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[33] **Austria**
[31] **A 7,677/67**

[54] **INTERNAL COMBUSTION ENGINE WITH SOUNDPROOFING COWLING**
3 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **123/195,** 123/52, 123/198, 181/33
[51] **Int. Cl.** **F02f 7/00,** F16f 7/00, F02b 77/00
[50] **Field of Search** 123/52MC, 195C; 1/198, 133.1; 181/33.4

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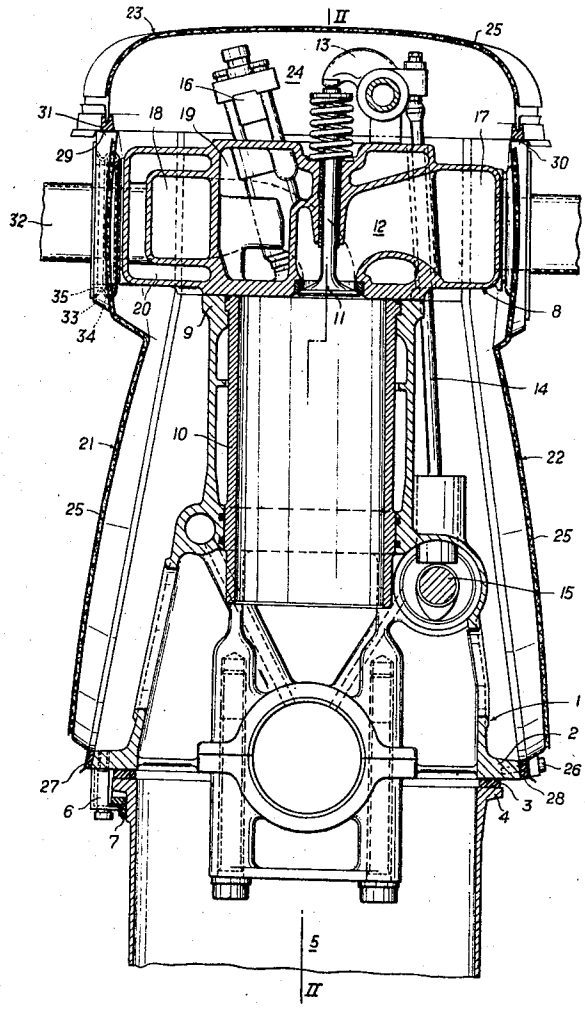
ABSTRACT: An internal combustion engine with soundproofing cowling having at least two covers secured to the sides of the crankcase and extending to the cylinder head and also surrounding the exhaust and intake manifolds of the engine. A coating of soundproofing material is applied to the covers and the upper cowling lid.



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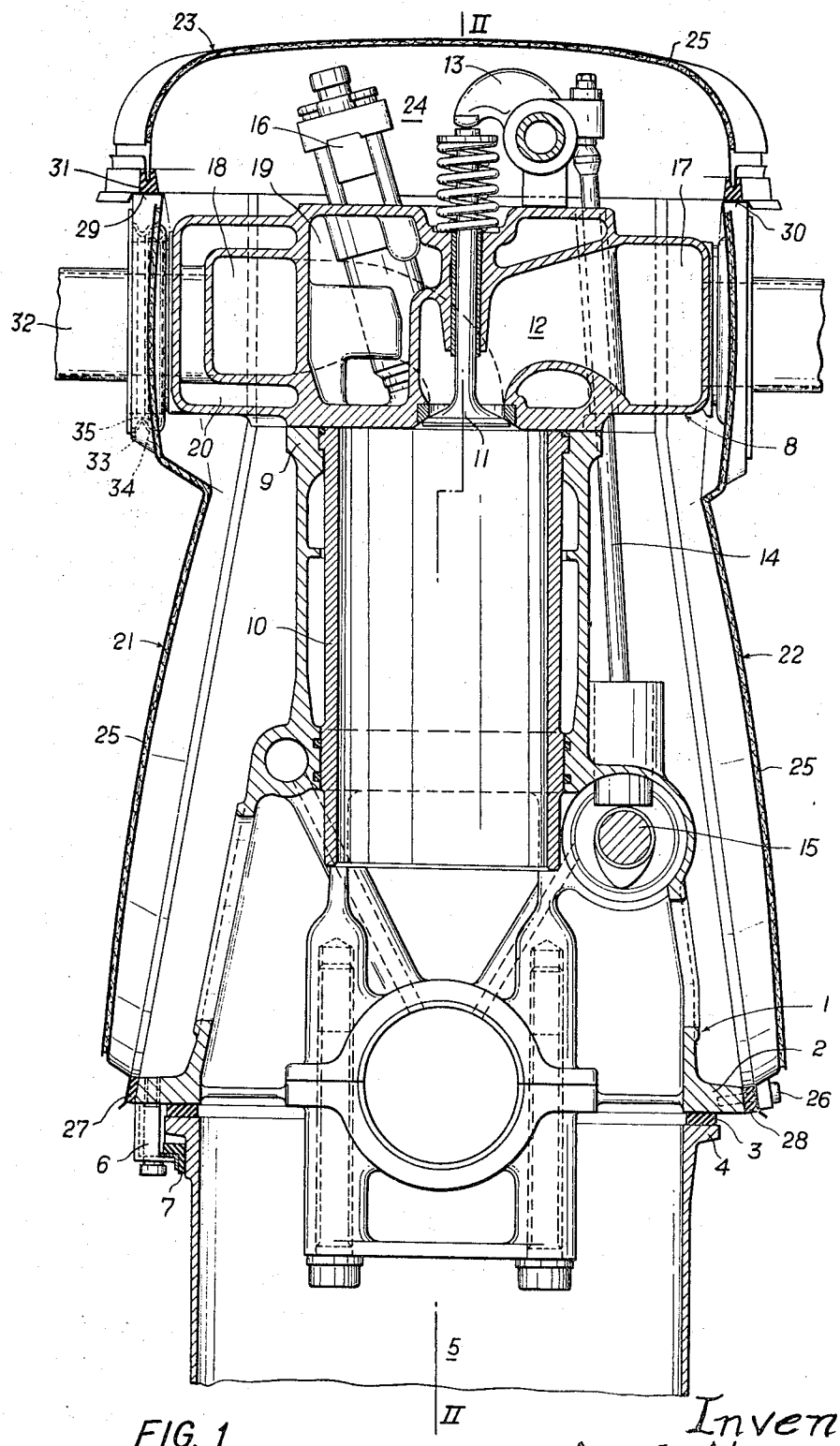

FIG. 1

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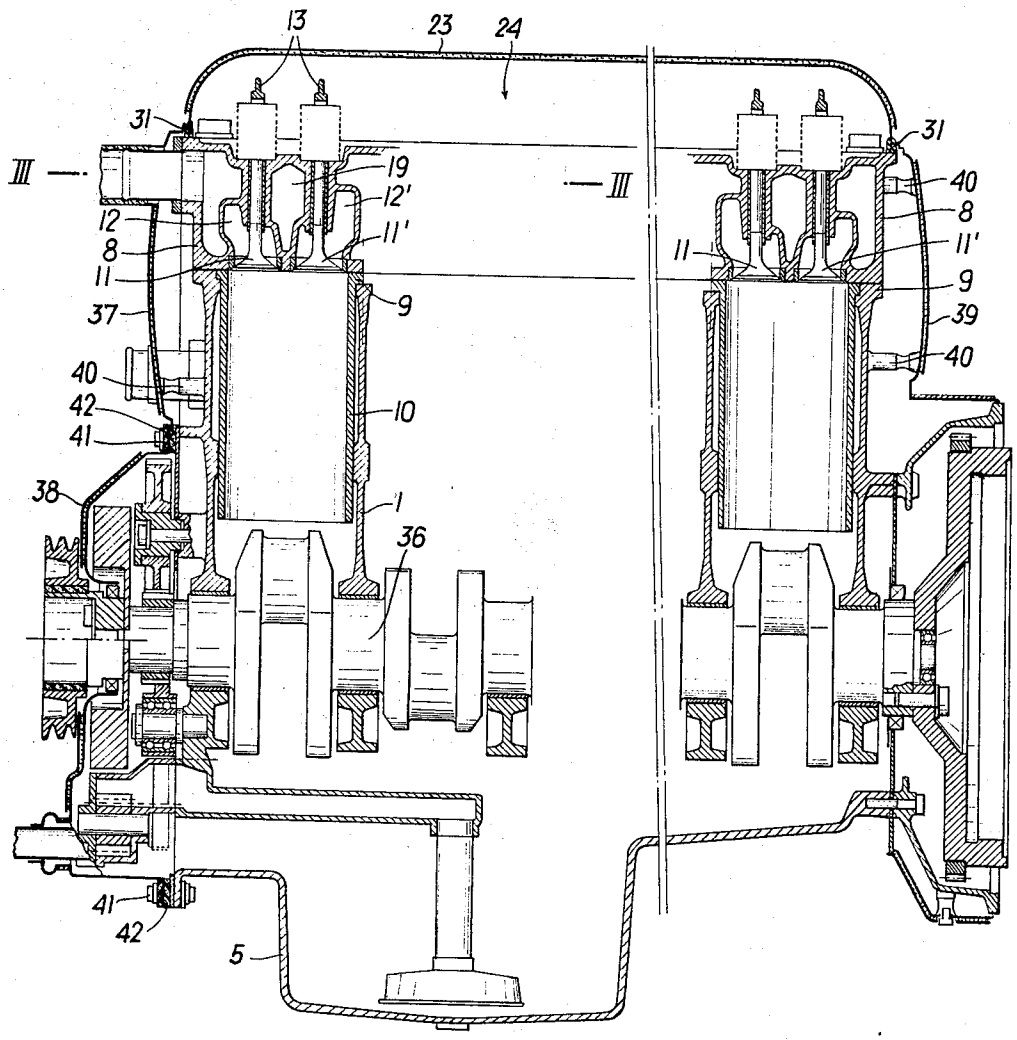
FIG. 2



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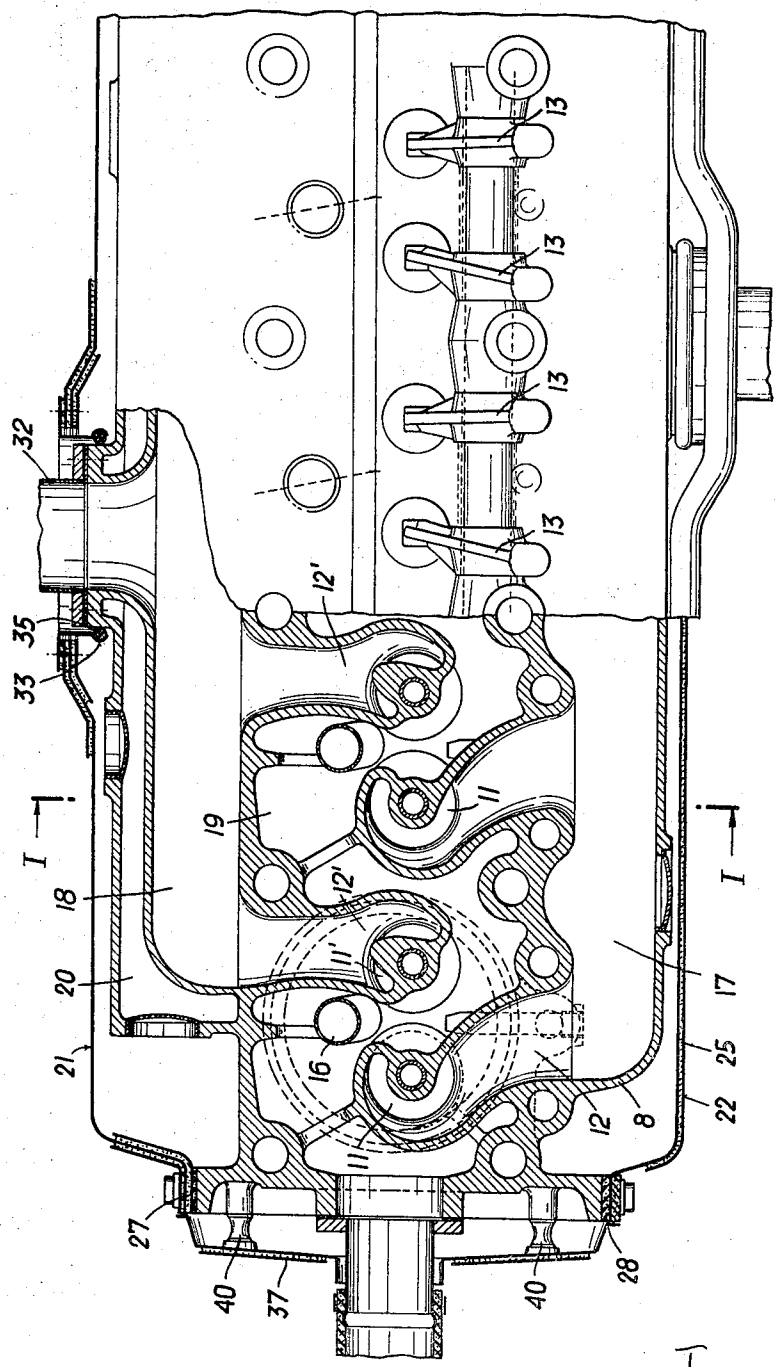

FIG. 3

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INTERNAL COMBUSTION ENGINE WITH SOUNDPROOFING COWLING

The general trend towards combating excessive noise produced by machines has also influenced the design of modern internal combustion engines to an ever greater degree. To this end a number of devices and arrangements have already been devised mainly for the purpose of decreasing sound radiation from the flat walls of the cylinder block. Apart from the conventional expedient of coating the outer surface of the crankcase with some sound-absorbing material, the usefulness of which is, however, highly problematic both in view of the fact that the coating is required to be heat resistant and oilproof to a considerable degree and because of the complicated process of applying such a coating, another known method of soundproofing internal combustion engines consists in designing the crankcase with large-size clearances and providing the latter with soundproofing covers.

However, the methods known so far provide for the soundproofing of the crankcase alone, more or less, so that the cylinder head and the intake and exhaust manifolds as well as the top of the cylinder head had to be taken care of by separate soundproofing devices to the detriment both of uniformity of design and construction and of efficiency, since the gaps involved allowed a certain amount of sound to be transmitted by air. Obviously, manufacturing costs are increased if a multitude of soundproofing devices are required and a large number of covering means make it difficult to achieve effective sealing.

It is therefore, the object of the present invention to provide an internal combustion engine featuring a self-contained, uniform soundproofing cowling avoiding the drawbacks of conventional devices. According to the invention, the cowling comprises two or more covers mounted on the side of the crankcase and possibly additional covers in the front and rear area of the engine, all of which extend as far as the upper edge of the cylinder head, being secured to the crankcase in such a manner as to provide isolation from sound conducted through solids, the said covers also surrounding the exhaust and intake manifold, as well as a cowling lid placed on top of the lateral covers in such a way as to provide isolation from sound conducted through solids and topping the rocker box, all of the said covers presenting at least one coating of soundproofing material. Thus sound radiation from the engine, for which not only the outer surface of the crankcase but also the intake and exhaust manifolds are largely responsible, is reduced to a considerable extent. A particular advantage of this arrangement resides in comparatively low material and labor costs in addition to the compactness of the extremely effective cowling. Another advantage is derived from the fact that the lid of the rocker box rests directly on the soundproofing cowling which is isolated from sound conducted through solids instead of being secured to the cylinder head proper as has been the case with conventional devices. This arrangement precludes any sound-conducting combination with combustion noises emerging from the cylinder head and mechanical noises produced by the valve gear. The rocker box lid extending beyond the exhaust and intake manifolds also prevents sound from being radiated from these pipes in an upward direction.

For greater convenience, the various sections of the cowling are designed as so-called sandwich metal sheets, that is, double-walled metal sheets with a soundproofing layer in between, the said metal sheets being preferably of a slightly arcuate design or otherwise reinforced such as by the provision of stiffening corrugations or otherwise in order to preclude natural vibrations of these sections of the cowling. Soundproofing packings made of rubber or any other flexible material, such as elastic plastics for example, can be used as shims inserted between sections of the cowling and the crankcase and/or the cylinder head for the purpose of providing isolation from sounds conducted through solids.

According to a preferred embodiment of the invention the exhaust and the intake manifolds are designed as conduits cast on to the cylinder head, a cooling pipe communicating with the cooling system extending between the exhaust manifold and the outer surface of the cylinder head adjoining the lateral cover. Thus the sound-radiating area is considerably reduced. This arrangement is particularly advisable in such cases where packing means made from materials which are sensitive to heat are used for the soundproofing cowling, since the special cooling of the exhaust manifold greatly reduces its heat radiation, thereby precluding premature wear of the packing means.

Further details of the invention will appear from the following description of an embodiment of the invention with reference to the accompanying drawing, wherein:

FIG. 1 shows a vertical cross-sectional view of an internal combustion engine according to the invention on line I–I of FIG. 3;

FIG. 2 is a longitudinal cross-sectional view on line II–II of FIG. 1; and

FIG. 3 is a horizontal cross-sectional view on line III–III of FIG. 2.

The crankcase **1** of the internal combustion engine rests with its lower connecting flange **2** with the interposition of an elastic packing **3** upon the upper connecting flange **4** of the crank chamber **5** and is connected with the latter in a soundproofing way by means of clamps **6** screwed to the underside of the connecting flange **2** gripping the flange **4** of the crank chamber **5** with the interposition of a packing **7** presenting an angular cross section.

The cylinder head **8** of the internal combustion engine is secured to the upper flange **9** of the cylinder block by means of clamping bolts (not shown) in a manner known per se, the underside of the cylinder head resting on the upper rim of the cylinder liners **10** inserted in the self-contained water space so as to secure same in an axial direction. Such members of the driving system as are not essential for the invention, such as pistons and connecting rod for example, are not shown in the drawing. The crankshaft is designated by reference number **36**.

Suspended in the cylinder head **8** of a watercooled engine of the four-stroke fuel injection type are the intake valves **11** and the exhaust valves **11'**, the inlet ports are designated by reference number **12** and the exhaust ports by number **12'**. The valves are actuated in a manner known per se via rocker arms **13** and pushrods **14** by means of the camshaft **15** laterally arranged inside the crankcase **1**. The fuel injection nozzle **16** is inserted in the cylinder head **8** in such a manner as to be slightly inclined in relation to a vertical line.

Both the intake manifold **17** and the exhaust manifold **18** of the internal combustion engine are designed as conduits cast on to the cylinder head **8**, the exhaust manifold **18** extending inside a cooling conduit **20** communicating with the cooling water chamber **19** of the cylinder head **8**, the said cooling conduit presenting a C-shaped cross section which is open in the direction of the center of the cylinder head.

The internal combustion engine is provided with a soundproofing cowling comprising two covers **21** and **22** secured to the sidewalls of the crankcase **1** and a lid **23** topping the rocker box **24**. Covers **21**, **22** and lid **23** are designed as so-called sandwich metal sheets, that is, double-walled metal sheets with a layer **25** of soundproofing material in between.

The two lateral covers **21** and **22** extend from the lower connecting flange **2** of the crankcase approximately as far as the upper edge of the cylinder head **8** and are secured to the crankcase **1** by means of bolts **26** of which only one is shown on the right side of the drawing, with the interposition of a soundproofing packing **27** and **28** respectively. The covers **21** and **22**, slightly arcuate in an outward direction both in the area of the sidewalls of the crankcase **1** and of the cylinder head **8** for the purpose of precluding natural vibrations, are warped outwardly C-fashion alongside their upper rim so as to produce flat flanges **29** and **30**. On these flanges the cowling lid **23** rests with the interposition of a grooves packing **31** consisting of a soundproofing material. The lid **23** is bolted only to the front and rear of the cylinder head **8** in a manner not shown. This bolting provides the necessary contact pressure

between the packing **31** and the flanges **29** and **30** of the two covers **21** and **22**.

Where the exhaust manifold **18** traverses the lateral cover **21**, which is also the place to which the exhaust pipe **32** of the engine is secured by means of a flange, the cover **21** presents an aperture with a retracted rim **33** (indicated by dash lines in FIG. 1). The passage of the exhaust manifold **18** is sealed by means of an O-ring **35** located in a peripheral corrugation of the rim **33**. The passage of the intake manifold **17** through the lateral cover **22** is of the same design.

Additional sheathing covers **37**, **38** and **39** are provided at the rear ends of the internal combustion engine and supported on the crankcase **1** by means of soundproofing supporting elements **40** attached to the crankcase in a similar manner as covers **21** and **22** by means of screws **41** with the interposition of elastic packings **42**.

As a result of the complete cowling of the crankcase **1** and cylinder head **8** including also the particularly noisy manifolds **17** and **18**, sound radiation from the outer walls of the internal combustion engine is considerably reduced. Likewise, the soundproofing connection, which is elastic within certain limits, between the crankcase **1** and the crank chamber **5** contributes towards the same effect. In the embodiment of the invention shown, the sidewalls of the crankcase are broken with the result that the sound-radiating area is further reduced. The openings in the sidewalls serve for the recirculation of the lubricating oil emerging from the camshaft and rocker arm shaft in the head.

A number of variants are possible within the scope of the present invention in addition to the embodiment of the invention hereabove described and illustrated in the accompanying drawing, both with regard to the designing, shape and attachment of the covers to the internal combustion engine. Likewise, auxiliary machines attached to the internal combustion engine can be accommodated inside the cowling.

We claim:

1. An internal combustion engine comprising a crankcase having perforated outer walls, a cylinder head secured to a top of the crankcase, an intake manifold provided on one side of the said cylinder head, an exhaust manifold located on the side of the cylinder head opposite the intake manifold, a chamber above the said cylinder head, a soundproofing cowling providing an oiltight outer shell for the engine and comprising at least two covers located on the side of the said crankcase in spaced relation to the said perforated outer walls and extending as far as the upper edge of the said cylinder head, the said covers also surrounding the said intake and exhaust manifolds and being secured to the said crankcase, soundproofing packing strips located between the said covers and their points of attachment to the said crankcase, a cowling lid on the said covers located on the side of the crankcase and topping the said chamber above the cylinder head, a soundproofing packing arranged between the cowling lid and the said covers located on the sides of the crankcase, and a coating of soundproofing material applied to the covers secured to the sides of the said crankcase as well as to the said cowling lid topping the chamber above the cylinder head.

2. An internal combustion engine according to claim **1**, comprising an additional cover secured to the rear and front face of the engine respectively, and likewise extending as far as the upper edge of the said cylinder head, the said additional covers being secured to the said crankcase, additional soundproofing packing strips provided between the said additional covers and their points of attachment to the said crankcase, and a coating of soundproofing material being applied to the said additional covers.

3. An internal combustion engine according to claim **1**, comprising a cast cylinder head, two ducts cast into the said cylinder head and extending alongside the two sides of the cylinder head, one of the said ducts forming the said intake manifold, the other duct forming a cooling water duct, and the said exhaust manifold being located in the said cooling water duct in spaced relation to the outer wall of the cylinder head adjacent to the said cover on the same side of the said crankcase.