April 20, 1937. E. CHAPMAN 2,078,056

FRAME FOR HIGH COMPRESSION APPARATUS

Filed Sept. 15, 1936 3 Sheets-Sheet 1

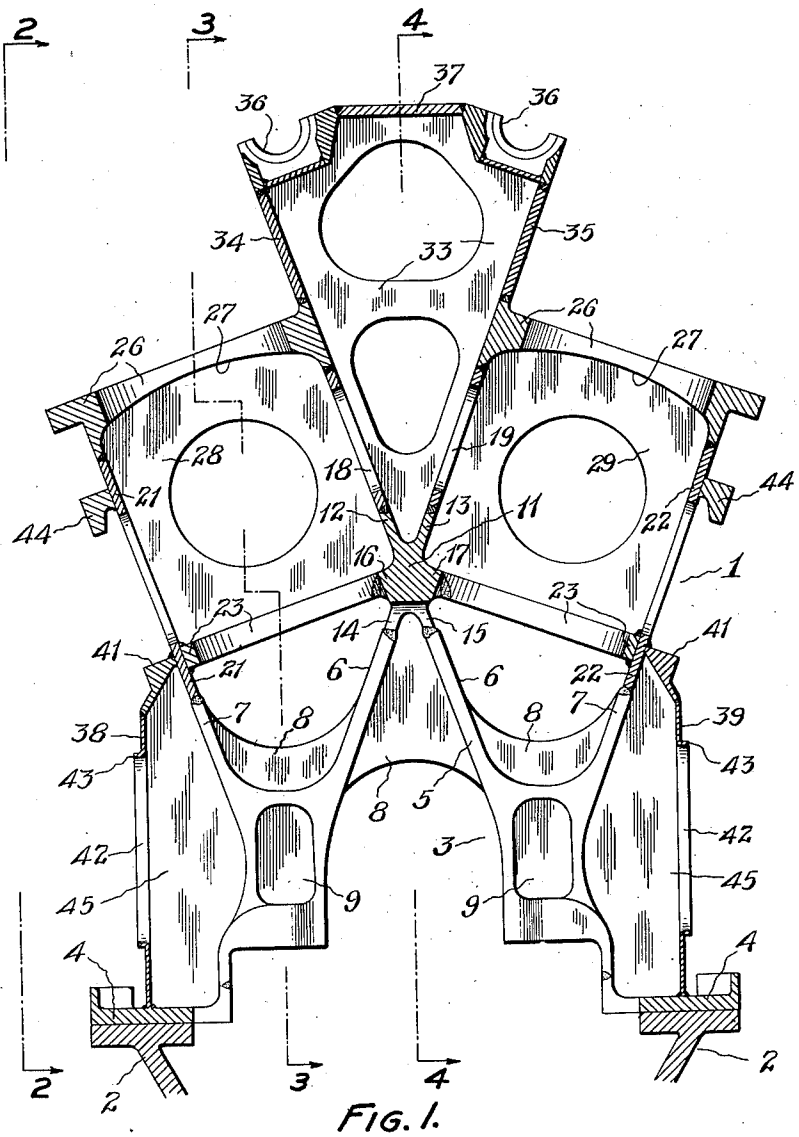


FIG. 1.

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Filed Sept. 15, 1936 3 Sheets-Sheet 2

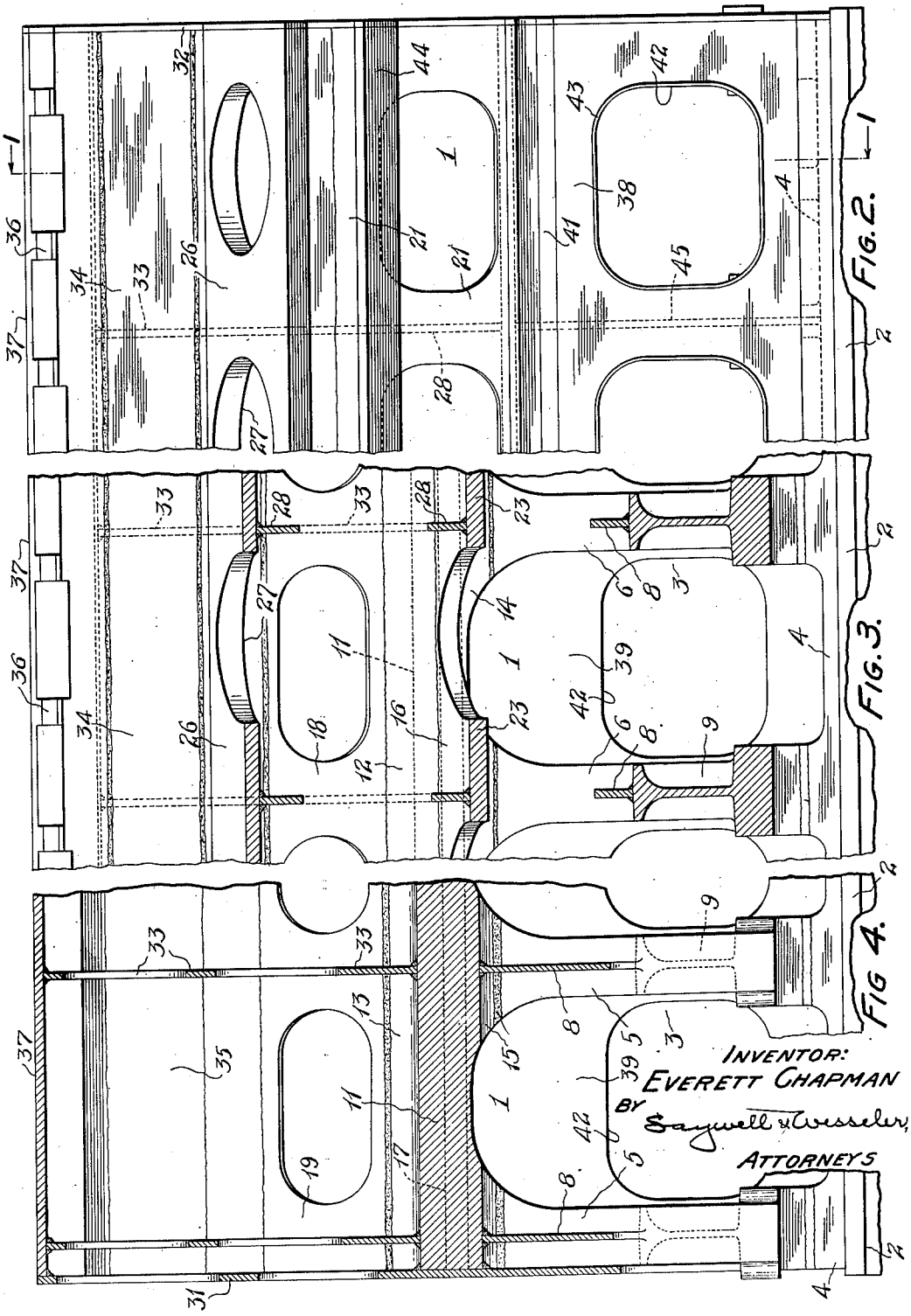


FIG. 2.

FIG. 3.

FIG 4.

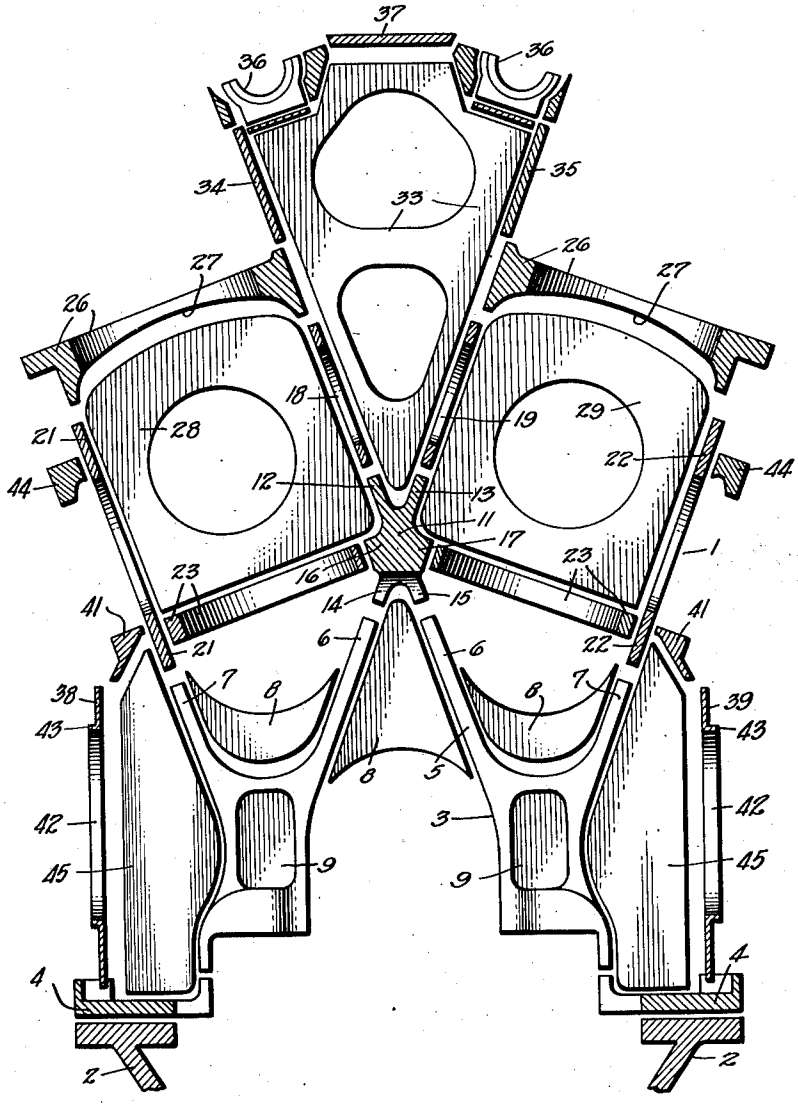
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Filed Sept. 15, 1936 3 Sheets-Sheet 3

FIG. 5.



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Patented Apr. 20, 1937 2,078,056

UNITED STATES PATENT OFFICE

2,078,056

FRAME FOR HIGH COMPRESSION APPARATUS

Everett Chapman, Coatesville, Pa.

Application September 15, 1936, Serial No. 100,909

12 Claims. (Cl. 121—194)

This invention, as indicated, relates to a frame for high compression apparatus and method of making the same. More particularly, it comprises a frame structure especially adapted for use in V-type heavy duty high compression apparatus such as internal combustion engines. It is also particularly applicable to the extra heavy high duty Diesel engines used in submarines and on railroads.

Heretofore efforts have been made to supply a structure of this type for heavy duty involving light weight and long service life, but in such previous efforts, where one of these objects has been accomplished, the other has been adversely affected. Thus, large blocks have been utilized as the head members with through bolts extending to the bottom of the engine and designed to take the stress, and, in other instances, a series of bolts crossing each other have been designed to take the stress, but have involved increased weight in providing anchorage for the bolts, and columns around the bolts, and have rendered difficult the assembling and disassembling of the structure. In addition to these disadvantages, the structures using such bolts involve additional weight and the bolts do not transmit the stresses throughout the structure in pure tension as to all its parts, for the reason that the bolts extending in opposite directions interfere with or interrupt the continuity of the strain resistance element as to approximately one half of its total extent.

The present invention seeks to obviate the difficulties referred to and to provide both a light weight structure and one having the ideal characteristics as to strain distribution and capacity for severe duty over a long period of time. The stress resistance provided for is continuous and uninterrupted throughout as to each of the angularly positioned loads with reference to the cross-over points.

The principal object of the present invention is to provide an improved frame for V-type structures adapted for high compression apparatus.

Another object of the invention is to provide a frame for V-type internal combustion engines wherein the gas load is transmitted in substantially pure tension to its reaction point in each and all of the cylinders.

Another object of the invention is to provide a V-type structure in which the transition cross-over of two non-simultaneously occurring loads has the stress concentrations minimized through the use of a specially shaped and fabricated member.

Another object of the invention is to provide a rigid central member for resisting transverse strains, carrying integral flanges merging along lines of gentle contour and constituting a "backbone" for the V-type high compression apparatus at the critical point through which a plurality of angularly related intersecting loads are carried in substantially pure tension.

Another object of the invention is to provide a method of making the frame structure of an internal combustion engine with the critical points formed of strain resisting members of special construction and the remaining portion of the frame formed of readily fabricated sheets and forms which may be welded to each other to form an integral structure of great strain resisting capacity and relatively light weight.

Another object of the invention is to provide a structure wherein desirable gentle changes of contour at critical points are effected by a machining operation or a forging operation rather than by a weld whose contour is indeterminate.

A further object of the invention is to assemble an engine structure of ready cut plates and special forms at critical points whereby a minimum of weight will be involved in the structure with an arrangement of all lines of stress in substantially pure tension.

A further object of the invention is to provide a structure wherein welded joints and stress concentrations are avoided at the critical points of heavy loading and wherein welded points are provided at easily accessible non-critical points.

Other and further objects of the invention will appear in the course of the following description.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means and method hereinafter fully described and particularly pointed out in the claims, the annexed drawings and the following description setting forth in detail certain means and methods embodying the invention, such disclosed means and methods constituting, however, but several of various forms in which the principle of the invention may be used.

In said annexed drawings:

Figure 1 is a transverse sectional view through an apparatus embodying the principles of the invention, as seen along the line 1—1 shown in Figure 2 looking in the direction of the arrows;

Figure 2 is a fragmentary side elevation as seen from the left hand side of Figure 1, and indicated by the line 2—2, looking in the direction of the arrows;

Figure 3 is a fragmentary vertical sectional view taken along the line 3—3 shown in Figure 1, looking in the direction of the arrows;

Figure 4 is a central vertical sectional view, taken along the line 4—4 shown in Figure 1, looking in the direction of the arrows; and

Figure 5 is a view similar to Figure 1, with the parts disassembled from each other but arranged in close relation to each other to indicate how they are joined together.

As is clearly shown in the drawings, the struc-

ture comprises a frame made up of members welded to each other and forming a rigid integral unit adapted to receive the additional operative and structural parts of the high compression apparatus. The parts are of steel or suitable alloys in most instances and the welds are disposed at points where they involve no stress concentrations. Metals and alloys of various kinds may be used.

The frame structure 1 has a base member 2 forming a bottom tie, which may comprise the lower half of the crank case, or the oil pan, to which the lower frame member 3 is secured by its flanges 4. The lower frame member 3 is preferably formed of a series of steel forged elements 5 having upwardly and inwardly projecting members 6 adjacent its central portion and having upwardly and outwardly projecting marginal members 7, presenting two pairs of diverging members parallel to the sides of the respective series of cylinders and to which the other structural members are united preferably by welding. The under sides of said elements 5 are preferably recessed to receive the main bearing members. The upwardly projecting members 6, 7, are preferably connected by reinforcing webs 8, and the lower portions are formed with recesses 9 to receive the main bearings bolts. The lower ends of the elements 5 are welded to flanges 4 formed of heavy metal plates.

The upper edges of the inwardly projecting members 6, are connected to a "backbone" or longitudinal central frame member 11 which extends substantially the full length of the apparatus. This central member 11 is located at the critical point of the apparatus where it may cooperate most effectively in transmitting the gas impact load in pure tension to its reaction point. The transition cross-over of two non-simultaneously occurring loads of a high fatiguing character is thus taken care of through the use of a central strain resistant member of special shape and structure which reduces stress concentrations to a mimimum. The critical contours of the member 11 are controlled by a machining operation or by a forging operation rather than by a welding operation. This provides for a wholly dependable structure whereas a contour formed by welding is of a random nature and cannot be relied on for a highly fatiguing load. Such loads as developed in a heavy duty Diesel engine require structural parts of known quality throughout.

The central member 11 is provided with integral flanges 12 to 17 joined with the body portion along lines of gentle contour. As shown in Figure 1, the flanges 12, 13, 14 and 15, at the top and bottom respectively are diagonally positioned in pairs, and when joined to other parts of the structure provide elements in alinement with each other and parallel to the line of action of the respective gas loads, and adapted to transmit the strains of such loads in pure tension to the reaction points. The lower flanges 14, 15 are connected respectively to the adjacent inwardly and upwardly projecting members 6 of the lower frame by welding, and the upper flanges 12, 13, are connected to plates 18, 19, forming part of the cylinder enclosing structure. These plates are preferably centrally apertured and the corners of said apertures are preferably rounded to provide light weight and maximum strength of the parts. Similar plates 21, 22, are connected to the outwardly and upwardly projecting members 7 and are similar apertured. All of the plates are welded and careful welding is required to avoid hidden defects, but throughout the structure the welding points are accessible and remote from the points of stress concentration, and welds of high quality can readily be made.

The intermediate flanges 16, 17, on the central member 11, between the pairs of diagonal flanges serve as points of connection for the plates 23 of the lower cylinder supporting members, which carry the lower ends of the cylinder liners. Said lower cylinder supporting members are secured by welding between said flanges 16, 17, respectively, and the plates 21, 22, respectively. Said deck plates are provided with suitable apertures with rounded corners to receive the cylinders of the apparatus. At the upper ends of the inner plates 18, 19, and the outer plates 21, 22, the head plates or upper cylinder supporting plates 26 of the cylinder enclosing frame are secured preferably by welding. These plates are preferably provided with inner concaved faces 27 to avoid the sharp corners which involve stress concentrations at the welding points. Between each of the cylinder positions, transverse plates 28, 29, are provided, such plates being centrally apertured to provide for lighter weight. End plates 31, 32, are provided at the respective ends of the frame. The end plates at the drive end and at the blower end of a Diesel engine are suitably apertured for the associated mechanism as required.

The space between the upper diagonal flanges 12, 13, and associated plates 18, 19, is provided intermediate the position of the cylinders with a series of triangular transversely positioned plates 33. These plates project above the cylinder enclosing frame and are secured by welding to the adjacent parts. Side plates 34, 35, are secured by welding to the upper outer edges of the plates 33, and provide a housing for operative parts of the apparatus. The triangular plates may be provided with one or more apertures and at their upper edges are provided with bearing members 36 adjacent the sides and a closure plate intermediate the same, said closure plate 37 and bearing members being welded to the triangular plates. The side plates 34, 35, it will be noted from Figure 1, are in alinement with the respective inwardly and upwardly projecting flanges 6, and the respective diagonal flanges 12, 15, and 13 and 14, and the respective plates 18, and 19, and the inner edges of the top deck 26.

The lower forged frame elements 5 as stated are welded to the flanges 4 which are secured to the base member 2. Side plates or auxiliary housing plates 38, 39, are provided at the base to form a closure for the upper side portion of the crank case outwardly of the lower frame member 3. Said plates are preferably secured by welding to the upper side of the flanges 4, and preferably have an inclined marginal member 41 welded thereto and connected by welding with the outer plates 21, 22, respectively. The plates 38, 39, may have central openings 42 provided with flanges 43, opposite each of the cylinders. Cover plates (not shown) may be provided and removably secured to said flanges to provide access to the crank case. A strip 44 channeled on its under side may be welded to the respective side plates 21, 22, to provide for closure elements opposite each of the cylinder positions whereby access may be had to the cylinder liners and piston rings. Plates 45 may join the frames 5 to the plates 38, 39. The accessory devices and operative parts of the high compression apparatus, such as crank shaft, pistons, connecting rods, fluid intake and discharge valves and passage-

ways and the like, may be of conventional design or may be special as to all or some of its parts, but the frame members will be found in practically all instances to be adapted for use with said parts without sacrificing any of the advantages set forth.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made as regards the means and steps herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:

1. An apparatus of the character described, having in combination a frame for V-type high compression apparatus providing upper and lower cylinder supporting members, a base member, a bearing supporting member united with said base and providing a plurality of projecting members, cylinder frame members angularly disposed toward each other and having inner and outer walls in alinement with the projecting members on said bearing supporting member, and a continuous central member extending substantially the entire length of said apparatus having integral flanges in alinement with said inner cylinder frame members and said inner projecting members of said bearing supporting member and secured to said members so as to provide a structure having the inner walls of each respective series of cylinder frame members in alinement and crossing the companion inner walls through said longitudinal member.

2. An apparatus of the character described, having in combination a frame for V-type high compression apparatus providing upper and lower cylinder supporting members, a base member, a bearing supporting member united with said base and providing a plurality of projecting members, cylinder frame members angularly disposed toward each other and having inner and outer walls in alinement with the projecting members on said bearing supporting member, and a continuous central member extending substantially the entire length of said apparatus having integral flanges in alinement with said inner cylinder frame members and said inner projecting members of said bearing supporting member and secured to said members so as to provide a structure having the inner walls of each respective series of cylinder frame members in alinement and crossing the companion inner walls through said longitudinal member, and parallel to the outer walls of said respective series of cylinder frame members.

3. An apparatus of the character described, having in combination a frame for V-type high compression apparatus comprising upper and lower cylinder supporting members, a base member, a bearing supporting member united with said base member and having projecting members substantially centrally thereof inwardly inclined toward each other and having outwardly inclined members along the outer margins thereof, said structure providing a plurality of upwardly diverging members, a central longitudinal strain resisting member extending the length of said apparatus and provided with projecting flange members joined to the main body thereof on lines of gentle curvature, the diagonally positioned flange members on the top and bottom sides of such longitudinal member being in alinement with the respective inwardly inclined diverging members, and structural members for said apparatus integrally united with the outer diverging members and with flanges on said central longitudinal member and effective to bring said central member into action.

4. An apparatus of the character described, having in combination a frame for V-type high compression apparatus comprising upper and lower cylinder supporting members, a base member, a bearing supporting member united with said base member and having projecting members substantially centrally thereof inwardly inclined toward each other and having outwardly inclined members along the outer margins thereof, said structure providing a plurality of upwardly diverging members, integral reinforcing webs intermediate each adjacent pair of diverging members, a central longitudinal strain resisting member extending the length of said apparatus and provided with projecting flange members joined to the main body thereof on lines of gentle curvature, the diagonally positioned flange members on the top and bottom sides of such longitudinal member being in alinement with the respective inwardly inclined diverging members, and structural members for said apparatus integrally united with the outer diverging members and with flanges on said central longitudinal member and effective to bring said central member into action.

5. An apparatus of the character described, having in combination a frame for V-type high compression apparatus comprising upper and lower cylinder supporting members, a base member, a bearing supporting member united with said base member and having projecting members substantially centrally thereof inwardly inclined toward each other and having outwardly inclined members along the outer margins thereof, said structure providing a plurality of upwardly diverging members, a central longitudinal strain resisting member extending the length of said apparatus and provided with projecting flange members joined to the main body thereof on lines of gentle curvature, the diagonally positioned flange members on the top and bottom sides of such longitudinal member being in alinement with the respective inwardly inclined diverging members, structural members for said apparatus integrally united with the outer diverging members and with flanges on said central longitudinal member, and auxiliary housing plates connected with said base member and united to said upper structural members and effective to transfer the torque reaction to the bearing supports through said central longitudinal strain resisting member.

6. An apparatus of the character described, having in combination a frame for V-type high compression apparatus comprising upper and lower cylinder supporting members, a base member, a bearing supporting member united with said base member and having projecting members substantially centrally thereof inwardly inclined toward each other and having outwardly inclined members along the outer margins thereof, said structure providing a plurality of upwardly diverging members, a central longitudinal strain resisting member extending the length of said apparatus and provided with projecting flange members joined to the main body thereof on lines of gentle curvature, the diagonally positioned flange members on the top and bottom sides of such longitudinal member being in alinement with the respective inwardly inclined diverging members, structural members for said

ing members and with flanges on said central apparatus integrally united with the outer diverg- longitudinal member, said members being in the form of longitudinally extending plates united at their lower edges respectively to said outer diverging members and the upper edges of the upper diagonal members of said central longitudinal member, and said upper cylinder supporting frame members being integrally secured to the upper edges of said plates.

7. An apparatus of the character described, having in combination a frame for V-type high compression apparatus comprising upper and lower cylinder supporting members, a base member, a bearing supporting member united with said base member and having projecting members substantially centrally thereof inwardly inclined toward each other and having outwardly inclined members along the outer margins thereof, said structure providing a plurality of upwardly diverging members, a central longitudinal strain resisting member extending the length of said apparatus and provided with projecting flange members joined to the main body thereof on lines of gentle curvature, the diagonally positioned flange members on the top and bottom sides of such longitudinal member being in alinement with the respective inwardly inclined diverging members, structural members for said apparatus integrally united with the outer diverging members and with flanges on said central longitudinal member, said members being in the form of longitudinally extending plates united at their lower edges respectively to said outer diverging members and the upper edges of the upper diagonal members of said central longitudinal member, said upper cylinder supporting frame members being integrally secured to the upper edges of said plates, and a plurality of transversely extending bracing plates secured to the longitudinally extending plates intermediate each of the cylinder positions.

8. An apparatus of the character described, having in combination a frame for V-type high compression apparatus comprising a base member, a bearing supporting member united with said base member and having projecting members substantially centrally thereof inwardly inclined toward each other and having outwardly inclined members along the outer margins thereof, said structure providing a plurality of upwardly diverging members, a central longitudinal strain resisting member extending the length of said apparatus and provided with projecting flange members joined to the main body thereof on lines of gentle curvature, the diagonally positioned flange members on the top and bottom sides of such longitudinal member being in alinement with the respective inwardly inclined diverging members, structural members for said apparatus integrally united with the outer diverging members and with flanges on said central longitudinal member, said members being in the form of longitudinally extending plates united at their lower edges respectively to said outer diverging members and the upper edges of the upper diagonal members of said central longitudinal member, cylinder supporting frame members integrally secured to the upper edges of said plates, a plurality of transversely extending bracing plates secured to the longitudinally extending plates intermediate each of the cylinder positions, and transverse plates of substantially triangular outline interposed between the respective inner longitudinally extending plates and their alined associated flange members and effective to bring said central member into action through said adjacent flange members.

9. An apparatus of the character described, having in combination a frame for V-type high compression apparatus comprising upper and lower cylinder supporting members, a base member, a bearing supporting member united with said base member and having projecting members substantially centrally thereof inwardly inclined toward each other and having outwardly inclined members along the outer margins thereof, said structure providing a plurality of upwardly diverging members, a central longitudinal strain resisting member extending the length of said apparatus and provided with projecting flange members joined to the main body thereof on lines of gentle curvature, the diagonally positioned flange members on the top and bottom sides of such longitudinal member being in alinement with the respective inwardly inclined diverging members, structural members for said apparatus integrally united with the outer diverging members and with flanges on said central longitudinal member, auxiliary housing plates connected with said base member and united to said upper structural members and effective to transfer the torque reaction to the bearing supports through said central longitudinal strain resisting member, and a plurality of transversely extending bracing plates secured to the longitudinally extending plates intermediate each of the cylinder positions.

10. An apparatus of the character described, having in combination a frame for cylinders of a high compression device disposed at an angle of less than 180° adapted to resist the high cross-over strains due to piston reaction, which includes an integral frame member having longitudinal integral flanges merged therewith along lines of easy contour, said integral frame member affording an area of metal of substantially uniform density and texture throughout the entire area of stress concentration, and means integrally united to said member at points remote from said areas of stress concentration to provide other structural members for said apparatus coacting to carry the stresses referred to through such integral frame member along straight lines and preserve the fatigue resisting properties of said structural elements.

11. A V-type high compression apparatus having in combination a central frame member having integral flanges joined thereto along lines of easy contour and formed as a structure of substantially uniform metal density and texture extending as a backbone substantially the entire length of said apparatus, and shaped frame members and plates secured to said flanges on said central frame member so as to transmit cross-over strains along straight uninterrupted lines through said entire structure.

12. A central frame member for V-type high compression apparatus comprising a longitudinal stress resistant element having integral flanges joined thereto along lines of easy contour and formed as a structure of substantially uniform metal density and texture extending as a backbone substantially the entire length of said apparatus, and having means for integrally uniting therewith other structural members at points remote from areas of stress concentration.

EVERETT CHAPMAN.

CERTIFICATE OF CORRECTION.

Patent No. 2,078,056. April 20, 1937.

EVERETT CHAPMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 1, claim 6, strike out the syllable and words "ing members and with flanges on said central" and insert the same before "longitudinal" in line 3, same column; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of June, A. D. 1937.

Henry Van Arsdale
Acting Commissioner of Patents.

(Seal)