

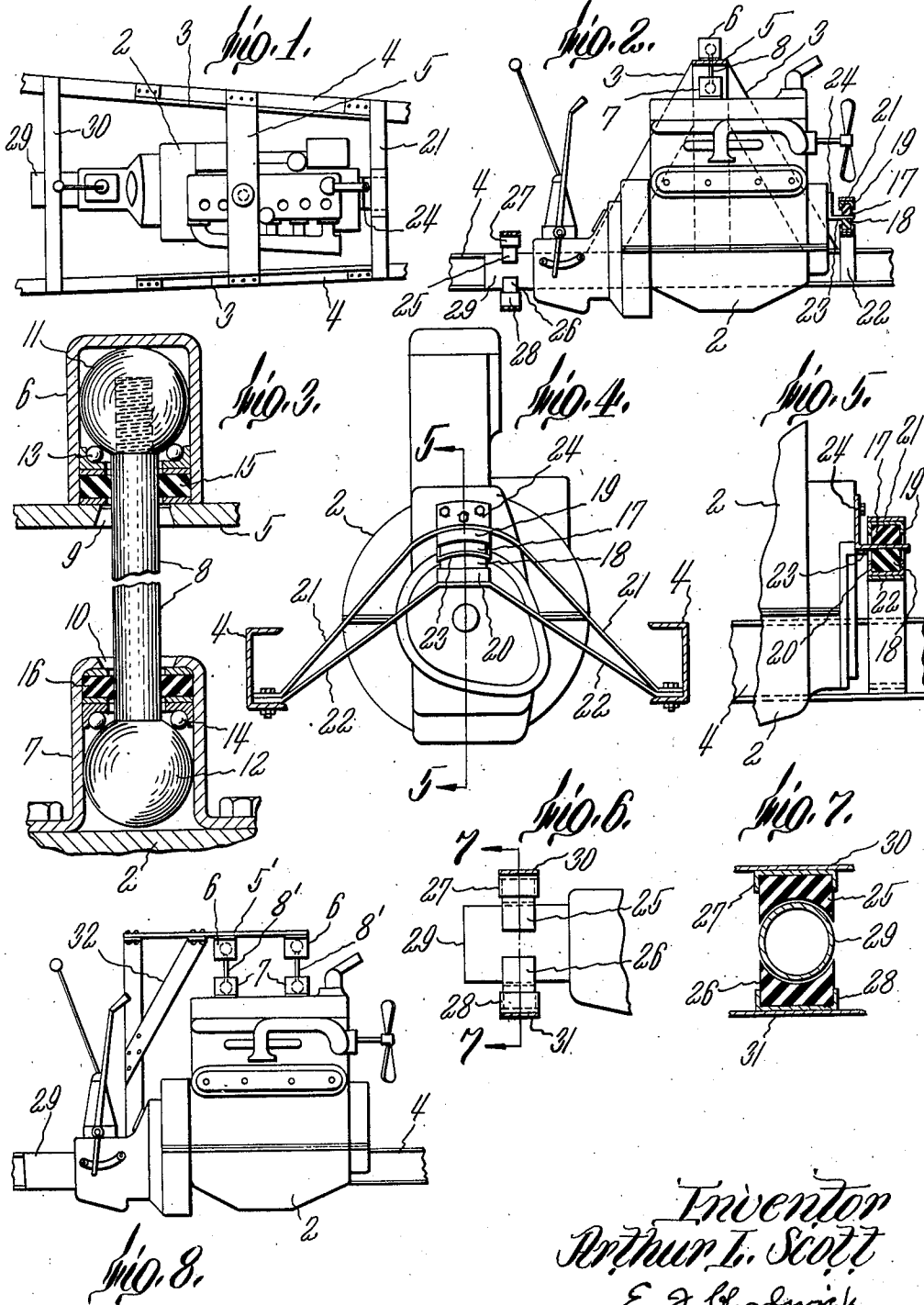
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MOTOR MOUNTING

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MOTOR MOUNTING

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The object of my invention is to provide improved means for supporting the motors of automobiles and other self-propelled vehicles, whereby vibrations generated by the operation of the motors will be effectively prevented from reaching the occupants of the vehicles and detracting from their comfort. This application is a continuation in part of my prior applications Serial No. 590,544, filed February 3, 1932, and Serial No. 636,299, filed October 5, 1932.

It is a matter of common knowledge that the internal combustion motors which constitute the power plants of practically all automobiles, as well as of many power boats, develop when in operation very pronounced vibrations, which are noticeable particularly during acceleration, deceleration and backing, and when the motor is idling. These vibrations result primarily from the fact that the power strokes of such motors are intermittent and are produced by combustions of explosive violence, so that a uniform torque is impossible and can be approximated only by increasing the number of cylinders beyond what is necessary for adequate power. To do this has become a common practice, and it has been supplemented in some cases by supporting the motor on resilient cushions, but so far as I am aware the suppression of vibrations in the vehicle body has not been fully accomplished heretofore.

According to my invention, which is particularly adapted and intended for use in connection with motors of the type above referred to, the motor is suspended above its center of gravity by means which permit it to swing freely in stable equilibrium, and the range of its swinging movements is limited sufficiently to keep it in proper alignment with the driven mechanism by means of cushioning stops suitably located to prevent it from coming in direct contact with the vehicle frame at any point. These stops, however, are not required to carry the weight of the motor, and therefore they remain sufficiently soft and resilient to react to and effectively absorb such vibrations as reach them, throughout the permissible range of bodily movement of the motor.

The accompanying drawing illustrates the preferred form of my invention as designed for use with an automobile motor of the unit type, in which the motor proper is combined with the transmission to form a single structural unit.

In the drawing,—

Figure 1 is a plan view of the motor unit and

its supporting means, together with adjacent parts of the chassis frame;

Figure 2 is a side elevation of the same parts, omitting one side of the chassis frame;

Figure 3 is a sectional detail view drawn to a larger scale and showing my preferred form of the motor-suspending means;

Figure 4 shows in front elevation the front end of the cylinder block and means for limiting the swinging movements of the motor unit at this point;

Figure 5 is a section on the line 5—5 in Figure 4;

Figure 6 is a side elevation of means for limiting the swinging movements of the motor unit at its rear end;

Figure 7 is a section on the line 7—7 in Figure 6; and

Figure 8 is a side elevation similar to Figure 2, illustrating a duplication of the means for suspending the motor unit.

In the construction illustrated in Figures 1 to 7 inclusive, the motor unit 2 is suspended from an overhead structure which may consist, for example, of side uprights 3 rigidly secured at their lower ends to the side bars 4 of the chassis frame, and a transverse bar 5 secured to the uprights 3 and located above the motor unit. The suspending means are carried by the transverse bar 5, and preferably constitute a species of double universal joint comprising, as shown in Figure 3, inverted cups 6 and 7 secured respectively to the upper face of the bar 5 and to the top of the unit 2, an upright rod 8 passing through perforations 9 and 10 provided in the bar 5 and in the top of the cup 7, respectively, a metal ball 11 attached to the upper end of the rod 8 and located in the cup 6, a similar ball 12 attached to the lower end of the rod 8 and located in the cup 7, a ball bearing 13 interposed between the ball 11 and the bar 5, and a similar ball bearing 14 interposed between the ball 12 and the top of the cup 7.

In addition to the parts above described, I prefer to interpose a cushion 15 of live rubber between the ball bearing 13 and the bar 5, and a similar cushion 16 between the ball bearing 14 and the top of the cup 7, for a reason hereinafter explained. When employed, these cushions are perforated to permit the rod 8 to pass through them and are in contact with it at the perforations, and the ball bearings 13 and 14 are made capable of vertical movement in the

respective cups, so that the cushions will be compressed by the weight of the motor unit.

The cup 7 is attached to the motor unit 2 at a point directly over the center of gravity of the latter, or substantially so, and the cup 6 is attached to the bar 5 at such a point that when the motor is at rest and the vehicle containing it is on level ground the weight of the unit 2 will cause it to assume its normal position, in which the motor shaft is in line with the propeller shaft. From this position it can swing in any direction on either of the ball bearings which carry it, the perforations 9 and 10 being made large enough to permit such movements. It can also turn on the rod 8 as an axis, and it is capable of undergoing various irregular movements by swinging on both ball bearings at the same time. In other words, so far as its suspension is concerned, it is wholly free from any rigid connection with the chassis, through which vibration can be transmitted from it to the chassis and thence to the body of the vehicle.

It will be evident that the above-described movements of the motor unit 2 must be kept within a range which is sufficiently limited to prevent the motor from taking any position in which its effectiveness in transmitting power to the driven mechanism would be materially diminished, and this is done by means including vibration-damping devices located below the point of suspension of the unit 2 and interposed between it and the chassis. While the number, location and construction of the damping devices may be widely varied, I have obtained the most satisfactory results by providing a damping unit adjacent to the front end of the cylinder block, and another at or near the rear end of the motor unit. When so located, the motor suspension is above and between them and at a substantial distance from each, resulting in an arrangement analogous to a three-point bearing and similarly effective.

The damping unit shown in Figures 2, 4 and 5, which is located at the front end of the motor unit 2, comprises two blocks of live rubber 17 and 18 located one above the other and held respectively in cups 19 and 20, from which they project toward each other. The upper and lower cups 19 and 20 are carried by metal straps 21 and 22, respectively, the ends of which are secured to the side bars 4 of the chassis frame, as shown in Figure 4. Between the opposed faces of the rubber blocks 17 and 18, which are similarly curved transversely, as shown, is located the forwardly-projecting lip 23 of an L-shaped member 24 rigidly secured to the front end of the cylinder block, the lip 23 being curved transversely in conformity with the curvature of the adjacent faces of the blocks 17 and 18 and being in contact with both. Thus this damping unit, in combination with the lip 23, provides a cushioning stop which is effective laterally in both directions, as well as vertically.

The other damping unit, located at the rear portion of the motor unit 2 and best shown in Figures 6 and 7, comprises two blocks of live rubber 25 and 26 held respectively in cups 27 and 28 and projecting toward each other therefrom. Their outer ends are concaved to fit the outer surface of the transmission casing 29 and are held in contact with it, one above and the other below it, by attaching the cups 27 and 28, respectively, to cross bars 30 and 31 which form a part of or are rigidly secured to the chassis frame, thus providing a cushioning stop which, like the one at the front end of the motor unit, is effective both

laterally and vertically. Collectively, the stop limit swinging movements of the motor unit in any direction, endwise as well as sidewise, because all endwise movements have a vertical component due to the location of the point of suspension between the stops, instead of directly above either of them. They also limit turning movements on the suspension as an axis, since they have lateral components at the stops.

The motor-suspending means and the cushioning stops are so arranged that the weight of the motor unit is carried wholly or mainly by the suspension on which it swings, and only to a minor extent, if at all, by the resilient blocks which constitute the damping elements. Consequently the blocks are normally uncompressed, or substantially so, and hence their effectiveness in damping vibrations is not interfered with by the weight of the motor unit. Since the swinging movements of this unit are necessarily kept within narrow limits, measured by fractions of an inch, it is important that at all points within these limits the damping elements shall remain soft enough to react fully to all vibrations transmitted to them from the motor, and this result is obtained in the manner just described.

In operation, the torque reaction of the motor tends to swing it in the opposite direction to that in which the crank shaft rotates, and in some cases, depending upon the weight distribution, the motor may also tend to twist or otherwise displace itself under the influence of the resultant of all the forces generated within it when running. Consequently, if the cushioning stops were omitted and the motor were allowed to idle on level ground, it would move a short distance out of its normal position when not running and would come to rest as soon as the weight of the engine block sufficed to balance the resultant force which displaced it. In such case no vibrations would be transmitted to the chassis frame because the swing of the block would be unopposed except by its own weight and there would be no path through which vibrations could travel, while the forces which would produce vibrations if the swing were opposed would be dissipated or expended in producing the swing itself. Although the cushioning stops which keep the motor in proper alignment necessarily limit its free swing, its capacity to swing against its own weight within the limits permitted has the effect of dissipating the internal vibration-producing forces to a substantial extent, whereby the violence of the vibrations transmitted to the stops is correspondingly lessened, and even if the stops are kept in contact with the engine block, as is preferably the case, and may therefore carry an inconsiderable fraction of the weight of the block in some positions, it has been found by actual performance that the stops are nevertheless effective to keep the movements of the block within the permissible range without being sufficiently compressed to prevent their absorption of such vibrations as reach them. This important result would be incapable of attainment if the swinging movements of the block were not opposed by its own weight or, in other words, if it were not supported so as to swing in stable equilibrium.

The cushions 15 and 16, when employed, have some capacity to absorb vibrations, but their main function is to diminish the effect of road shocks upon the suspended unit, which furthermore is not materially affected by distortions of the chassis frame resulting from inequalities in the road surface, because there is no rigid con-

nection between the unit and the frame at any point. These and the other features of my invention, above described, result in a freedom from vibration and a degree of riding comfort which, as I have found by road tests, are not equalled by any prior construction with which I am acquainted, even when my supporting means are applied to a motor having fewer cylinders than are customarily employed.

In Figure 8 I have shown a modified arrangement in which the motor unit 2 is hung on two suspensions 8', 8', carried by an overhead structure 5' which is secured to the chassis frame at the rear of the motor unit and includes a diagonal brace 32 to give it rigidity. The suspensions 8', 8', are duplicates of the one shown in Figure 3 and their mode of operation is the same in all material respects. This arrangement may be used when it is desirable to distribute the weight of the motor unit.

My motor-supporting means can be applied to motors of various kinds and types of construction, as will be evident, and the manner in which the cushioning stops are applied to the motor may be varied in accordance with the requirements of each particular case. It is not essential to employ a double joint in the suspending means, or to include a ball bearing therein, so long as the swinging movements of the motor are provided for, and the details of construction and arrangement of the other parts may be modified widely in various ways within the scope of the appended claims.

I claim:

1. The combination with an internal-combustion motor of supporting means therefor, said means including a universal joint whereby the motor is suspended above its center of gravity and enabled to swing freely in stable equilibrium, a compressible and resilient cushion included in the suspending means and subjected to the weight of the motor, and resilient cushioning stops located in position to narrowly limit the swinging movements of the motor and substantially free from the weight thereof when in its normal position.

2. The combination with an internal-combustion motor, of an overhead support therefor, motor-suspending means connecting the motor and the support and constructed to provide for universal swinging movement of the motor at a point directly above it, and resilient cushioning stops located in position to engage the lower portion of the motor in front of and behind its suspending means and limit its swinging movements both laterally and vertically, said stops being substantially free from the weight of the motor when in its normal position.

3. The combination with an internal-combustion motor, of supporting means therefor, said supporting means including two universal joints located one above the other, whereby the motor is suspended above its center of gravity and enabled to swing freely in stable equilibrium as well as to undergo irregular displacements in various directions, and resilient cushioning stops located in position to limit the swinging movements and other displacements of the motor in all directions, said stops being substantially free from the weight of the motor when in its normal position.

4. The combination with an internal-combustion motor and a support therefor, of means for suspending the motor from the support and enabling it to swing freely in stable equilibrium, and means for limiting the swinging movements

of the motor comprising resilient cushioning stops having transversely-curved surfaces engaging similarly shaped surfaces on the motor in front of and behind its suspending means, respectively, said stops being substantially free from the weight of the motor when in its normal position.

5. The combination with an internal-combustion motor of suspending means therefor comprising a universal joint on which the motor is adapted to swing, a resilient cushion included in the suspending means and subjected to the weight of the motor, and resilient cushioning stops located below the point of suspension of the motor and having transversely-curved surfaces engaging similarly shaped surfaces on the front and rear portions of the motor, said stops being substantially free from the weight of the motor when in its normal position.

6. Motor-suspending means comprising an overhead support, a rod having a ball at each end, a bearing for each ball, a receptacle for each bearing in which the latter is movable, a resilient cushion interposed between each ball and a wall of its receptacle and subjected to the weight of the motor when suspended, and means for attaching the receptacles to the motor and to said overhead support, respectively.

7. The combination with an internal combustion motor of an overhead support therefor, motor suspending means connecting the motor and the support and constructed to enable the motor to swing freely in all directions at a point located directly above the motor, a frame for the motor, and resilient cushioning stops carried by the frame and located in position to engage portions of the motor for narrowly limiting the swinging movements of the motor without being substantially compressed by the weight thereof when in its normal position, whereby vibrations not dissipated within the mass of the motor are absorbed by the stops.

8. The combination with an internal combustion motor of an overhead support therefor, motor suspending means connecting the motor and the support and constructed to enable the motor to swing freely in all directions at a point located directly above the motor, a compressible and resilient cushion included in the suspending means and compressed by the weight of the motor, a frame for the motor, and resilient cushioning stops carried by the frame and located in position to engage portions of the motor for narrowly limiting the swinging movements of the motor without being substantially compressed by the weight thereof when in its normal position, whereby vibrations not dissipated within the mass of the motor are absorbed by the stops.

9. The combination with an internal combustion motor of an overhead support therefor, motor suspending means connecting the motor and the support and constructed to provide for universal swinging movement of the motor at a point directly above it, and resilient cushioning stops made of live rubber constructed and arranged constantly to engage portions of the motor and located in position to narrowly limit the swinging movements of the motor without being substantially compressed by the weight thereof when in its normal position, whereby vibrations not dissipated within the mass of the motor are absorbed by the stops.

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