Dec. 8, 1936. R. S. TROTT ET AL 2,063,063

EYED C-SPRING POWER PLANT MOUNTING

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Fig. 1

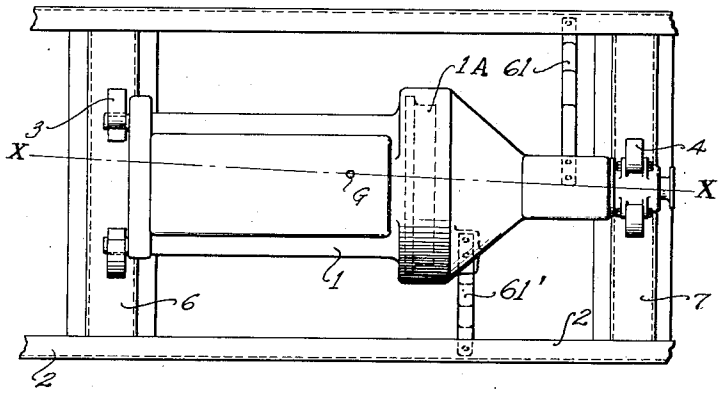


Fig. 4A

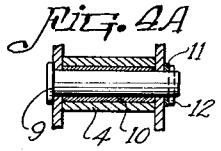


Fig. 4

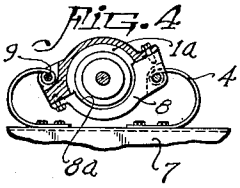


Fig. 2

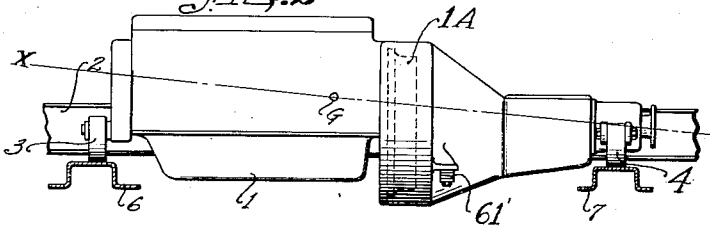


Fig. 3

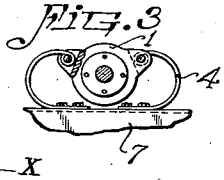


Fig. 5

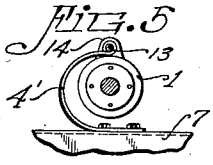


Fig. 6

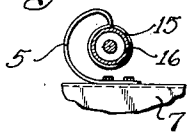


Fig. 7

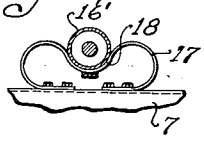


Fig. 8

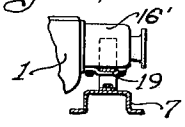


Fig. 14

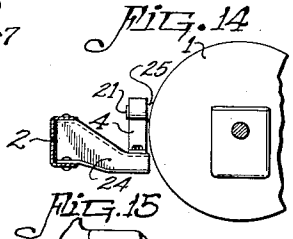


Fig. 9

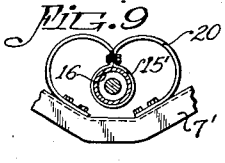


Fig. 10

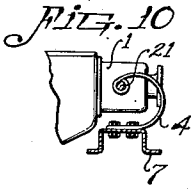


Fig. 11

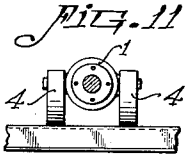


Fig. 15

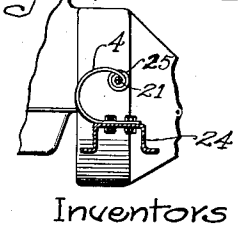


Fig. 12

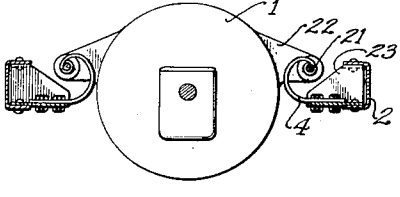
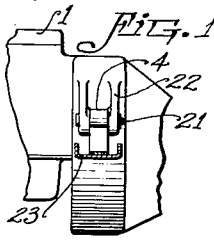


Fig. 13



Inventors
Rolland S. Trott
Benjamin A. Swennes
Kay Miller
By Vernon E. Hodges
their Attorney

Dec. 8, 1936. R. S. TROTT ET AL 2,063,063

EYED C-SPRING POWER PLANT MOUNTING

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Fig. 16

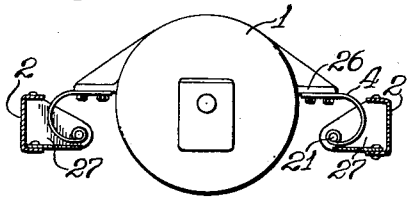


Fig. 17

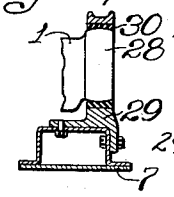


Fig. 18

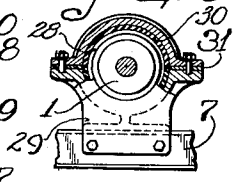


Fig. 31

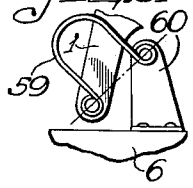


Fig. 19

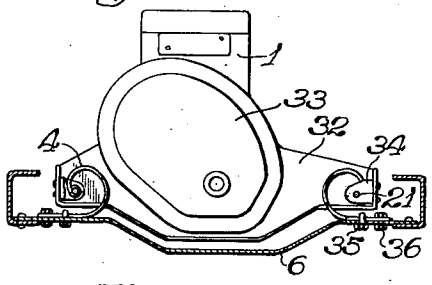


Fig. 20

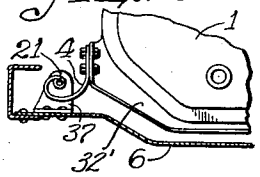


Fig. 21

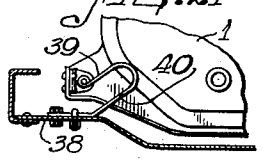


Fig. 22

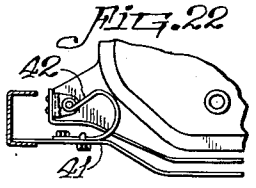


Fig. 23

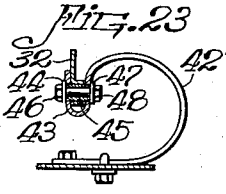


Fig. 27A

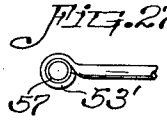


Fig. 24

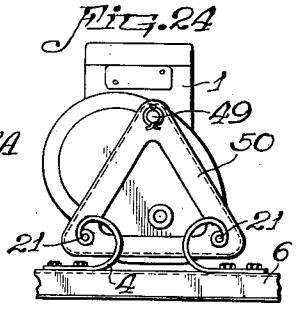


Fig. 25

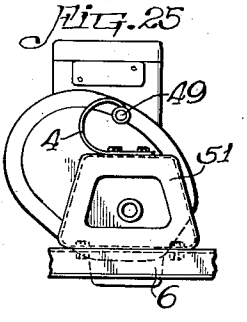


Fig. 26

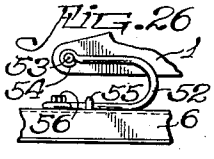


Fig. 27

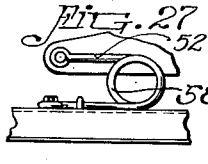


Fig. 30

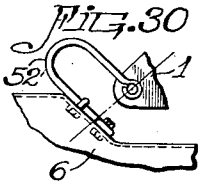


Fig. 28

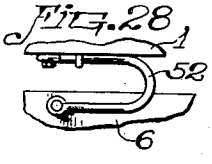


Fig. 29

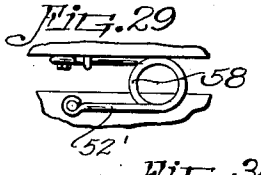


Fig. 35

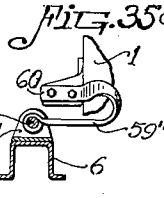


Fig. 33

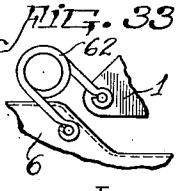


Fig. 32

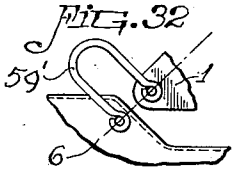
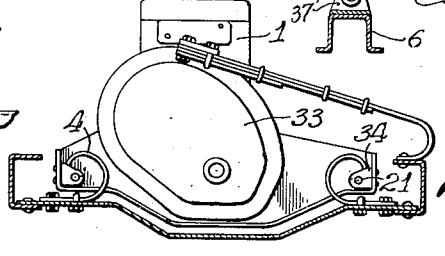


Fig. 34



Inventors
Rolland S. Trott
Benjamin A. Swennes
Kay Miller
By Vernon E. Hodges
their Attorney

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EYED C-SPRING POWER PLANT MOUNTING

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FIG. 37

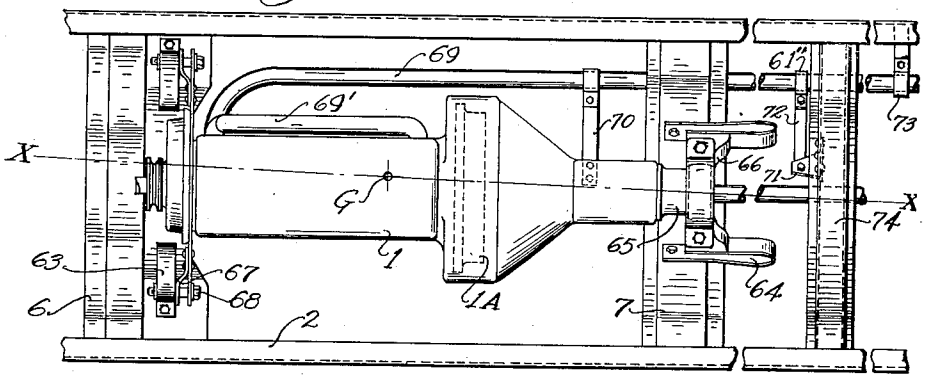


FIG. 38

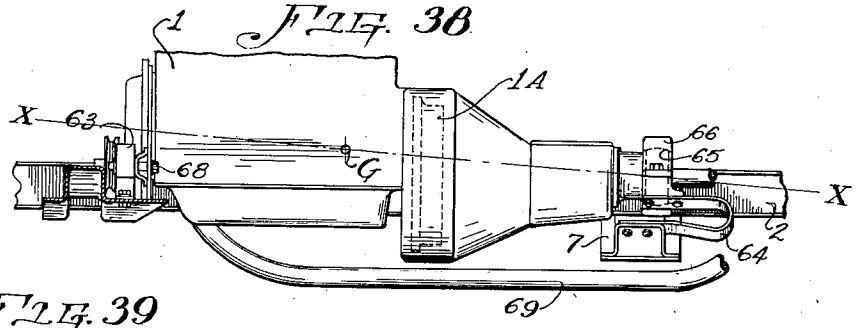


FIG. 39

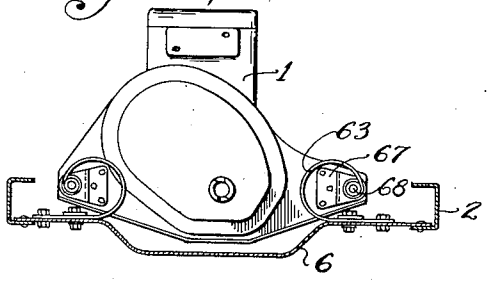


FIG. 40

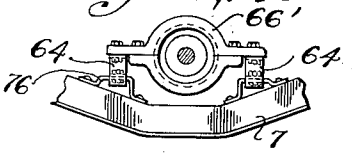


FIG. 41

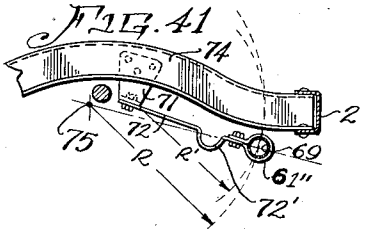


FIG. 36

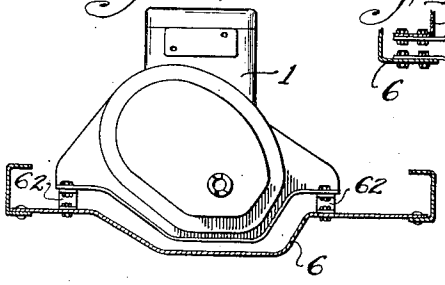
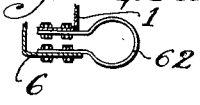


FIG. 36A



Inventors
Roland S. Trott
Benjamin A. Swennes
Kay Miller
By Vernon E. Hodges
their Attorney

Patented Dec. 8, 1936

2,063,063

UNITED STATES PATENT OFFICE

2,063,063

EYED C-SPRING POWER PLANT MOUNTING

Rolland S. Trott, Denver, Colo., and Benjamin A. Swennes and Kay Miller, Rockford, Ill.; said Swennes and said Miller assignors to said Trott

Application May 27, 1933, Serial No. 673,289

5 Claims. (Cl. 248—7)

This invention has to do with engine unit mountings and more especially with such mountings which provide a certain amount of movement between the engine unit and its support or frame, by which movement, noise, as well as engine sensation or vibration is adsorbed and prevented from being transmitted to the support or frame.

This invention more specifically is called an "eyed C-spring engine mounting" and was executed at the same time and filed at the same time as our two co-pending and supplementary applications which are entitled respectively "Clamped C-spring engine mounting", Serial No. 673,290, filed May 27, 1933 and "Torque spring engine mounting", Serial No. 673,288, filed May 27, 1933.

These three inventions are all for metallic constructions, to mount an engine to deaden or eliminate the sound and vibration of the engine unit and their effects upon the balance of a motor vehicle. We have found that metallic mounting springs, properly proportioned and formed will not only eliminate the transmission of vibration, but will also deaden sound more perfectly than rubber mountings. Other things being equal, we have found the deflection rate is decreased and nicety of resilience of a leaf or wire spring greatly increased if at least one end of the spring is provided with a pivotal mounting. In one case where a clamped C-spring was found to have a deflection rate of 1394 pounds per inch, the same width, thickness and form of spring was found to have a deflection rate of only 360 pounds per inch when one end of it was pivotally mounted.

Ordinarily the extra softness of action provided by the eyed C-spring construction is more especially adapted to the more sensitive front mounting of an engine unit. However, with six and eight cylinder cars, the eyed C-spring construction may not be required. But for high compression four cylinder engines with short connecting rods and other factors that go toward making a rough engine, we have found the best results are obtained by the use of our eyed C-spring front construction, and a clamped C-spring rear mounting combined with a spherical connection which rear mounting in effect produces the eyed C-spring result where required, combined with the longitudinal and transverse strength desired to avoid endwise movement of the engine under clutch operating forces, and desired to avoid transverse mass displacement under extreme high torque low speed conditions.

Previously, such a method of mounting the engine unit so as to provide a "floating engine" was composed of weight-supporting and insulating rubber members adjacent the ends of the engine unit, which rubber members were either clamped, vulcanized, bolted, or otherwise properly held in place so as to provide the desired amount of motion of the engine unit with respect to the frame.

This application is hereinafter known as the eyed C-spring application because at least one end of the mounting spring is pivotally mounted as distinguished from a spring both ends of which are clamped, as described in our co-pending clamped C-spring application. This application offers many novel features and advantages by virtue of its construction which will be referred to in the detailed description of the various elements.

The rear mounting we have found through experiment to be the less delicate of the various positions for mountings. We have found that it must provide pivotal and universal motion to permit the flexibility desired in the front mounting, and in some constructions with resilient opposition to the torque forces, and also with a slight amount of resiliently resisted horizontal or vertical or combined movement in any direction.

The front mounting must be so designed as to provide the proper softness for cushioning the forces incident to the front end of the engine unit. It must be a more flexible type of mounting in that the motion in any direction, vertically, horizontally, or in any combined vertical and horizontal direction, is of greater amplitude than at the rear mounting. This softness of the front mounting is desirable in that it must cushion and dampen out even slight forces, which are still large enough to be otherwise objectionable, and beyond such slight forces the movement of the engine unit should be resiliently but strongly resisted. The front mounting should also provide torque cushioning oscillation in conjunction with the rear mounting, and may combine with the rear mounting in resiliently opposing such oscillation. Various forms and designs of front and rear rubber mountings have heretofore been used in the attempt to provide the actions and results required, all of which are subject to the natural limitations of rubber.

It is therefore the object of this invention to provide front and rear metallic weight-support-

ing mountings for an engine unit upon its supporting frame, whereby these mountings will not be subjected to the limitations provided by rubber.

It is a further object of this invention to provide a method of mounting an engine unit movably upon its support that is of extremely cheap construction, whereby the production costs of the mounting may be low.

It is a further object of this invention to provide a mounting of extremely good performance characteristics by the exclusive use of metallic mounting means.

It is a further object of this invention to provide an engine unit mounting such that its construction will be of a unit type whereby some or all of the units may be manufactured and sold separately.

It is a further object of this invention to provide such an engine unit mounting in which the production assembly labor costs will be low.

It is a further object of this invention to provide a method for metallically mounting an engine unit to give it oscillatory and transverse force cushioning movements, which transverse movements are more responsive to small forces at the front end of the engine unit and more restrained at the rear end thereof.

It is a further object of this invention to produce such an engine unit mounting, which, by its individual details of construction, will tend to maintain the endwise position of the engine unit while permitting the most delicate force cushioning movement of small amplitude at the front end thereof, as well as torque cushioning oscillation of small amplitude, while providing resilient resistance to all movements of greater amplitude.

It is a further object of this invention to produce an engine unit mounting having front and rear metallic constructions which will perform properly when combined respectively with rear and front non-metallic or combined metallic and non-metallic mountings.

It is a further object of this invention to provide such an engine unit mounting which, by its individual details of construction, will permit an ease of accessibility to its various mounting units for purposes of unit replacement or complete removal of the engine unit after production assembly.

We accomplish the above objects by providing an eyed C-spring mounting in which a leaf or round wire spring is constructed and arranged to support weight and at the same time provide horizontal as well as vertical movements along with the movements necessary for the oscillation of the engine unit. We use the term "eyed C-spring" broadly to cover both leaf and round wire eyed springs so formed as to provide the above-mentioned movements.

All of the above is more fully described in detail hereinafter and is fully illustrated in the drawings, in which:—

Figure 1 is a plan view of an engine unit mounted by our eyed C-spring construction upon its frame.

Figure 2 is a side view of Figure 1.

Figures 3–18 inclusive show variations of our eyed C-spring construction as adapted to the rear mounting.

Figures 19–33 inclusive show variations of our eyed C-spring construction adapted to the front mounting.

Figure 34 shows our eyed C-spring mounting used in conjunction with a locating torque spring.

Figure 35 shows another form of eyed C-spring construction adapted to the front mounting.

Figures 36 and 36A show a clamped C-spring type of front mounting.

Figures 37, 38, and 39 show a complete engine unit mounting with an eyed C-spring front mounting, spherical bearing clamped C-spring rear, and resilient mounting of exhaust line and muffler.

Figure 40 shows a variation of the type of rear mounting shown in Figure 38.

Figure 41 is a view showing C-spring mounting of exhaust line to the frame cross member.

The construction of these various figures will now be described more in detail as follows:—

In Figure 1, the engine unit 1 is supported upon the front frame member 6 through the eyed C-springs 3 and upon the rear frame member 7 through the eyed C-springs 4. Torque reaction of the engine unit may also be taken through either one or both of the springs 61 or 61', or by similar torque springs mounted in any other proper location upon the engine unit.

Figure 2 is a side view of Figure 1.

In Figure 3, the eyed C-springs 4 are properly attached to the rear cross member 7 and support the rear of the engine unit 1.

Figure 4 shows a rear mounting construction whereby a rearwardly projecting portion 1a is received in the split bearing bracket 8 supported by the eyed C-springs 4, which rest upon the frame member 7. The C-springs 4 are attached to the bearing bracket 8 by the shackle bolts 9 or in any other proper pivotal manner. The bracket 8 is provided with flanges 8a which restrict the endwise movement of the engine unit with respect to the frame.

Figure 4A is an enlarged section showing the details of one form of construction at the shackle 9 of the eye-spring 4. The shackle bolt 9 is received in a bushing 10, of bronze or any other proper material, which is pressed into the eye of the spring 4. The shackle bolt 9 is held in place by the washer 11 and the cotter pin 12.

Figure 5 shows another form of supporting means for the rear of the engine unit wherein one eyed C-spring 4' is attached by means of the overhung shackle bolt 13 mounted in a lug 14 at the rear of the transmission of the engine unit 1.

Figure 6 shows another form of adapting our eyed C-spring to the rear mounting, wherein a large eye 15 is provided in the spring 5 which completely encircles a trunnion portion 16 extending from the rear of the engine unit.

Figure 7 shows another form of rear mounting construction, wherein a double ended C-spring 17 is provided with a half-eye 18, which lies under and supports the rearwardly projecting trunnion portion 16' of the engine unit.

Figure 8 is a side view of Figure 7 showing the clip 19 attached to the trunnion portion 16' of the engine unit 1 and so disposed as to restrict or limit the upward movement of the engine portion 16' away from the spring 17.

Figure 9 shows another form of rear mounting, wherein the double ended C-spring 20 is so formed as to provide the large eye 15' which encircles the rearwardly projecting trunnion portion 16 of the engine unit. The C-spring 20 is so formed as to fit the angle of the frame member 7'.

Figure 10 shows a rear mounting construction, wherein the eyed C-spring 4 is so mounted upon the frame member 7 as to be parallel with the center line of the crankshaft. The bolt 21 is

received in the eye of the spring 4 and is properly secured to the rear of the engine unit 1.

Figure 11 is a rear view of Figure 10.

Figure 12 shows a rear mounting construction, wherein the eyed C-springs 4 are moved forward and mounted approximately in line with the flywheel of the engine unit 1. The bolts 21 are properly attached to the flywheel housing arms 22 and are received in the eyes of the springs 4 which rest upon and are properly attached to the brackets 23, which are in turn bolted or riveted to the frame side rails 2.

Figure 13 is a side view in partial section of Figure 12.

Figure 14 shows a variation in the construction of the rear mounting at the bell housing wherein the eyed C-springs 4 lie parallel to the crankshaft. The bolt or pin 21 is properly attached to a boss 25 of the bell housing and is received in the eye of the spring 4 which rests upon a bracket 24 carried by the frame 2.

Figure 15 is a side view of Figure 14.

Figure 16 shows another form of rear mounting, with the eyed C-springs at the bell housing placed transversely with respect to the crankshaft. The bell housing of the engine unit 1 has thereon two arms or pads 26, to which the springs 4 are attached in an inverted position. The shackle bolts 21 are received in the eyes of the springs 4 and are supported in the brackets 27 which are bolted, riveted or otherwise properly attached to the side rails of the frame.

Figures 17 and 18 show a rear mounting construction designed to provide freedom of pivotal and universal motion at the rear of the engine unit. The engine unit 1 has the spherical trunnion portion 28 projecting rearwardly therefrom. The spherical trunnion portion 28 is received in the split bearing bracket 29 which has a split bushing 30 therein, which is made of bronze, babbitt, rubber or any other proper material. The bearing bracket 29 rests upon and is attached to the frame cross member 7. This construction, through the spherical bearing and trunnion portion, serves to restrict endwise movement of the power plant with respect to the frame while permitting pivotal and universal movements.

Figure 18 is a fragmentary section of the construction shown in Figure 17 looking from the rear. It will be seen in Figure 18 that any type of fit desired for the trunnion portion of the engine unit in the split bearing can be arrived at by the use of the proper number of shims 31.

Any type of mounting as set forth in our clamped C-spring application may be used in conjunction or combination with any type of eyed C-spring construction to form a complete engine unit mounting.

Figure 19 shows our eyed C-spring construction adapted to the front mounting of the engine unit. The engine unit 1 has the plate 32, which is properly attached between the timing gear cover 33 and the cylinder block casting. The brackets 34 are riveted to, or may be otherwise formed or made integral with, the plate 32, and retain the shackle bolts 21 which are received in the eyes of the eyed C-springs 4, which are in turn properly attached to the front frame member 6 by the U-bolts and nuts 35 and the nuts and bolts 36.

Figure 20 shows a front mounting similar to Figure 19 except that the eyed C-spring 4 is secured by means of the shackle bolt 21 to the brackets 37, which are bolted, riveted or otherwise properly attached to the frame cross member 6 and the C-springs 4 are properly attached directly to the engine unit plate 32'.

Figure 21 shows a construction very similar to Figure 19, the only variation being in the form of the eyed C-spring 38.

Our experiments and research have proved that the spring form is one of the vital points in getting the proper characteristics into a mounting unit. As will be seen in Figure 21, the eyed C-spring 38 has two of its portions parallel, as at 39 and 40 which provides a certain proportion of resilient vertical opposition relative to its horizontal resilient opposition, and the portion 39 forms an angle with the vertical central plane of the engine unit and if extended would intersect this plate at or adjacent the axis of oscillation. This construction tends to cause the front of the engine unit to oscillate properly about the desired axis of oscillation; that is, it tends to fix the center.

Figure 22 shows a front mounting construction similar to Figure 19, the only variation being in the forming of the eyed C-spring 41. The straight portion 42 of the spring 41 is at an angle with the vertical central plane of the engine unit and tends to properly locate the front end of the axis of oscillation. The results obtainable in this form of spring may be very similar to those of a type shown in the spring 39 of Figure 21.

Figure 23 shows another form of eyed C-spring wherein one end of the spring 42' is formed in the shape of a U, as at 43, and the eye is provided by the hole 44 in the U portion 43 rather than being wrapped out of the flat stock as is the case in the spring 4 previously mentioned. A bushing or sleeve 45 of bronze steel, or any other proper material is inserted in the hole 44 and is held in place by the bolt 46, washers 47 and nut 48. The hole in the plate 32 of the engine unit is provided with a loose fit on the bushing or sleeve 45 so that the resulting action at this point in each case will be pivotal.

Figure 24 shows a construction of a front mounting wherein the engine unit 1 has a stud 49 located at the front end of the axis of oscillation of the engine unit and projecting forwardly and received in a bearing in the pedestal 50, which is in turn mounted through the shackle bolts 21 upon the eyed C-springs 4 which are properly attached to the front frame member 6.

Figure 25 shows a front mounting construction similar to Figure 24 except that the stud 49 is received directly in the eye of the eyed C-spring 4 which is mounted upon the pedestal or bracket 51, which is bolted, riveted, or otherwise properly attached to the front frame member 6.

Figure 26 shows another form of eyed C-spring, formed of round wire stock, whereas the previously mentioned springs have all been formed of flat spring stock. The eyed C-spring 52 is pivotally attached to the engine unit 1 by means of the eye 54 and the shackle bolt 53 and is clamped to the front frame member 6 by the U-bolt 55 and the bolt 56.

Figure 27 shows an eyed C-spring similar to that shown in Figure 26, the only variation being in the addition of another loop 58 in the forming of the spring.

Figure 27A is an enlarged view showing the eye formed by flattening the end of the spring of the round wire stock. This provides an eye 53' of sufficient length to be properly bushed with

bronze, steel, or any other proper bearing material as at 57.

Figure 28 shows another form of round wire eyed C-spring, wherein one end is clamped to the engine unit 1, and the eyed portion is pivotally secured to the front frame member 6. It will be noted that the spring 52 of Figure 26 is used in this construction, but in an inverted position.

Figure 29 shows a construction similar to Figure 28 except for the addition of another loop 58 in the forming of the spring.

Figure 30 shows a round wire eyed C-spring similar to the spring 52 shown in Figures 26 and 28, the only variation being in the positioning of the eyed C-spring with respect to the front frame member 6 which is formed to such an angle that the perpendicular therefrom through the eye of the spring will intersect the front end of the axis of oscillation of the engine unit. It will also be noted that the spring shown as 52' of Figures 27 and 29 may be used in this position.

Figure 31 shows a flat leaf eyed C-spring wherein both ends of the spring 59 are formed to an eye and a line passing through the centers of said eyes would intersect the axis of oscillation at the front of the engine unit. The spring 59 is properly mounted on the engine unit 1 and on the bracket 60 by means of the shackle bolt construction shown in Figure 4A, or in any other proper pivotal manner.

Figure 32 shows a round wire double-eyed C-spring 59' similar to that shown in Figure 31, but with the engine unit in unstable equilibrium, other means being required in combination to provide the required stability.

Figure 33 shows a round wire double eyed C-spring 62 similar to that shown in Figure 32 but with the addition of another loop.

Figure 34 shows one form of mounting the torque spring at the front of the engine unit as embodied in our torque spring application of even date. Any of the forms included in our co-pending torque spring application may be used in conjunction with any type of eyed C-spring construction for either front or rear mountings, or the complete mounting design may incorporate any of the eyed C-spring forms for either front or rear mounting with any of the forms of the clamped C-spring, as set forth in our co-pending application of even date, for the other mounting in conjunction with any of the forms of torque springs used either at front or rear or both as illustrated and described in our copending torque spring application, or any combination of any parts or elements of all three of our co-pending applications may be used if necessary to provide the complete engine unit mounting desired.

Figure 35 shows an eyed C-spring 59'' which has the flat portion 60 clamped to the engine unit 1 and twisted so as to be at an angle of 90° with the eyed portion which receives the shackle bolt 21 and which bolt is properly retained in the bracket 37'. The bracket 37' is bolted, riveted or otherwise properly attached to the front frame member 6.

Figure 36 shows one form of construction similar to those embodied in our co-pending clamped C-spring application. Any one or any combination of the various types of clamped C-springs may be used in combination with one or more of the eyed C-spring forms as set forth in this application. The engine unit 1 is mounted upon the clamped C-springs 62 which are properly attached to the front frame member 6.

Figure 36A is a side view of the clamped C-spring 62 as used in Figure 36.

Whereas the eyed C-springs as shown in Figures 19, 20, 21, 22, 24, 25, and 31 are shown to be in the transverse plane, they may, if so desired, be placed parallel to or at any angle with the longitudinal central vertical plane of the engine unit, or at any proper height; and further the C-springs as shown in Figures 26, 27, 28, 29, 30, 32, and 33 may be placed parallel to, at any angel with, or transversely with respect to the longitudinal central vertical plane of the engine unit or at any proper height; and further, any of the springs which have been shown to be used primarily as a part of the front mounting, may, if so desired, be adapted to and used at the rear or at any point intermediate the two ends of the engine unit. Also any of the rear constructions shown may be adapted to and used at the front or at any point intermediate the two ends.

Figures 37, 38, and 39 show an engine unit 1 mounted upon its frame 2 by means of the eyed C-springs 63 and the clamped C-springs 64. The springs 63 are properly clamped to the front frame member 6 and are secured to the engine unit by the stud 68 and bracket 67. The engine unit is mounted at the rear by a rearwardly projecting trunnion portion 65 received in the split bracket 66, which is mounted upon the clamped C-springs 64 which rest upon the frame member 7. The exhaust pipe 69 is rigidly attached to the engine unit at the exhaust manifold 69' in any of the usual ways, and by the bracket 70 which is attached to the engine unit. The exhaust pipe 69 is mounted on the frame member 74 by the bracket 71 and the spring 72, and to the frame 2 by the bracket 73 in such a manner as to allow the entire exhaust line and muffler (not shown) to oscillate in step with the engine unit, except where constrained by the bracket 73.

Figure 41 is a section through the exhaust pipe 69 immediately to the rear of the frame member 74, and illustrates how the mounting of the exhaust pipe by the spring 72 causes it to swing in an arc which is very nearly concentric with the axis of oscillation extended from the engine unit to that point. The exhaust pipe 69 will move along the arc induced by the radius R' while the true arc about the axis of oscillation 75 would be described by the radius R. Due to the comparatively slight movement of the exhaust pipe in any case, these two arcs are sufficiently close together so that the pipe 69 will be able to move substantially with the engine unit 1 as it oscillates. The clamping of the spring 72 upon the bracket 71 allows the spring 72 to resiliently support the exhaust pipe 69 and the curve 72' in the spring 72 acts to further absorb annoying vibrations and effects due to the exhaust pipe. In some cases but one of these radial spring supports for the exhaust pipe will be required, that is, the construction shown in Figure 37 will be sufficient. But in other cases it will be found that the entire exhaust line must be spring supported, not only to permit it to swing freely with the engine unit, but also to entirely eliminate the least drumming or other sound at certain speeds and under certain conditions. Also, under some conditions it will be found that the results will be better if the bracket 70 is eliminated.

Figure 40 shows a slightly different form of spherical rear mounting in which the clamped C-springs 64 are attached to the bracket 66' at the height of the transmission shaft, whereby the transverse side thrust will be directly opposed

and without a vertically extending lever effect upon the springs; or at least with less of such effect than if the springs were attached to the bracket 66' at a lower level. The springs 64 are properly attached to the brackets 76, which are secured to the frame member 7.

Having now described our eyed C-spring power plant or engine unit mounting, what we claim as new and desire to protect by Letters Patent is as follows:—

1. In a motor vehicle, the combination of an engine unit having a crankshaft, and at least two longitudinally spaced resilient mounting structures supported by the vehicle and supporting the engine unit for oscillatory movement about a longitudinal axis extending approximately through the center of mass of the engine unit, the mounting structure adjacent the front end of the engine unit being metallic and yieldable in all transverse directions and having a pivotal connection with the engine unit approximately at the height of the engine crankshaft.

2. In a motor vehicle, the combination of an engine unit having a crankshaft, and at least two longitudinally spaced resilient mounting structures supported by the vehicle and supporting the engine unit for oscillatory movement about a longitudinal axis extending approximately through the center of mass of the engine unit and intersecting the crankshaft axis adjacent the rear end of the engine unit, the mounting structure adjacent the front end of the engine unit being metallic and yieldable in all transverse directions and having a pivotal connection with the engine unit approximately in the horizontal plane of the crankshaft.

3. In a motor vehicle, the combination of an engine unit having a crankshaft, and at least two longitudinally spaced resilient mounting structures supported by the vehicle and supporting the engine unit for oscillatory movement about a longitudinal axis extending approximately through the center of mass of the engine unit and intersecting the crankshaft axis adjacent the rear end of the engine unit, the mounting structure adjacent the front end of the engine unit comprising a pair of springs yieldable in all transverse directions and having pivotal connections with the engine unit on opposite sides of the crankshaft and approximately in the horizontal plane thereof.

4. In a motor vehicle, the combination of an engine unit having a crankshaft, and at least two longitudinally spaced resilient mounting structures supported by the vehicle and supporting the engine unit for oscillatory movement about a longitudinal axis extending approximately through the center of mass of the engine unit and intersecting the crankshaft axis adjacent the rear end of the engine unit, the mounting structure adjacent the front end of the engine unit comprising a pair of bowed leaf-springs constructed and arranged for yielding in all transverse directions and having pivotal connections with the engine unit on opposite sides of the crank shaft and approximately in the horizontal plane thereof.

5. In a motor vehicle, the combination of an engine unit having a crankshaft, and at least two longitudinally spaced resilient mounting structures supported by the vehicle and supporting the engine unit for oscillatory movement about a longitudinal axis extending approximately through the center of mass of the engine unit and intersecting the crankshaft axis adjacent the rear end of the engine unit, the mounting structure adjacent the front end of the engine unit comprising a pair of bowed leaf-springs constructed and arranged for yielding in all transverse directions and each having one end pivoted to the engine unit approximately in the horizontal plane of the crankshaft and the other end fixed to the vehicle.

ROLLAND S. TROTT.
BENJAMIN A. SWENNES.
KAY MILLER.