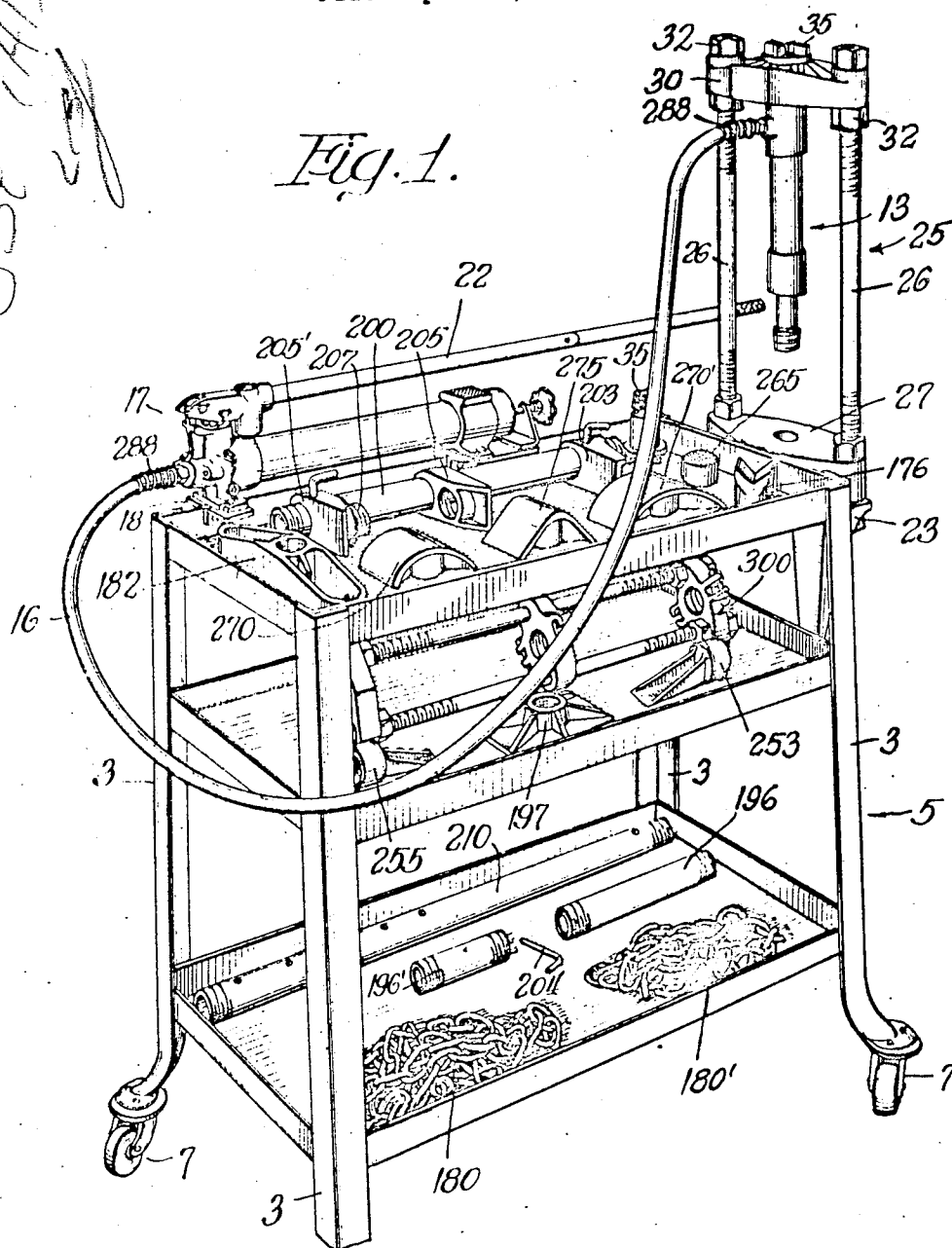
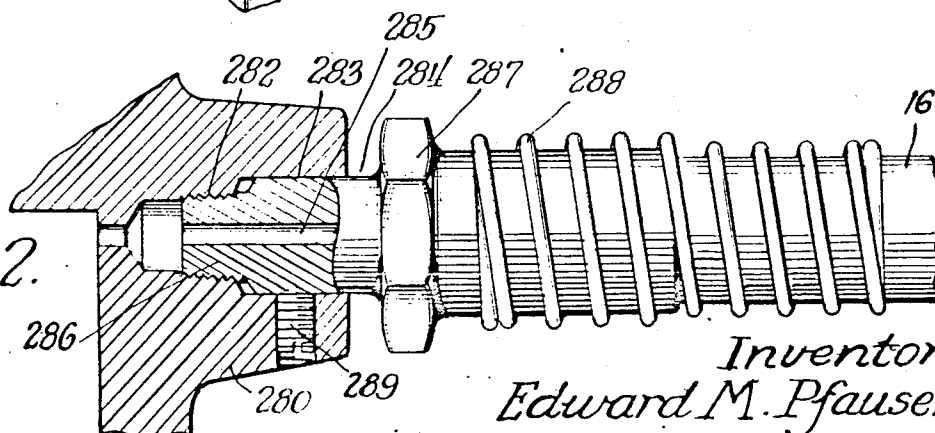


Fig. 32.



Inventor:
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By Brown Jackson Bercher, Attorneys

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PORTABLE HYDRAULIC METAL STRAIGHTENING MACHINE

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Fig. 30.

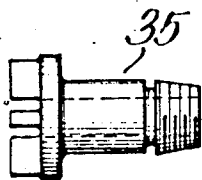


Fig. 31.

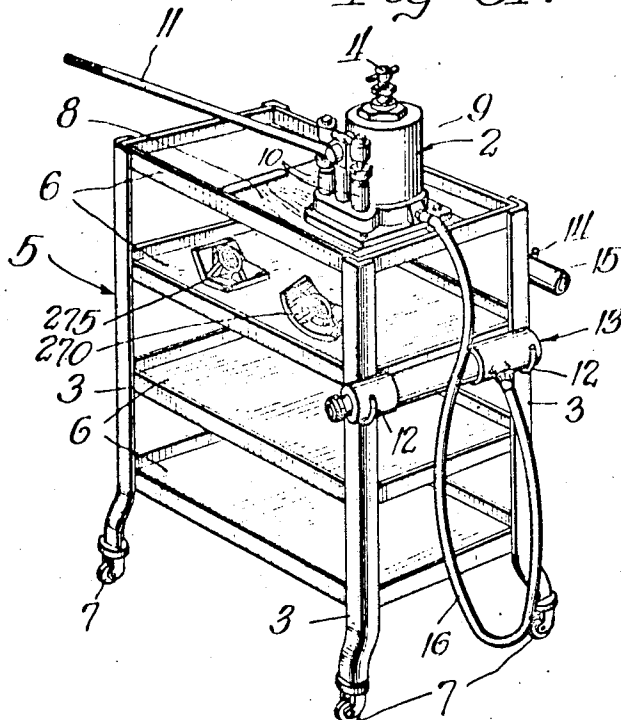
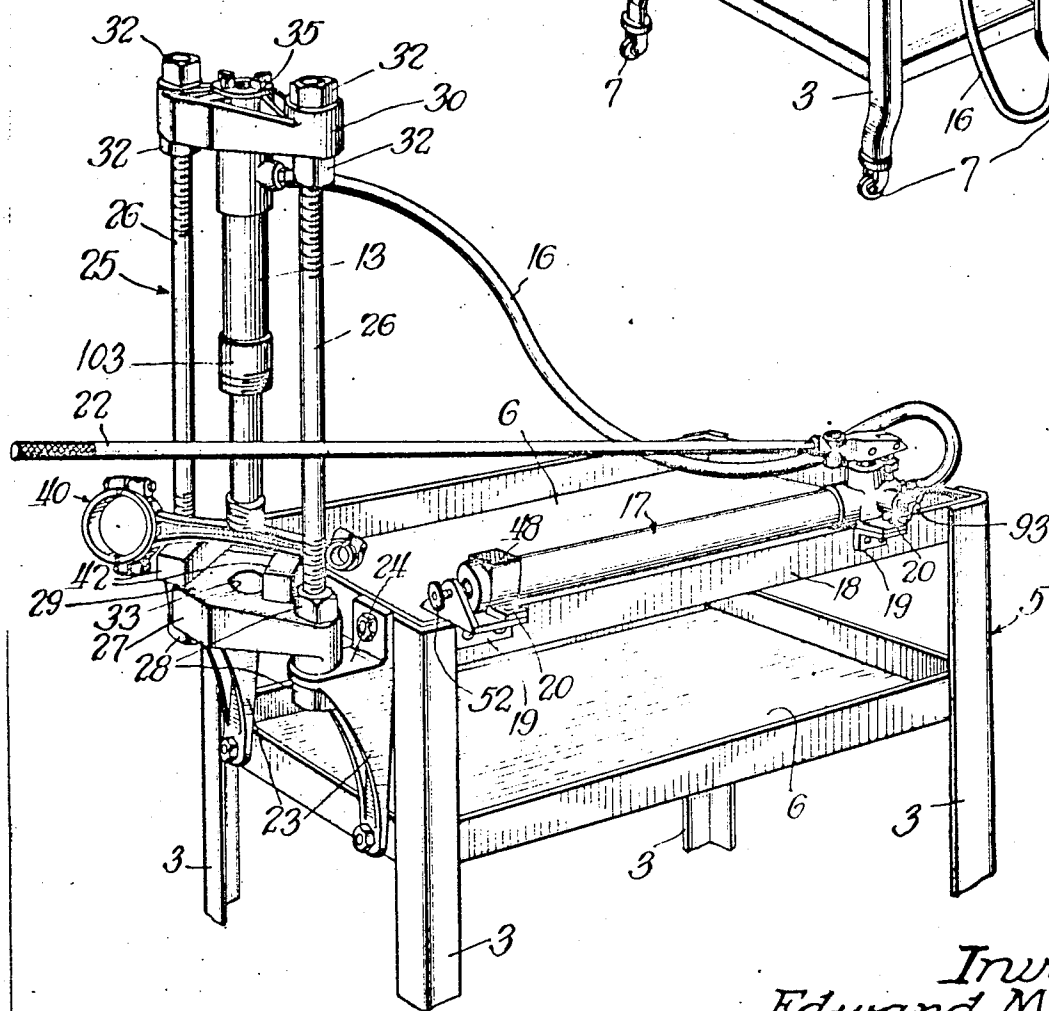


Fig. 2.



Inventor:
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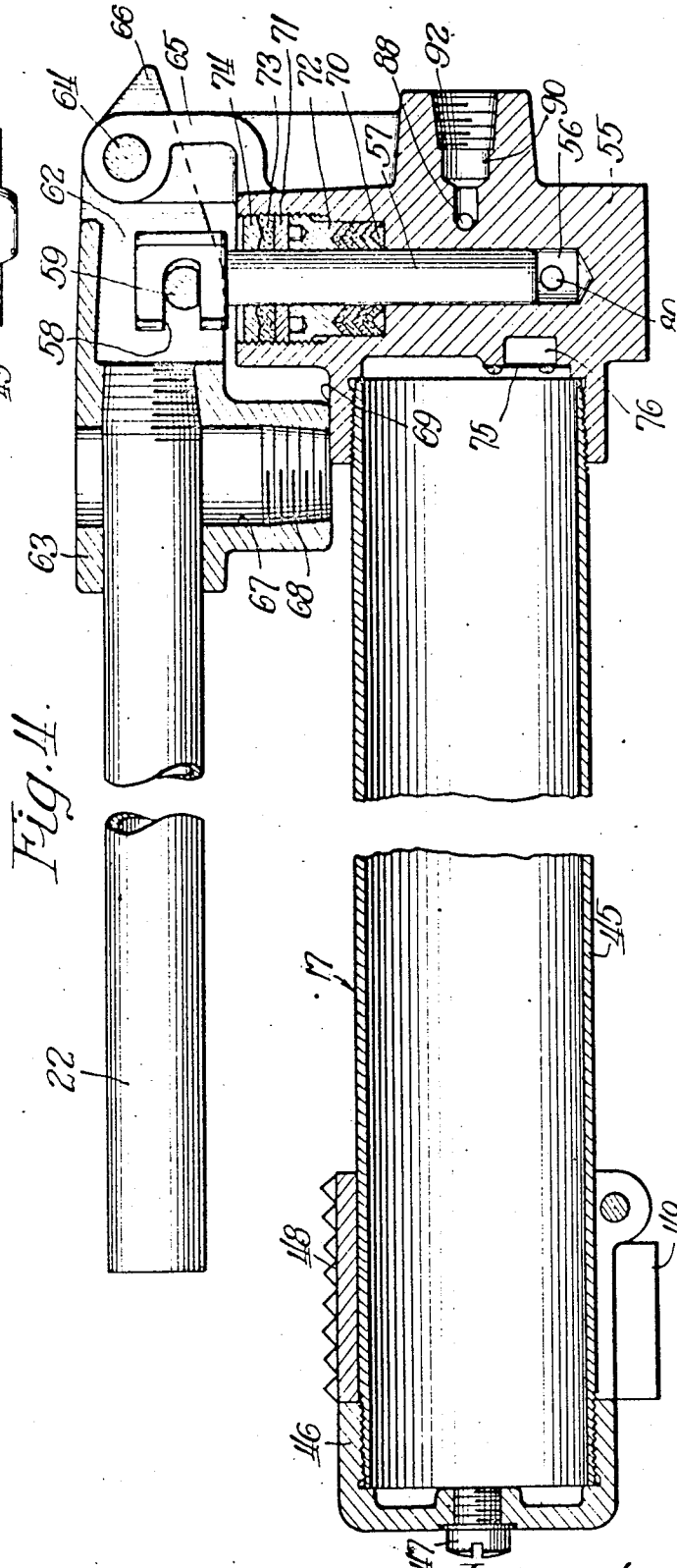
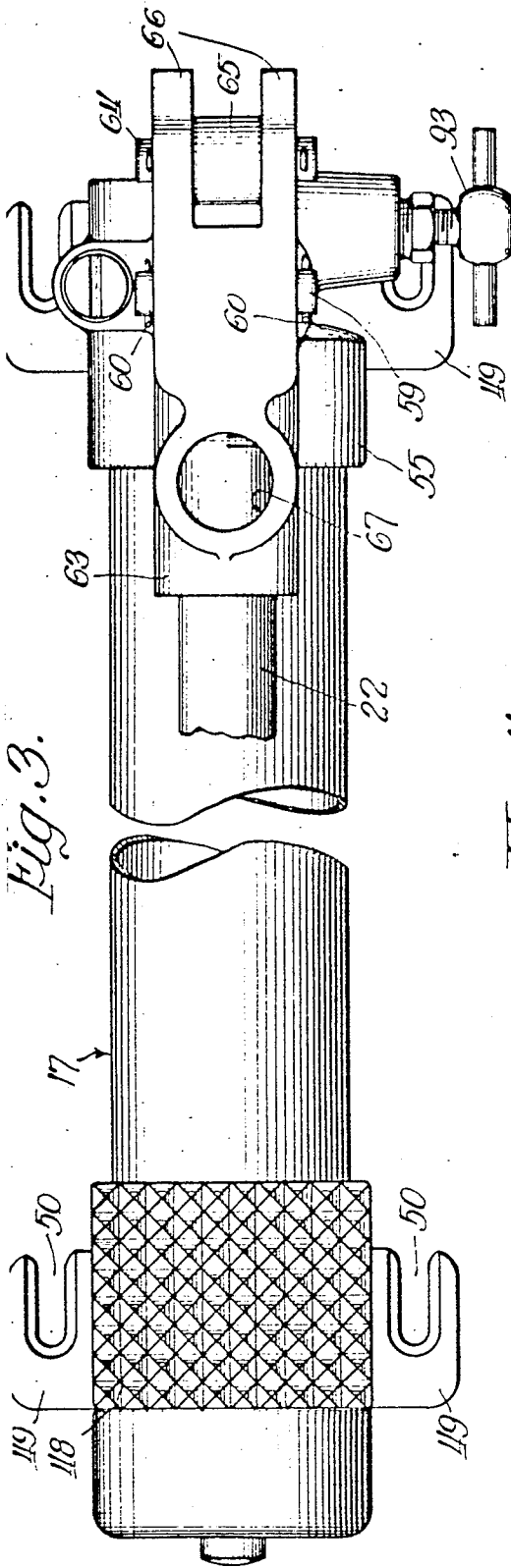
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PORTABLE HYDRAULIC METAL STRAIGHTENING MACHINE

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10 Sheets-Sheet 3



Inventor:
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PORTABLE HYDRAULIC METAL STRAIGHTENING MACHINE

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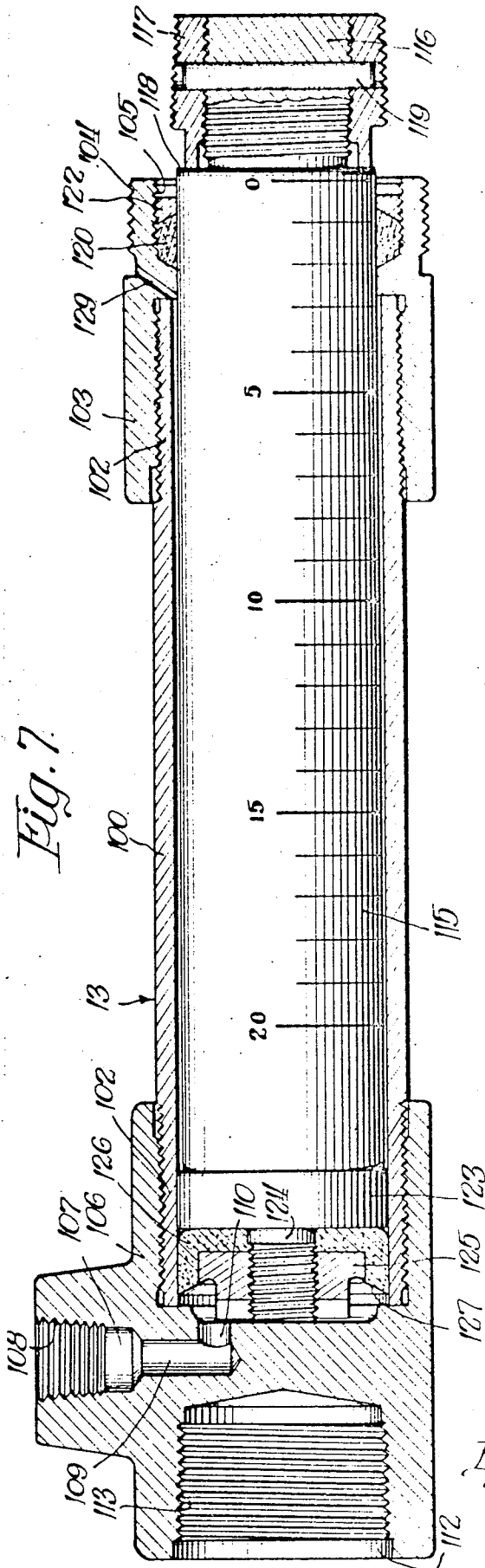


Fig. 5.

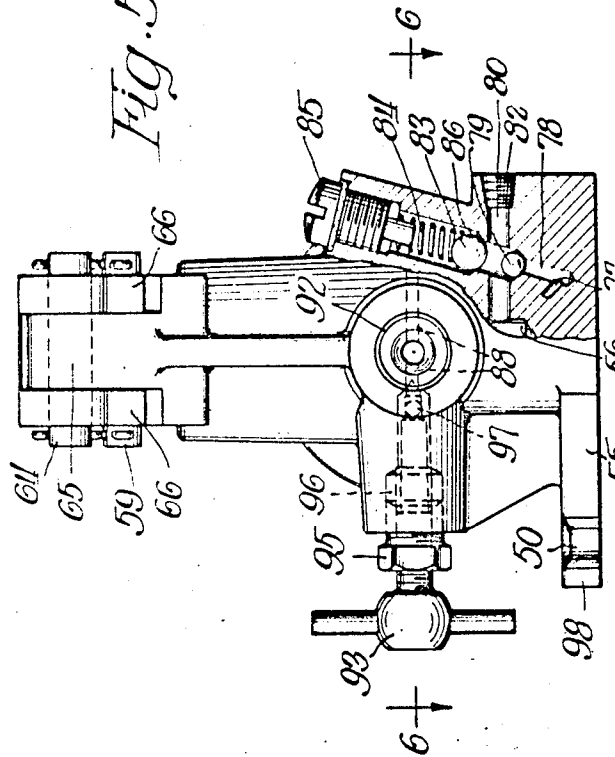
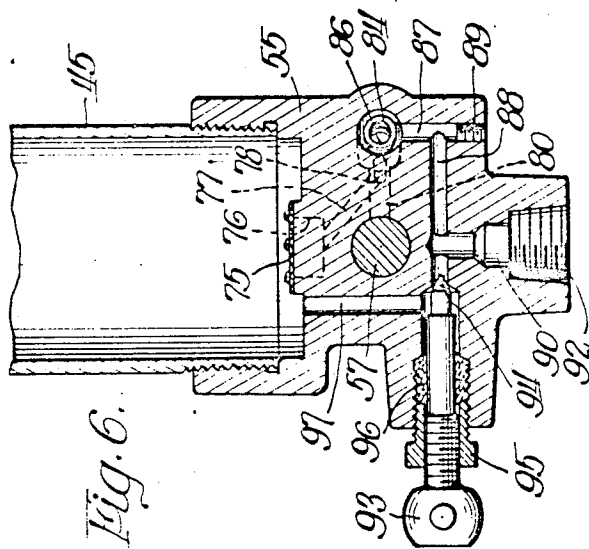


Fig. 6.



Inventor:
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PORTABLE HYDRAULIC METAL STRAIGHTENING MACHINE

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Fig. 8.

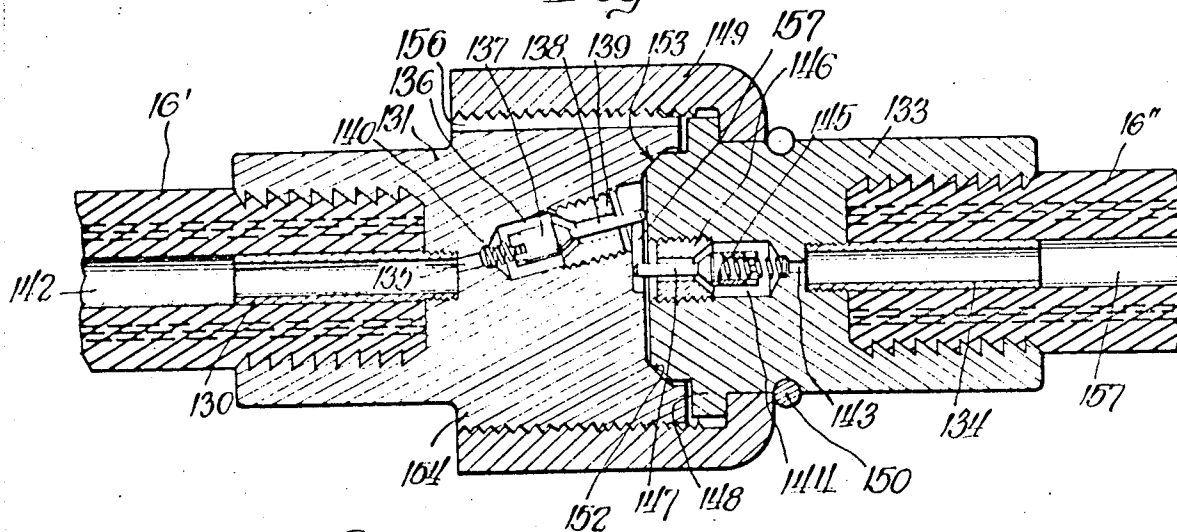


Fig. 9.

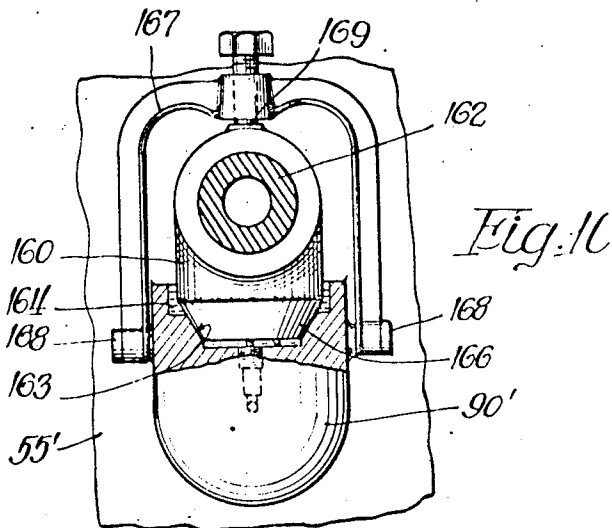
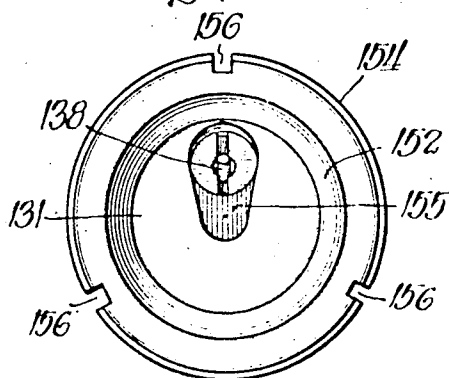


Fig. 12.

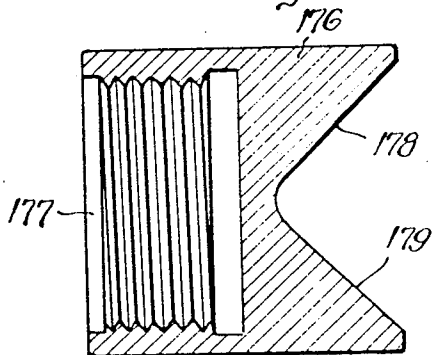
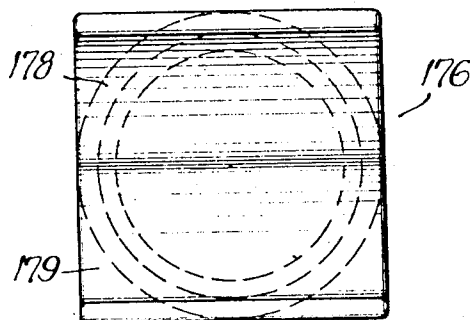


Fig. 13.



Inventor:
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Fig. 17.

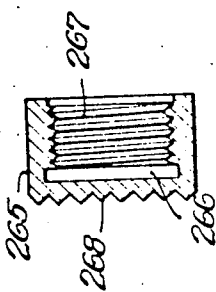


Fig. 16.

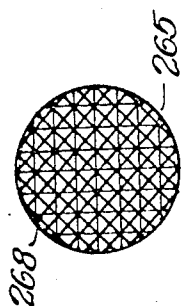


Fig. 14.

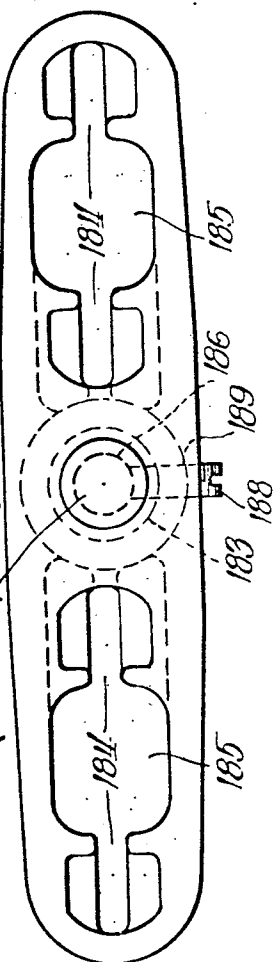


Fig. 15.

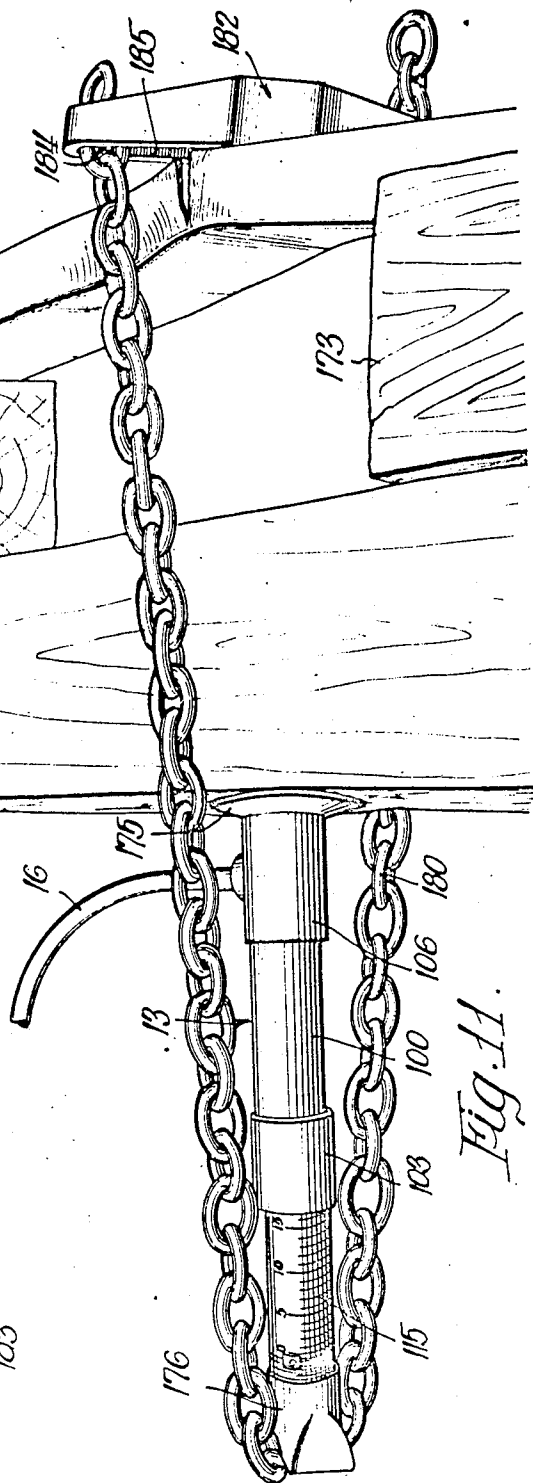
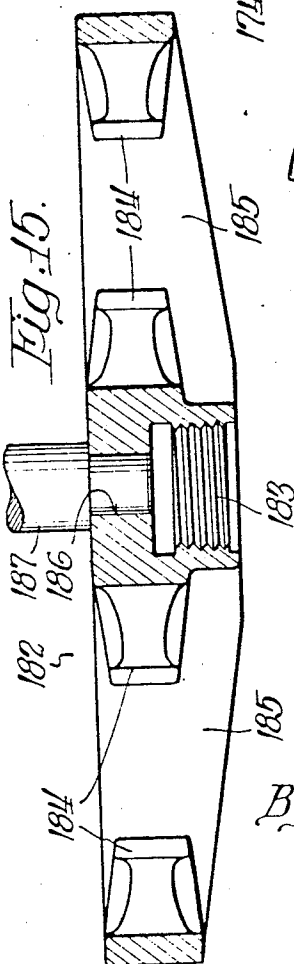


Fig. 11.

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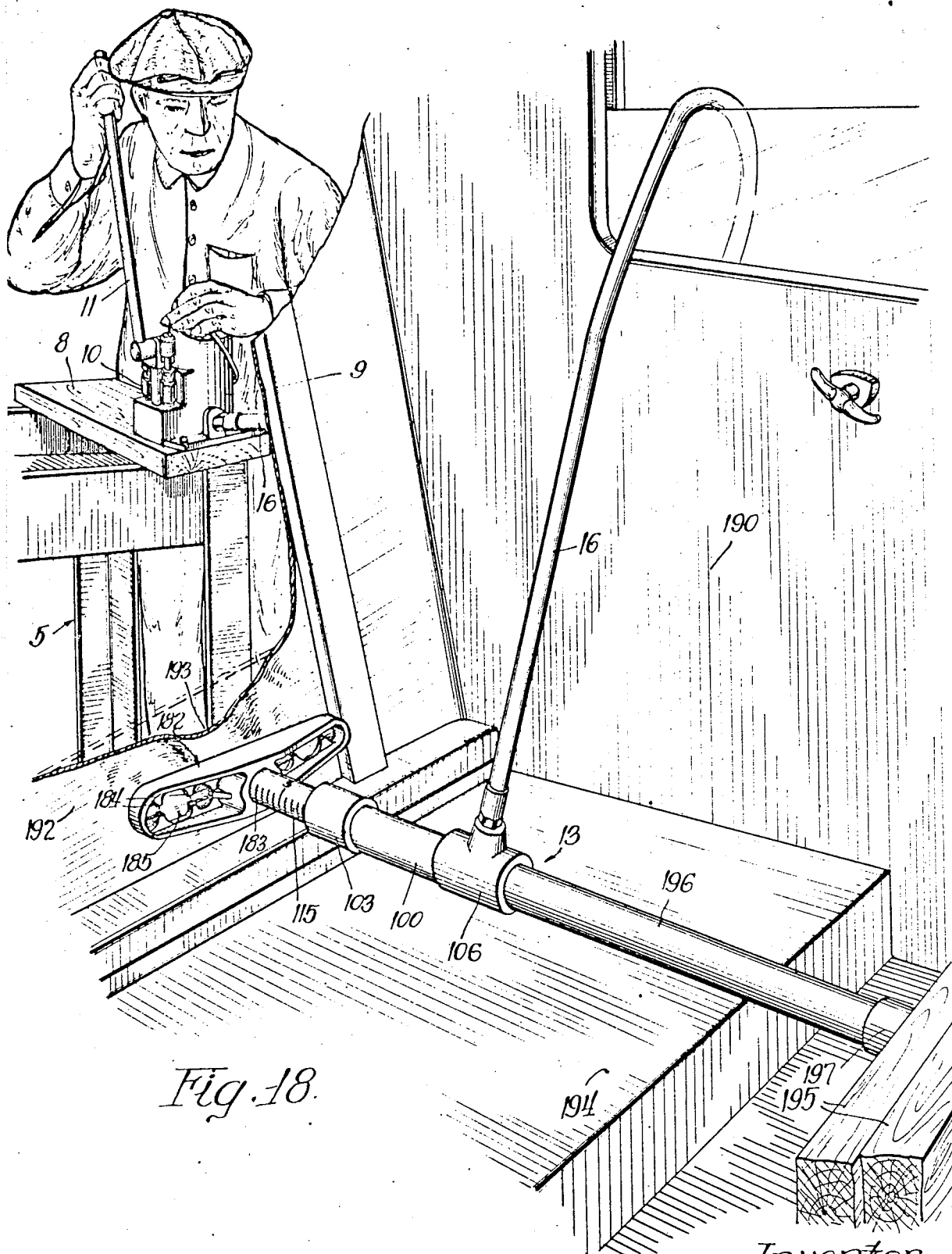


Fig. 18.

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PORTABLE HYDRAULIC METAL STRAIGHTENING MACHINE

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Fig. 19.

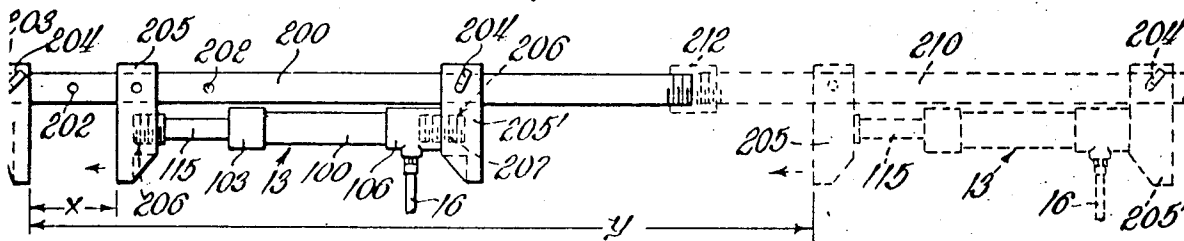


Fig. 20.

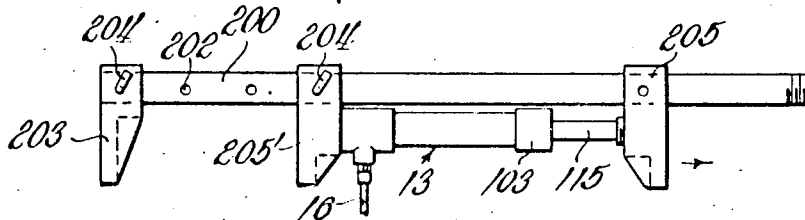


Fig. 21.



Fig. 22.

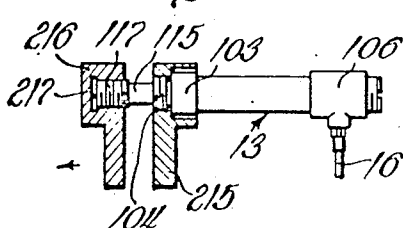


Fig. 23.

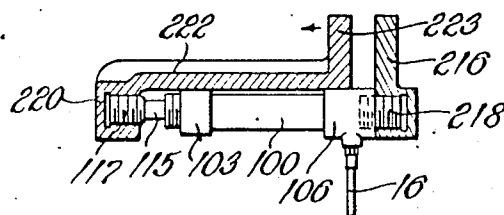


Fig. 24.

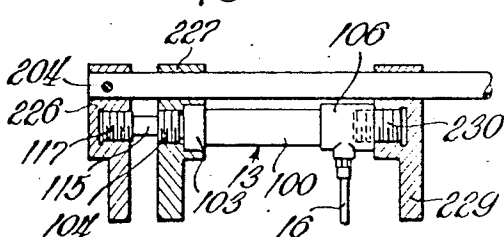
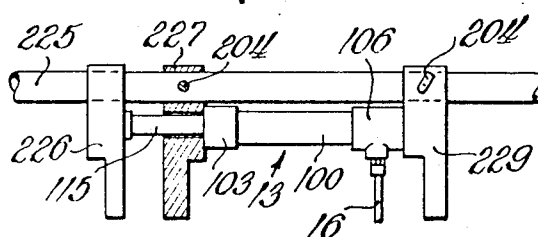


Fig. 25.



Inventor:

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By *Max Jacobson* Attorney

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2,165,504

PORTABLE HYDRAULIC METAL STRAIGHTENING MACHINE

Filed April 4, 1936

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Fig. 26.

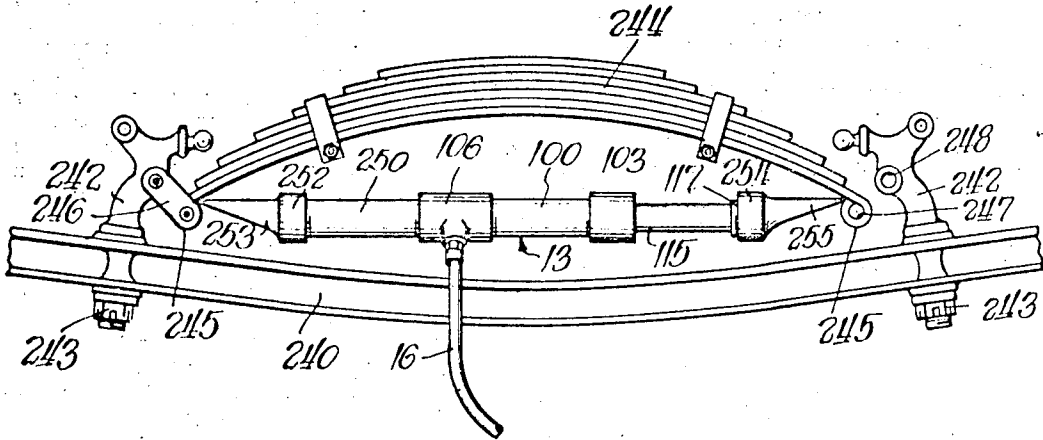


Fig. 28.

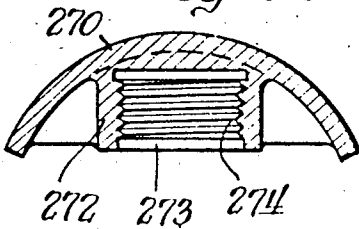


Fig. 29.

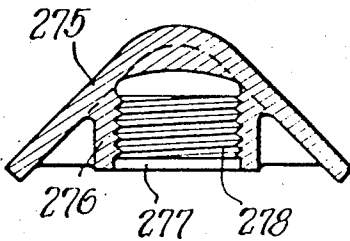
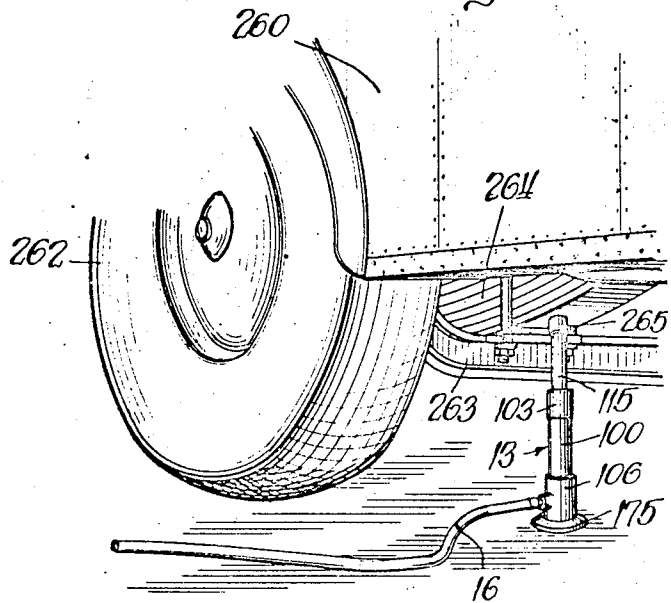


Fig. 27.



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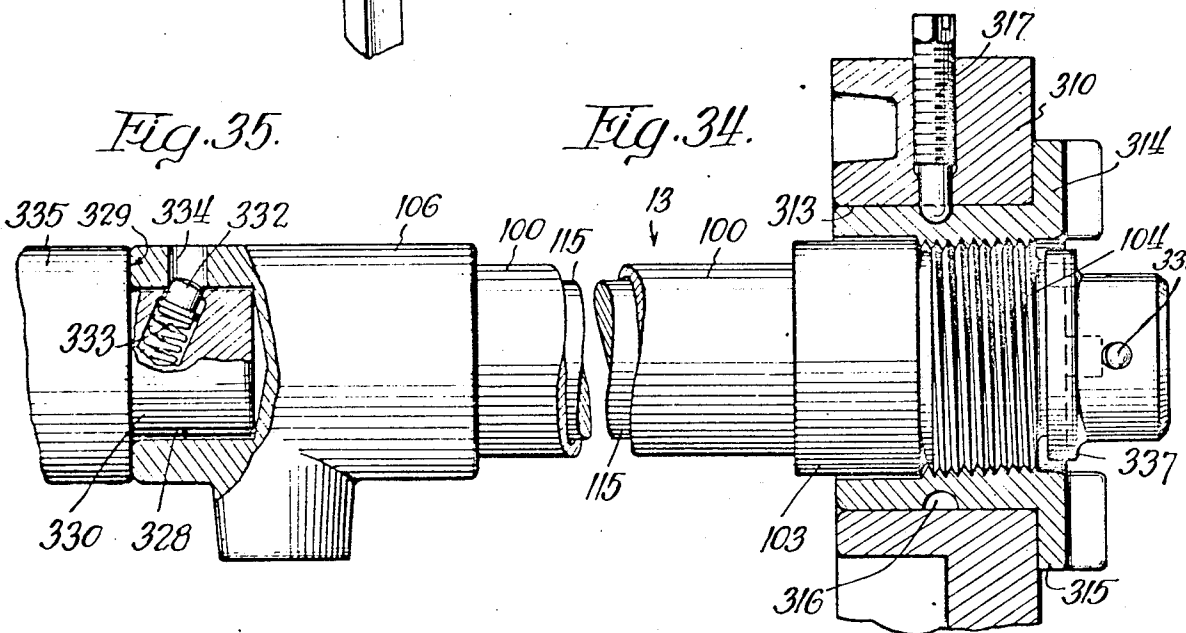
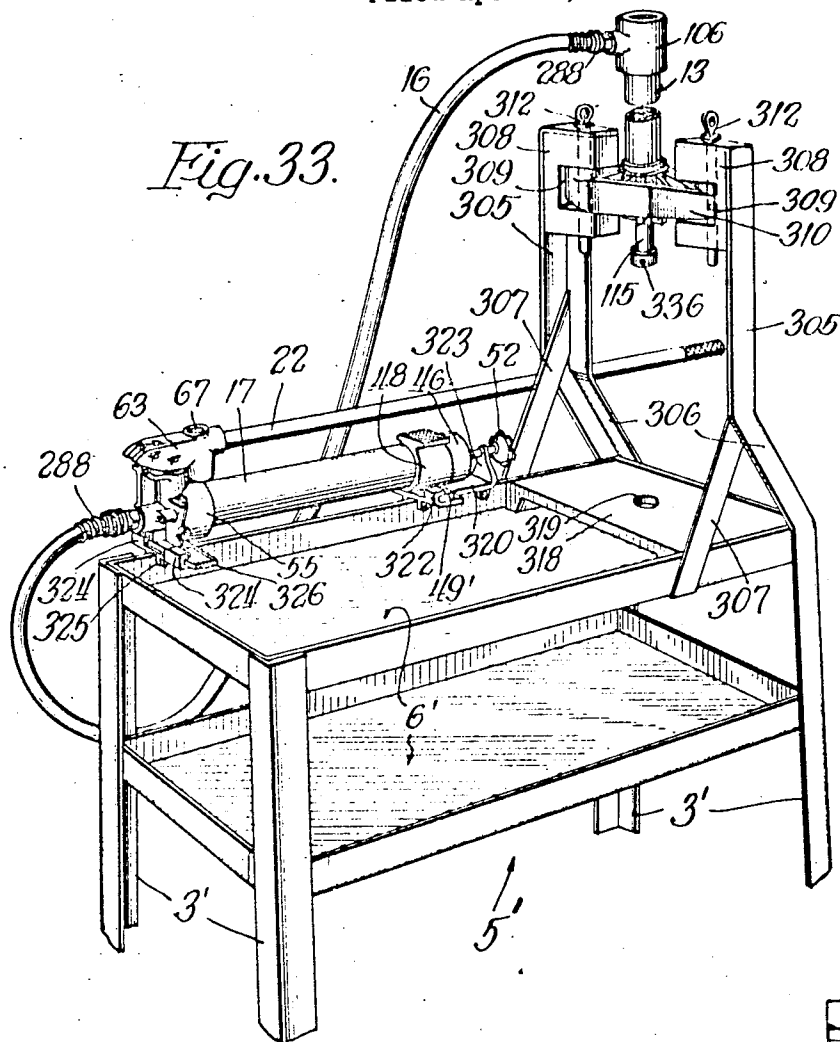
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PORTABLE HYDRAULIC METAL STRAIGHTENING MACHINE

Filed April 4, 1936

10 Sheets-Sheet 10



Inventor:
Edward M. Pfauiser.

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UNITED STATES PATENT OFFICE

2,165,504

PORTABLE HYDRAULIC METAL
STRAIGHTENING MACHINEEdward M. Pfauser, Elm Grove, Wis., assignor to
Blackhawk Mfg. Co., Milwaukee, Wis., a cor-
poration of Wisconsin

Application April 4, 1936, Serial No. 72,750

23 Claims. (Cl. 153—32)

My invention provides a portable hydraulic metal straightening machine. The machine of my invention is particularly applicable to automobile repair work. While it may be applied to other uses it finds a maximum utility in the straightening or reshaping of bent or deformed frames, bodies, fenders, etc., as well as the various incidental applications of force to various parts to force them apart or together, as the case may be.

The present application is a continuation in part of my copending application, Serial No. 4,728, filed February 4, 1935.

There has been a demand of long standing for a machine applicable to the various operations involved in repairing automobiles damaged by collision or the like, which machine will provide for the ready and convenient application of a large amount of force, but under the most minute and accurate control. Such a device should be conveniently applicable to various straightening or bending operations. The operator should be able to observe the action of the device, even though the force must be applied at a point or from a position which is concealed from the view of the operator. That is to say, the operator should be able to stand at a position where he can observe the straightening effect, for example, sight along a beam or bar, or see the outside of a dented sheet metal part which is being straightened, while he is producing, or applying the necessary force. The machine should not require excessive exertion on the part of the operator. A machine constructed in accordance with my invention should have relatively great capacity and should operate at extremely high unit pressures in order to keep the mass and size down to where the machine may be conveniently placed and operated by a single operator, while retaining all the essential characteristics of portability, manual operation, and safety in use.

Such a machine should be able to produce a pure straight line force in tension or compression, between parts to be pulled or pushed together or apart, and it should be able to do this no matter how narrow or how wide the spacing.

The machine should preferably be hand operated, for simplicity and low cost. Also, it should, if motor operated, be under most accurate and sensitive control.

The available force should be very great, and yet its application should be attended with no danger to the operator or to the work. To this end there should be no tendency, as in hand operated jacks employed in the prior art, to slip,

due to the reaction of the force applied by the operator in actuating the device. That is to say, jacks, both mechanical and hydraulic, as now employed are dangerous and inconvenient to use, as the reaction of the leverage of the force applied by the operator tends to produce slippage of the jack with respect to the work. As a result many operations cannot be performed by pressure and resort must be had to hammering, which is frequently lacking in effectiveness, often inconvenient, and usually injurious to the part operated upon.

Such a machine should have the convenience of a tool, but provide the inherently guided and controlled action of a machine.

Such a machine should be readily applicable to various surfaces, areas, modes and directions of applying its effect. It should be able to act in confined places without diminution of effect or speed of operation. It should be able to work on close spacing or where parts are at considerable distance from each other, or from a support.

Such a machine should be able to produce and exert a high degree of force upon a part of the automobile to be straightened or forced into desired position, even though no stable base or foundation is available for taking up the reaction of the pump.

Such a machine should have no lost motion, or overthrow. There should be no yield in any of the parts. It should be light, strong, conveniently transportable to the work, and easily applicable to the particular operation to be performed. It should be capable of being conveniently operated by one man. It should comprise no heavy parts inconvenient to handle or to apply.

Such a machine should have the capability of performing numerous incidental operations, or general operations, along with the ability to perform its special work.

Such a machine should be inexpensive, so that it is available to small shop owners, and be widely available to the public.

Such a machine should have simplicity of connection between the pump unit and the ram unit, capable of accommodating any desired ram disposition, and controlled by a positive seating reliable single control member which can be readily manipulated by the operator.

Now it is the chief object of my invention to provide a machine which will fulfill the above and numerous other requirements.

The particular embodiment of my invention

which I shall hereinafter describe in detail, fulfills all of the above requirements and secures, in addition, certain resultant advantages which indicate the marked advance in the art which it has produced.

The machine of my invention is of low cost. This enables a small shop to employ it as equipment and compete in quality and speed of output with larger shops more elaborately equipped, or able to purchase and employ more expensive equipment.

The speed of operation of the present device on a repair job is much greater than was ever possible with the most advanced equipment heretofore known. For example a job that under prior methods of repair i. e. with previously known equipment would take 20 man hours, was by the aid of my machine done in 7 man hours. This is reflected in lower cost to the public.

The quality of work done by my machine is superior to that done by the best of prior equipment. The accuracy of operation and the certainty with which accurate results are obtainable expedites and improves operations.

With the present machine it is possible to do certain straightening operations by pressure which previously could only be done by impact i. e. hammer blows. Now it is to be observed that most automobile collision repair work is no more than straightening out bent parts or unfolding thin metal parts that have been dented or wrinkled by collision or impact. I have found that most such parts can readily be bent back into their original shape or straightened. Where sheet metal parts are involved it is usually a case of pushing out dents or unfolding wrinkles. For this the slow powerful and accurately controlled motion produced by my machine is ideal.

Now in attaining the above objects and advantages and meeting the above demands I have provided an unusually simple and inexpensive but highly effective machine. In constructing my machine I have conceived as the central thought a simple hydraulic system involving a pump preferably manually operated or at least manually controlled, a small and light hydraulic ram of a size that can conveniently be carried in and placed by one hand employed as the force converting medium and a flexible connecting conduit of convenient length. The ram is provided with quick detachable coupling parts so that the ram may be connected to and operate upon the work through various work engaging and reaction absorbing devices. These quick detachable couplings are preferably telescopic in character, i. e., consisting of sockets and studs telescoping longitudinally so that the ram may exert its force through a column or strut, i. e., be braced inherently against lateral displacement, and they are interlocked against endwise separation. In the preferred form of the present invention the machine has a normal load capacity of seven tons and operates at pressures up to 7500 pounds per square inch, but can be safely loaded to ten or twelve tons and operated at pressures from 10,700 to 11,500# per square inch, but the ram unit still retains an overall diameter of only 2½" and a total length of only 11½ inches, and weighs less than ten pounds. The flexible connecting unit and ram unit are capable of withstanding bursting pressures of over 20,000 pounds per square inch.

In a practical embodiment of my invention this central concept is elaborated in order to

support certain desired capabilities, among others the following:

First, the machine must be applicable to all ordinary operations encountered in repairing a damaged automobile. This involves straightening out and reforming fenders, bodies, frames, running gear, motor parts and the like. Two distinct classes of operations are required to be performed, namely, first pushing, i. e., compression, and second, pulling, i. e., tension. For each there is the further requirement that there be two conditions met, namely, first, that a suitable engaging member, to move or shift or press upon the part or surface to be worked upon, be provided, and second, that a suitable engaging means, for firmly bearing upon and safely retaining engagement with whatever abutment or support is available, to take up the reaction of pushing or pulling, be provided. Also there is the requirement for quick and simple adjustment of the spacing of the operating parts, so that spacing requirements are easily met.

Each part of the machine must be developed with a view to meeting fully the above requirements. Certain features looking to this are the following: compactness of the ram, to go into or act within almost any space requirements commensurate with the dimensions of an automobile or other vehicle to be repaired; a wide variety of working devices and appliances, both for the work to be engaged and the abutment or reaction support; ease in interchanging or adjusting the working appliances, some of which are quite elaborate machines in themselves; suitability of the pump unit for support, both conveniently near the working device, i. e., the ram and its work-engaging appliance, and independent of the working device; suitability of the pump to be operated under widely varying conditions and in various positions and in confined spaces; flexibility and strength of the connecting hose. The hose should be long enough to allow of convenient performance of all usual operations. It should be strong and non-yielding for hydraulic pressure, but flexible for convenient placing of the parts. The hose should not, by kinking or writhing, transmit any displacing force to the working device or to the pump, nor should it be capable of loosening the hose couplings. The hose should be relatively short.

Second, the machine and all its parts and work-engaging appliances are made conveniently portable. This capability includes not only the portability of the machine as a whole, but includes convenient portability of each of the parts with such independence as is permitted by the hose and the separability of the appliances. The entire device, with all its parts, is conveniently assembled upon a supporting frame which is designed to be readily movable on caster wheels, but which has the parts of the machine so disposed thereupon that maximum stability is provided, and at the same time unusual convenience and facility of operation are secured.

Third, the machine, with its working appliances, is surprisingly compact when the wide variety of operations that can be performed by it are taken into account.

Fourth, the machine is developed with a view to convenience of adaptability to various operations and conditions, and rapid change from one operation to another. When the machine is set up to perform one special operation it may quickly and conveniently be changed over to

another set-up without the use of tools. Likewise, the various adjustments for different spacing may be made quickly, conveniently and positively.

5 Fifth, the supporting stand forms a frame having a peculiar utility in the use of the present machine. First, it carries the pump about waist-high, in a suitable position for the application of maximum force by the operator with minimum effort. Next, it serves as a convenient support for the ram when assembled with one of the working appliances to form a press. The pump being so placed that the handle is in a most convenient position for operation, not only to operate the press but also numerous other appliances.

10 Sixth, the hose is, in one optional form of my invention, made disconnectable for convenience in placing the parts. This is arranged with suitable means to prevent leakage of liquid, which is preferably oil, and to exclude air. By this arrangement additional lengths of hose may be employed if desired.

15 The present invention therefore has as a primary object the provision of a machine which is light in weight, all directional and powerful in action, simple and safe in operation, and small in size. The three units comprising the basic elements of the machine, namely, the pump, ram, and hose units, have a total weight of only slightly more than twenty-five pounds, over half of which is in the pump unit supported on the portable frame. The ram unit is capable of delivering its full rated capacity of pressure in any direction and between any reaction element and work element. By reason of the flexible connection effected by the hose, the operator can stand away from the work a distance sufficient to assure his safety in case of slippage or breakage of the parts, and simple reciprocatory motion of the operating handle of the pump, together with manipulation of the single valve member, affords him full and entire control of the operation of the device. Each of the units is of relatively small size and can be readily carried in one hand for positioning or attachment.

20 Other objects and advantages of the present invention will appear more fully from the following detailed description, which, taken in conjunction with the accompanying drawings, will disclose to those skilled in the art the particular construction and operation of a preferred form of the present invention.

In the drawings:

25 Figure 1 is a perspective view of the preferred embodiment of my invention, with the ram combined with one of the working appliances to form a hydraulic press;

30 Figure 2 is a perspective view from the opposite side of Figure 1, showing the machine as operating upon a connecting rod to straighten the same;

35 Figure 3 is a top plan view, on approximately three quarter scale of actual size of the pump unit shown in Figure 2;

40 Figure 4 is a vertical sectional view on a scale similar to Figure 3, of the pump unit shown in Figure 3;

45 Figure 5 is an end elevational view on three-quarter scale, partly in section, of the pump unit shown in Figure 3;

50 Figure 6 is a sectional view taken substantially on line 6-6 of Figure 5;

55 Figure 7 is a full scale vertical sectional view through the ram unit;

Figure 8 is a sectional view through a flexible coupling between two parts or lengths of the flexible connecting hose;

Figure 9 is an end elevational view of one of the coupling elements shown in Figure 8;

Figure 10 is a detail view, partly in section, of a modified form of coupling means;

Figure 11 is a perspective view showing one manner in which the ram unit may be employed in straightening a bent frame;

Figure 12 is a vertical sectional view through one of the appliances adapted for use with the ram;

Figure 13 is a front elevational view of the appliance shown in Figure 12;

Figure 14 is an elevational view of another appliance which may be employed with the ram unit;

Figure 15 is a sectional view through the appliance shown in Figure 14;

Figure 16 is an end elevational view of a serrated form of head which may be employed with the ram unit;

Figure 17 is a vertical sectional view through the head shown in Figure 16;

Figure 18 is a perspective view, showing the manner in which the back panel of an automobile body member may be straightened by the power unit of the present invention;

Figure 19 is a side elevational view of an appliance for exerting a gathering or compressive force, with the ram unit built therein;

Figure 20 is a diagrammatic view showing the appliance set up with the ram therein and acting as a spreading device;

Figure 21 is a detail view of the locking pins shown in Figures 19 and 20;

Figure 22 is a modified form of a spreading appliance operating in a small space, with the ram itself serving as the guide;

Figure 23 shows a modified spreading appliance for heavy duty, also using the ram as a guide;

Figure 24 illustrates an appliance with external guide means and two jaws providing different spacings for spreading;

Figure 25 shows a modification of the use of the appliance shown in Figure 24;

Figure 26 illustrates the ram unit set up so that it constitutes a spring spreading appliance;

Figure 27 is a perspective view illustrating the use of the ram unit set up as a lifting jack;

Figure 28 is a vertical sectional view of an appliance which is particularly useful in fender straightening work;

Figure 29 shows an appliance similar to that of Figure 28 and used for the same class of service;

Figure 30 is a side view of the anchor bolt for securing the cylinder of the ram to either end of the yoke;

Figure 31 is a perspective view of another embodiment of my invention employing a double-acting pump;

Figure 32 is a longitudinal section through a hose coupling of my invention;

Figure 33 is a perspective view of a stand for the machine, having the ram unit combined with a modified form of press;

Figure 34 is a sectional view showing the manner in which the ram is supported in Figure 33; and

Figure 35 is an elevational view, partly in section, showing a modified form of detachable connection.

In the embodiment illustrated in Figures 1 and 2 there is shown a pressed metal stand 5 having a

series of flanged trays or shelves, in this case three, pressed from heavy sheet stock and mounted on the legs 3 which are formed of angle iron stock, or pressed into angle iron form out of sheet stock. The corners of the trays are preferably welded to the legs to secure the parts rigidly and permanently together. The legs 3 are provided with caster wheels 7 so that the stand and supported parts may conveniently be rolled to any desired place on the floor of the shop. There is a peculiar utility in the stand in that it is not only a suitable support for the pump and the ram and press or either the pump or ram and press, but also it is a convenient support for the work engaging appliances. And these appliances not only are always conveniently at hand, but also add weight and stability to the stand, so that the reaction of the pump or the added weight of a piece of work in the press do not unbalance the stand.

A single acting pump is clamped to the vertically extending defining edge 18 of the top shelf 6 by means of fixed angle brackets 19 which are secured upon opposite sides of the vertical edges of the tray 6. These brackets are adapted to support headed pins or studs 20 which fit into slots 50 in the feet 49 carried by the pump unit 17. The unit 17 is provided with a removable rodlike operating handle 22, which may be swung up and down to operate the pump plunger 57 (see Fig. 4).

There is a peculiar advantage in the single-acting pump disposed as shown on the stand and supported about waist high, in that a workman can readily, by straightening out his arm, put substantially his entire weight upon the handle 22, thereby exerting maximum force. The double-acting pump of Figure 31 will permit more rapid operation, but if the maximum load should be encountered upon the upstroke the workman is at a disadvantage, and also the wheel base of the stand is disadvantageously disposed.

One end of the stand 5 of Figure 2 is provided with a pair of bracket members 23, suitably secured in fixed position with respect thereto, and which have laterally projecting shoulder portions 24 upon which is mounted the bottom pressure plate of a press unit indicated generally at 25.

The press unit 25 comprises a pair of yoke members or press rods 26 which, at their lower ends, pass through the base plate member 27 and are secured by suitable nuts 28 to the shoulder portions 24 of the bracket members 23. The base member 27 is of relatively solid and heavy construction, and preferably has a flat surface 29 extending between the yoke rods 26. At their upper end the yoke rods are provided with a second connecting member 30, secured thereto by means of nuts 32, the member 30 corresponding to the member 27. The length of the yoke is thereby adjustable. Also, by removing the lower nuts 28 the yoke may be removed from the stand. The press plates 27 and 30 are provided with flat spots so that the press may be laid in stable position on a flat support, such as a floor or bench.

Extending centrally through the member 30 is an opening, corresponding to the opening 33 in the member 27, and the base of the ram unit 13 is adapted to be locked in position with respect thereto by means of the bolt 35 shown in Figure 30, having an extending stud projecting through this opening. The ram unit 13 is connected to the pump unit 17 by means of the flexible connecting hose 16, so that the liquid discharged by the pump 17 may be transmitted to the ram unit 13, and when the relief valve 93 is opened it may

be returned to the reservoir. This hose is made expressly for high pressure work and comprises a synthetic rubber inner tube about $\frac{1}{4}$ " internal diameter with alternate layers of high tensile wire braid or wrapping and layers of the rubber composition. A final exterior coating of synthetic rubber is then applied, with the layers and coatings all being then vulcanized together. The head end of the cylinder of the ram 13 is disposed in depending position within the press rods 26, and serves to guide the ram plunger for movement outwardly of the ram cylinder. The threaded end of the plunger is thus moved downwardly under hydraulic pressure toward the opening 33. The outer end of the ram plunger is provided with a threaded head, so that a suitable contacting appliance may be fitted thereupon to engage the work which it is desired to operate upon. The supporting stand constitutes a frame for the pump and press, and also forms a convenient receptacle and support for the various appliances which may be used in the various operations to which the machine is applied.

In Figure 1 I have illustrated a number of such appliances suitable for performing substantially all of the chief operations which may be involved in straightening out a damaged automobile. First, the simple appliances for adapting the ram to exerting pressure on sheet metal parts, such as fenders and the like, are shown at 270, 270' and 275. A simple form of base for engaging the flat surface of the floor or the like, for either the plunger or the cylinder, is shown at 197. These appliances, 270, 270', 275 and 197 may be fastened directly to the head of the ram plunger by threading thereupon, or they may be secured to the rear end of the cylinder by the employment of a pipe nipple illustrated at 207.

A bar for connecting with and using a chain is shown at 182.

A serrated head is shown at 265 and a V-shaped head is shown at 176. These heads may be employed on either end of the ram, as will appear later.

Adjacent the pump on the upper tray, I have shown a pushing and pulling appliance, involving the length of pipe 200, the jaws 203, 205, and 205' and the nipple 207. Additional lengths of pipe are shown at 210, 196, 196', on the lowermost tray. A number of locking pins are shown at 204. Spring spreader heads 253 and 255, for use in spreading a spring as shown in Figure 26, are illustrated on the second shelf. Also, on the second shelf, is shown the pulling appliance adapted for the use of two chains. This comprises fixed heads at the opposite ends of a pair of rods, and a slidable head guided on the rods. A slidable head and one of the fixed heads are threaded to receive a cylinder and plunger of the ram, and the chains at 180 and 180' are adapted to be employed with the fixed and movable heads for pulling together two members which can be engaged only by a chain.

While this by no means exhausts the appliances which may be operated and which may form a part of the present invention, they serve to perform most of the ordinary operations encountered in straightening parts of a damaged vehicle, or in performing incidental operations in connection with the repair or servicing thereof.

I have illustrated in Figure 2 one manner in which the ram unit may be employed for the straightening of a connecting rod 40. This rod is disposed upon a pair of block members 42, and is adapted to be straightened by pressure applied

by the end of the plunger, the plunger being forced against the connecting rod 40 by means of hydraulic pressure developed by the pump 17. Any desired bending, forcing, or straightening

5 may be produced by the press.

If desired, the ram unit 13 may be reversed in position, in which case its base is mounted over the opening 33 and held thereon by bolt 35. The ram plunger then extends vertically thereabove

10 within the rods 26, and operates against or toward the upper platen 30.

Referring now in detail to the construction of the pump unit 17, which is shown in Figures 3 to 6, inclusive, the unit comprises a reservoir cylinder, indicated at 45, which is threaded at its

15 opposite ends, the outer end of the reservoir tube or cylinder receiving the reservoir cap member 46, which is provided with a suitable opening through which oil or other liquid may be admitted to the interior of the reservoir to charge

20 the same. In practice I find that light mineral oil, such as S. A. E. #10W may be employed, the capacity of the pump with the hose and ram being about one quart. This opening is preferably

25 closed by the filler plug 47, suitable gasket means being provided for preventing leakage.

A foot rest and clamp member, indicated generally at 48, is clamped about the outer end of the reservoir 45 adjacent the cap 46. It preferably

30 has its upper surface serrated in order to provide for firm gripping thereof by the foot of the operator when the pump unit is disposed for operation upon the floor. The clamp 48 is provided with oppositely extending lugs or feet 49 at the

35 lower portion thereof, which feet portions are provided with slots 50 extending lengthwise from one end thereof, the slots 50 receiving securing

40 means, such as the headed pins 20, for holding the feet of the pump 17 to the brackets 19 of Figure 2. Suitable clamp means, such as the

45 hand wheel 52 and threaded stem shown in Figure 2, may be provided for engagement with the filler cap 47 for thrusting and holding the pump unit in position by causing the slots 50 at each

50 end of the pump to pass under and be held by the headed pins or rivets 20. The pump reservoir is made of considerable length for a number of reasons. Its length renders it suitable for

55 manual operation in the manner of the handles of a pair of tongs, while the extended base allows maximum seating efficiency on the stand. Also, by reason of its length, the operator's feet

60 can be disposed in a more balanced position when it is placed on the floor for operation.

At its opposite end the reservoir tube 45 is

65 threaded into a socket in the pump frame, indicated generally at 55, which frame comprises a pump cylinder 56. The pump plunger 57, which

70 is in the form of a cylindrical member approximately $\frac{1}{2}$ " in diameter, is adapted to have reciprocatory movement in the pump cylinder 56. The upper end of the pump plunger 57 has a

75 head which is slotted transversely, as shown at 58, to receive a cross pin member 59. The member 59 is preferably locked in position by means

of cotter pins 60. The cross pin 59 is slotted

off or flattened on its bottom side and the ends are

carried by extending web portions 62 of a rocker

beam 63, which beam is pivoted at 64 about an

70 upwardly extending bracket portion 65 of the base 55. The centers of pins 59 and 64 are laterally

spaced approximately $1\frac{1}{4}$ inches. Upon

rocking movement of the beam 63 by means of

the handle 22, the pin 59 engaged in the slotted

75 end 58 of the plunger 57 provides for reciproca-

tory movement of the plunger within the cylinder 56. The pin 59 cannot turn in the slot. It has a small sliding movement in the slot, due to its arcuate travel. Projecting ends 66 of the beam 63 serve as stop means for limiting the upward

5 movement of the plunger 57, so that it will not be accidentally withdrawn too far or disengaged from the pin 59. The handle 22 may be of any

desired length, but I find that a length of about

10 26 inches is preferable both for convenience in operation and for application of pressure. Thus

with the handle length of twenty-six inches

working on a half inch diameter plunger at a

lever arm of one and one-eighth inches the unit

15 pressure upon the liquid in the pump cylinder will be of the order of two hundred times the numerical

value of the pressure put upon the end of

lever 26.

The beam 63 is provided with a horizontally

20 extending socket the bottom of which is threaded. This socket is engaged by the handle 22 for rock-

ing the beam about the pivot 64. Several lengths

of handle are provided. However, when the pump

unit 17 is disposed upon the floor, it may be

25 desirable to provide for vertical disposition of the handle 22, in which case the handle is inserted

into the opening 67 formed in the beam 63, and suitably engaged within the threaded

portion 68 thereof. In that position preferably

30 a greater length of handle is used. The lower end of the vertical socket of the beam 63 is

adapted to have abutting engagement with a

portion of the base 55 indicated at 69, for the

purpose of limiting downward movement of the

35 plunger 57.

A packing spreader is indicated at 70, and

40 chevron packing is disposed between the same and the gland nut indicated at 72, which is adapted to be disposed within a counterbored

portion of the pump cylinder 56, to provide a suitable

45 packing gland for preventing escape of liquid along the surface of the plunger 57. Suitable resilient rings of packing 71 and 73, such as oil

proof rubber, cork or the like, are disposed above

the gland follower 72. Above the packing 73 is

50 threaded the retaining nut indicated at 74, which holds the packing in compression between

the gland follower 72 and the retaining nut 74.

In the operation of the pump shown in Figures

1 to 6, as the pump plunger 57 is moved upwardly,

55 suction is created in the cylinder 56, which results in drawing of fluid from the reservoir 45

through the filter or screen 75 and the inlet

opening 76 formed in the base 55, through the

passageway 77 shown in Figure 6 to the angu-

55 larly extending passageway 78 shown in Figure 5. A suitable ball inlet check valve 79 is provided

adjacent the upper end of the passageway 78, and

is raised by the suction in the pump cylinder

60 56, providing for flow of fluid from the passageway 78 to the horizontally extending passageway

80 which leads into the lower end of the

65 pump cylinder 56. The passageway 80 is suitably closed at its outer end by means of the threaded

plug 82.

This serves to fill the pump cylinder beneath

the plunger with liquid to be discharged. Upon

70 downward movement of the handle 22, the pump plunger 57 displaces the liquid from cylinder 56

under pressure, and this pressure serves to close

the ball check valve 79. The liquid is forced

75 out through the passageway 80, and opens the ball check valve 83, which normally is closed by

the compression spring 84 disposed between the

check valve and the valve plug 85, and the liquid

80 75

flows into the enlarged bore 86 of the discharge passageway.

From adjacent the upper end of the bore 86, the liquid flows through the passageway 87 to a transversely extending passageway 88 drilled through the base 55, the passageway 87 being closed at its outer end by the plug 89. From the passageway 88 the liquid flows outwardly through the outlet opening 90, and into the flexible hose 16, the coupling of which is threaded into the recess 92. The hose is preferably a reenforced oil proof or synthetic rubber hose of great strength and quite flexible. The hose is impervious to the oil and is not subject to deterioration by the oil. Preferably the hose is some six feet in length, so that it will be long enough to reach across the width of an automobile with a little slack. As will be described in detail hereinafter, suitable coupling means is provided for inserting additional lengths of hose between the pump and ram when special jobs are encountered requiring such extra lengths.

To relieve the pressure upon the ram unit the release valve 93, which has a needle valve face 94 at its inner end, is threaded outwardly with respect to the packing nut 95, which closes the bore through which the spindle extends. The nut 95 is adapted to compress the packing 96 to prevent leakage of oil therepast. Backing off of the spindle 93 and valve 94 allows the oil from the chamber 90 and the passageway 88 to pass through the passageway 97 into the reservoir 45.

It is thus apparent that upon reciprocation of the plunger 57, liquid is drawn from the reservoir and forced into the flexible hose 16. When the ram has performed the desired work the valve 94 is opened and the pressure is released, the liquid being returned to the reservoir 45.

The base member 55 is provided with lateral extending feet or lugs indicated at 98, which are provided with slots 50 adapted to receive suitable means, such as the headed pins 20, for securing the base 55 to the brackets 19 mounted on the edge of the tray 6.

The pump unit shown in Figures 1 to 6 is adapted for operation when held in the hands. This is advantageous where no suitable support for the pump can be provided, due, for example, to the position occupied by the operator, or due to the length of the hose being insufficient to permit the pump to be carried to a suitable support. The handle 22 employed in that case is of just about the same length as the barrel of the reservoir which forms a hand hold. The operator grasps the handle 22 in one hand and the barrel 17 in the other and works the pump like the handles of a pair of tongs, or the handles of a pair of hedge shears. Or the operator may place the barrel against his body and pull on the handle 22. The stop 68-69 prevents pinching of his fingers between the handle 22 and barrel 17 or plate 48. The stroke may be made anywhere between stops 66 and 68. Since the total weight of the pump unit and handle is less than 14 pounds, it is obvious that it can be readily manipulated in the hands.

The pump and reservoir unit may be considered as consisting of two handle members hinged together and each supporting one of the cooperating parts of the hydraulic pump. The handle member which contains the cylinder is hollow to provide a reservoir for the hydraulic medium. It also contains the various passageways and valves and supports the connection for the flexible hose. The capacity of the reservoir is such

as to provide adequate liquid within the capacity of the ram unit to receive the same. When the pump and reservoir unit is supported in the hands of the operator the natural tendency is to allow the two handle members to be inclined downwardly assuring that the entire contents of the reservoir are available to the pump.

Referring now in detail to Figure 7, which shows the preferred construction of the ram unit 13, this unit includes the cylinder 100, about 1.540" in diameter, which cylinder is threaded at its opposite ends, as at 102, and at one end thereof receives the packed guiding head 103, which head is threaded over the end of the cylinder 100. At its outer end the head 103 is provided with an exteriorly threaded end portion 104 of slightly reduced diameter, which is also interiorly threaded, as indicated at 105, and provided with a packing gland nut. The external diameter of the head 103 is less than 2 1/2". I have here shown the threaded parts 104 and 117 of different diameters, but as will be explained later, particularly with reference to Figures 19 to 25, these parts 104 and 117 may be made of the same diameter and pitch, so that interchangeable brackets or jaws may be secured to either one or the other. The threads 113 and 117 are preferably of the same diameter and pitch in any event, for the purpose of interchangeable connections.

The opposite end of the cylinder 100 is adapted to receive the base 106 of the ram unit. This base is provided with a laterally offset boss portion having a recess 107 which is interiorly threaded at 108 to receive the threaded coupling on the end of the flexible connecting hose 16. The liquid from the hose passes into the duct 109, and from this duct is transmitted through the passageway 110 to the interior of the cylinder 100. The base 106, which is approximately 2 1/4" in diameter, is also provided with a socket 112, which socket is interiorly threaded, as shown at 113, preferably with standard 1 1/4" pipe threads, to accommodate the coupling of suitable appliances and adapters thereto. The end of the cylinder is turned down and faced off to bear tightly against the bottom of the socket 106. The overall length of the ram cylinder with heads 103 and 106 is only slightly over 10".

Within the cylinder 100 the ram plunger 115 is closely fitted for reciprocatory movement, having a diameter of slightly less than 1 1/2". The plunger 115 is provided, at its outer end, with a projecting stud 116 of reduced diameter, which is adapted to receive thereover a removable externally threaded sleeve member 117, the sleeve member 117 at its inner end having abutting engagement with the shoulder 118 formed by the reduced stud portion 116 of plunger 115. A suitable transverse locking pin 119 is provided for the purpose of locking the sleeve 117 upon the plunger. The exterior threads of the sleeve 117 are preferably standard pipe threads receiving suitable appliances which may be threaded thereunto. The threads on stud 116 preferably are standard machine threads for adapting the plunger to be coupled to a different set of connections. The sleeve 117 is readily renewable in case the threads are battered or otherwise damaged. If desired, the stud 116 may not be threaded, and the threaded sleeve 117 is then merely slipped over the straight shank and keyed in place by cross-pin 119.

Suitable fibrous packing 120 is disposed within the interior of the threaded portion 105 of the

cap 101, and is held in position by means of a packing nut 122 which threads thereto and holds the packing against displacement.

At its opposite end the plunger 115 is provided with an enlarged stop and guiding head portion 123, from the rear of which extends a projecting stud member 124. This stud is threaded to receive a suitable spreader nut 125. The nut 125 is provided with an annular shoulder portion bearing against the interior surface of a cup leather 126 or the like. This cup 126 is clamped between the nut 125 and the end of the plunger 115. The pressure against the cup 126 serves to force it into tight sealing engagement with the interior surface of the cylinder 100, to prevent leakage of fluid therepast. A chevron packing as shown in my copending application, Serial No. 6,618, filed February 15, 1935, may be employed instead of the cup leather packing shown herein, if desired.

It will be noted that the diameter of the main body of the plunger 115 is slightly less than the internal diameter of the cylinder 100, whereby free sliding movement is provided. In order to drain any leakage that might accumulate between the outer periphery of the plunger 115 and the interior of the cylinder 100, a passageway 129 is provided in the cap member 103, so that any tendency to build up pressure by movement of the head or flange 123 outwardly of the cylinder 100 will be released, whereby the full effective pressure of the fluid from the passageway 110 is available to move the plunger 115 outwardly of the ram unit. The packing 120 merely prevents leakage from creeping out upon the coupling parts.

The ram plunger 115 is shown as provided with graduated markings along its outer length. These graduations may be in either the metric or English units of linear measure, since they are employed, ordinarily, only for relative reference. However, in certain operations for which the ram is employed it may be desirable to employ definite linear measure. The length of the plunger from end to end is about 9½" and in collapsed position the entire unit is approximately 11½" long, while in extended position it is slightly less than 18" in length.

Sometimes in pressing or straightening certain parts there is a certain amount of resilience or spring, which, when the pressure is released, causes the metal to tend to return toward its former position. In order to make it possible for the operator to determine the exact amount of additional travel or throw required, he may note, before the pressure is released, the marking on the plunger closest to the end cap, indicating its extended position. Then, after releasing the pressure and finding that the metal has not been displaced to the desired position, the operator has, upon the next application of pressure, a gauge by which he can judge as to how far the plunger should be extended. Thus he can be assured that he will not exceed this position too greatly, and overstress the metal. By the successive application and release of pressure, therefore, the accurate displacement of the metal can be effected.

In order to ascertain definitely the allowable force which may be applied to a member, I contemplate providing a standard type of pressure gauge which may be conveniently mounted upon the pump, or upon an auxiliary coupling member connected between the flexible hose and either the pump or ram unit. The purpose of this gauge

is to indicate the pressure being applied per unit of deflection of the member engaged by the machine. For example, it may sometimes be desirable to know the deflection produced by a given pressure applied by the machine to a member, which can be easily ascertained by controlling the pressure in accordance with the gauge and noting the advancement of the graduations on the plunger. Or, if a bearing or pin is being driven, the gauge will indicate increased resistance showing seating of the member, thus preventing damage thereto by overdriving.

In the testing of structural members for bending stresses, the machine can be employed to indicate the pressure necessary to produce a given deflection, and can thus be utilized instructively to predetermine the strength of various structural members, so that overstressing of these members in actual practice will be eliminated.

As a further use of the graduated plunger, in certain adjustment and repair work on aeroplanes, for example, it is necessary that the plane be held or adjusted to a certain level. If a hydraulic jack having a graduated plunger is used for this work, the operator can elevate the plane to a predetermined level, and after completing the work can check to see that this level has been maintained, or can easily restore the plane to proper height if it does drop to any extent.

Many other useful purposes can be served by the combination of the graduated plunger and pressure indicator, such, for example, as checking loads on the springs or wheels of vehicles and the like.

In addition to these features the ram can be employed, because of these graduations, for many other press operations where it is desired to limit the insertion or displacement of members to a certain amount. Under certain circumstances it may be desirable to free the ram completely from the pump for the purpose of placing the ram in position without the impediment of the length of hose and the pump element connected thereto. Under such circumstances the hose may be made severable, or may be uncoupled from the ram or from the pump.

Referring now to Figure 8, I have disclosed one manner in which the flexible hose may be coupled together when the hose is to be made disconnectable. In this feature of the invention one end or part of the reinforced flexible hose is indicated at 16'. The fitting 131 has a socket for receiving the end of the hose, which is stripped over the spigot or projecting sleeve 130, which sleeve is anchored in the central part of the socket. The walls of the socket are then swaged down upon the end of the hose. The interior of the socket in the fitting 131 is provided with grooves forming a gripping means which bites into the exterior surface adjacent the end of the hose 16', thereby firmly gripping the hose and preventing pulling the hose 16' out of the fitting 131. Similarly, the other end or piece of hose 16'' is secured to a fitting 133, which has a socket like the one described in fitting 131.

The fitting 131 is provided with an angularly extending passageway 135 which communicates with the interior of the sleeve 130, and which is counterbored, as shown at 136, to house a spring-pressed check valve 137. The valve 137 is guided by means of an extending stem 138 extending through a valve seat member 139 and providing a valve seat for the check valve 137. A suitable spring 140 is provided for normally forcing the valve plunger 137 into engagement with the valve

seat 139 when the fitting is not in connected position. This prevents any leakage of oil outwardly from the passageway 142 of the hose through the sleeve 130 and through the valve opening at the end of the fitting 131. Thus the hose 16' may be uncoupled or coupled with very small leakage of oil and practically no inclusion of air.

The fitting 133 is provided with a passageway 143 which extends axially with respect to the sleeve 134, and which is counterbored, as shown at 144, for receiving a check valve plunger member 145 corresponding to the member 137. A suitable valve seat bushing 146 is threaded into the passageway 144 and provides a valve seat for the plunger 145, which has a projecting stem 147 extending beyond the end surface of the fitting.

The fitting 133 is provided with a head or flanged portion 148 which provides a shoulder over which is fitted a coupling nut or union 149, which nut is loosely mounted about the shoulder 148 and is held against rearward movement with respect to the fitting 133 by means of the split ring 150 which engages in a suitable groove formed in the surface of the sleeve 133 behind the shoulder 148.

The end face of the fitting 133 is convexly tapered, as indicated at 152, and engages a corresponding concave surface 153 formed in the fitting 131. Thus, when the hose is coupled together, the fitting 131 engages the tapered surface 152 of the fitting 133, and the coupling nut is threaded over the external threads formed on the shoulder portion 154 of the fitting 131, forcing these two fittings into tight abutting engagement. The fitting 131, in its end face, is provided with a cutaway recess portion 155, Fig. 9, which extends downwardly into alignment with the bore 144 in the fitting 133. As the fitting is drawn together, any air or oil which may be present escapes through suitable outlet passageways 156 formed at spaced intervals about the periphery of the shoulder portions 154 of the fitting 131, and upon engagement of the surfaces 152 and 153 the extending spindle portions 138 and 147 of the valve plungers 137 and 145, respectively, have abutting engagement with the adjacent surfaces of the opposite fitting, whereby the plungers are moved inwardly with respect to the valve seats 139 and 146, and thus provide for communication from the passageway 142 in the hose 16' to the passageway 157 in the hose 16''. Both valves must be opened, as the liquid must return when the ram plunger retreats.

Only a small quantity of air could remain within the coupling in this particular arrangement, inasmuch as the air is displaced by oil released on opening the valves and is forced outwardly through the passageways 156 as the fittings are coupled together. Thus, when pressure is applied to the fluid in the passageway 142, this fluid may flow, under pressure, through the valve bore 136 and the recess 155 to the valve bore 144 in fitting 133, and thence through the passageway 157 in the hose 16'', and also in the reverse direction. Thus a positive and effective hose coupling is provided.

In Figure 10 I have shown a modified form of coupling connection, in which the hose is detachably coupled to the base 55' of a pump unit corresponding to the pump unit 17. In this embodiment, an elbow connecting member 160, which is provided at one end with a suitable socket for a hose member 162 secured therein in the same manner as the hose members 16' and 16'' are secured in the fittings 131 and 133, respectively, is

provided, and is adapted to have engagement in a suitable vertically disposed socket or well 90' formed integral with the base 55' of the pump unit. Preferably this well is provided with a tapered outlet portion 163, above which is provided a counterbore 164 adapted to contain suitable liquid to displace air from the coupling. Upon insertion of the fitting 160 therein, the tapered surface 166 of the fitting is adapted to engage the tapered surface 163 formed in the well 90', below the surface of the liquid. The inclusion or trapping of air in the fitting is thereby prevented. Suitable valve plunger members, such as the members 145 and 137 of Figure 8, are carried by the well 90' and the fitting 160, and are adapted to be moved to open position upon movement of the fitting 160 into sealing engagement with the surface 163. The space between the end of the part 166 and the bottom of the well forms a connecting passageway between the valves when they are opened. Due to the oil in the reservoir 164, substantially all air is excluded from this coupling connection, and therefore a liquid to liquid connection is established from the well 90' to the hose 162 carried by the fitting 160.

In order to secure the fitting 160 in positive sealing engagement, a suitable yoke member 167, with a pressure screw, is provided. This yoke is pivoted upon studs 168 on the well 90', and is adapted to engage a suitable lug portion 169 formed on the top of the fitting 160, whereby the fitting 160 is held in tight sealing engagement with the surface 163.

Referring now in detail to Figure 11, I have disclosed in this figure how a frame or channel member such as an automobile side frame, which has been deformed or bent, may be straightened by the use of the ram of the present invention. In this figure, the frame member 170 to be worked on by the power unit has been bent outwardly and distorted from its initial and desired shape. Suitable wooden blocks 172 and 173 are placed between the frame 170 and the beam 174 on each side of the bent part of the frame 170. The base portion 106 of the ram unit is disposed on the opposite side of beam 174. Preferably a suitable base plate 175, provided with a stud screwed into the socket 113, is mounted on the base of the ram unit 13. The nipple 207 and base plate 197 may be employed to form this base.

The outer end of the plunger 115 is provided with a grooved fitting 176 which is shown in detail in Figures 12 and 13. The fitting 176 is provided, at one end thereof, with a recessed interiorly threaded opening 177 which is adapted to thread over the sleeve 117, and to be fixedly secured thereto. The opposite end of the member 176 is provided with a V-groove in the end thereof, which V-groove is adapted to form a suitable guide for a chain member, such as the chain 180 shown in Figure 11, or to seat against a rod, pipe, bar or the like. I prefer to use an electrically welded heat treated steel for the chain having a break test of over 11,000 pounds.

The chain 180 is looped over the end of the plunger and lies in the V-groove in the member 176, and its ends extend over and under the supporting member 174. These ends are suitably engaged by a second fitting 182 which is disposed upon the opposite side of the frame member 170 which is being worked upon. The fitting 182 is shown in detail in Figures 14 and 15. It is provided centrally with a threaded socket portion

183 which may, if desired, be threaded upon the end of the plunger 115 for certain purposes, or may be used in any other manner. It may be threaded upon a suitable pipe or rod extension threaded into the base 106 of the ram 13. The member 182 is provided with openings 185 through which the ends of the chain may be freely passed. At opposite sides of openings 185 I provide slots 184, with recesses just back of the openings of the slots on both back and front to hold the adjacent transverse link of the chain to keep the chain from slipping out of the slot. Thus the chain is kept from slipping out, no matter which way the force is applied.

The member 182 may also be provided with an opening 186, in which a drift pin 187 may be mounted, if desired, when the unit is to be employed for punching out wrist pins, bearings, or the like. The pin 187 is preferably secured in position by means of a set-screw 188 extending into the opening 186 through the threaded opening 189 of the member 182. Obviously, the pin 187 may be threaded into the opening or otherwise mounted on member 182 or upon a similar member.

The inner slots 184 are provided where the member between the chains is relatively narrow. The outer slots 184 are used where the intervening member is wider.

In the application of the unit shown in Figure 11, the chain 180 is hooked into one of the outer pair of slots 184, being thereby firmly secured in fixed position with respect to the member 182, and is then laid in the V-groove in the member 176 carried by the plunger 115, and is passed under the supporting member 174 formed in the opposite end of the fitting 182. Pressure is then supplied to the ram through the flexible hose 16, and serves to move the plunger 115 outwardly of the pressure cylinder 100 of the ram 13, the reaction being taken through beam 174, blocks 172, and upon the spaced parts of frame 170. This outward movement exerts a tension upon the chain 180, which tension is imparted to the bar 182 and in turn draws the bar towards the supporting member 174. Thus, upon forcing liquid into the ram unit, the bar member 182 is drawn toward the base 106 of the ram, and consequently forces the bent portion of the member 170 into the desired position. Since the pressure applied by the ram unit can be readily controlled by the operator, just the desired amount of bending may be produced in the member 170, and no overthrow is produced. The metal is subjected to minimum punishment in straightening.

It is obvious that any desired member might be so worked upon in place of the member 170, either to straighten or to bend it. The operator may dispose the pump in such position that he can sight along the frame 170 to see when it is straight, while he is actually operating the machine.

Referring now to Figure 18, in this embodiment of the invention I have shown the unit as equipped and applied to the straightening of a sheet metal member, such as the back panel of a motor vehicle.

In this particular employment of the invention, the side panel of a motor vehicle is indicated generally at 190, and the rear panel portion of the vehicle is indicated at 192, being dented, as shown at 193, from its true form as shown in dotted lines. The operator, in this particular figure, has moved the stand 5 to a position adjacent the rear of the vehicle and has disposed the

base 8, carrying the hydraulic unit 9, in a position to facilitate operation of the pump while the operator may watch the effect being produced by the ram unit. He may stand where he can sight along the surface to be straightened. The floor of the vehicle is shown at 194, and the ram unit 13 is shown as braced between the rear surface 192 of the vehicle and a pair of supporting members 195 mounted in the floor of the vehicle and having abutting engagement against the rear portion of the front seat of the vehicle. They may pass through the door openings, if desired.

An extension member 196, which may comprise a standard size pipe member, threaded at its opposite ends, is threaded at one end into the opening 112 of the ram unit 13, and the opposite end thereof is provided with a base plate member threaded thereon and indicated at 197. The base member 197 has bearing engagement against the supporting block 195. This provides for an extension of the support of the ram unit 13, so that upon pressure being applied by the pump 9 through the flexible hose 16 to the ram cylinder 100, the plunger 115 thereof, which, upon its threaded end 117, is adapted to carry the fitting 182 previously described, moves outwardly of the cylinder 100, and forces the member 192 into the proper position. The ram unit 13 and a part of the hose 16, in this case, has been passed through the rear side window, and although the hose is short, for example, about 6 to 8 feet, it is long enough to let the operator stand where he can readily observe the progress of the operation as he works the pump unit 9.

Since the operator may dispose himself substantially in any desired position, because of the remote flexible connection of the pump 9 with respect to the ram unit, it is possible for the operator to assume the most advantageous position for viewing the operation on the machine and judge the proper amount of pressure to be applied thereby in straightening the member.

Overstretching of the metal, or bending of the metal into more than its required shape may be prevented, due to the positive control of pressure applied by the hydraulic pump which is under the operator's control. Controlled straightening, under observation, may similarly be applied to fenders, side portions of the body, running boards, and like metal portions of motor vehicles, machinery, or other metal members.

Referring now to Figure 19, I have disclosed the ram unit 13 embodied in this figure for both short spacing and wide spacing compression of parts, or clamping thereof. In this particular embodiment of the invention a suitable pipe length 200 is provided. This pipe length may be provided, at intervals therealong, with transverse openings 202 such as aligned drill holes. An adjustable end bracket or jaw 203 is suitably bored to fit over the pipe 200 and is provided with transverse registering openings through which a lock pin 204, shown in detail in Figure 21, may extend for locking the bracket 203 in fixed position with respect to the pipe 200. The pipe herein referred to is preferably extra heavy $1\frac{1}{4}$ " pipe, carefully machined to uniform size, drilled, threaded and polished. A movable bracket or jaw 205 is slidably mounted and guided on the pipe 200. The bracket or jaw 205 is provided with a threaded socket 206, which socket is adapted to receive the threaded end 117 of the plunger 115 of the ram unit 13. Upon movement of the plunger 115 the jaw 205 is moved axially along the pipe 200, to cooperate with the

adjustable jaw 203, to clamp members or spring members placed between the two jaws within the space indicated by the dimension X.

The ram unit 13 is held against rearward movement by means of the end bracket 205', which corresponds to the end bracket 205 carried by the plunger 115. The bracket 205' is locked to the pipe 200 by means of the pin 204 against axial and rotary movement. A nipple member, indicated at 207, connects the bracket 205' to the base 106 of the ram unit, the nipple 207 being threaded into the socket 206 of the bracket 205', and being also threaded into the opening 112 in the base 106 of the ram unit. It is therefore apparent, when pressure is applied to the ram cylinder 100 by the flexible hose 16 leading from the pump, that the plunger 115 will be moved outwardly with respect to the cylinder, moving the jaw or bracket 205 toward the fixed jaw or bracket 203. The movable jaw is thus guided in register with jaw 203 and bracket 205'. Thus, clamping of any suitable members, bending of members, drawing two spaced members toward each other, or other forming operations may be produced by such action.

If it is desired to provide for a wide spacing of the clamp, whereby two spaced frame members may be pulled toward each other, or for similar or analogous operations, an extension pipe connection 210 is provided, indicated in dotted lines in Figure 19. The extension pipe, indicated in dotted lines at 210, is coupled to the pipe 200 by means of the union 212. The bracket 205' is then pinned to the extension pipe 210 adjacent its outer end, and the ram unit 13 is secured thereto in the same manner. The sliding jaw 205 now has a much greater clamping spread, as indicated by the dimension Y. Thus, upon application of pressure to the ram 13, the plunger 115 moves the jaw 205 toward the union 212, serving to pull spaced frame members toward each other, or similar operations, as desired. It is, of course, to be understood that various lengths of pipes 200 and 210 may be employed or substituted, as desired, depending upon the desired spacing for the clamping jaws.

Referring to Figure 22, I have shown in this figure the use of the power unit for spreading members apart which have been crushed together, or for similar operations upon metal members. In this particular embodiment the ram unit 13 is provided with a jaw member 215 which is threaded to the cap or head 103 of the ram cylinder, being engaged over the threaded portion 104 of the cap. This fixes the position of the spreading jaw 215 with respect to the ram unit 13. A second jaw 216, having a threaded socket 217, is threaded upon the threaded end 117 of the plunger 115. Upon application of pressure to the ram the jaw 216 moves outwardly, away from the jaw 215, whereby it spreads any metal members which may be in contact with the opposite surfaces of the jaws 215 and 216. This spreading operation is usefully employed in connection with the pulling apart or bending of metal members which have been deformed toward each other, or in the straightening of any metal members or frame members which may be deformed and must be spread in this manner.

In Figure 23 I have shown a modified form of spreading jaws in which the jaw 216 is mounted through a suitable stud 218 or pipe nipple 207, which has its opposite end threaded into the opening 112 in the end of the base 106 of the

ram unit. This holds the jaw 216 in fixed position.

The plunger 115 carries, upon its threaded end 117, a spreading bracket 220, which is adapted to have a portion 222 overlying and guided on the outside of the ram unit. A jaw or bracket portion 223 projects laterally in register with the jaw 216, and it is moved by the plunger 115 away from the bracket or jaw 216 to produce a spreading action. The spreading action produced may be employed for any purpose to which it is applicable, such as the bending of fenders or running boards away from the frame of a vehicle, the straightening of cross bracing members, or analogous operations in which such action is capable of being employed to produce the desired straightening of metal. The bending stress on plunger 115 is less in the set-up shown in Figure 23 than in Figure 22.

In Figures 24 and 25 is disclosed the provision of a spreading action employed in connection with an extension pipe, forming a guide. In these figures an extension pipe 225 is adapted to carry thereon a fixed bracket member 226, shown in detail in Figure 24, keyed thereto by means of a suitable pin such as the pin 204. The member 226 has a threaded socket to receive the threaded end 117 of the plunger 115 of the ram unit 13. A bracket member 227 is adapted to have sliding engagement upon the pipe 225, and is carried in fixed position with respect to the ram unit 13 by means of a threaded opening adapted to be threaded over the extending portion 104 of the cap 103 of the ram member. The jaw 227 therefore moves as an integral part of the ram unit 13. At its opposite end the ram unit is provided with a second sliding jaw or bracket member 229, which member has sliding movement with respect to the base 106 of the ram unit by means of the nipple connection 230. Thus, upon application of pressure to the ram unit, the jaw 229 moves outwardly away from the fixed jaw 226 in register therewith, and thereby produces a spreading action between the surfaces of the jaw members 226 and 229. The threaded parts 104 and 117 are shown as of different diameters. They may be of the same pitch and diameter. So may the parts 104 and 113. Where the head 117 is smaller than part 104 it may be freely passed through an opening which threads upon part 104. If the parts are of the same diameter and pitch, the bracket 215, for example, must first be threaded past part 117 before it can be threaded upon part 104.

In the embodiment shown in Figure 25, the jaw or bracket member 229 is pinned to the pipe 225 by means of pin 204, and the jaw member 227 is likewise pinned to the pipe by means of a pin 204, and is thus held in fixed position with respect to the ram unit. The plunger 115 of the ram unit is adapted to carry on its end the jaw or bracket member 226 which, in this particular embodiment, is not keyed to the pipe 225. Therefore, upon application of pressure to the ram unit, the plunger 115 moves outwardly with respect to the jaws 227 and 229, moving the jaw 226 outwardly along the pipe 225 and producing a spreading action between either jaws 226 and 227 or jaws 226 and 229. Thus, various spacings between the jaw members and the ram unit may be provided, so that the ram unit may be employed for spreading purposes with practically any given spacing, to accommodate all ordinary conditions which might be encountered in work of this class.

Referring now in detail to Figure 26, I disclose the present machine set up as a means for spreading a leaf spring to dispose it in proper position for attachment to spring shackles or the like.

- 3 For example, in this figure I have shown a well known form of front axle 240, of a vehicle. This axle is provided, at spaced points, with spring perch bolts 242 projecting through the axle and secured thereto by means of the castellated nuts 10 243.

- A multi-leaf spring member, indicated generally at 244 and provided at its ends with integral eyes 245 forming suitable bearings for the shackle pins, is to be placed in position so that shackles such as 246 may be connected thereto. These 15 shackles comprise members which are generally of U-configuration, having bolt portions which are adapted to register with the openings 247 in the ends of the spring members 244, and with bearing openings 248 in the supporting members 20 242. The tension of the spring member 244 is such that with prior devices great effort is required to spring the member outwardly sufficiently to bring the ends 245 into register with the bearing opening 248 so that the shackles may be 25 connected.

- With the use of the ram unit 13, such spreading movement is easily secured, and connection can be made in substantially less time than formerly required, and with ease and accuracy. The 30 ram unit, in this set-up of the machine, is provided with a pipe extension 250 threaded into the opening 112 of the base 106 of the ram unit, and carrying at its opposite end a spring spreader or spadelike member 252. The member 252 35 threads over the outer end of the extension 250 and is provided with a tapered end portion 253 adapted to engage back of the curled eye portion 245 of the spring member, as shown. The plunger 115 is provided, upon its threaded head 117, 40 with a spreader member 254 corresponding to the member 252, and having the extending tapered end 255 engaging the opposite curled end 245 of the spring 244. Upon application of pressure 45 to the ram unit through the flexible hose 16, the plunger 115 moves outwardly with respect to the pressure cylinder 106, and exerts a stretching or tension stress upon the spring 244, tending to move the free end 245 thereof into juxtaposition 50 with the free bearing portion 248 of the supporting spindle 242, whereby a shackle, such as the U-shaped shackle 246, may be readily inserted through the openings 247 and 248.

- By varying the size of the extension 250 it is 55 apparent that the unit may be adapted for any spring size, or for any spreading purpose similar to that performed in this embodiment. Further, it is apparent that the pressure which is applied to the ram unit is under ready control, so that 60 just the required amount of pressure to bring the member to the desired position may be provided. If too great a spreading is accidentally produced, the by-pass valve 94 is opened. With transverse springs, such a spreader is of considerable utility. 65 However, it is of the same utility in connection with the use of the longitudinal spring used with automotive vehicles, trucks, busses, and similar appliances, since the pressure that can be applied is easily sufficient to produce the desired flexing action of the spring to position it 70 for the shackling engagement, and may be readily controlled.

- Figure 27 shows one of the possible incidental 75 uses of the machine as a jack for lifting a heavy load. This illustrates the adaptability of my ma-

chine to various incidental jobs about a garage or repair shop by making a suitable set-up of the machine. The machine may thus be set up as a means for jacking up vehicles where access to the underside of the vehicle is not readily available, and requires skillful and difficult operation 5 of the ordinary jack in order to produce a lifting effort. In many cases the usual vehicle jack cannot be employed.

Thus, in this figure, I show a bus 260, such as 10 the trans-continental busses now employed for passenger purposes, and which is provided with the oversize rubber-tired wheels 262, with the wheels extending partially into the body of the vehicle. The supporting axle of the vehicle is 15 indicated at 263, and a suitable spring suspension assembly is indicated at 264. Ordinarily, with the usual type of mechanical or hydraulic jack, the jack could not be inserted under the vehicle in position to secure a proper lifting effect without at the same time nullifying the operativeness 20 of the jack, since no effective movement of the operating handle of the jack could be employed because of the relatively inaccessible positioning of the jack under the vehicle. The ram unit of my machine being disassociated with respect to 25 the pump unit, and being connected thereto only by flexible hose which does not transmit to the ram unit any reaction of the actuating force applied to operation, the jacking operation of a vehicle of this type is readily facilitated, and no 30 danger to the operator is occasioned.

The ram unit 13 is disposed under the vehicle, the base 106 thereof being provided with a pressure plate such as shown at 175, which bears 35 against the surface upon which the vehicle is resting. A larger plate may be utilized, if desired. The plunger 115 of the ram unit is provided, at its threaded end 117, with a serrated head portion 265. The head 265 (see Figures 16 and 17), is provided with a socket 266, which is 40 interiorly threaded with 1¼" pipe threads at 267. The supporting surface of the member 265 is generally planar but is serrated, as indicated at 268, to provide a positive gripping surface 45 which will not readily slide off of the surface with which it is in abutting engagement during a lifting or jacking operation. The ram unit 13, which is light in weight, and may be readily handled by one hand of the operator, is disposed 50 underneath the vehicle as in the manner shown, and the operator may then stand away from the vehicle at any distance within the length of the flexible connecting hose 16 and operate the pump, free from any danger of the vehicle slipping or falling upon or against him. Neither is 55 he subject to coming in contact with dirt, mud, grease or oil which may be underneath the vehicle. This is quite an item with the bus driver or similar operator of the vehicle who is required to maintain a neat appearance. 60

In Figure 28 I have shown one form of head or saddle for the plunger of the ram unit. This head is indicated generally at 270, and comprises a substantially semi-cylindrical outer surface. 65 The head is provided with a boss 272 having a socket 273 suitably threaded as at 274 to be secured to the plunger head 117, or it may be of a size to take a nipple or the like which may be threaded to the end of the base 106 of the ram 70 unit. The member 270 may be sized so that it may be threaded over the head 117 of the plunger 115, and as a ram head may be employed for forcing rounded metal surfaces back into shape when they are dented, such as fenders or 75

the like. For this purpose it is contemplated that a variety of members, such as the members 270, be provided, of different shape or radius or configuration, so that the desired head unit 5 may be selected for any desired curvature or shape of fender or metal surface which is being deformed or straightened. Thus, in the use of the ram unit for straightening fenders or the like, the base 106 of the unit may be supported 10 upon any desired support, such as the wheel, axle or the like, and the plunger, provided with the selected head, such as the head 270, is placed under the fender or other sheet member which it is desired to straighten, and pressure applied 15 to the ram unit will force the head 270 against the metal of the fender, thereby causing the same to assume its normal shape without in anywise subjecting the metal member to hammer blows, possible denting or overstretching of the metal, or similar disadvantages produced by 20 former methods of straightening fenders.

In Figure 29 there is shown a different form of head 275, with a flat, wedge-shaped working face. The point or edge is rounded. This head 25 also has a central boss portion 276 having a socket 277 which is suitably threaded, as shown at 278. These members may be applied as by a pipe nipple 207 to the base 106 of the ram unit, or to the threaded head 117 of the plunger 115 30 of the ram unit, depending upon the particular operations to be performed.

It is obvious that the ram unit may be employed end for end, that is, the plunger end may be fixed against the stationary support, while 35 the base is provided with a suitable appliance for operating upon work, or the base 106 may be disposed against a suitable fixed support and the plunger employed to engage the work.

In Figure 32 I have shown a form of hose coupling which is particularly advantageous for the 40 present device. I have found that in the handling of the ram unit frequently a twist is put into the hose and also that the hose is often pulled. Either of these actions tends to loosen 45 a threaded connection. When both actions occur simultaneously, as is not infrequently the case, the result is a powerful twisting of the hose coupling. Likewise, application of pressure when the hose is twisted tends to loosen the joint. The 50 alternate application and release of hydraulic pressure, particularly with mechanical pulling and twisting, also has a tendency to loosen up the threaded joint. I have therefore provided a novel form of coupling which resists these loosening tendencies. The boss or frame member 55 280 has a socket portion provided with tapered pipe threads 282 and a cylindrical counterbore 283. The coupling member 284 comprises a cylindrical stud or shank portion 285 which fits snugly in the bore 283. At its outer end it has a tapered threaded portion 286 which is threaded tightly into the threaded part of the socket 282. The coupling 284 has a polygonal wrench engaging portion 287, and outside that a socket member 65 for receiving the adjacent end of the flexible hose 16. This socket member is substantially as shown in Figure 8, at the fittings 131 and 132, with an internal nipple. A coil spring 288 embraces the outer surface of the socket and extends over an adjacent portion of the hose 16, 70 to prevent kinking at the edge of the socket.

The boss 280 has a threaded transverse hole for cooperation with the lock set screw 289. Preferably the shank 285 has a conical depression 75 drilled in register with the set screw after

the threads 282 are fully tightened and the conical lock set screw is seated in said depression to lock the shank against either rotation or lateral displacement. The cylindrical shank 285 5 and the cylindrical bore 283 provide ample bearing and supporting surface to keep the threads from loosening by sidewise pulling of the hose 16, independently of the set screw. But with the set screw the entire assembly is firmly locked against any motion or loosening whatever, from 10 any of the stresses which may be encountered.

In Figure 31 I have shown the stand 5 provided with a double acting pump unit, comprising the double acting pump 10, with detachable 15 handle 11, insertable into the pump yoke in either vertical or horizontal position, so that the pump may be operated on the stand 5 with the handle horizontal, or on the floor with the handle vertical.

The cylinders and frame of the pump 10 are 20 mounted upon a base casting which also supports the reservoir 2. This base casting is fastened upon a baseboard 8 which occupies the remote right hand corner of the upper tray 6, as viewed from the operator's position. Suitable guides 25 overhang the front and rear edges of the baseboard 8, so that the baseboard is anchored against movement in the vertical plane in which the handle 11 is actuated. The baseboard may be withdrawn by sliding the same in a horizontal 30 plane out of the guides for removal from the stand. The ram unit 13 is connected to the pump 10 by the flexible hose 16. Hooks 12 are provided on the end of the stand for supporting the ram 13 when not in use. The trays 6 are provided 35 for supporting various appliances, such as 275 and 270, here shown. A length of pipe for forming an extension or guiding part of an appliance is shown at 15 supported on hooks 14. A press yoke such as 25, shown in Figures 1 and 40 2, may be employed on the stand 5 adjacent the end of the actuating lever 11 shown in Figure 31. The yoke has been omitted from this figure for the sake of clearness.

A double acting pump operates more rapidly 45 than a single acting pump, as will be obvious, assuming the plungers to be of the same diameter. But there is some disadvantage in a double acting pump without modification, for the reason that maximum pressure may come upon the 50 lifting stroke of the lever 11, and it is obvious that the operator cannot exert the same force lifting a lever about waist high as he can depressing the same, at the same height. For this reason the single acting pump shown in Figures 55 1 to 6 is usually preferable.

However, the double acting pump with its more rapid output is desirable in certain operations, and if at the same time the necessary pressure must be quite high, I interpose a compression spring between the yoke and the right hand plunger, shown at Fig. 31, limiting the pressure which can be applied to the said pump plunger. The plunger thus becomes inactive and the spring is compressed without moving 65 the plunger when the pressure rises above a predetermined value. Such spring actuated plunger may be made of a fairly large diameter, if desired, in order to give a rapid displacement for the initial placing of the ram or the appliance actuated thereby. Thereafter, the high 70 pressure is applied by operation of the smaller bore left-hand plunger, which is actuated by downward movement of the handle 11.

The reservoir cylinder 17 of the pump, shown 75

In Figures 1 to 6, may be provided with a handle extension attachable to the feet 49—49, where operation of the pump like a pair of tongs is desired.

- 5 I am aware that there are known power driven pumps under suitable clutch control, or overload automatic, or under straight manual control, which can be substituted for the hand operated pump of my specific embodiment. I intend to
10 include all such devices when they are so used. Also it is to be understood that the pump of Figures 1 to 6 may be double acting, and/or provided with a quick acting spring loaded pump
15 plunger for rapid advance of the ram plunger idly. This may also be accomplished by a double plunger pump with the large diameter cylinder provided with a spring loaded by-pass valve.

- The pulling head shown in Figure 1 is adapted to provide a guide for each bight of the pulling
20 chains, the chains being disposed in two planes intersecting at right angles substantially at the axis of the ram.

- In Figure 33 I have disclosed a stand for the machine and including a modified press construction. The stand 5' of this embodiment of
25 the invention comprises shelves 6', corresponding to the shelves of the stand shown in Figure 1, and leg members 3' extending vertically upwardly at the corners of the shelves and supporting the shelves in spaced relationship.

- The pair of legs 3' at one end of the stand are extended upwardly, as shown at 305, being bent
30 inwardly of the stand at 306, whereby the upper portions of the legs are disposed over the upper shelf portion 6' of the stand. Suitable reinforcing
35 strut members 307 are secured between the top shelf 6' of the stand and the portions 305 of the extending legs 3', and serve to provide a rigid and positive support for the upwardly extending portions of the legs.

- At the upper ends of the leg portions 305
40 channel-shaped block members 308 are rigidly secured to the angle portions of the legs by welding or the like, and have central transverse recesses 309 formed therein, receiving the oppositely
45 extending ends of a crosshead 310, the crosshead corresponding to the crosshead 30 of Figure 1. The crosshead 310 has sliding engagement into the recesses 309 of the blocks
50 308, and is secured against lateral movement therein by means of pin members 312 which pass through suitable openings in the block members and corresponding aligned openings in the ends
55 of the crosshead 310 when it is moved into operating position.

- The cross head 310 is provided with a central bore 313, shown in detail in Figure 34, within
60 which is positioned an adapter member 314, having a projecting annular shoulder portion 315 bearing against the under surface of the crosshead 310. The adapter 314 is provided, upon its
65 cylindrical extending surface, with an intermediate annular groove 316 which receives the end of the set screw member 317 laterally threaded into the crosshead 310. Thus the adapter 314 is
70 held in position within the bore 313 by the engagement of the end portion of the set screw member 317 in the groove 316.

- The ram unit 13, as described in detail in connection with Figure 7, has an end cap member
75 103 having a reduced externally threaded portion 104, and is disposed in vertical position within the adapter 314, the adapter being preferably provided with internal threads receiving the threaded portion 104 of the ram unit 13. The

ram unit may thus be secured in fixed projecting position with respect to the crosshead 310, and the plunger portion 115 of the ram unit is adapted to project below the crosshead and is movable downwardly within the press defined by
5 the leg portions 305 of the stand.

The upward thrust transmitted to the crosshead by the shoulder portion 315 of the adapter 314 is transferred from the crosshead to the
10 block members 308, and thence to the leg portions 305 of the legs 3' of the stand.

By mounting the ram unit in this manner, considerably more clearance within the press
15 itself is provided, inasmuch as the cylindrical portion 100 of the ram unit is not disposed within this portion of the press, but projects outwardly therefrom, whereby the plunger 115 has a greater range of movement within the press. A suitable press plate 318 is supported upon the
20 upper shelf portion 6' of the stand 5', and serves the same function as the press plate 27 of Figure 1, being preferably provided with a central opening 319, whereby the plunger member 115 may be employed for driving pins through pistons or
25 for similar driving purposes.

In Figure 33 I also have disclosed a modified
30 manner of mounting the pump unit 17 upon the stand. In this embodiment of the invention the foot rest and clamp member 48 of the pump unit is provided with an upper serrated surface, and
35 has opposite laterally extending lugs or feet 49' at the lower portion thereof. These foot portions are provided with a slightly forwardly tapering section and need not be slotted in the manner described in connection with the foot rest 48 of
40 Figure 3. In place of the clamping bracket 19, I provide a modified type of bracket 320, which is riveted or otherwise suitably secured to the vertically extending edge of the shelf 6', and
45 which is provided with upwardly and rearwardly bent gripping portions or flanges 322, adapted to engage over the leg portions 49' of the clamp
50 48, the bracket 320 being provided, at its rear end, with an upwardly extending flange portion 323 suitably threaded to receive the hand wheel
55 52 corresponding to the hand wheel shown in Figure 2, whereby the hand wheel may be screwed against the rear cap member 46 of the pump unit to force the foot portions 49' thereof into engagement within the channels formed by
60 the gripping flanges 322 of the bracket 320.

At the forward end of the pump unit 17, the housing 55 is provided with similar oppositely
65 extending foot portions, which are adapted to be engaged by suitable clamping portions 324 of a bracket member 325 secured to the vertical
70 edge of the shelf 6'. The housing 55 is also provided with an outwardly and laterally extending foot pad portion 326 formed integral with the foot portions gripped by clamp 325, and which is preferably serrated or roughened on its upper surface to provide a suitable foot support for the operator when the pump is placed upon the floor for operation by a person standing thereabove. In this event the handle 22 of the pump
75 is disposed in the bore 61 of the rocking beam 63, and the operator places one foot upon the supporting surface of the clamp 48 and the other foot upon the foot pad 326 to hold the pump unit 17 firmly upon the floor during reciprocation of the handle 22 to develop pressure in the pump.

In mounting the pump unit upon the stand, the forward end thereof is slipped under the
gripping flanges 324 of the bracket 325, and at 75

the same time the foot portions 49' are slipped within the gripping flanges 322 of the bracket 320. The hand wheel 52 is then threaded against the rear cap portion 46 of the pump unit, and forces the foot portions 49' and the corresponding foot portions of the housing 55 at the forward end of the pump unit 17 into engagement with the clamping brackets. This facilitates ready attachment and detachment of the pump from the stand, and allows a more flexible operation of the machine.

Throughout this specification I have stated that the various couplings, adapters and appliances are preferably provided with pipe threads or the like for securing them in operative engagement. Obviously it is not necessary that these extensions, attachments and the like be coupled by a threaded means. They could be slipped together and held by means of a cross pin through both members, similarly to the means described in connection with the threaded coupling 117 carried by the projecting stud 116 of the ram unit, or by means of a bayonet lock, an interrupted thread, or a quick-acting multiple thread screw or the like. By way of example, in Figures 34 and 35 I have shown one manner in which a quick detachable coupling between various parts of the machine may be secured without the use of threads or the like.

In the latter figure, the base portion 106 of the ram unit 100 is provided with an axially extending recess or socket portion 328, which is provided with a smooth machined cylindrical defining wall. The extension members which are to be secured in this socket, such as the adapter nut 35 shown in Figure 18, or nipple members such as the member 230 shown in Figure 24, are provided with a machined shoulder 329, and with a reduced projecting cylindrical stud portion 330 of substantially the same diameter as the socket recess 328. The stud portion 330 is provided with an angularly inclined spring-pressed locking plunger 332, normally urged outwardly of the surface of the stud by means of the spring 333. This plunger is adapted to engage in a suitable opening 334 formed in the base 106 and extending radially inwardly to the recess 328. Upon insertion of the stud portion 330 into the recess 328, the plunger 332 is depressed against the pressure of the spring 333 to allow the stud portion 330 to enter the recess. Upon the engagement of the shoulder 329 with the annular shoulder formed at the end of the base 106, the plunger 332 is in such position that it is disposed in alignment with the opening 334 in the base 106, and consequently the spring 333 presses it outwardly into this opening, thereby locking any suitable extension member or adapter 335 in fixed position with respect to the base 106 of the ram unit. Inasmuch as the extension member 335 is under a straight thrust stress or compression at all times, the engagement of the shoulder 329 with the annular shoulder of the base 106 is sufficient to provide the proper support for the attached member, and it is unnecessary to rely upon the plunger 332 for any engagement except to prevent displacement of the member 335 from the base 106 of the unit. The particular construction and operation of the coupling engagement shown in this figure is described in detail in Patent No. 1,982,008, issued November 27, 1934.

In the same manner, the forward end of the plunger member 115 shown in Figure 34 may be provided with a corresponding plunger 336, and

extension members or appliances which are to be mounted on the plunger are provided with suitable sleeve portions extending over the headed end of the plunger and have openings corresponding to the openings 334 for engagement by the plunger 336. In such cases, the plunger head is preferably provided with a flange portion or shoulder 337 forming an abutment against which the adapter or extension member is adapted to abut, whereby the thrust is taken by this flange or shoulder 337 and no stress is imparted to the plunger 336, this member merely preventing displacement of the members relative to each other. As pointed out in the patent above referred to, the plungers 332 and 336 provide for a positive wedging action which prevents rattling or relative play between the members that are coupled together thereby, so that an accurate and positive coupling engagement is provided. It is obvious that any other suitable or desired coupling means might be employed in this connection.

The machine of my invention takes the place of a wide variety of devices now used for automobile repair work. It is capable of doing not only all that such prior devices can do, and of doing it much better, but it provides entirely new utilities and capabilities. Among these are the following: freedom from slippage produced by the reaction of the operating lever, which is a basic defect of devices of the prior art; the ability to get into places and spaces where there is no room for the usual lever or crank operated jacks; relieving the operator from danger of parts snapping, springing or sliding, due to the force applied; allowing the leverage to be developed in a position advantageous to the operator; providing enormous force, easily developed and advantageously applied; ease in interchangeability of setups or appliances for going from one operation to another; the ability of the operator to stand where he can best judge the effects of the operation as it is proceeding; adaptability to a wide range and variety of straightening operations, and to many incidental or ancillary operations where force application is desired; the development of pushing or pulling forces without complicating components; the suitability for chain operation; the extensibility or retractability for operation with wide variations in spacing of the support and the part to be operated upon; a high degree of portability and ease of handling; and many others.

While the invention has been particularly described in connection with automobile repair work, it is believed obvious that the particular features and distinct advantages secured by the machine of the present invention are equally applicable to other industrial uses, and provide a portable hydraulic metal straightening machine which is capable of use in any situation in which the utilities and capabilities provided thereby can be employed.

I do not intend to be limited to the details of the specific embodiment of my invention above described, except as they are essential to the law of the machine, and are recited in the appended claims.

I intend to protect the invention both broadly and specifically.

I claim:

1. In combination, a ram unit of the class described having a ram cylinder, a plunger therein, a cap member at one end of said cylinder guiding said plunger for movement outwardly of said cylinder, a base member at the opposite end thereof, means comprising a flexible conduit carried by

said base member and communicating there-through with said cylinder for transmitting fluid pressure to said cylinder, and means on said cap member, base member and plunger, adapted to

5 receive detachable work engaging appliances.

2. In a portable machine of the class described, a cylinder, a plunger therein, said cylinder comprising a base having an internally threaded socket with an annular planar bearing seat facing axially in one direction, said plunger having a reduced portion surrounded by an externally threaded annular planar bearing seat facing axially in the opposite direction, pressure transmitting members coupled by said threads to said cylinder and said plunger and transmitting pressure through said annular seats to a metal member and to a reaction supporting member respectively, and means comprising a flexible hose for supplying hydraulic pressure to said cylinder.

3. In a portable machine of the class described, a cylinder, a plunger therein, said cylinder comprising a base having an internally threaded socket with an annular planar bearing seat facing axially in one direction, said plunger having a reduced portion surrounded by an externally threaded annular planar bearing seat facing axially in the opposite direction, pressure transmitting members coupled by said threads to said cylinder and said plunger and transmitting pressure through said seats to a metal member and to a reaction supporting member respectively, and means comprising a flexible hose for supplying hydraulic pressure to said cylinder, one of said pressure transmitting members comprising a transverse bar having a central threaded socket and an aperture at each end for passing a chain, said apertures having slots opening into said apertures for engaging chain links.

4. In a portable machine of the class described, the combination of a piston, a cylinder therefor, means for supplying hydraulic pressure to the cylinder, said piston having an externally threaded head, said cylinder having a recessed base with an internal thread mating with the external threads on said head, and a coupling portion for the open end of the cylinder, said coupling portion having external coupling threads.

5. In a portable machine of the class described, the combination of a piston, a cylinder therefor, and a flexible hose connection extending laterally of the cylinder for transmitting hydraulic pressure, said piston having a reduced end portion terminating in an axially facing annular shoulder, a sleeve pinned on said reduced end portion and having coupling means thereon, and means at the base of the cylinder adapted to receive coupling means such as carried by said piston.

6. In a machine of the class described, a portable stand having a horizontal supporting member, a hydraulic pump unit mounted at one end and having an operating handle extending toward the opposite end, brackets on said opposite end, a pair of yoke plates, rods coupling said yoke plates in spaced relation to each other and fixing the same upon the brackets, said yoke plates having central apertures, a hydraulic ram unit having a cylinder and a piston, said cylinder having a threaded recess in its base, and means adapted to be passed through either aperture and threaded into the recess to hold the ram unit in said yoke and a flexible pressure hose connecting the pump and cylinder.

7. In combination, a mounting stand, a hydraulic pump unit secured thereto, a pair of brackets mounted at one end of said stand, a press

mounted on said brackets comprising a pressure plate secured to said brackets, a pair of yoke rods extending normal to said plate, a ram unit, means for mounting said ram unit within said yoke rods, and a flexible conduit between said ram unit and pump unit.

8. In combination, a mounting stand, a hydraulic pump unit secured thereto, the leg portions of one end of said stand projecting thereabove, a crosshead detachably secured across the extending ends of said leg portions, a ram unit comprising a cylinder and a piston, an end cap secured to said cylinder for guiding said piston in its movement axially outwardly of said cylinder, means engaging said cap for mounting said ram unit upon said crosshead with the piston thereof movable into the space between said leg portions, and means for transmitting pressure from said pump unit to said ram unit.

9. In combination, a mounting stand having legs at the opposite ends thereof, the legs at one end of said stand being projected upwardly, a crosshead member connected across the extending end of said legs, a platen member carried by said stand beneath said crosshead, a ram unit including a cylinder and a piston, means for mounting said cylinder in vertically projecting position on one of said members, said piston being movable through said member on which it is mounted toward said other member, and means for transmitting hydraulic pressure to the ram unit.

10. In combination, a mounting stand having an upper shelf member provided with a vertically extending defining flange, a pair of brackets mounted in spaced position on said flange and having gripping portions opening in the same direction, a pump unit comprising a reservoir cylinder and including oppositely laterally extending foot portions at the front and rear thereof, said foot portions being engageable in said gripping portions to mount said unit on said stand, means carried by one of said brackets for forcing said unit into firm engagement with the gripping portions of said brackets, and foot supporting means formed integral with the foot portions of said unit and adapted to be engaged by the feet of the operator when the pump unit is detached from the stand and placed on the floor for operation.

11. In a machine of the class described, including a hydraulic press having a crosshead provided with an opening therethrough, an adaptor mounted in said opening and having a shoulder abutting against said crosshead, a ram unit having an externally threaded end cap adjacent the piston of said unit, means in said adaptor for receiving said threaded end cap, said piston projecting through said adaptor and movable outwardly of said unit, and means for transmitting hydraulic pressure to said unit.

12. In a machine of the class described, a pump unit, a ram unit comprising a cylinder, a piston in said cylinder, graduations on said piston for indicating the extent of movement thereof outwardly of said cylinder, means for developing hydraulic pressure at said pump unit, flexible means transmitting said pressure to said ram unit, a work engaging element carried by said piston, and pressure indicating means associated with said machine whereby the movement of said work engaging element with respect to pressure can be determined.

13. In a device of the class described, the combination of a portable stand, a hydraulic press mounted on one end of the stand, said press com-

prising upper and lower transverse members and longitudinal tension members providing a working space between them opening out at the adjacent end of the stand for ready access by the operator, a hydraulic cylinder attached to one of the transverse members, said cylinder having a ram cooperable with the other transverse member, a hydraulic pump connected to the cylinder and being mounted on the stand and having an operating handle extending along one side of the press and adjacent thereto at a convenient height for the operator to actuate the pump with one hand while holding a piece to be worked upon by the ram in the press, and a flexible hose connecting the pump and the cylinder.

14. The combination of claim 13 wherein the pump comprises a cylinder frame having a cylinder and a single acting piston for forcing hydraulic medium only upon the down stroke of the handle whereby the operator may exert maximum pressure at any position of the ram by placing his weight upon the handle.

15. In a portable metal bending and straightening machine comprising, a hydraulic ram unit adapted to be grasped by the hand of an operator and placed in substantially any working position relative to the metal to be bent, said ram unit including a cylinder and a ram, quick detachable coupling means on said cylinder and ram for attachment thereto of work engaging fittings, a hydraulic pump unit having a handle and a frame pivoted together in the manner of a pair of tong handles and lying substantially parallel to each other, said frame being provided with a hand hold whereby it and said handle are adapted to be grasped by and operated by both hands of the operator, and a flexible hose interconnecting said ram and pump units, said flexible hose being connected to said pump unit adjacent the pivot of said handle and frame.

16. In a portable metal bending and straightening machine comprising, a hydraulic ram unit adapted to be grasped by the hand of an operator and placed in substantially any working position relative to the metal to be bent, said ram unit including a cylinder and a ram, a hydraulic pump unit having a handle and a frame pivoted together in the manner of a pair of tong handles and lying substantially parallel to each other, said frame being provided with a hand hold whereby it and said handle are adapted to be grasped by and operated by both hands of the operator, and a flexible hose interconnecting said ram and pump units, said flexible hose being connected to said pump unit adjacent the pivot of said handle and frame, said pump unit including a reservoir from which a liquid is pumped through said hose to operate said ram unit and to which the liquid is returned on completion of an operation by said ram unit.

17. In a portable metal bending and straightening machine comprising, a hydraulic ram unit adapted to be grasped by the hand of an operator and placed in substantially any working position relative to the metal to be bent, said ram unit including a cylinder and a ram, a hydraulic pump unit having a frame and a pair of handles pivoted together and lying substantially parallel to each other and operable to and from each other in the manner of a pair of tong handles, and a flexible hose interconnecting said ram and pump units, said flexible hose being connected to said frame of said pump unit adjacent the pivot of said handles.

18. In a portable metal bending and straight-

ening machine comprising, a hydraulic ram unit adapted to be grasped by the hand of an operator and placed in substantially any working position relative to the metal to be bent, said ram unit including a cylinder and a ram, a hydraulic pump unit having a frame and a pair of handles pivoted together and lying substantially parallel to each other and operable to and from each other in the manner of a pair of tong handles on being grasped by the hands of the operator, and a flexible hose interconnecting said ram and pump units, said flexible hose being connected to said frame of said pump unit adjacent the pivot of said handles, said pump unit including a reservoir from which a liquid is pumped through said hose to operate said ram unit and to which the liquid is returned on completion of an operation by said ram unit.

19. In a portable metal bending and straightening machine comprising, a hydraulic ram unit adapted to be grasped by the hand of an operator and placed in substantially any working position relative to the metal to be bent, said ram unit including a cylinder and a ram, a hydraulic pump unit having a frame and a pair of handles pivoted together and lying substantially parallel to each other and operable to and from each other in the manner of a pair of tong handles on being grasped by the hands of the operator, a flexible hose interconnecting said ram and pump units, said flexible hose being connected to said frame of said pump unit adjacent the pivot of said handles, a portable stand, and means for removably clamping one of said handles to said stand.

20. In combination, a ram unit of the class described having a ram cylinder, a plunger therein, means at one end of said cylinder guiding said plunger for movement outwardly of said cylinder, a base at the opposite end of said cylinder, means comprising a flexible conduit communicating with said cylinder for transmitting fluid pressure thereto to force said plunger outwardly, and means on the outer end of said cylinder, base, and plunger, adapted to receive detachable work engaging appliances.

21. In combination, a ram unit of the class described having a cylinder member, a ram member slidably mounted in said cylinder member including a plunger and packing means carried thereby for sealing the same in said cylinder member, guiding means removably mounted at the outer end of said cylinder member for guiding said ram member and on removal permitting insertion of the same into said cylinder member, the outer end of said plunger, the outer end of said cylinder member and the other end of said cylinder member having means for receiving detachable work engaging fittings, and means comprising a flexible conduit communicating with said cylinder member for transmitting fluid pressure thereto to force said plunger outwardly.

22. In a portable metal bending and straightening machine comprising, a hydraulic ram unit adapted to be grasped by the hand of an operator and placed in substantially any working position relative to the metal to be bent, said ram unit including a cylinder and a ram, a hydraulic pump unit having a frame and a pair of handles pivoted together and lying substantially parallel to each other and operable to and from each other in the manner of a pair of tong handles, and flexible hose interconnecting said ram and pump units, said flexible hose being connected to said frame of said pump unit adjacent the pivot

of said handles, said pump unit including a reservoir from which a liquid is pumped through said hose to operate said ram unit and to which the liquid is returned through said hose on completion of an operation by said ram unit.

23. In a portable metal bending and straightening machine comprising, a relatively light portable ram unit adapted to be readily positioned by an operator in practically any working position relative to the metal to be bent, said ram unit including a cylinder and a ram, a hydraulic pump unit having a frame and relatively pivoted elongated members lying approximately parallel to each other and operable to and from each

other in the manner of a pair of tong handles, the construction of the pump unit being such that it is operable in the manner described in the hands of the operator, a flexible hose interconnecting said ram and pump units, said flexible hose being connected to said frame of said pump unit adjacent the pivot of said members, there being a reservoir for hydraulic working fluid associated with the pump unit, and a valve carried on the pump unit for controlling the return of working fluid through the hose to the reservoir when the same is retracted.

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