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ENGINE CYLINDER CONSTRUCTION

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FIG. 1.

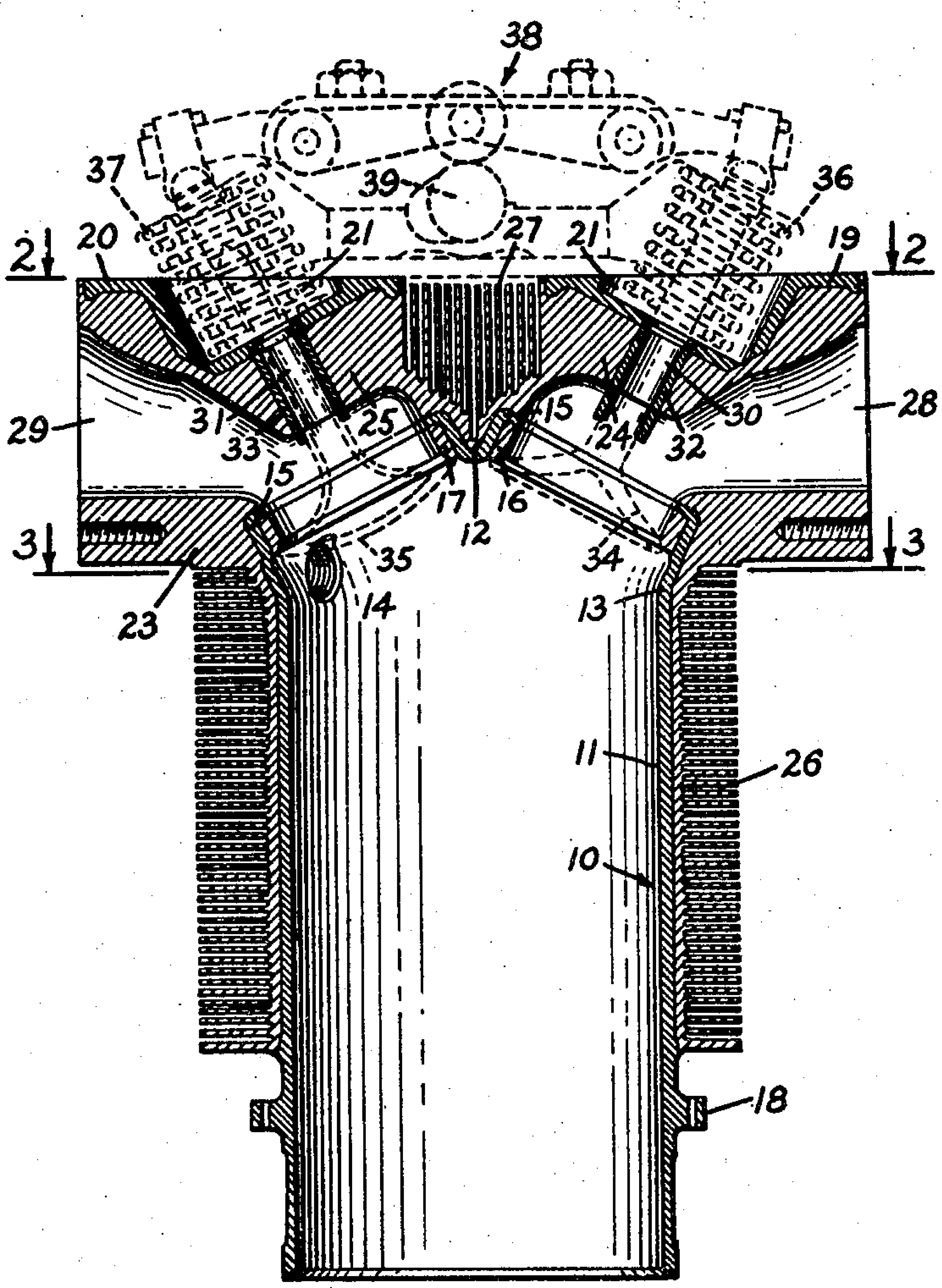

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FIG. 2.

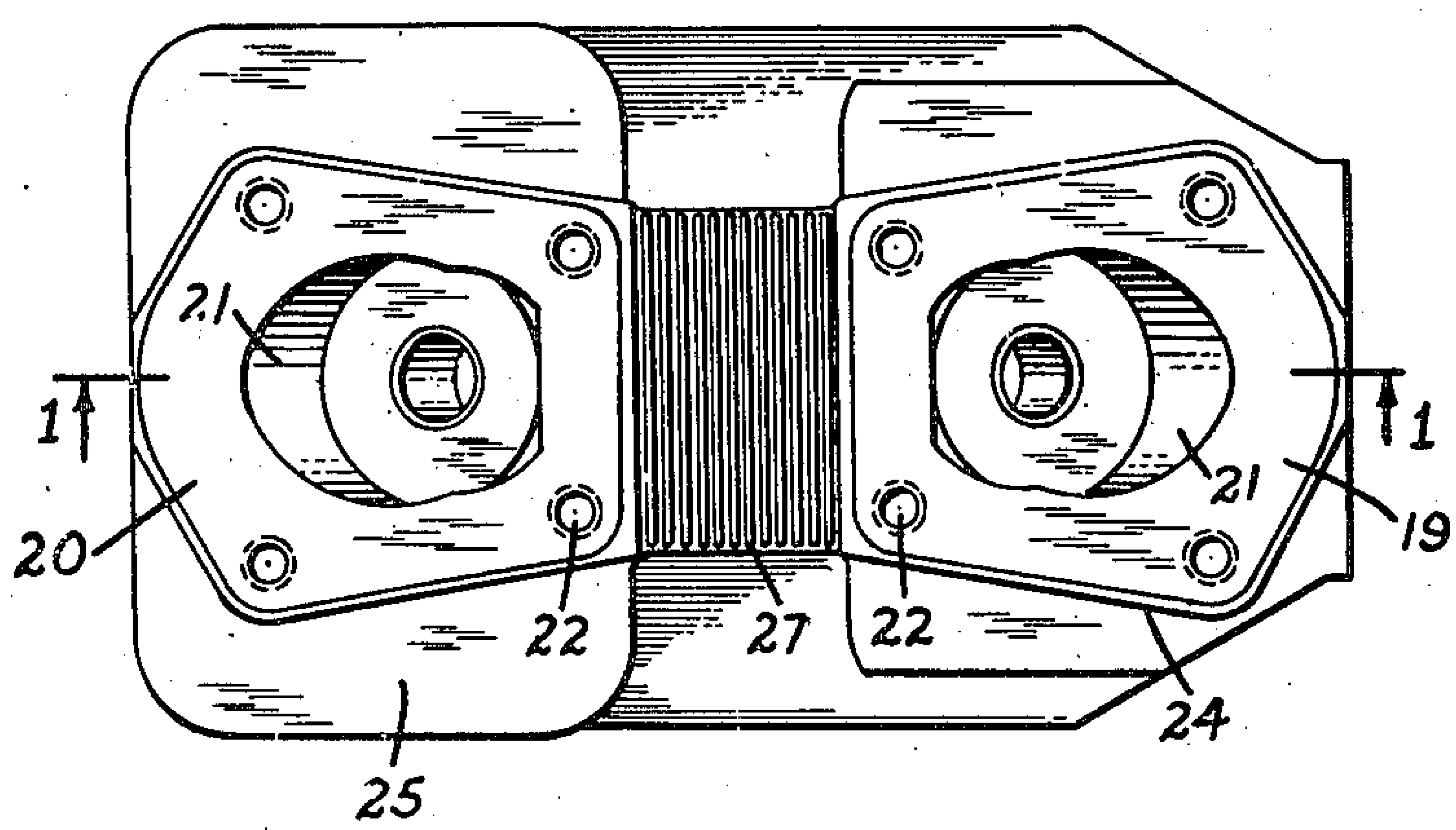
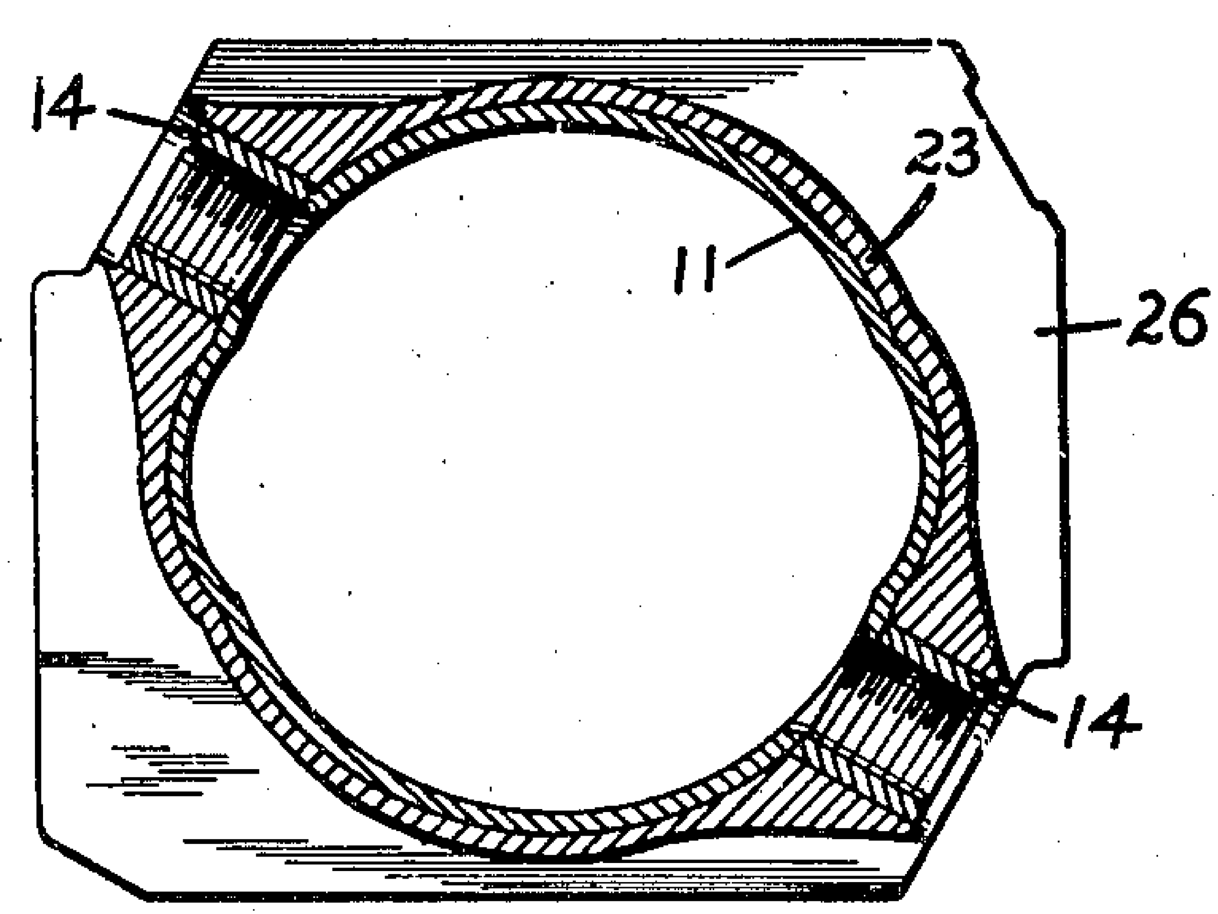


FIG. 3.



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ENGINE CYLINDER CONSTRUCTION

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5 Claims. (Cl. 123—193)

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This invention relates to cylinders having heat-radiating surfaces, and has particular reference to cylinders for air-cooled internal combustion engines, although the invention is not limited to that use.

Cylinders for air-cooled internal combustion engines are commonly constructed of two basic elements, a steel sleeve known as the cylinder barrel, and an aluminum head of forged or cast construction which is screwed and shrunk onto the cylinder barrel and sometimes is bolted to the cylinder barrel. Both the cylinder head and barrel are provided with external fins for dissipating heat, and in some cases the cylinder barrel is encased in a muff of metal of high heat conductivity, such as aluminum, in which the heat-dissipating fins are machined or otherwise provided.

There are many limitations to cylinders of the above type construction, such as the manner of attaching the head to the barrel, which is a limiting factor in the strength of the cylinder, because heavy wall thicknesses must be maintained in the aluminum head to provide adequate strength to grip the cylinder barrel. The sealing of the joint between the head and the barrel is an extremely important problem, in view of the high loads carried across the joint and the thermal distortions which take place under operating conditions. The joint, furthermore, provides a heat dam, obstructing the flow of heat from the inner cylinder wall surface to the cooling fins on the lower portions of the cylinder head. The above problems, while serious in a radial type air-cooled engine, become even more so for inline type engines where cylinder spacing is dependent to a considerable extent upon the space required for passing cooling air over the fins in the region between cylinders. The one-piece cylinder liner, including barrel and head, encased in a muff of aluminum, offers a partial solution to the cooling problem because thickened walls for joints are not needed and more intercylinder air space results, but in the case of overhead valve mechanisms, the considerable operating load thereof presents a problem because of the low physical strength of aluminum. Various expedients have been proposed in the effort to solve this problem, but they involve complicated and expensive load-transferring structures.

In accordance with the present invention, a unitary or one-piece cylinder liner encased in aluminum is provided which not only affords the adequate cooling air circulation between closely-spaced cylinders, but also provides adequate support for overhead load, so that the invention is applicable to overhead valve mechanism engines without requiring special load-transferring arrangements.

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The preferred embodiment of the invention consists of a one-piece or unitary steel cylinder liner encased in aluminum muff extending over the head of the liner so as to form an aluminum pad of substantial area, to which a steel deck plate is unitarily bonded and on which the overhead valve mechanism, including the cam housing, valve springs, and the like, is wholly supported and secured. Spark plug bushings and intake and exhaust duct liners may be secured directly to the cylinder liner and also encased in the aluminum, but in most instances duct liners will be found unnecessary with the construction of the present invention.

It will be seen that the aluminum muff not only affords high cooling efficiency, lightness, and enables closer cylinder spacing without limiting cooling air circulation, but it also minimizes distortion of the thinnest liner during temperature fluctuaton because of its low strength. Furthermore, notwithstanding the low strength of the aluminum, the novel construction of the muff nevertheless enables it to act as a medium to distribute and transfer the valve mechanism loads directly from the deck plate to the liner and thence to the crank-case or engine bed without the aid of special or separate load-transferring members.

For a more complete understanding of the invention, reference may be had to the accompanying drawings, in which:

Figure 1 is an axial section through an internal combustion engine cylinder embodying the present invention, as seen along line 1—1 of Fig. 2;

Fig. 2 is a plan view of the cylinder with the valve-operating mechanism removed, as seen along the line 2—2 of Fig. 1; and

Fig. 3 is a transverse section through the cylinder at the spark plug bushings, as seen along the line 3—3 of Fig. 1.

Referring to the drawing, numeral 10 designates a one-piece or unitary engine cylinder liner, preferably of steel having the proper strength requirements, and made either by joining a tubular cylinder barrel portion 11 to a dome-shaped head or cap 12 by welding at 13, or by forging, shaping, or machining the entire liner 10 from one poice of metal. Spark plug bosses or bushings 14 are attached to the cylinder liner 10 by welding, brazing, or the like. Similarly, valve seat pockets 15 are pressed or otherwise formed in the dome or cap 11, and valve seat inserts 16 and 17 are pressed, brazed, or otherwise securely fastened in position within the valve seat pockets 15. The lower end of the liner 10 may be provided with a mounting flange 18 whereby the entire cylinder may be secured to the crank-case of the engine.

Formed independently of the cylinder liner 10 are deck plates 19 and 20 having recesses 21, whose bases are arranged normally to the axes of the respective intake and exhaust valve seats 16 and 17. These deck plates 19 and 20 are made of high strength material, such as cast steel, and are tapped at 22 for cap bolts or other fastening means, this tapping being performed either before or after the deck plates are placed on the cylinder unit in the manner to be described.

The deck plates 19 and 20, and the cylinder liner 10 are spaced, and, at the same time, united permanently and rigidly together by a unitary casing 23 for the cylinder liner 10, which also includes the lateral extensions for intake and exhaust ports 28 and 29, these extensions also providing large area pads 24 and 25 lying between deck plates 19 and 20 and the dome or cap 12 of the liner 10 and constituting the support for the deck plates 19 and 20. The material of which muff or casing 23 and its integral pads 24 and 25 are formed is preferably commercially pure aluminum, but it may be an aluminum-base alloy of such composition as to substantially retain the high heat-conductivity and low weight of aluminum. Preferably the method of forming the aluminum casing 23 and bonding it to the steel cylinder liner 10 and deck plates 19 and 20 is that disclosed in Patent No. 2,396,730, issued March 19, 1946, to Whitfield and Sheshunoff. Preferably commercially pure aluminum is employed, notwithstanding its low physical strength, which is compensated by the present invention so that it constitutes the major load-carrying element of the structure, as will be described. Also, the low strength commercially pure aluminum has the advantage that it minimizes distortion of the cylinder liner 10 during thermal expansion and contraction, thus enabling a thin, high strength liner 10 to be used. The casing 23 thereby affords substantially all of the support for the mechanism carried by the deck plates 19 and 20, as will be described. This aluminum casing 23 is bonded to the cylinder liner 10 so that no heat dam exists between the aluminum and the steel to retard heat conduction from the interior of the liner 10 to the cylinder fins. Also, the deck plates 19 and 20 are bonded to the aluminum casing 23 in the same way.

Thin heat conducting fins are either formed in the aluminum during casting of the casing 23, or are machined therein after casting. Preferably such fins are perpendicular to the cylinder axis, as indicated at 26, except for those that lie between the deck plates 19 and 20, which are axial, as indicated at 27.

In casting the casing 23 and pads 24 and 25 of aluminum around the cylinder liner 10 and between it and the deck plates 19 and 20, the aforementioned intake and exhaust ports 28 and 29, respectively, are formed by a coring operation or by liners of thin preferably heat-resisting sheet metal, not shown, but conforming to known constructions. Holes 30 and 31 may be cored or bored and reamed through the corresponding pads 24 and 25 in axial alignment with the corresponding valve seats 16 and 17, respectively,

for receiving the corresponding valve stem guides or bushings 32 and 33, respectively, which may be pressed, shrunk, or otherwise securely fitted in place.

Slidable axially in these valve guide bushings 32 and 33 are the intake and exhaust valves 34 and 35, respectively, whose corresponding valve springs 36 and 37 directly engage the recessed surfaces 21 of deck plates 19 and 20, and whose rocker arms and corresponding cam mechanisms are bolted or otherwise secured directly on the deck plates 19 and 20 by cap screws threaded into the tapped holes 22. The construction of the valve-operating mechanism, generally designated 38 in Fig. 1, is conventional and forms no part of the present invention, it being sufficient to illustrate one common form of such mechanism to show how it is mounted directly on the deck plates 19 and 20. It will be understood that in case of inline engines, a row or bank of such cylinders is mounted on a crank-case and that the valve-operating mechanism 38 is actuated by a common cam shaft 39 which extends along the heads of the row of cylinders. Also that a cam box preferably encloses the valve-operating mechanism and, being of conventional construction, need not be shown.

The cylinder of this invention, particularly when applied to internal combustion engines in the manner described, enables close spacing of the cylinders and deeper fins, without restricting circulation of cooling air between the cylinders, because the head is not enlarged transversely to compensate for thickened walls normally required to carry the loads or occasioned by screw threads joining the cylinder barrel and head. Also, ample cooling space is provided between the pads 24 and 25 and their corresponding deck plates 19 and 20, this space being filled with the axial fins 27, as shown.

The large area surface of the deck plates 19 and 20 resting on commensurately large mass of the aluminum casing 23, including the pads 24 and 25, reduces the unit load from the valve-operating mechanism on the casing 23, so that the latter, although of low strength material, is nevertheless capable of sustaining the load which is re-distributed over the surface area of the liner 10 through the strong chemical bond between the alumnium and steel, so that the unit load on the liner 10 is relatively small. Hence, the liner 10 need not be made thick and heavy, but is required merely to be formed of sufficiently high strength material to withstand internal combustion gas pressures and piston side loads to which it is subjected in use. For example, the cylinder liner 10 may be made of very high strength material to resist such gas pressures within the cylinder, and may be made comparatively thin and light, being backed by the aluminum mass afforded by the casing 23.

In this way, lightness of construction and compactness are obtained by reason of the division of the cam-shaft loads and internal cylinder pressures between the casing 23, as a whole, and the liner 10. It is understood that the deck plates 19 and 20 are likewise of high strength material, so as to resist bending and distortion, with the aid of the aluminum pads 24 and 25 which serve as a backing for the deck plates 19 and 20, as well as distribution of the load from the deck plates over a large area. Particularly in inline types of engines, wherein a row of cylinders is attached to a common valve gear housing, the deck plates 19 and 20 prevent or reduce wear between the valve gear housing and the cylinder heads engaging the same.

Although the cylinder liner 10 is preferably made of high strength steel, the barrel portion 11, where the barrel and head or cap are welded together, may be made of different material having greater wearing properties for cooperation with the piston. Likewise, the spark plug bosses or bushings 14 may be of material suitable for that purpose, preferably material of high corrosion resistance, such as steels containing chromium and the like. Such bosses or bushings 14 need not be heavy because of the backing afforded by the aluminum casing 23, which is also bonded to the exterior surfaces of the bosses or bushings 14, according to the aforementioned process. Likewise, where liners are used for intake and exhaust ports 28 and 29, they may be of thin heat-resisting material, such as sheet metal, as they are supported by the aluminum casing 23, which is bonded to them.

Although a preferred embodiment of the invention has been illustrated and described herein, it is to be understood that it is not limited to internal combustion engine cylinders but is equally applicable to pump cylinders and the like, and is otherwise susceptible to changes in form and detail within the scope of the appended claims.

I claim:

1. A cylinder for the overhead valve type of internal combustion engine and the like, comprising a barrel and head liner of ferrous metal having high structural strength, a casing for said barrel and head liner of light weight metal integrally secured thereto and having a structural strength less than the ferrous metal of said liner, lateral extensions on that portion of said casing overlying the head of said liner and forming a platform substantially normal to the axis of said cylinder and having an area substantially greater than the cross-sectional area of said casing around the barrel of said liner, and a platform integrally united with the casing metal of said extensions for mounting the operating mechanism for said overhead valves on said casing, whereby the operating load of said valve mechanism is transmitted from said platform solely through said casing to said liner.

2. A cylinder for the overhead valve type of internal combustion engine and the like, comprising a barrel and head liner of ferrous metal having high structural strength, a boss for a spark plug projecting from said liner, a casing for said barrel and head liner of light weight metal integrally secured thereto and having a structural strength less than the ferrous metal of said liner, lateral extensions on that portion of said casing overlying the head of said liner and forming an area substantially greater than the cross-sectional area of said casing around the barrel of said liner, a platform on said extended portion of said casing, and means for mounting the operating mechanism for said overhead valves on said platform, whereby the operating load of said valve mechanism is transmitted from said platform solely through said casing to said liner.

3. A cylinder for the overhead valve type of internal combustion engine and the like, the combination of a unitary thin-wall barrel and head liner of ferrous metal and having insufficient structural strength to withstand full operating loads without external support, a massive casing for said barrel and head liner of light weight metal integrally secured thereto and serving as a coextensive support therefor, and supporting means integrally united with said casing metal for mounting the overhead valve-operating mechanism on that portion of said casing overlying the head of said liner, said casing being the sole load transferring means between said liner and supporting means whereby the operating load of said valve mechanism is distributed solely through said casing over a substantial area of said liner covered by said casing.

4. A cylinder for the overhead valve type of internal combustion engine and the like, the combination of a unitary thin-walled barrel and head liner of ferrous metal and having insufficient structural strength to withstand full operating loads without external support, a massive casing for said barrel and head liner of aluminum base metal integrally secured thereto and serving as a coextensive support therefor, and a platform integrally secured to that portion of said casing overlying the head of said liner for mounting valve operating means, whereby the operating load of said valve mechanism is distributed from said platform solely through said casing to and over a substantial area of said liner covered by said casing.

5. A cylinder for the overhead valve type of internal combustion engine and the like, the combination of a unitary thin-walled barrel and head liner of ferrous metal and having insufficient structural strength to withstand full operating loads without external support, a massive casing for said barrel and head liner of light weight metal integrally secured thereto and serving as a coextensive support therefor, an outwardly flaring extension on that portion of said casing overlying the head portion of said liner, a platform secured to said extension and lying substantially normal to the axis of said cylinder, and means on said platform for mounting the overhead valve-operating mechanism, whereby the operating load of said valve mechanism is distributed by said platform solely through said casing to and over a substantial area of said liner covered by said casing.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,741,678	Brewer	Dec. 31, 1929
2,227,933	Hersey	Jan. 7, 1941