

[54] **HYDRAULIC CRUSHING MACHINE**

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[51] Int. Cl. .... **B30b 1/16**

[58] Field of Search ..... **100/100, 271, 272, DIG. 1, 100/286; 254/124; 72/451; 425/DIG. 222, 450 R; 92/66; 74/106, 520**

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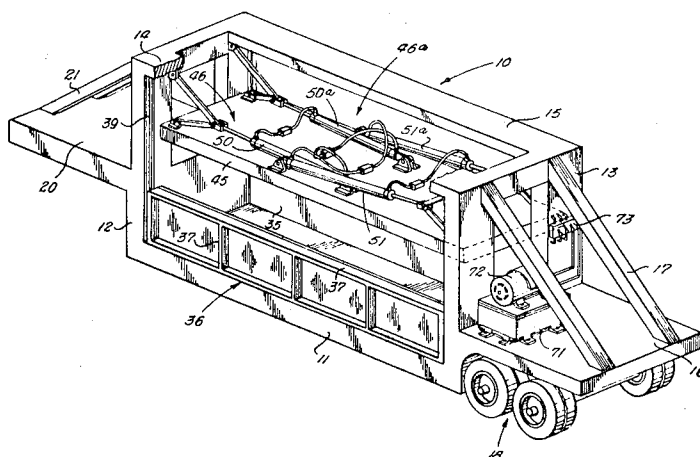
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[57]

**ABSTRACT**

The crushing machine particularly adapted for crushing automobile bodies is a portable trailer unit. The trailer body includes a bed defined by a horizontal base platform, end frame structures, and stringers connecting the upper ends of the end frame structures. A rear deck extending from the bed carries the trailer supporting wheels, and a forward deck carries the tractor coupling. A horizontal crusher ram is supported in overlying relation to the bed by parallel hydraulic subsystems pivotally connected between the body end frames and the crusher ram, these systems providing multiple bearing points for transmitting force to the crusher ram. One side panel for the bed is vertically shiftable to permit loading and unloading.

**9 Claims, 5 Drawing Figures**



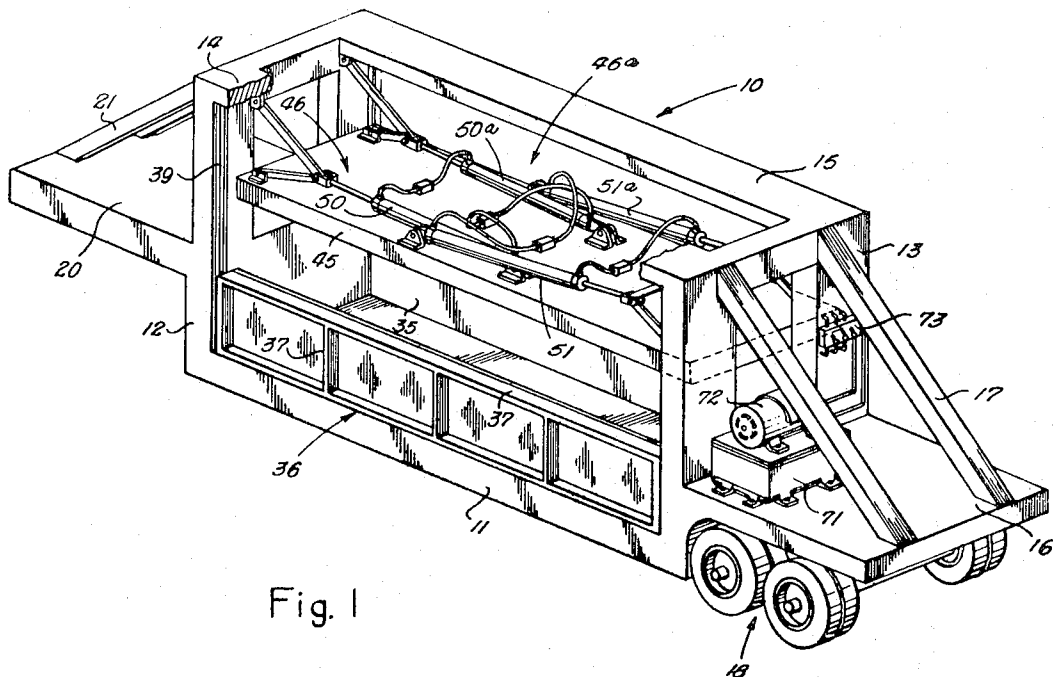


Fig. 1

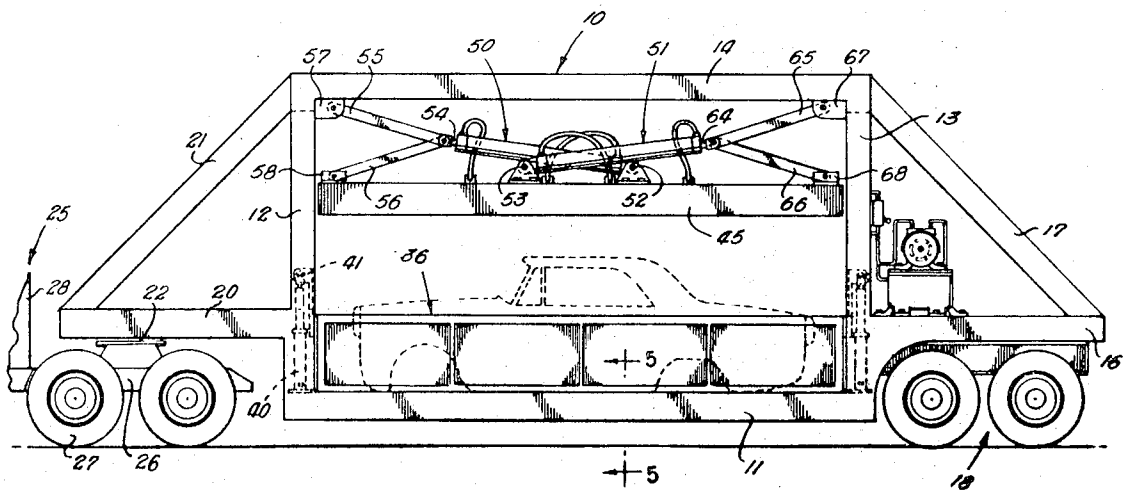


Fig. 2

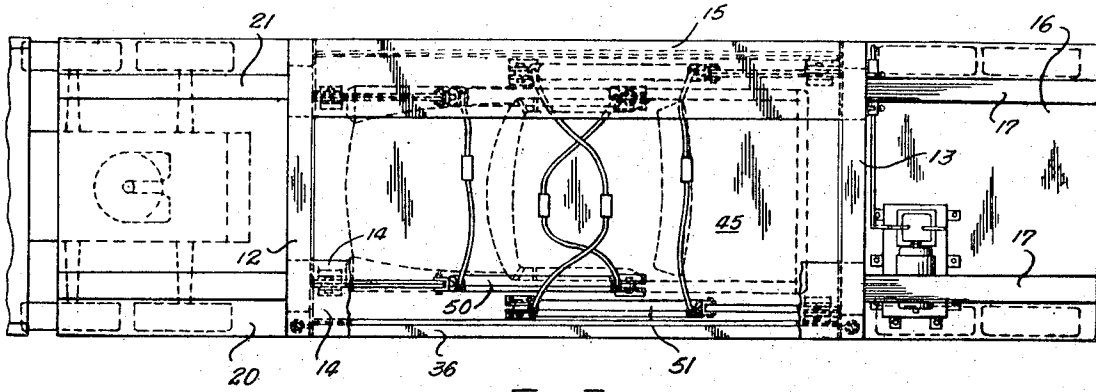


Fig. 3

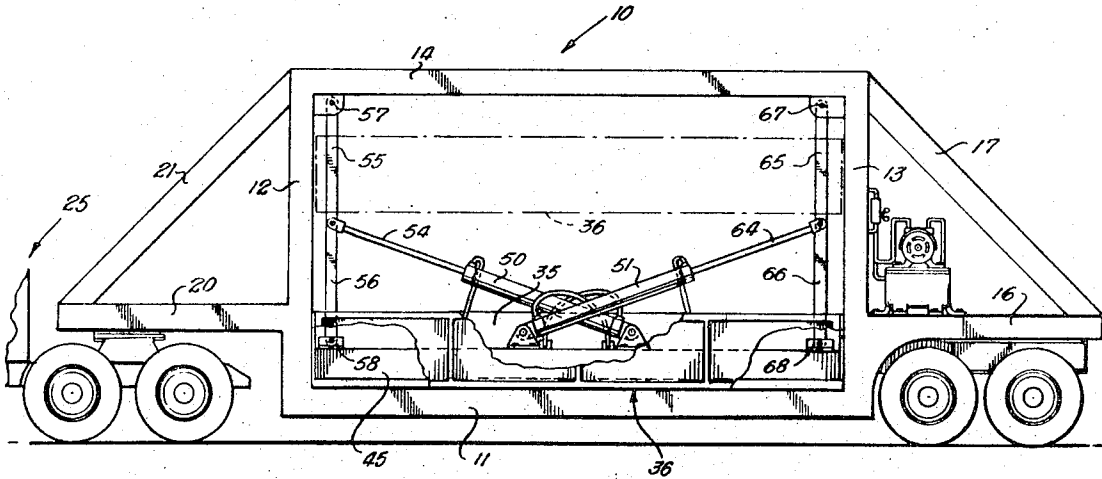


Fig. 4

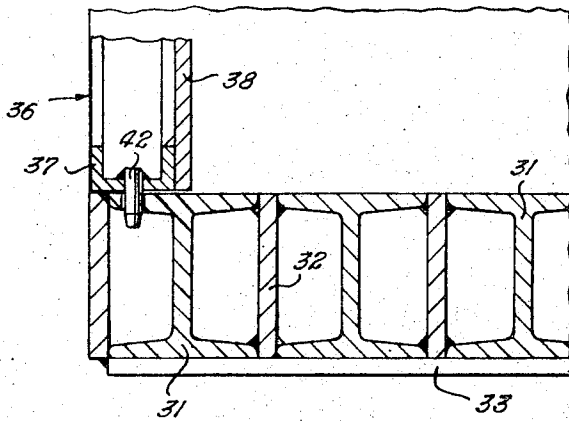


Fig. 5

## HYDRAULIC CRUSHING MACHINE

## BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to portable metal crushing apparatus and more particularly to hydraulic crushing apparatus for crushing automobile bodies and the like.

It is the principal object of this invention to provide a crushing apparatus for automobile bodies which is adapted to be towed from place to place by means of a suitable tractor, which has sufficient crushing force for the efficient crushing of automobile bodies and the like, and which is of a weight and size to be conveniently moved from one location to another on public highways, to minimize the necessity for special travel permits and to enable passage through standard underpasses.

It is another object of this invention to provide such portable crushing apparatus which is ready for operation with little or no set up time at a new location and which, by the same token, requires little or no knock down time prior to movement to a new location.

A further object of this invention is to provide such apparatus having an improved hydraulic system to minimize the weight and mass of the crusher ram.

For accomplishing these objects a crushing machine consists of a body including a crusher bed defined by a generally horizontal platform for supporting an article to be crushed, end frames extending upwardly from opposite ends of the bed, horizontal stringers connecting the upper ends of the end frames, and upright walls at the periphery of the bed for restricting lateral flow of the crushed metal. A generally horizontal crusher ram disposed above the crusher bed for vertical movement toward and away from the bed is supported and powered by a hydraulic power system including two hydraulic subsystems operating in generally parallel vertical planes, powered by a motor driven hydraulic pump and system supported on the body. Each planar subsystem includes first and second hydraulic power cylinders each having one end pivotally attached to the crusher ram intermediate the ends thereof and extending respectively toward opposite ends of the ram. First and second scissors assemblies are associated respectively with the first and second power cylinders, each scissors assembly having an upper and lower arm pivotally connected at one end to each other and to the other end of its associated power cylinder. The free end of each upper scissors arm is pivotally connected to a respective end frame adjacent to the upper end thereof; and the free end of each lower scissors arm is pivotally connected to the crusher ram adjacent to the respective end thereof. The pivotal connections of the two lower scissors arms and the two power cylinders to the crusher ram define at least three and preferably four spaced bearing points of the hydraulic subsystem transmitting force to the crusher ram, with the two hydraulic subsystems defining at least six and preferably eight spaced bearing points.

The novel features and the advantages of the invention, as well as additional objects thereof, will be understood more fully from the following description when read in connection with the accompanying drawings.

## DRAWINGS

FIG. 1 is a perspective view of a crushing machine according to the invention;

FIG. 2 is a side view of the machine of FIG. 1, showing the crusher ram in the upper position;

FIG. 3 is a top view of the apparatus of FIG. 1;

FIG. 4 is another side view of the apparatus of FIG. 1 illustrating the crusher ram in the lower position; and

FIG. 5 is a fragmentary sectional view taken in the plane 5—5 of FIG. 2.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the crushing machine according to the invention is embodied in the form of a trailer adapted to be transported over the highways by means of a suitable tractor vehicle. The overall trailer is illustrated in FIGS. 1 through 4, with the crusher ram being shown in the raised position in FIGS. 1 and 2, in condition for loading an automobile body onto the machine bed, and in the lower most position in FIG. 4 which would be the position of the crusher ram when the trailer is being moved from one location to another.

Referring to these Figures, the crushing machine body 10 includes an elongated crusher bed 11 defined by a generally horizontal platform which extends for a substantial portion of the length of the trailer and may have a ground clearance for example of about 1 foot when in the transport mode as seen in FIG. 2. A front frame structure 12 and a rear frame structure 13 extend upwardly from the bed 11 to a height of 2.5 feet, for example, from the base of the bed, or an overall ground height of 13.5 feet. The frame structures are joined at the top by longitudinal frame or stringer members 14 and 15 thereby defining a box-like body structure.

A rear deck structure 16 extends rearwardly from the rear frame structure 13 and is rigidly supported relative to the rear frame by angle braces 17. The rear deck 16 carries the tandem trailer wheel assembly 18 for supporting the rear end of the trailer, so that the bed is maintained at approximately the 1 foot ground clearance above mentioned.

A front deck structure 20 extends forwardly from the front frame 12, generally horizontally, and is rigidly supported relative to the front frame by angle braces 21. This front deck 20 carries the coupler 22 on its under side for engagement with the mating coupler of a towing tractor.

A tractor 25, illustrated fragmentarily in FIGS. 2, 3 and 4 includes a chassis 26, drive wheels 27, cab 28 and coupler assembly 29.

The above described body is fabricated from suitable structural steel members such as I beams, H beams and plates. The stringers 15 and 14 for example may be fabricated of I beams or H beams; and, while only two such stringers are shown, the number and strength of these stringers are selected to withstand the required compression and tensile forces for supporting the trailer body 10 and for absorbing the reaction forces during operation of the crusher ram as will be described.

A preferred form of structure for the bed 11 is particularly illustrated in FIG. 5, the bed consisting of side-by-side H beams 31 and elongated plates 32 welded in an integral assembly wherein the plates supplement the

H beam webs and providing additional beam strength. Transverse plates or straps 33 may be welded to the under side of this H beam structure to provide additional transverse beam strength for the bed.

As an example of the bed structure, the bed may be fabricated of seven 14 × 12 inch H beams for example welded in side-by-side relation with the intervening supplementary beam plates being fabricated of 13 ½ × ¾ inch steel plates. These members being welded into an integrated assembly as above described. The additional transverse straps or plates may also be fabricated of ¾ inch steel plate. A length of the bed assembly may be in excess of 20 feet.

The front and rear frame structures define end walls for the bed 10 and side walls are defined by side panels 35 and 36, the panel 35 on the right side of the trailer being a fixed panel, and the panel 36 on the left side of the trailer being a sliding panel or gate. The two panels are generally similar in structure being constructed of a frame work of structural channels 37 for example with the interior walls being fabricated of metal plates 38 welded to the frames.

The sliding panel 36 is guided for vertical sliding movement within vertical guide slots 39 provided in the front and rear frames at the left side of the trailer, as best seen in FIG. 1. As best seen in FIG. 2, the sliding panel is provided with suitable ears extending from the ends thereof which are guided in the slots 39; and double acting hydraulic power cylinder or jacks 40 are positioned within the front and rear frame structures and coact with brackets 41 secured to the sliding panel for raising and lowering the panel. The raised position of the sliding panel 26 is illustrated in phantom lines in FIG. 4; and in this position an auto body may be placed on the machine bed by means of a fork lift for example. The crushed auto body is removed from the bed in a similar manner.

The panel 36 is shown fragmentarily in cross-section in FIG. 5; and in this view it is seen that the lower edge of the panel may be provided with downward projecting pins 42 for engagement in mating holes in the confronting surface of the bed, for the purpose of inhibiting lateral movement of the panel 26 during the crushing of an auto body. Several such pins 42 may be provided intermediate the ends of the panel, where the bending moment is greatest.

The crusher ram 45 is a planar member which may have a structure similar to that of the bed 1; that is being fabricated of side-by-side H beams welded together, either with or without intervening plates to supplement the H beam webs for longitudinal beam strength. The beam strength required for the pressure ram may not be so great because of the multiple bearing points provided by the hydraulic system to be described; and accordingly the structural members which make up the crusher ram need not be as heavy as those for the bed. For lateral beam strength, the crusher ram also may include plates or horizontal straps which are welded to the top of the crusher ram structure. The crusher ram is dimensioned to be closely received within the confining walls of the bed defined by the end frames and the side panels 35 and 36.

A hydraulic system for supporting the crusher ram and for applying the crushing force thereto is best illustrated in FIGS. 1 and 2, with the crusher ram shown in the raised position. The hydraulic system consists of two subsystems 46 and 46a functioning respectively at

the left and right sides of the crusher ram and body, these systems being described as planar since they function generally in parallel vertical planes adjacent to the opposite sides of the crusher ram. Since the subsystems are identical, the subsystem at the left side of the ram will be described, with the counterpart components of the other subsystem being indicated by the same reference numbers with the subscript *a*.

The subsystem 46 consists of two double acting hydraulic power cylinders 50 and 51 which are disposed in overlapping or staggered relation, with the cylinder 50 being disposed toward the front end of the crusher ram and the cylinder 51 being disposed toward the rear. The cylinder of the power cylinder 50 is pivotally attached to the crusher ram by means of a bracket 52 to swing in a vertical plane relative to the crusher ram; and the power cylinder 51 is similarly pivotally mounted to the crusher by means of a bracket 53 again to swing in a vertical plane. Due to the staggered relation, while the power cylinder 50 is the front cylinder, its pivot bracket 52 is nearer the rear end of the crusher ram while the bracket 53 for the rear cylinder 51 is nearer the front end of the ram.

The extension rod 54 for the front power cylinder 50 is pivotally attached to a scissors assembly consisting of an upper arm 55 and a lower arm 56, the inner ends of these arms also being pivoted relative to each other at the pivot connection to the extension rod. As best seen in FIG. 2 the front end of the upper arm 55 is pivotally connected to the front frame 12 by means of a bracket 57; and the lower arm 56 is pivotally connected to the front end of the crusher ram by means of a bracket 58. It will be seen then that the assembly of power cylinder 50 and its associated scissors arms 55 and 56 is anchored at one point to the front frame at the bracket 57, and at two points to the crusher ram at the brackets 52 and 58.

Similarly the extension rod 64 of the power cylinder 61 is pivotally attached to a scissors assembly consisting of an upper arm 65 and lower arm 66, with the upper arm being pivotally connected to the rear frame 13 adjacent to its upper end by means of the bracket 67, and with the lower arm being pivotally connected to the crusher ram adjacent to its rear end by means of a bracket 68. Again the assembly of the power cylinder 51 and its associated scissors arms is connected to the crusher ram at two points, and to the body rear frame at one point.

Looking at the overall hydraulic subassembly 46 then, which functions generally in a vertical plane adjacent to the left hand edge of the crusher ram 45, this subassembly is connected to the body at two points namely the bracket 57 and 67, and is connected to the crusher ram at four points namely the brackets 58, 53, 52 and 68. The brackets 52 and 53, and the bearing points defined thereby, are located generally in the center of the length of the ram and, depending upon the function for which the crushing machine is designed, could be pivotally connected at a common center point, or the bearing points could be spaced substantially as shown to define separated central bearing points.

The hydraulic subassembly 46a is identical in structure, and functions in an identical manner acting along the right hand edge of the crusher ram 45. The overall hydraulic assembly then consisting of subassemblies 45 and 46 is pivotally attached to the body 10 at

four points overlying the four corners of the rectangular crusher ram 45; and is connected to the crusher ram at eight points which are relatively uniformly distributed over the area of the pressure ram to provide for good force distribution to the ram and to make possible a ram structure of lighter weight and strength than would be required if the force were applied to the ram at bearing points fewer in number and less uniformly distributed.

Other components of the hydraulic system are conveniently mounted on the rear deck 16 and rear frame 13 for example. The hydraulic system is conventional, and illustrated components include a reservoir 71 conveniently mounted on the rear deck 16, an electric motor-pump assembly 72 mounted on a reservoir 71, and a manually operable control valve assembly 73 mounted on the rear frame 13 for convenient manual control and operation of the several power cylinders. While an electric motor is illustrated for the motor-pump assembly 72, it will be appreciated that other sources of power such as internal combustion engines may be employed.

A feature of the hydraulic power system for the crusher ram is the arrangement of the power cylinders and associated scissors assemblies wherein the components thereof are disposed generally horizontally when the ram 45 is in its uppermost position as best seen in FIG. 2, with the scissors arms extending from the common pivot connection with the power cylinder extension rod and forming an acute angle at this pivot point which may be as little as 30° for example. Each arm of the respective scissors assembly then would be disposed approximately one half that amount or 15° relative to a horizontal plane, and the associated power cylinder would have an angle of inclination of less than 15° relative to the horizontal so that the line of force when the power cylinder extension rod is extended is directed along a line between the axis of the two arms or within the acute angle formed by the two arms.

As the crusher ram begins to move downward, relatively little force is required, and indeed the weight of the ram will assist in this movement until such time at least as the ram contacts the uppermost portion of the automobile body to be crushed. With the beginning of the crushing action, the force required will increase and will continue to increase as the auto body continues to be compacted or crushed.

The particular arrangement of the crusher ram hydraulic system lends itself well to this situation since, due to the leverage action provided by the scissors assemblies, the downward components of force exerted at the several bearing points increases as the distance of the ram from the upper starting position increases.

Comparing FIG. 4 with FIG. 2, it will be seen that the angle of the power cylinders increase to a relatively small degree during movement from the uppermost ram position to the lowermost ram position and this of course will effect an increase of the downward component of force acting on the power cylinder bearing points defined by the brackets 52, 52a, 53 and 53a. The multiplication of the downward component of forces by the scissors assembly is much more pronounced however, these forces acting on the bearing points defined by the ram bracket 58, 58a, 68 and 68a. Referring to the FIG. 2 position, the horizontal components of force acting on the brackets 67 and 68 for example are

much greater than the vertical components of force acting on these brackets. As the assembly approaches the FIG. 4 position however, the horizontal components of force acting on the brackets approach zero while the vertical components of force acting on these brackets are multiplied many times from the original vertical components. In other words, with this system, the vertical component of force, which is the crushing force is greatest toward the end of the compacting stroke where the greatest force is required.

A trailer crushing machine as above described may be designed to have ample crushing force for the intended purpose, and yet have a weight and size limitation which permits movement over state and federal highways with minimum inconvenience. For example, the trailer may be designed to have a length which, when combined with the length of the towing tractor, will not exceed 55 feet and a gross weight of the trailer and tractor assembly which will not exceed 72,000 lbs. Additionally the maximum height of the trailer will not exceed 13 feet 6 inches and the maximum width will not exceed 8 feet. Under present regulations, units which exceed these criteria may not be moved in certain areas and at certain times without special permit; and additionally a vehicle having a greater height may not be able to negotiate certain underpasses, possibly requiring travel of many additional miles to enable transport from one particular location to another.

Since all of the functions during operation of the crushing machine are accomplished hydraulically, the machine is well adapted to be operated either manually at the unit, or could be operated manually at a location remote from the unit through suitable remote control connections, and it could also be operated automatically through a programmed control mechanism.

## OPERATION

The trailer crushing machine as shown in the transport mode in FIG. 4 where it is coupled to a towing tractor 25, wherein the crusher ram 45 is positioned at its lowermost position, and wherein the sliding panel 36 is positioned at its lowermost position. For the transport mode, suitable blocks may be positioned between the crusher bed 11 and the crusher ram so that the weight of the ram is supported by the blocks rather than by the hydraulic support system.

When the machine arrives at a working location, there is little or no set up required to prepare the machine for use. Since the crushing forces are absorbed entirely within the body 10 it would not be necessary to support the body by auxiliary means, although this would probably be desirable.

Since the machine is a hydraulically controlled and operated machine, it would be convenient to provide hydraulic jacks for supporting the body 10 during operation. This then would permit removal of the tractor unit and remove the load from the rear wheel assembly 18. Alternatively, the jacks could be employed to temporarily raise the body 10 so a sufficient height to insert leveling timbers between the ground surface and the under surface of the bed, and then lower the body for support on these timbers during crushing operations. Another possible construction is that the rear wheel assembly 18 may be removable from the rear deck 16 to permit lowering of the crusher bed nearer to ground level.

Considering these alternatives, the set up time to place the crushing machine in condition for operation is very small. By the same token, when the operation is completed at that location and the machine is to be moved to another location, the knock down time, or the time required to ready the machine for the transport mode, is correspondingly small.

For the crushing operations, both the crusher ram and the sliding panel are raised to their upper positions to permit loading of an automobile body from the side by means of a fork lift for example. FIG. 2 illustrates the machine in loaded condition ready for the crushing operation, with the sliding panel 36 lowered to restrain lateral expansion of the auto body during crushing. The controls are then actuated to extend the power cylinders 50 and 51 to vertically compress the auto body to the required extent. If desired, a second auto body could be placed over the first body already crushed, with a second crushing operation then being effected so that the sandwiched bodies of two autos may then be removed in a single operation.

What has been described is a crushing machine particularly adapted for the crushing of bodies of automobiles or other vehicles, which is designed to be transportable over state and federal highways with minimum inconvenience, and which requires little or no set up time for the purpose of commencing crushing operations and correspondingly little or no knock down time for the purpose of preparing the device for the transport mode following crushing operations.

While the preferred embodiment of the invention has been illustrated and described, it will be understood by those skilled in the art that changes and modifications may be resorted to without departing from the spirit and scope of the invention.

What is claimed is:

1. A crushing machine comprising

a body including a crusher bed defined by a generally horizontal platform for supporting an article to be crushed, end frame means extending upwardly from the opposite ends of said bed, horizontal stringer means connecting the upper ends of said end frame means, and upright wall means at the periphery of said bed for restricting lateral flow of the crushed metal;

a generally horizontal crusher ram disposed above said crusher bed for vertical parallel movement toward and away from said bed;

a hydraulic power system for supporting and powering said crusher ram including two hydraulic subsystems operating in generally parallel vertical planes, and a motor driven hydraulic pump for supplying pressurized hydraulic fluid to said subsystems;

each planar hydraulic subsystem including first and second hydraulic power cylinders each having one end pivotally attached to said crusher ram intermediate the ends thereof and extending respectively toward opposite ends of said ram; first and second scissors assemblies associated respectively with said first and second power cylinders, each scissors assembly having an upper and lower arm pivotally connected, at one end, to each other and to the other end of its associated power cylinder; the free end of each upper scissors arm being pivotally connected to a respective end frame adjacent to the upper end thereof, and the free end of each lower

scissors arm being pivotally connected to the crusher ram adjacent to a respective end; the pivotal connections of said two lower scissors arms and said two power cylinders to said crusher ram defining at least three spaced bearing points of the hydraulic subsystem transmitting force to said crusher ram;

and said two hydraulic subsystems defining at least six spaced bearing points for the transmission of force to said planar crusher ram.

2. A crushing machine as set forth in claim 1

wherein said one ends of the first and second hydraulic power cylinders of a hydraulic subsystem are pivotally attached to said crusher ram at spaced points intermediate the ends thereof, whereby each hydraulic subsystem defines four bearing points for the transmission of force to said crusher ram, and whereby said two subsystems define eight spaced bearing points for transmitting force to said crusher ram.

3. A crushing machine as set forth in claim 2

wherein the first and second power cylinders of a subsystem overlap each other with the one end of said first cylinder being pivotally attached to said crusher ram nearer the end of the ram remote from the pivotal connection of its associated scissors assembly; and with the second hydraulic power cylinder having its one end pivotally attached to the crusher ram nearer the end of the ram remote from the pivotal connection of its associated scissors assembly.

4. A crushing machine as set forth in claim 1

wherein the cylinder ends of the several hydraulic power cylinders are the one ends which are pivotally attached to said crusher ram intermediate the ends thereof; and wherein the extension rod ends of the several power cylinders are the ends which are pivotally connected to the respective scissors assembly.

5. A crushing machine as set forth in claim 1

wherein the four hydraulic power cylinders of the two hydraulic subsystems are connected to a common hydraulic pump for the uniform application of force to the several bearing points of said crusher ram.

6. A crushing machine as set forth in claim 1

wherein one of said upright wall means is movable vertically for permitting loading and unloading of the machine bed from one side.

7. A crushing machine as set forth in claim 6

including hydraulic power cylinder means disposed at each end of the vertically movable wall for raising and lowering said wall relative to the machine bed.

8. A crushing machine as set forth in claim 1

said body defining a portable trailer adapted to be towed by a tractor; said body including a deck extending from the rearward end of the bed for carrying the rear supporting wheels of the trailer body; and said body including a deck extending from the forward end of said bed for carrying a coupler for coupling to a towing tractor.

9. A crushing machine as set forth in claim 8

wherein said hydraulic pump and its power driving means are supported on one of said decks.

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