July 16, 1929. J. O. ALMEN 1,721,197

METHOD OF MAKING CYLINDERS

Filed Feb. 24, 1925

Fig. 1

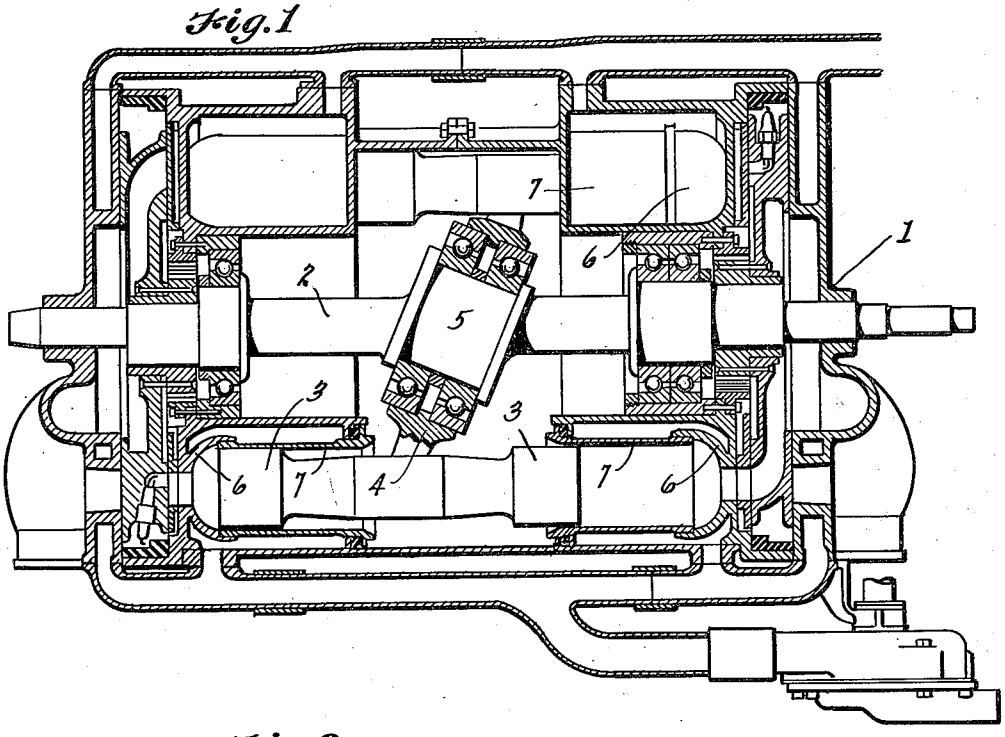
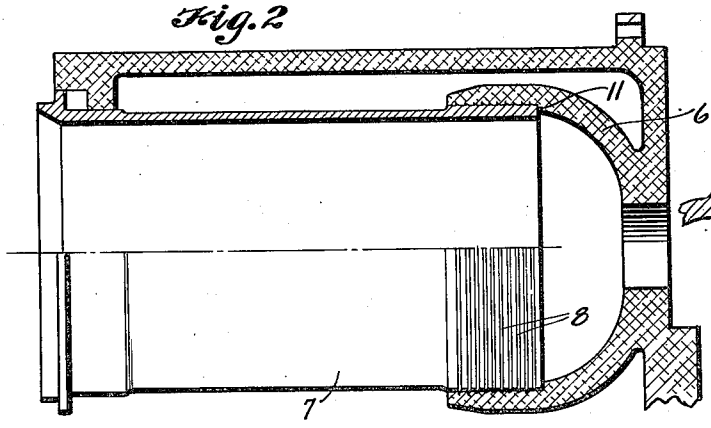


Fig. 2



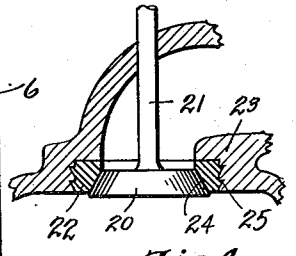
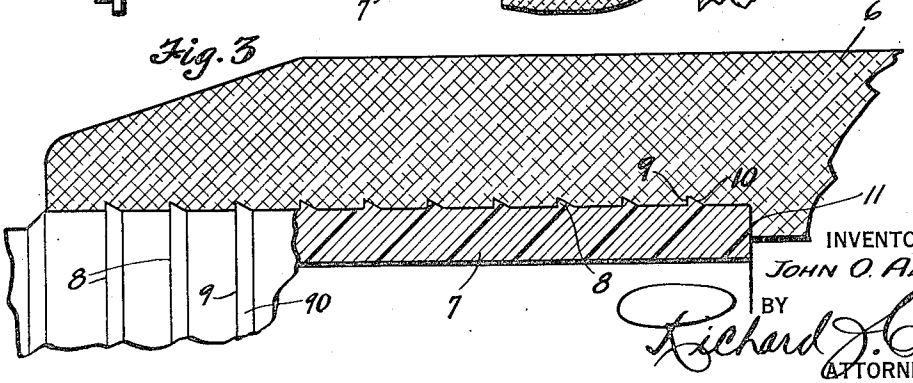


Fig. 4

Fig. 3



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UNITED STATES PATENT OFFICE.

JOHN O. ALMEN, OF SEATTLE, WASHINGTON.

METHOD OF MAKING CYLINDERS.

Application filed February 24, 1925. Serial No. 11,123.

My invention relates to improvements in internal combustion engines and particularly to the construction and mode of assembly of cylinders and cylinder heads for use in internal combustion engines.

In the construction of engines of the internal combustion type it is generally desirable that they be made as light in weight as is possible without impairing the durability and efficiency. Furthermore it has been found practical to construct the body of the engines and the cylinder heads of aluminum, since this metal meets the above requirements and at the same time is all the more desirable on account of the property of aluminum to quickly absorb and to radiate the heat incidental to explosions of fuel charges within the cylinder. It is not desirable, however, that the cylinder walls be made of this particular metal since, for one reason, it is not as capable as steel in resisting wear caused by the operation of pistons therein.

In view of the above, it has been the object of the present invention to provide a method of assembling and securing together certain engine parts, particularly the cylinders and cylinder heads of internal combustion engines wherein the former are constructed of a relatively hard and durable metal such as steel and the latter are of a lighter metal with a greater co-efficient of expansion and of radiation, such as aluminum.

Specifically stated, the invention resides in the details of construction of the parts and in the means for and method of connecting the steel cylinder sleeves to the aluminum heads.

Another object resides in the details of construction which provides for an easy replacement of parts.

In accomplishing these and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Figure 1 is a central, longitudinal section of an internal combustion engine wherein the cylinder walls and cylinder heads are constructed and joined together in accordance with the present invention.

Figure 2 is an enlarged sectional view of one of the cylinder heads and its attached cylinder sleeve.

Figure 3 is an enlarged view showing in cross section an end portion of the cylinder sleeve and the joint between it and the aluminum head, particularly illustrating the locking lands on the cylinder sleeve.

Figure 4 is a sectional detail view illustrating the same method and details of construction as applied in the mounting or assembly of valve seats.

Referring more in detail to the drawings—

1 designates, in its entirety, an engine wherein the cylinder sleeves and heads are constructed and joined together in accordance with the present invention. In this particular type of engine the drive shaft 2 is rotatably mounted in parallel relation to the axial line of the cylinders which are arranged circularly about it, and the pistons 3 are connected to the shaft through the intermediacy of a swash plate, or the like, as designated at 4, and which is revolubly mounted on a journal 5 formed on the shaft at an angle that is oblique with respect to its axial line.

In this construction the body portion of the engine and the cylinder heads 6 are cast from aluminum and the cylinder sleeves 7 are of steel. In preparing these parts for assembly the aluminum heads 6 are bored smooth about their interior surface, and the end of the steel sleeve 7 that is to be applied therein, is turned down smooth, except for a plurality of encircling, spaced apart lands 8 that are left sharp on their outer or peripheral edges and which have perpendicular surfaces 9 faced away from the head and inclined surfaces 10 directed toward the head. The inside diameter of the head is lesser than the diameter of the end of the sleeve that is to be applied thereto when these parts are at the same degree of temperature and before assembling.

In assembling these parts, the portion of the sleeve provided with the lands 8 is first painted with castor oil which serves to better seal the joint to be made. The aluminum head is then heated to about 700 to 750 degrees Fahrenheit, so that it is sufficiently expanded thereby to allow the sleeve at normal temperature to be dropped into the

bore provided. The inner end of the sleeve is seated squarely against a shoulder 11 formed at the base of the bore within the head, and the aluminum is then allowed to cool in air.

In the cooling process the aluminum contracts and tightens with such force against the sleeve that the lands 8 are completely embedded and the joint made perfectly tight. During operation of the engine the head does not heat to a degree much above 212 degrees Fahrenheit for the reason that it is jacketed and water cooled and at this degree it does not expand sufficiently to loosen the joint.

This method of assembling provides an absolutely tight and non-leaking joint which is superior to a threaded connection for the reason that the latter can not be made gas tight. The parts are easily assembled and may be disassembled if such should be desired to become necessary by applying heat to the head sufficient to expand it to the diameter that will permit the sleeve to be withdrawn. This provides for quick and easy replacement of worn or damaged sleeves.

In Figure 4, I have illustrated the same methods of construction and application as applied to the assembly of valve parts. In this figure, 20 designates a valve head on a stem 21, and 22 a steel ring that is set into a manifold or housing 23 and provided with a seat 24 against which the valve operates. The ring 22 may be of steel and is provided with encircling lands 25 and the housing may be of aluminum. In the assembly of these parts, the housing is heated as was previously described in connection with the cylinder assembly and then the ring is dropped in place and the housing allowed to cool and to shrink onto the ring.

While I have illustrated the cylinder assembly in a certain type of engine, it is to be understood that it is not to be confined only to this type, but also is practical and can be satisfactorily used in various types of gas engines such as are used in automobiles, airplanes or for stationary work.

Having thus described my invention, what I claim as new therein and desire to secure by Letters-Patent, is:

In the manufacture of engines of the class described, the method of making and assembling cylinder sleeves and heads which consists of turning down the ends of the sleeves with a plurality of encircling lands, boring the heads to diameters slightly less than the outside diameters of the turned-down ends of the sleeves and forming annular shoulders therein, expanding the heads by the application of heat to diameters sufficient to receive the turned ends of the sleeve, inserting the turn-down ends of the sleeves in said bores and against the shoulders therein, and then allowing the heads to cool and tighten by contraction about the sleeve ends so that the lands are imbedded in the metal of the head.

Signed at Seattle, King County, Washington, this 16th day of May, 1924.

JOHN O. ALMEN.