Dec. 2, 1941. A. C. STARR 2,264,895

ENGINE MOUNTING

Filed July 28, 1939 2 Sheets-Sheet 1

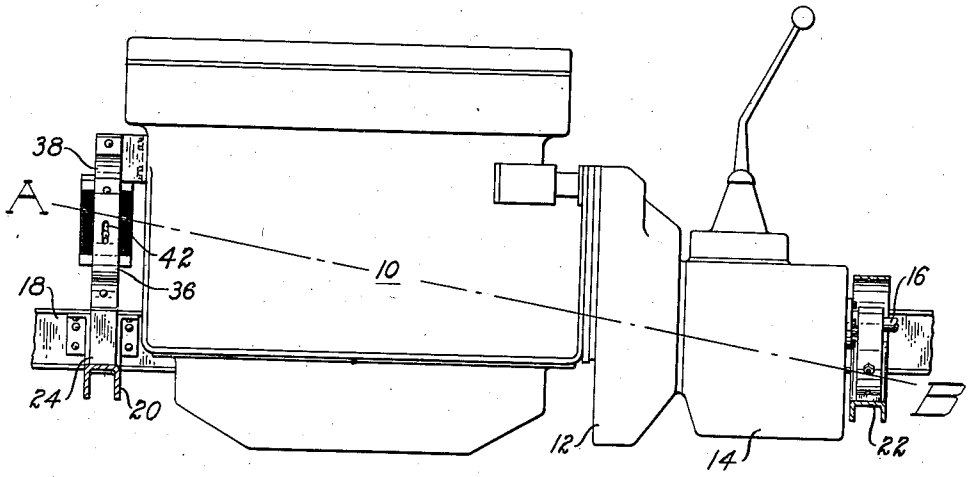


FIG. 1

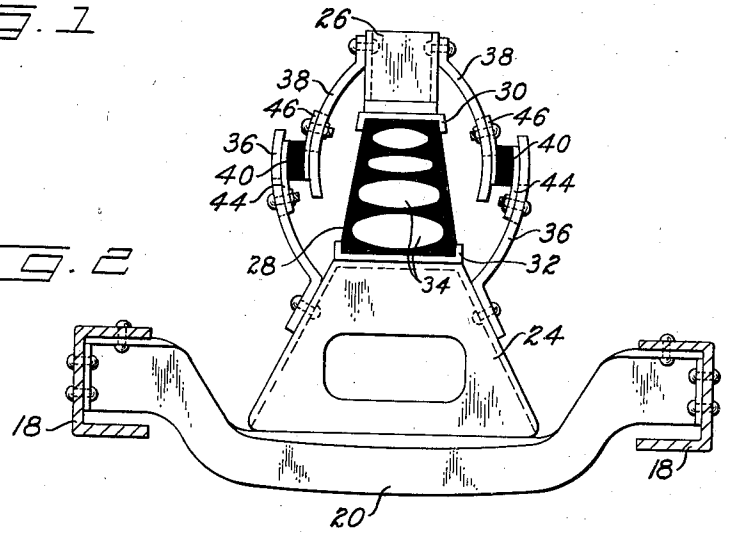


FIG. 2

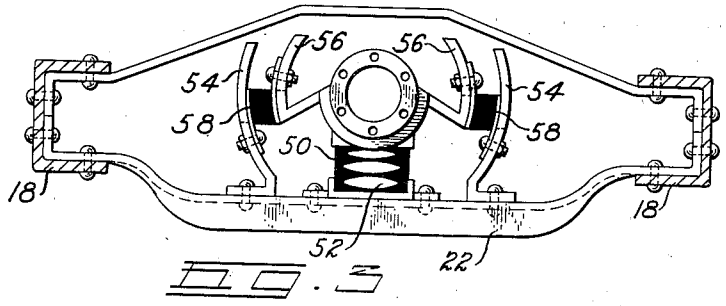


FIG. 3

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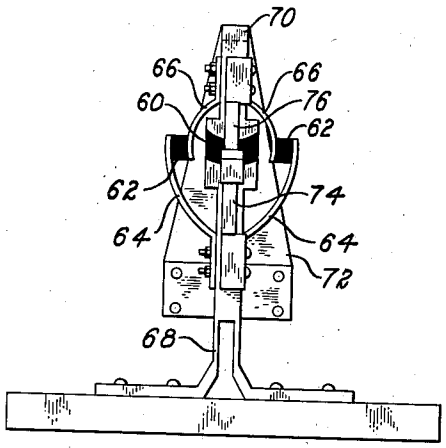


FIG. 4

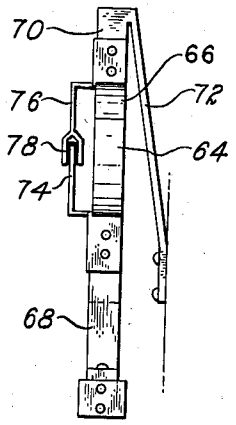


FIG. 5

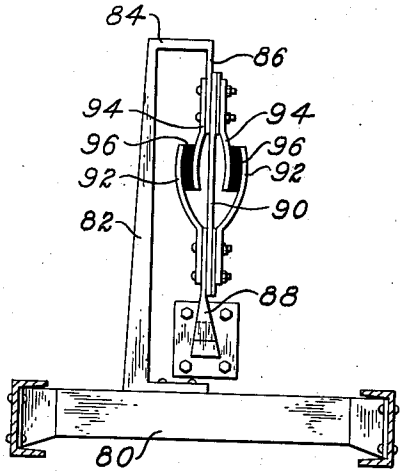


FIG. 6

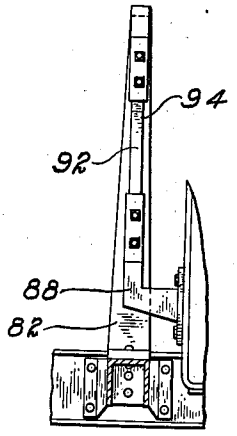


FIG. 7

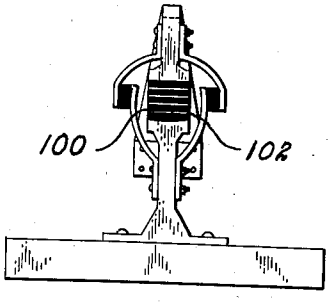


FIG. 8

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ENGINE MOUNTING

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Application July 28, 1939, Serial No. 287,043

8 Claims. (Cl. 248—7)

This invention relates to engine mountings and particularly to such a mounting and a method of installation which is especially adapted for internal combustion engine units.

An important object of this invention is to provide a novel method of and a novel supporting structure for mounting engine units which absorbs the vibrations and oscillations of the unit while permitting a slight natural rocking or rotating movement of the unit about an axis passing approximately through the central of mass of the unit. Another object of this invention is to provide a novel form of engine mounting which is adjustable after the engine is installed and in use to obtain the smoothest operating performance.

More particularly, it is the purpose of this invention to provide a novel flexible mounting for internal combustion engine units including improved auxiliary stabilizing devices which are adjustable to get the most desirable performance out of the engine. The flexible portions of the mounting preferably support the opposite ends of the engine in such a manner that the axis of engine rotation or oscillation projects through the flexible parts of the mounting. The improved stabilizing devices are preferably positioned on opposite sides of the flexible supporting portions of the mountings in spaced relationship to the axis about which the engine oscillates. The stabilizers include novel yieldable elements acting to restrain or dampen the vibrations and oscillations of the engine. These novel elements are in the form of blocks mounted for bodily adjustment in paths preferably curved which extend from a level below the axis of oscillation to a level thereabove. An important result derived from such a construction is that it is possible to adapt the mounting to any idiosyncrasies of operation of the engine or compensate for any change in the distribution of weight occasioned by the addition of extra parts or special equipment to the engine after it has been installed and in use.

Various other objects and meritorious features of this invention will become more fully apparent from the following specification, appended claims and accompanying drawings, where:

Figure 1 is a side view of an internal combustion engine unit of the reciprocating piston type showing the location of the mountings for the front and rear end thereof,

Fig. 2 is a front view of the engine unit shown in Fig. 1 illustrating the form of mounting therefor,

Fig. 3 is a back view of the engine unit shown in Fig. 1 illustrating the form of mounting therefor,

Figs. 4 and 5 are front and side views respectively of a modification of the invention,

Figs. 6 and 7 are front and side views respectively of another modified mounting, and

Fig. 8 is a front view of a still further modification of the invention.

It is the purpose of this invention not to construct an ideal engine but to make an ordinary engine to act like an ideal engine would. An ideally mounted engine would be one wherein the forces causing vibration and movement of the engine are of such a cause and direction that they tend to make the engine unit rotate naturally about a line passing through the engine longitudinally in the neighborhood of the center of mass of the same and which said forces at the same time are opposed so that they can counteract or neutralize one another. In the ideal arrangement the engine could be suspended on highly flexible supports and no vibration of any sort would reach the supporting frame or chassis. The ordinary type of reciprocating engine, however, is not perfect in its construction and operation and, moreover, for motor vehicles some provision must be made in the engine mounting for stabilizing the engine unit against road shock and the inertia of the power plant itself.

In Figs. 1, 2 and 3 I have shown one embodiment of my invention. In the remaining figures there are shown additional embodiments of the invention. It is understood that the structures illustrated herein are merely representative of my invention and that they may be modified to suit any condition presented.

Referring to the embodiment of the invention in Figs. 1, 2 and 3, the engine unit is general indicated by the reference numeral **10**. It is of the reciprocating piston type and includes as is well known the flywheel enclosed in the housing **12**, gear shift mechanism enclosed in housing **14** and the propeller shaft **16** leading to one set of road wheels for driving the same. The line A—B extending at an incline across the engine unit represents the axis about which the unit can rotate or oscillate in operation. It is believed by many that the axis A—B passes through the center mass of the engine. Considering the nature of the moving parts in a freely running engine and the amount of internal forces due to reaction and location and design of the supports for the engine, it is doubtful in many cases if the axis of oscillation A—B passes through the center of mass. However, it makes no

difference in the engine mountings described herein whether or not the line A—B passes through the center of mass of the unit. As will be more fully described hereinafter, adjustable means is provided for altering the mountings to obtain the best performance of any given engine unit.

The mountings described herein are adapted for supporting an engine unit upon the chassis frame of a motor vehicle. Referring to Figs. 1, 2 and 3 the engine unit 10 is disposed longitudinally between the side members 18—18 of the chassis frame and the weight of the engine is carried directly upon a front cross member 20 and a rear cross member 22. Upon these cross members are supported the engine mountings formed in accordance with this invention.

The structure or mounting carried by the front cross member 20 is shown particularly in Fig. 2. It comprises an upstanding plate 24 secured to the cross member along its bottom edge in any desirable way and flanged along its sides and top edges to form supporting surfaces. Secured to the front end of the engine unit is a bracket 26 which overhangs the cross member 20 therebelow. Interposed between the top flanged side of the plate 24 and the bracket 26 is a block 28 of resilient material such as rubber, although other material of similar character may be used if found desirable. This block of rubber is of considerable thickness and, as shown, the top and bottom surfaces are enclosed within plates 30 and 32 respectively which have upturned marginal portions to keep the rubber material from spreading unduly. The plates 30 and 32 are bonded to the rubber block in any desirable way and as such form with the rubber block a unitary assembly separately installable in the engine mounting. An important feature of the invention is the fact that the rubber block 28 is mounted on the plate 24 so that the projection of the axis A—B as shown in Figure 1 passes therethrough substantially between the upper and lower ends of the block.

The rubber block 28 carries therewithin a plurality of metal objects or members 34 preferably of solid elliptical formation as shown. These solid members are arranged in spaced superimposed relationship in line with the plate 24 and the bracket 26 so that they serve to carry the major portion of the load of the engine unit. They are preferably arranged as shown with their long axes extending horizontal. In addition, it is preferred that the surfaces of these objects be bonded to the rubber material by vulcanization. The series of spaced metal objects 34 act to prevent distortion of the rubber material by the weight of the engine.

Arranged on opposite sides of the load bearing portion of the mounting are stabilizing devices which yieldingly resist oscillating movement of the engine unit about the axis A—B and also dampen the vibrations incident to the operation of the unit. These devices comprise a pair of rigid members or arms 36 secured at one of their ends to the opposite sides of the plate 24 and extend upwardly to a height above the level at which the axis A—B passes through the block 28. Similarly a pair of rigid members or arms 38 are secured at one of their ends to opposite sides of the bracket 26 and extend downwardly past the upper ends of the other arms. As shown, the arms 36 and 38 on each side of the rubber block 28 are slightly spaced apart from one another in the plane of the block. The arms 38 are inside the arms 36 but the positions may be reversed, if desired.

Interposed between the unattached or free ends of each set of arms 36 and 38 is an element 40 of resilient material such as rubber. Due to the fact that the rubber elements 40 are spaced from the axis A—B they act to dampen the engine vibrations and to restrain the engine unit from rocking movement about the axis. However, it is very difficult to make all engines of a given kind function alike. In certain instances, as previously mentioned, the axis A—B may extend in different angular directions and may avoid the center of mass altogether. In order to provide for any idiosyncrasy of engine construction and operation, I have provided a novel adjustment for the rubber elements 40 which after the engine has been installed and operated can be regulated to the positions where the best operating results are obtained.

As shown in Figure 2, the free ends of each set of arms 36 and 38 are concentrically curved. Preferably the centers about which these curved portions are formed are on a line which passes through the block 28 and, if possible, intersects the axis A—B in the plane of the block 28. The curved end sections of the arms 36 and 38 are slotted as at 42 in Figure 1 to adjustably secure to each arm 36 a curved plate 44 and to each arm 38 a curved plate 46. These plates are adjustably secured to their respective arms by bolts which extend through the slots and are secured in fixed position by nuts threaded thereto. The rubber elements 40 hereinabove mentioned are bonded or vulcanized to the adjacent sides of the plates 44 and 46 of each set of arms. As thus assembled the rubber elements 40 and the plates 44 and 46 form separate units capable of bodily adjustment in the curved path formed by the arms 36 and 38 to which they are secured. Each set of arms 36 and 38, as previously described, extend both above and below the plane at which the axis A—B passes through the load bearing block 28 so that as a result the auxiliary stabilizing elements 40 may be shifted along the curved path formed by the arms to positions either above or below the axis A—B. As a result, after the engine has been installed and operated, the stabilizing elements may be adjusted up and down until the exact point is found where the engine runs with the least vibration and oscillation.

The mounting for the rear end of the engine unit is similar in many respects to the front mounting. As shown in Figure 3 it comprises a block of resilient material 50 having encased therewithin a series of elliptically shaped solid metal objects 52. As in the front mounting, a curved arm assembly 54 and 56 is arranged on each side of the block 50 and rubber elements 58 are provided between the arms which are adjustable along the curved sections thereof like that described in connection with the front mounting.

Figures 4 and 5 illustrate a modification of the invention wherein the stabilizing arms are arranged in a slightly different manner. The main load bearing resilient block 60 is smaller than blocks 28 in the front mounting of Figure 2 and does not contain metal reinforcing objects therein. Arm assemblies in general like that shown in Figs. 1 to 3 are used but instead of obtaining adjustment by bodily shifting resilient elements 62—62 between the arms 64 and 66, the entire arm assemblies are capable of adjustment relative to the fixed support 68 and the bracket 70

on the engine unit. This is accomplished by the provision of bolts extending through slots in the support **68** and the bracket **70** as is clearly apparent from these figures. The bracket **70** as shown has a wide section **72** extending downwardly as shown in Figure 5 and is attached to the engine unit so that the latter is suspended or hung from the mounting.

In this modification an auxiliary stabilizing device is provided in front of the mounting, and comprises arm **74** attached to the fixed support **68** and arm **76** attached to the bracket **70**. Arm **76** is forked at its free end as shown and carries a rubber shock and vibration insulating unit **78** embracing the end of arm **74** on the top, front and rear side thereof.

The modification shown in Figures 6 and 7 approaches the more ideal arrangement for supporting the power unit. Supported on the cross member **80** is an upright frame member **82** extending to a considerable height and provided at its upper end with a laterally extending part **84** and a depending part **86**. The supporting bracket on the end of the engine unit is shown at **88** below the depending part **86** of the upright frame. Extending between the depending part **86** and the bracket **88** is a highly flexible metal strip **90** preferably of spring steel. This flexible strip may be replaced by any material capable of absorbing shock and vibration which is also strong enough to carry the weight of the engine and which will not elongate over a period of time. The structure of this modification thus far described is what might be used for an ideal engine, the only requirement being that the axis of oscillation A—B must pass through substantially the central portion of the flexible strip **90**.

Since most engines are not perfect operating units, some provision must be made to stabilize against engine vibrations and oscillations and the road shocks encountered in use if the engine is mounted on a vehicle. As in the previously described modifications, rigid members are provided which extend from the fixed support, in this instance from the upright frame **82**, and from the bracket **88** on the engine, and resilient elements spaced from the axis of oscillation are provided between these rigid members to dampen the vibrations and oscillations of the engine unit. As shown, the rigid members are in the form of arms **92** and **94** arranged to extend past one another in spaced relationship. Interposed between the free ends of these arms and fully vulcanized thereto are live rubber shock absorbing units **96—96**. Adjustment of these arms in this instance is provided as in Figures 4 and 5 by shifting the rigid members or arms **92** and **94** to various heights. For the near perfect engine the adjustment would probably be to such a height or position that the axis of oscillation would pass through a line connecting the corresponding central portions of the rubber shock absorbing units **96—96**.

The modification in Figure 8 is similar to those previously described, particularly the modification in Figure 4. In this modification the primary load supporting rubber block **100** is formed of a series of long rubber sections banded together with metal strips **102**. These metal strips function to prevent undue distortion of the rubber block by the weight of the engine.

In general, the principle involved in all the modifications of the mounting illustrated herein is the provision of flexible supports for the opposite ends of an engine unit functioning to take the load of the engine and the provision of auxiliary adjustable stabilizing devices on opposite sides of the engine unit capable of adjustment after the engine is installed to the position where the engine operates with the least vibration and rotation. The flexible supports may take the form of the rubber blocks **28** and **50** in Figs. 1 to 3 where they have an additional cushioning characteristic or they may be strips of metal which are flexible but not cushioning in their action as exemplified by the modification in Figs. 6 and 7. In addition to the side auxiliary stabilizing devices, a front stabilizer such as that shown in Figs. 4 and 5 may be used. In this last instance, the forked character of the mounting will prevent too great displacement of the engine in the line of the motion of the vehicle due to inertia.

What I claim:

1. In combination with an internal combustion engine unit having an axis about which it oscillates in operation, a support disposed below one end of said engine unit, flexible means interposed between said support and said end of the engine and sustaining the weight of the latter, said flexible means so arranged relative to said support and said engine that the axis about which the engine unit tends to oscillate passes therethrough, a pair of arms projecting from opposite sides of the support and rising upwardly to positions spaced from the opposite sides of said flexible means, a pair of arms projecting from said supported end of the engine and depending downwardly to positions spaced from the opposite sides of said flexible means, said arms passing one another in the plane of said flexible means and having concentric curved sections where they pass one another whose center is disposed substantially on the horizontal plane of the axis of oscillation as it passes through said flexible means, and resilient means disposed between the curved sections of each set of arms on the opposite sides of the mounting and yieldingly acting to dampen out oscillations of the engine in operation.

2. In combination with an internal combustion engine unit adapted in operation to oscillate about an axis, a mounting for one end of said engine comprising a support disposed below said end of the engine unit, flexible means interposed between said support and said end of the engine unit taking the load of the latter upon said support, said flexible means so disposed relative to said support and said engine unit that the axis about which the engine oscillates extends therethrough, an arm projecting from each side of the support and extending upwardly in spaced relation to the flexible means to a level above the projection of said axis of oscillation through said flexible means, an arm projecting from each side of the supported end of the engine unit and extending downwardly in spaced relation to said flexible means to a level below the projection of said axis of oscillation through said flexible means, the arms on each side of said mounting being offset from one another in the plane of said flexible means and each having an arcuate formation opposite one another whose axis of curvature is within the upper and lower planes of said flexible means, a block of rubber or like material disposed between the arcuate portions of each set of arms acting to dampen the oscillations of the engine unit, and means for bodily adjusting said rubber blocks along

the curved portions of said arms and securing the same in adjusted position.

3. The invention described in claim 2 characterized by the fact that the means for bodily adjusting the rubber blocks comprises plates adjustable along the curved portions of the arms and to which said rubber blocks are bonded, and means for securing said plates to the curved portions of said arms at a plurality of points therealong.

4. In combination with an internal combustion engine unit oscillatable about a longitudinal axis while in operation, a support, means disposed between said support and one end of said engine taking the weight of said end while permitting said engine unit to oscillate about said axis, a rigid element having one end attached to said engine unit and its other end disposed in a position spaced from said axis of oscillation, a second rigid element having one end attached to said support and the other end disposed adjacent to but slightly spaced from the unattached end of the other rigid element, a block of resilient material interposed between said unattached ends of said rigid elements and acting to yieldingly resist oscillatory movement of said engine unit about said axis, and means for adjusting said block of resilient material relative to said rigid elements in an arcuate path the center of which is approximately in alignment with the block and that part of the axis opposite to which the block is disposed.

5. In combination, an internal combustion engine unit, a support, and a resilient mounting for said engine interposed between said support and the engine, said mounting comprising a block of rubber or like material having a series of metal objects enclosed therewithin and arranged in spaced superimposed relation to one another in line with the load of the engine transmitted through the block to the support.

6. In combination, an internal combustion engine unit, a support, and a resilient mounting for said engine interposed between said support and the engine, said mounting comprising a block of rubber or like material having a series of solid metal objects enclosed within the block in spaced superimposed relationship to one another in line with the load of the engine transmitted through the block to the support, the surfaces of said metal objects being bonded to the rubber block material.

7. In combination, an internal combustion engine unit, a support below one end of the engine, a mounting for bearing the weight of the end of the engine from the support comprising a block of rubber or like material, a series of substantially elliptically-shaped solid metal members encased in said block in a spaced superimposed relationship directly in line between the supported end of the engine and said support, said encased members arranged with the long axes approximately horizontal and having the peripheral surfaces bonded under heat and pressure to the material forming the block.

8. In combination with an internal combustion engine unit oscillatable about a longitudinal axis while in operation, a support, means disposed between said support and one end of said engine taking the weight of said end while permitting said engine unit to oscillate about said axis, a rigid element having one end attached to said engine unit and its other end disposed in a position spaced from said axis of oscillation, a second rigid element having one end attached to said support and the other end disposed adjacent to but slightly spaced from the unattached end of the other rigid element, a block of resilient material interposed between said unattached ends of said rigid elements and acting to yieldingly resist oscillatory movement of said engine unit about said axis, and means for varying the position of attachment of said rigid elements to said support and said engine to vary the position of said block of material relative to the axis of oscillation of the engine.

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