April 9, 1946. A. CHILTON 2,398,206

VALVE OPERATING MECHANISM

Filed Oct. 6, 1942 3 Sheets-Sheet 1

FIG. 1

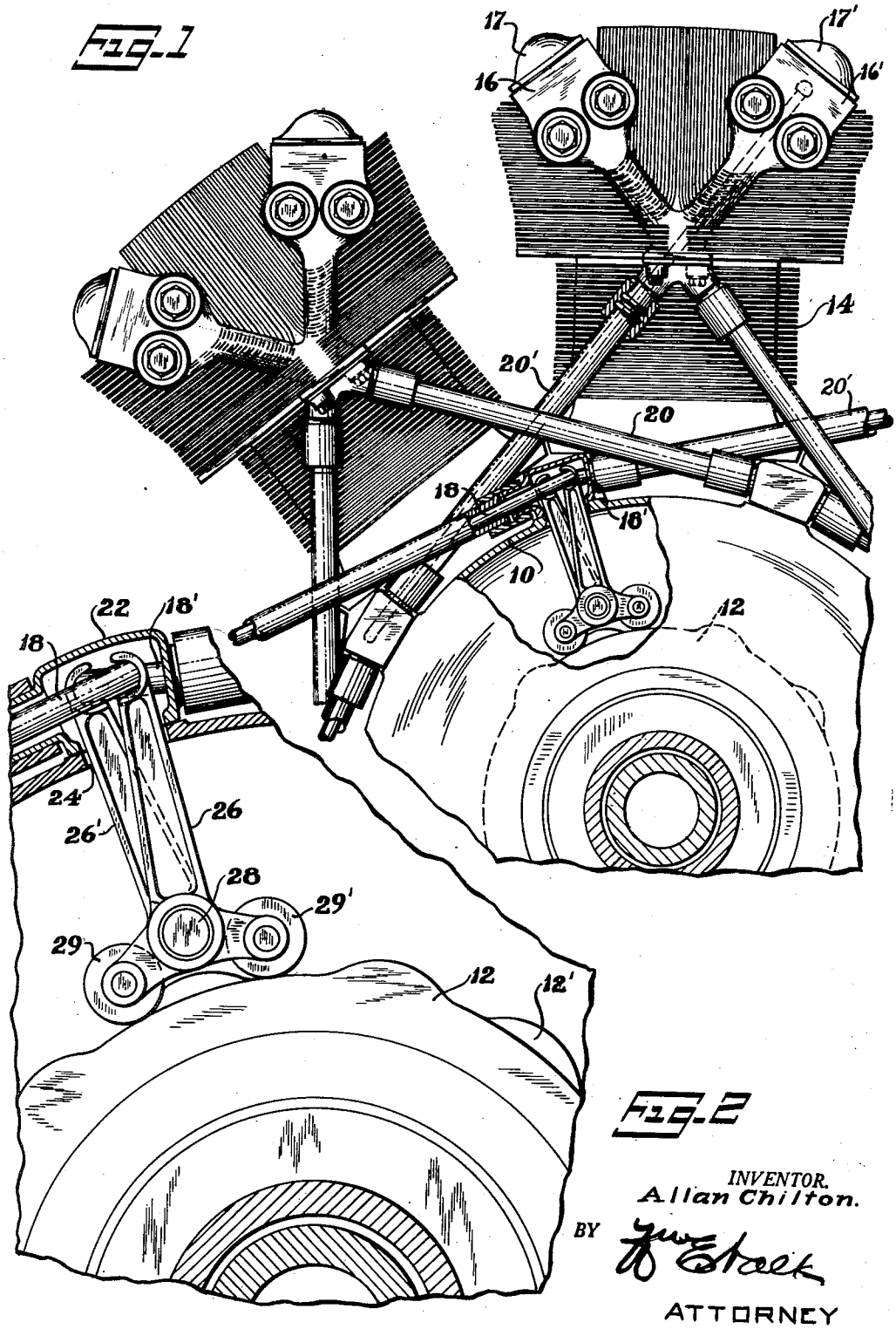


FIG. 2

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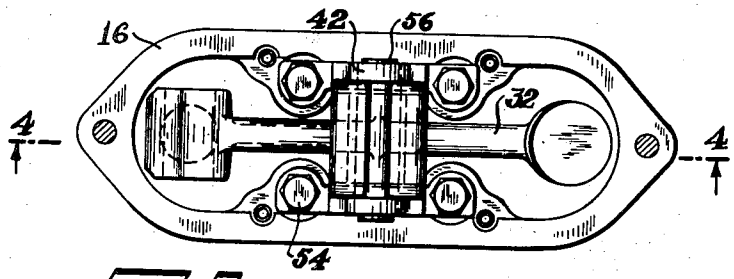


Fig. 3

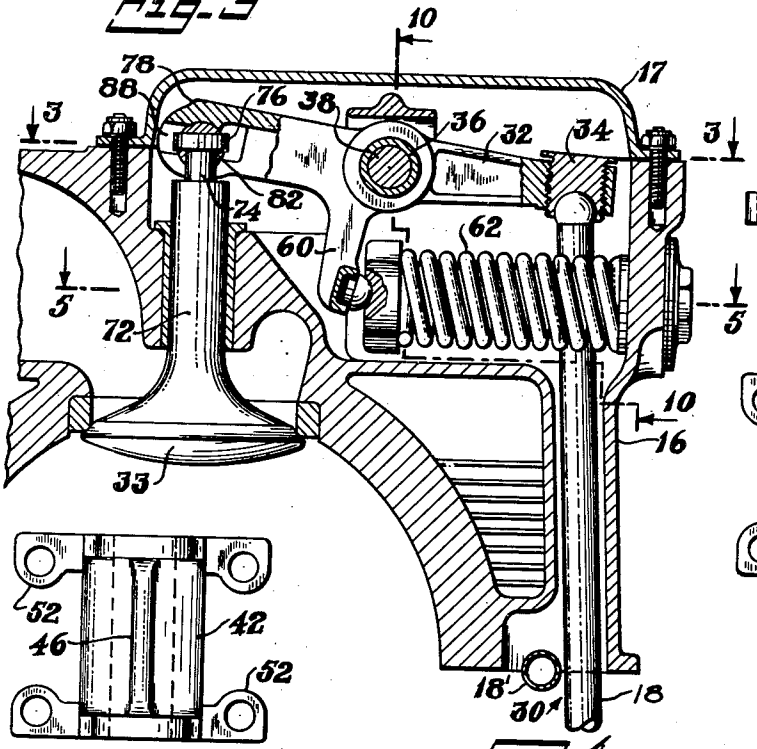


Fig. 4

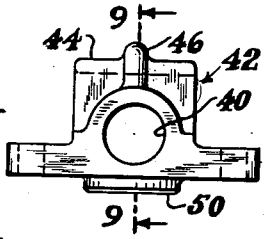


Fig. 7

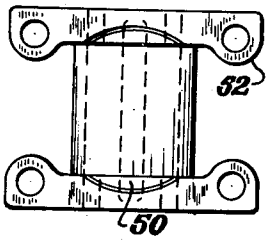


Fig. 8

Fig. 6

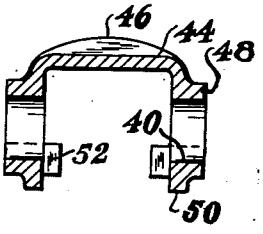


Fig. 9

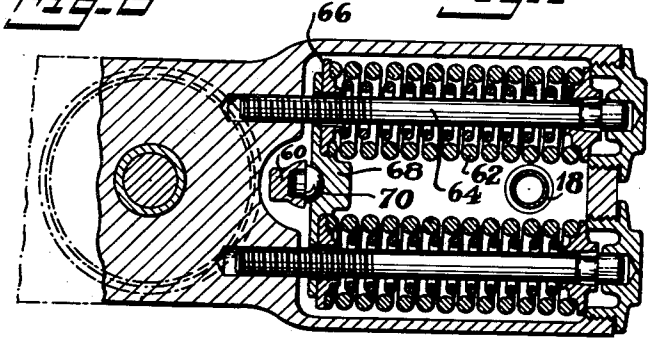


Fig. 5

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VALVE OPERATING MECHANISM

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Fig. 10

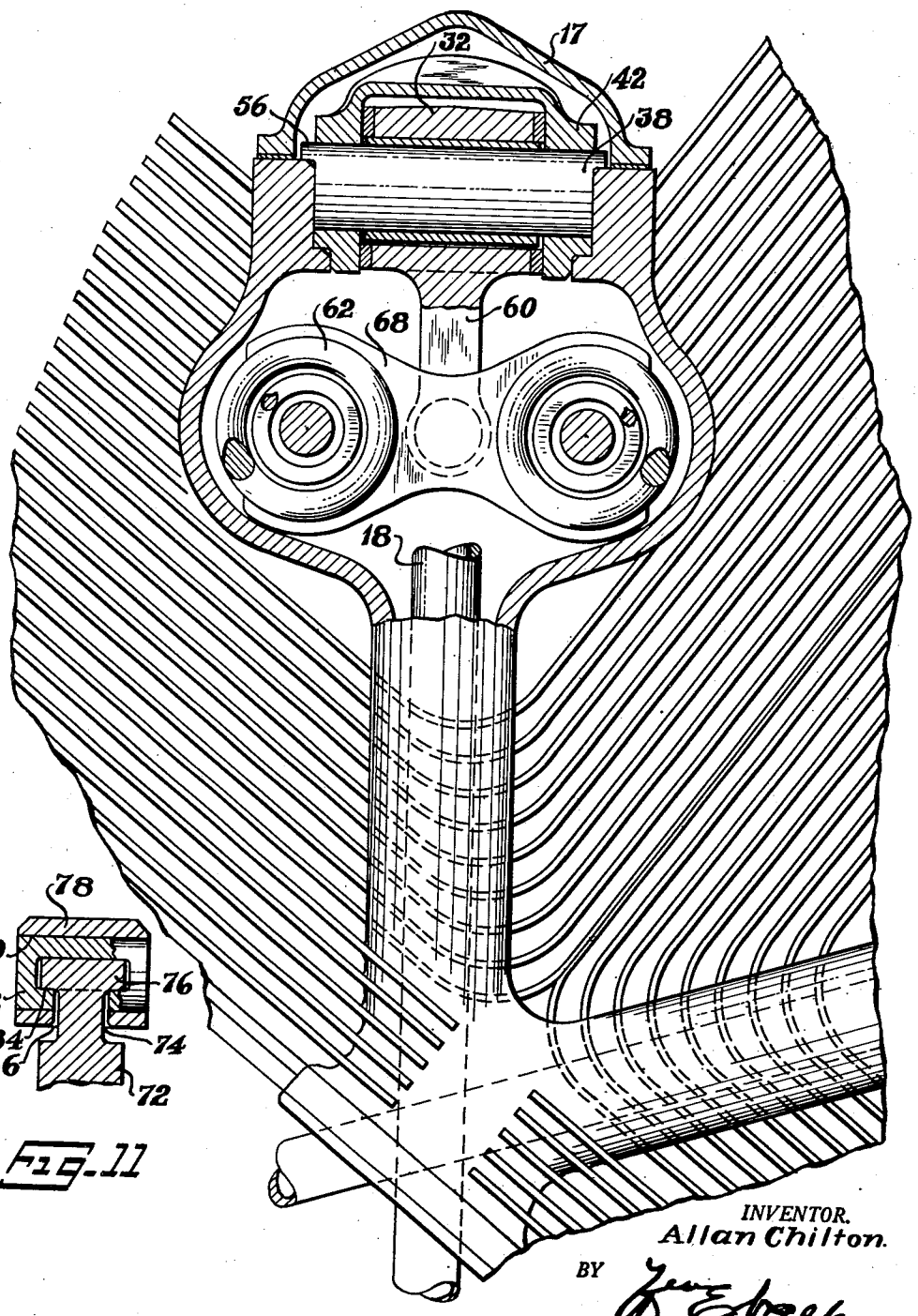


Fig. 11

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2,398,206

UNITED STATES PATENT OFFICE

2,398,206

VALVE OPERATING MECHANISM

Allan Chilton, Ridgewood, N. J., assignor to Wright Aeronautical Corporation, a corporation of New York

Application October 6, 1942, Serial No. 461,029

11 Claims. (Cl. 123—90)

This invention relates to valve gears for radial type aircraft engines. One of the objects of this invention is to provide a valve gear which occupies less length axially of the cylinders than the arrangements heretofore used. Consequently, it is an object of this invention to provide a valve operating mechanism for radial cylinder engines by which the overall diameter of the engine may be reduced. To this end the valve springs are disposed at right angles to the valve stems instead of concentric with the valve stems, as is the usual practice.

In the conventional practice the rocker box is cast integral with the cylinder head and the rocker arm is journaled about a bolt which extends across the rocker box and is supported in bosses on the sides of the rocker box. As a result of this construction, the valve operating loads are concentrated in a small area on the sides of the rocker box by the rocker arm supporting bolt thereby tending to crack the rocker box. Therefore, it is a further object of this invention to provide an improved supporting means for the valve gear rocker arm. According to this invention, a rocker arm saddle bracket is attached to the cylinder head within the rocker box and this bracket supports the rocker arm bolt. This bracket may be forged so that a stronger construction is possible with the result that there is less tendency for cracking to occur about the support for the rocker arm bolt.

Furthermore, in the usual radial engine construction, the intake and exhaust valves are mounted on opposite sides of each cylinder and these valves are inclined to the cylinder axis while the valve operating push rods are substantially radial. With such a construction, there is a relatively large angle between the valve axis and the axis of its associated push rod thereby producing a side thrust on the rocker arm. This side thrust also tends to cause rocker box failures. Therefore, it is a further object of this invention to provide a valve gear construction in which the valve and push rod axes are substantially parallel.

Other objects and advantages will be obvious from or will be pointed out in the following description with reference to the drawings, in which:

Fig. 1 is a front elevation of a portion of a radial aircraft engine with a section of the crankcase broken away;

Fig. 2 is an enlarged detail of a portion of Fig. 1;

Fig. 3 is a top plan view of the rocker box with the cover removed, as viewed along the line 3—3 of Fig. 4;

Fig. 4 is a section on the line 4—4 of Fig. 3;

Fig. 5 is a section on the line 5—5 of Fig. 4;

Figs. 6 to 8 are top, end, and bottom plan views respectively of the rocker arm saddle bracket;

Fig. 9 is a section on the line 9—9 of Fig. 7;

Fig. 10 is a section on the line 10—10 of Fig. 3; and

Fig. 11 is a section through the push-pull connection between the rocker arm and valve stem.

The drawings illustrate the application of the invention to an air-cooled radial engine. In Figs. 1 and 2, 10 represents the engine crankcase with the usual axially offset intake and exhaust valve operating cams 12 and 12' of which the intake valve operating cam is indicated at 12. Finned cylinders 14 are radially mounted about the crankcase with integral intake and exhaust rocker boxes 16 and 16' respectively, having covers 17 and 17'. Intake and exhaust valve operating push rods 18 and 18' are enclosed by the usual tubular casings 20 and 20' and are mounted parallel to the axes of their respective valves. These push rods extend into housings 22 mounted about openings 24 in the crankcase adjacent the periphery of the valve operating cams 12 and 12'. The valve tappets comprise bell crank levers 26 and 26' which are oppositely disposed in the crankcase and are provided with cam followers 29 and 29' mounted on one of their arms for engagement by the engine driven cams 12 and 12' while the other arm of the bell crank levers extends radially out through the crankcase openings 24 for operative engagement with the push rods 18 and 18' respectively. The crankcase 10 is of such diameter at this point, and the housings 22 are so disposed relative to the valves of the associated push rods, that these rods are substantially parallel to the axes of their associated valves. As is the usual practice in radial aircraft engines, the intake and exhaust valves of each cylinder are circumferentially spaced on opposite sides of the cylinder with their axes inwardly inclined with respect to the cylinder axis, as best seen in Fig. 1. Therefore, the axes of an intake and an exhaust valve of spaced cylinders will be substantially oppositely directed. Consequently, it is possible to mount the oppositely disposed bell crank levers 26 and 26' about a common shaft 28 for engagement with the oppositely directed push rods 18 and 18' extending substantially parallel to the axes of the intake and exhaust valves respectively of such oppositely directed cylinders. As best seen in Fig. 1 and at 30 in Fig. 4, these intake and exhaust push rods are axially offset corresponding to the axial offset of the intake and exhaust valve operating cams 12 and 12'. Rocker arms 32 are interposed between each valve push rod and the associated valve 33. These rocker arms are provided with a spherical bear-

ing seat 34 for engagement by the associated push rod. The opposite ends of the rocker arms are secured to the valve stems 36 by push-pull connections hereinafter described. These connections form no part of the present invention and may be similar to that illustrated in the co-pending application of R. Chilton, Serial No. 418,649, filed November 12, 1941.

In the invention so far described, the engine valve operating cams 12 and 12' engage bell crank levers 26 and 26' to operate push rods 16 and 18' respectively. Rocker arms 32 operatively interconnect each push rod with its valve and each push rod is disposed substantially parallel to the axis of its associated valve so that each push rod, rocker arm and valve axis are coplanar. As a result of this construction, no side thrust is transmitted to the rocker arms thereby tending to reduce rocker box failures.

The rocker box construction of the intake and exhaust valves is similar so that the description of one will suffice. The rocker arm 32 is journaled on bushing 36 about a fulcrum bolt 38. This bolt is received within bores 40 in the rocker arm saddle bracket 42. This bracket consists of a U-shaped or saddle-like structure having downwardly extending side portions 48 and a bridge 44 with a reinforcing rib 46. The downwardly extending side portions 48 are provided with bores 40 for receiving the rocker bolt 38. Guide extensions 50 are provided at the bottom of each side portion 48 for reception in correspondingly shaped recesses in the rocker box. The rocker arm bolt 38 is supported in bores 40 in the sides 48 of saddle bracket 42 and has end flanges 56 which engage the flat upper surface of the rocker box 16 to prevent turning of this bolt. The side portions 48 of the bracket are snugly received between the sides of the rocker box housing, as best seen in Fig. 10, and bosses 52 are provided on this bracket for securing same to the cylinder head within the rocker box by bolts 54. The saddle bracket 42 thereby transmits the valve operating forces directly to the cylinder head and since this bracket may be forged, a much stronger rocker bolt support is possible as compared to the usual support for this bolt on the sides of the cast rocker box. This construction thereby further reduces rocker box failures. Also, this method of supporting the rocker arm permits a much simpler machining of the rocker box.

In the usual valve gear construction, the valve spring is disposed concentric with the valve stem so that the valve spring adds to the engine diameter. By placing the valve spring at right angles to the valve stem axis, as illustrated in Figs. 4, 5, and 10, it is possible to reduce the engine diameter. An arm 60 is integrally formed with the rocker arm 32 and extends inwardly therefrom. Two sets of helical valve springs 62 are mounted about guide rods 64 on opposite sides of the push rod 18. One end of these spring sets bears against the front of the rocker box while the other end bears against washers 66 carried by a transverse plate 68. This plate has a bearing seat for engagement by the spherical end 70 of the depending arm 60 of the rocker arm. A push-pull connection is provided between the rocker arm and the valve stem. Any suitable connection may be used. However, the connection disclosed in the previously cited co-pending application of R. Chilton is preferred and is illustrated in Figs. 4 and 11. The upper end of the valve stem 72 is grooved at 74 to provide a head portion 76. The rocker arm is provided with a boss 78 having a cross bore 80. A trunnion 82 is supported in the cross bore and has a T-shaped slot 84 for the reception of the head portion 76 of the valve stem 72, as best seen in Fig. 11. The lower end of the boss 78 is bifurcated as at 86 and reeved at 88 to allow for the passage of the valve stem head portion 76. As a result of this construction, the push rod 18 is operable to open the valve 33 against the bias of springs 62. These springs being disposed at right angles to the valve axis, produce a corresponding reduction in the engine diameter. Also, in view of the symmetrical disposition of the valve springs 62, these springs, like the push rods, do not transmit any side thrust to the rocker arms.

From the above description of the invention it will be seen that the valve gear has been designed to reduce rocker box failures on radial-type engines and at the same time reduce the overall diameter of the engine.

While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claims to cover all such modifications and changes.

I claim as my invention:

1. In an engine having a plurality of radially disposed cylinders with the intake and exhaust valves of each cylinder circumferentially spaced on opposite sides of the associated cylinder, and with the axis of each valve inclined inwardly and downwardly with respect to the associated cylinder whereby an intake valve of one cylinder and an exhaust valve of another cylinder have substantially alined axes; valve gear means for said valves comprising axially offset intake and exhaust engine driven cam means, a push rod for each valve disposed substantially parallel to the axis of the associated valve, the push rods for intake and exhaust valves respectively being axially offset to correspond to said cam offset, and valve tappets each comprising a rocker member having one arm adapted to be actuated by said cam means and having the other arm extending radially outward for operative engagement with a valve push rod, the rocker members operatively connected with an intake valve push rod of one cylinder and a substantially parallel exhaust valve push rod of another cylinder, respectively, being pivotally mounted about the same axis, oppositely disposed and axially offset to correspond to said cam offset.

2. In an engine, a plurality of radially disposed cylinders each having intake and exhaust valves, valve gear means for said valves comprising axially offset, engine driven intake and exhaust valve cam means within the engine crankcase, a push rod for each valve extending inwardly toward said crankcase and being disposed substantially parallel to that portion of the general crankcase surface adjacent the crankcase end of said push rod, the push rods for the intake valves being axially offset from the exhaust valve push rods to correspond to said cam offset, and valve tappets each comprising a rocker member having one arm adapted to be actuated by said cam means and a second arm extending radially outward through said crankcase into operative engagement with a push rod, said rocker members being mounted in pairs about the same axis, oppositely disposed and axially offset to correspond

to said cam offset, one rocker member of each pair being interposed between the intake valve cam means and a push rod for an intake valve of a particular cylinder, while the other rocker member of each pair is interposed between the exhaust valve cam means and a push rod for an exhaust valve of another cylinder.

3. In a valve gear for an engine cylinder, a rocker box comprising side and bottom walls integral with the head of said cylinder, a U-shaped bracket extending across said rocker box and secured thereto, said U-shaped bracket having its open end facing the bottom of said rocker box with its sides fitted between the sides of said box, a rocker arm bolt supported by and extending between the sides of said bracket, a valve operating push rod, a rocker member journalled about said bolt between the sides of said bracket and having opposed arms in operative engagement with said rod and valve respectively, said rocker member having a third arm extending toward the bottom of said rocker box, and valve spring means acting against said third arm.

4. In a valve gear, a rocker arm box having side and bottom walls, a U-shaped bracket extending across said rocker box and secured thereto, said U-shaped bracket having its open end facing the bottom of said rocker box with its sides fitted between the sides of said box, a valve operating rocker arm, and means for pivotally securing said rocker arm between the sides of said bracket.

5. In a valve gear for an engine cylinder, a rocker box comprising side and bottom walls integral with the head of said cylinder, a U-shaped bracket extending across said rocker box and secured thereto, said U-shaped bracket having its open end facing the bottom wall of said rocker box with its sides fitted between the sides of said box, a valve operating rocker arm, and means for pivotally securing said rocker arm to said bracket.

6. In a valve gear for an engine cylinder, a rocker box comprising side and bottom walls integral with the head of said cylinder, a U-shaped bracket extending across said rocker box and secured thereto, said U-shaped bracket having its open end facing the bottom of said rocker box with its sides fitted between and engaging the sides of said box, a rocker arm bolt supported by and extending between the sides of said bracket and a valve operating rocker arm journalled about said bolt.

7. In combination, an engine having a crankcase, a plurality of radially disposed cylinders mounted about said crankcase, an intake valve and an exhaust valve for each cylinder, said valves being circumferentially spaced relative to the engine axis and being disposed on opposite sides of their associated cylinder, and a valve gear for each of said valves comprising a valve operating push rod, the push rods for the intake and exhaust valves of a cylinder extending inwardly to the engine crankcase and being so orientated that they cross each other inboard of the outer cylinder end and said push rods each being disposed substantially parallel to that portion of the general crankcase surface adjacent to the crankcase end of the associated push rod.

8. In combination, an engine having a crankcase, a plurality of radially disposed cylinders mounted about said crankcase, an intake and an exhaust valve for each cylinder, said valves being circumferentially spaced relative to the engine axis and being disposed on opposite sides of their associated cylinder, and a valve gear for each of said valves comprising a push rod and a rocker arm having its opposed ends in operative engagement with the associated valve and push rod respectively, each push rod and associated rocker arm being disposed in a common plane with the axis of their associated valve, and each push rod extending inwardly to the engine crankcase and being disposed substantially parallel to that portion of the general crankcase surface adjacent to the crankcase end of the associated push rod.

9. In combination, an engine having a crankcase, a plurality of radially disposed cylinders mounted about said crankcase, an intake and an exhaust valve for each cylinder, said valves being circumferentially spaced relative to the engine axis and being disposed on opposite sides of their associated cylinder, a valve gear for said valves comprising valve operating push rods, each push rod extending inwardly to the engine crankcase and being disposed substantially parallel to that portion of the general crankcase surface adjacent the crankcase end of the associated push rod, engine driven cam means, and valve tappets each comprising a rocker member having one arm adapted to be actuated by said cam means and having another arm extending substantially radially outwardly for engagement with one of said push rods.

10. In combination, an engine having a crankcase, a plurality of radially disposed cylinders mounted about said crankcase, an intake valve and an exhaust valve for each cylinder, said valves being circumferentially spaced relative to the engine axis and being disposed on opposite sides of their associated cylinder, valve gear means for said valves comprising a push rod extending inwardly toward said crankcase, said push rods being so disposed that the intake valve push rod of one cylinder is substantially parallel with the exhaust valve push rod of another cylinder, each of said pairs of parallel push rods terminating at the crankcase adjacent each other and extending in substantially opposite directions therefrom.

11. In combination, an engine having a crankcase, a plurality of radially disposed cylinders mounted about said crankcase, an intake valve and an exhaust valve for each cylinder, said valves being circumferentially spaced relative to the engine axis and being disposed on opposite sides of their associated cylinder, valve gear means for said valves comprising a push rod for each valve disposed substantially in a plane with the axis of its associated valve and extending inwardly toward said crankcase, said push rods and valve axes being so disposed that the intake valve push rod of one cylinder is substantially parallel with the exhaust valve push rod of another cylinder, each of said pairs of parallel push rods terminating at the crankcase adjacent each other and extending in substantially opposite directions therefrom.

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