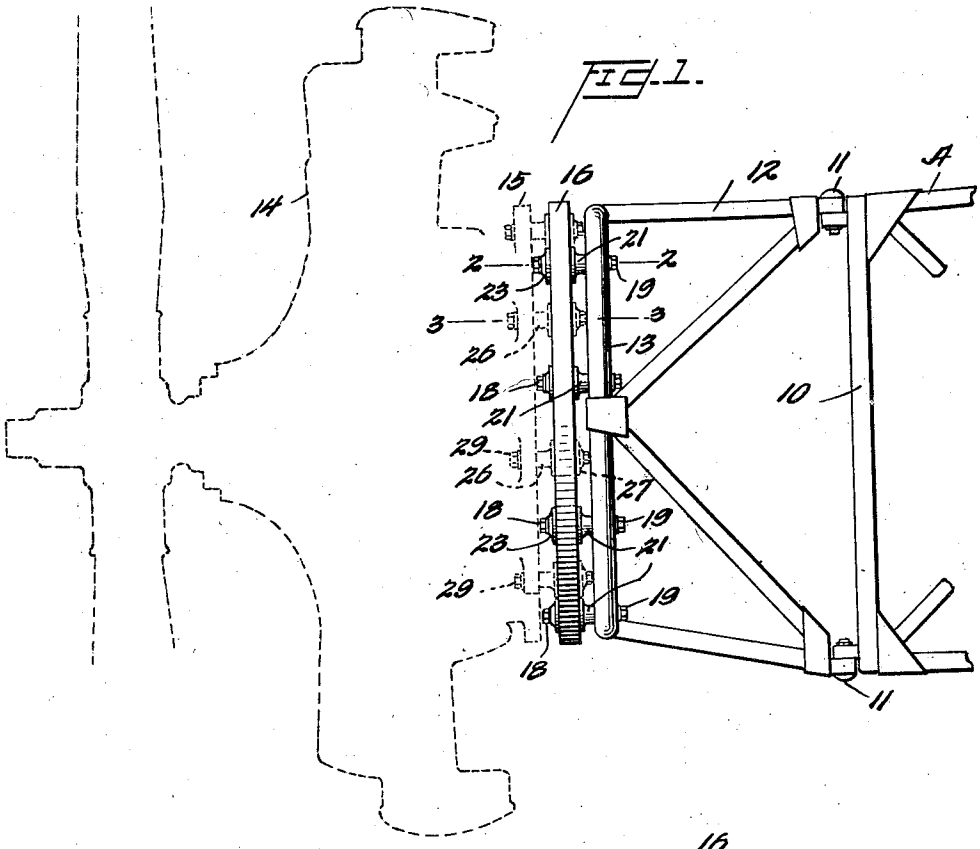
May 31, 1932. L. M. WOOLSON 1,860,444

INTERNAL COMBUSTION ENGINE

Filed July 22, 1930

FIG. 1.



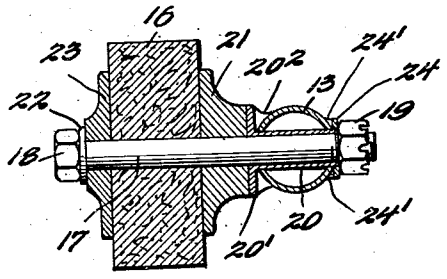
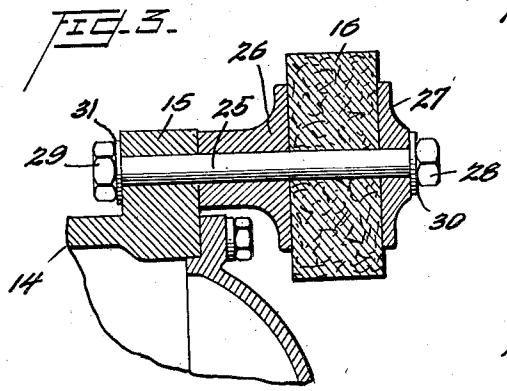




FIG. 2.

FIG. 3.




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Patented May 31, 1932

1,860,444

# UNITED STATES PATENT OFFICE

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## INTERNAL COMBUSTION ENGINE

Application filed July 22, 1930. Serial No. 469,898.

The present invention relates to aeroplanes, and particularly to means for mounting an aeroplane engine upon the forward end of an aeroplane frame.

The problem of mounting an aeroplane engine upon the forward end of the framework of an aeroplane has, in the past, been solved in various ways. Where the engine itself is of the high speed and comparatively low cylinder pressure type, the problem presents no great difficulty, it generally being found entirely feasible to directly connect the engine and frame by suitable mechanical connections. With the tendency toward increased compression ratios in the engine cylinders, however, and particularly where an engine of the Diesel type is to be mounted upon the aeroplane front end, it has become increasingly important to employ engine mounting constructions which insulate, so far as possible, the relatively light aeroplane frame from the shocks and vibrations due to the normal running of the engine.

The present invention contemplates an improved means for mounting an aeroplane engine, particularly an aeroplane engine of the high compression ratio type, to the forward end of an aeroplane frame, the novel mounting being comparatively rigid and yet having to a high degree the property of shielding the aeroplane frame from the shock, vibration, and noise of the engine.

In the accompanying drawings one embodiment of the invention is set forth by way of example, but it will be understood that numerous changes in design and arrangement of the component elements thereof will naturally be effective in adapting the mounting to aeroplane frames of different types and constructions and to engines of various shapes and mechanical designs.

In the drawings:

Figure 1 is a side elevation of a portion of the forward end of an aeroplane frame, the engine being indicated in outline in advance of the frame, and the novel connecting means being clearly shown;

Figure 2 is a section on line 2—2 of Figure 1; and

Figure 3 is a section on line 3—3 of Figure 1.

The aeroplane frame is generally indicated at A, and it will be unnecessary, for the purposes of the present invention, to describe this frame in any detail inasmuch as it may be of any well-known type or design. The fusilage forward end member or frame is indicated at 10, and secured to this member by suitable bolts 11 is the engine mount, generally indicated at 12. This engine mount may likewise vary considerably in the design and arrangement of its structural elements, but in the present instance it terminates at its forward end in a transversely disposed ring member 13, preferably formed of a metallic tube. The engine itself is not illustrated in detail, but its outline is indicated at 14.

While the engine may be of any suitable type, that one which is outlined in the drawings is a nine-cylinder Diesel engine of the radial type, such, for instance, as is described in my copending application, Serial No. 358,899, filed April 29, 1929. The engine frame terminates rearwardly in an annular flange 15 substantially equal in diameter to that of the ring 13 of the frame, and this flange is, as shown in the drawings, spaced from the ring 13 and in a transverse plane which is substantially parallel to a transverse plane including the ring 13.

Interposed between ring 13 and flange 15 is a member 16, to which both ring and flange are secured and which in reality constitutes a connecting member, with the necessary bolts, etc., between the engine and frame. This ring is fabricated of some non-rigid material, as, for instance, a composite material fabricated of fibrous material and rubber of the type now used for automobile brake linings and the like. Its exact internal structure and composition may vary widely, but, inasmuch as its primary purpose is to insulate, as far as possible, the aeroplane frame from the noise and vibration of the engine, it should be formed of a material which may be classed as a poor conductor of noise and vibration.

The ring 16 is also of substantially the same

outer diameter as the flange 15 and ring 13 and is disposed concentrically therewith and in a plane which lies substantially parallel to the planes of the engine flange and the forward frame ring. This intermediate connecting member 16 is rigidly attached at a plurality of spaced points to the frame ring 13, for instance, at nine points equally spaced around the periphery of the ring. One such connecting means is shown in Figure 2, and from this figure it will be seen to comprise essentially a bolt 17 which extends through both the ring 13 and the ring 16, the bolt having at one end a head 18 and at the other a nut 19. Each bolt-receiving aperture in the frame ring 13 is formed slightly larger in diameter than the bolt which passes through the same in order that a sleeve 20 may be positioned therein, this sleeve closely fitting bolt 17 and being provided at the end adjacent ring 16 with an annular flange, indicated at 20′. Fillets $20^2$ are formed integral with each flange 20′, the curved surfaces of these fillets lying against the adjacent surfaces of ring 13.

Between the flange 20′ and the surface of the ring 16 is a washer-like member 21, preferably formed of a very light metal, such as aluminum. Between the head 18 of the bolt and ring 16 are positioned a washer 22 of conventional type and an enlarged washer-like member 23. Members 21 and 23 may be designated "pressure distributing members" inasmuch as it is the primary function of these members to effect the distribution of the clamping pressure exerted upon the ring 16 by this securing means over wide areas of the surface of the ring. Intermediate the frame ring 13 and nut 19 is a second washer 24, this washer having cheeks or fillets 24′ with curved surfaces which fit closely the adjacent surfaces of the ring 13. It will be seen that, when the nut 19 is rotated upon bolt 17, the ring 16 will be tightly clamped between members 21 and 23 of each of the securing devices and also firmly attached to ring 13. The fillets $20^2$ and 24′ serve to distribute the clamping pressure exerted on ring 13 over relatively wide areas, preventing distortion of the ring.

The engine frame is likewise attached to ring 16 by a plurality of somewhat similar securing devices, one of which is illustrated in section in Figure 3. The flange 15 of the engine frame is apertured at a number of spaced points around its circumference (in this case nine) to receive bolts, one of which is shown at 25. This bolt also passes through an aligned aperture in ring 16, and positioned on opposite sides of this last mentioned ring are light metallic clamping members 26 and 27 likewise centrally pierced by the bolt 25. The head of the bolt is indicated at 28, an adjustable nut threaded thereon at 29, and washers of conventional type at 30 and 31, respectively. By tightening the nut 29, clamping members 26 and 27 may be caused to exert any desired amount of pressure upon the intermediate ring 16.

It will be observed from Figure 1 of the drawings that the points of attachment of ring 13 to ring 16 are spaced from each other and are also spaced from the points of attachment of the engine flange 15 to ring 16. It is not possible, therefore, for vibrations of the engine to pass directly from the engine frame to the aeroplane frame, and such engine vibrations are, as a matter of fact, largely damped out in passing along ring 16 from a point of attachment of this ring to the engine to the nearest point of attachment of this ring to the aeroplane frame, the ring being so fabricated, as has been heretofore pointed out, as to present a maximum resistance to the passage therethrough of mechanical vibrations.

The mounting above described is quite effective, and adds very little, if any, weight to the aeroplane, while adding greatly to the comfort of the aeroplane operator and passengers and at the same time prolonging the life of the aeroplane by lessening the wear and tear thereon due to engine vibration.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In an aeroplane, in combination, a frame having a transversely extending forward portion, an engine having a transversely extending rearward portion, said forward portion of the frame and rearward portion of the engine being spaced apart and substantially parallel, a vibration absorbing member interposed between said portions and arranged substantially parallel thereto, means connecting said member to the engine, and means connecting said member to the frame, said means, respectively, being attached to said member at spaced points, the entire weight of the engine being transmitted through said vibration absorbing member to the frame, and torque and vibration developed by the engine being cushioned thereby.

2. In an aeroplane, in combination, a frame having a transversely extending forward portion, an engine having a transversely extending rearward portion, said forward portion of the frame and rearward portion of the engine being spaced apart and substantially parallel, a vibration absorbing member interposed between said portions and arranged substantially parallel thereto, a plurality of devices for connecting said member to said frame at spaced points, and a plurality of devices for connecting said member to the engine at points spaced from each other and from the points of connection of said member to the frame, whereby the entire weight of the engine is transmitted to the frame

through said member and the torque and vibration developed thereby cushioned.

3. In an aeroplane, in combination, a frame, an engine, and means for supporting the engine forwardly of the frame and damping the vibrations developed thereby, said means comprising a substantially flat member interposed between said frame and engine and connected to both at spaced points, the points of connection of said member to the frame being also spaced from the points of connection of the member to the engine whereby the entire weight of the engine is transmitted through said member, said member being fabricated of fibrous material and rubber so as to be high in tensile strength while having the capacity to dampen vibrations.

4. In an aeroplane, in combination, a frame, an engine, and means for supporting the engine forwardly of the frame and damping the vibrations developed thereby, said means comprising a transversely disposed ring fabricated of fibrous material and rubber, and a series of bolt-like members spaced equidistantly around the ring and secured thereto, alternate members extending in opposite directions from the ring, one set forwardly and the second set rearwardly, the forwardly extending members being rigidly connected to the engine and the rearwardly extending members to the frame, said ring and members comprising the sole means for supporting the engine upon the frame.

In testimony whereof, I have hereunto subscribed my name this 17th day of July, 1930.

EMMA F. WOOLSON,
*Executrix of the Estate of Lionel M. Woolson, Deceased.*