

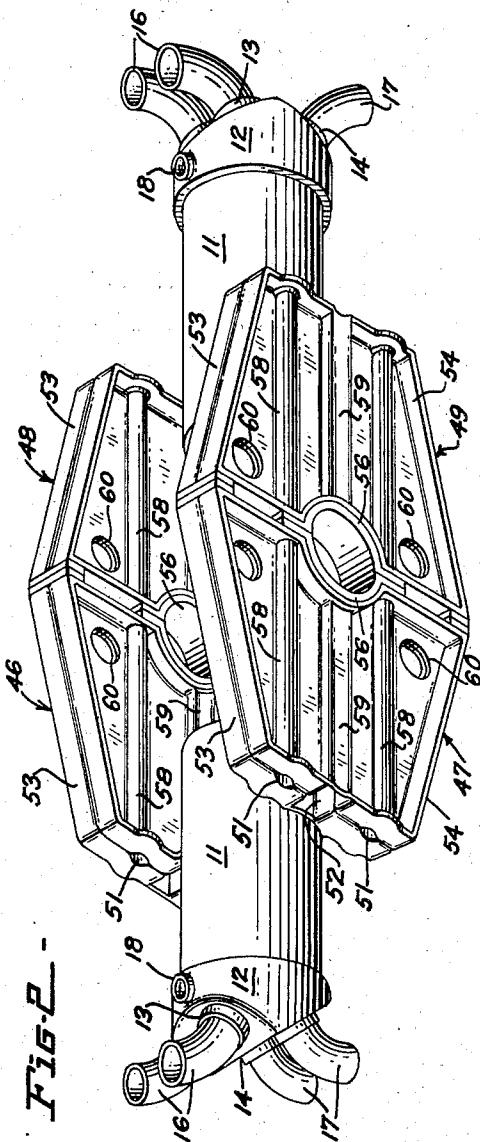
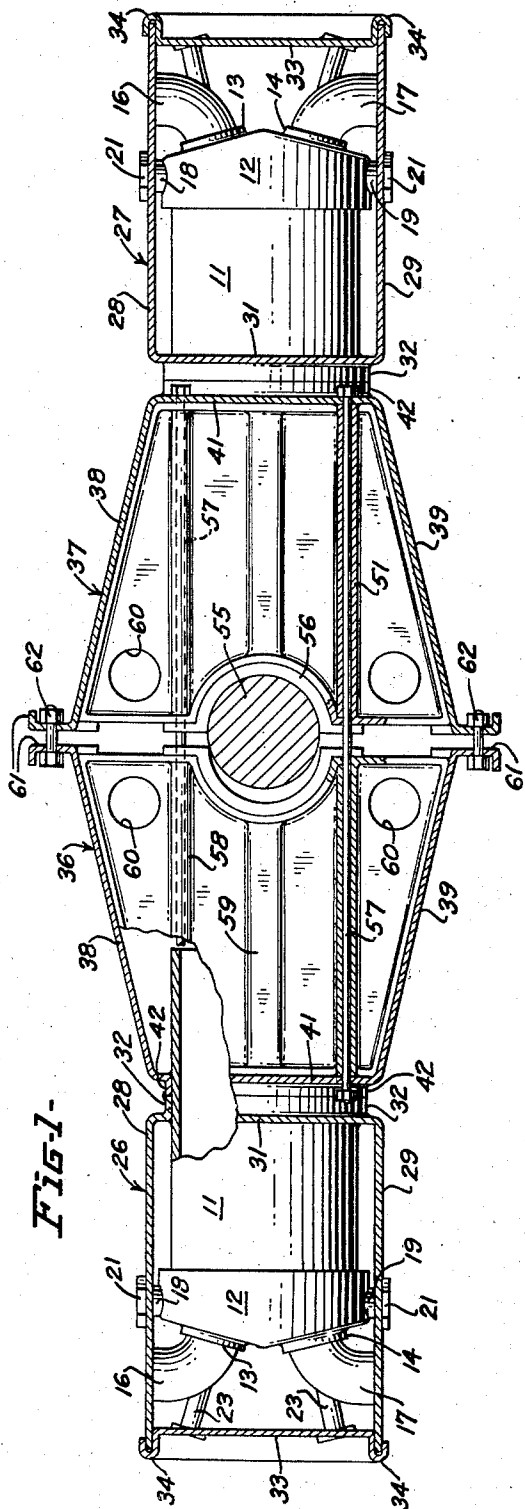
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L. M. TAYLOR

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LIGHT WEIGHT ENGINE

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INVENTOR.
LLOYD M. TAYLOR
BY *Arlington C. White*
ATTORNEY.

UNITED STATES PATENT OFFICE

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LIGHTWEIGHT ENGINE

Lloyd M. Taylor, San Leandro, Calif., assignor,
by direct and mesne assignments, to Taylor
Engines, Inc., Oakland, Calif., a corporation
of Nevada

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2 Claims. (Cl. 123—56)

The invention, in general, relates to the construction of internal combustion engines and, more particularly, relates to a fabricated sheet metal engine of great rigidity and strength which effectively takes care of the internal load and stresses set up, the construction enabling the elimination of relatively heavy castings throughout.

This application is a continuation in part of my co-pending application, Serial No. 139,114, filed April 27, 1937, and entitled, "Internal combustion engine," wherein I have depicted and claimed a fabricated engine embodying a united internal structure consisting of a cylinder head, a cylinder sleeve and reinforcing webs carrying crankshaft bearings for taking care of the internal stresses set up by the explosion of the combustible charge introduced into the cylinder. The invention disclosed in the aforesaid co-pending application is embodied, as shown, in an engine having a plurality of separate cylinders arranged in a straight line, all encased in a sheet metal casing. The present improvement is primarily directed to an opposed cylinder engine and while the accompanying drawings and the following description allude to sets of opposed, in line cylinders with the axes of the cylinders in each set horizontally aligned, the improvement is entirely suitable for adaptation in an engine of either the so-called V-mounting or an engine in which the sets of opposed cylinders are arranged with their axes in vertical alignment. It may be observed also that while I have designed the present embodiment primarily for aircraft, the invention is equally suitable for application to stationary, automotive or marine uses.

A primary object of the present improvement, as in the case of the invention set forth in my aforesaid co-pending application, is to provide a rugged, light weight engine especially suitable for aircraft having no heavy castings and in which the internal stresses are taken care of through a united series of structures consisting of the cylinder heads, the cylinder sleeves, reinforcing webs on the skirts of the cylinders, and crankshaft bearings carried by the webs.

Another object of my improvement is to provide an engine of the opposed cylinder type in which but one crankshaft is required and in which the lower half of the crankshaft is entirely eliminated.

A still further object of the present invention is to provide a compact, strong engine of the opposed cylinder type wherein the cylinder heads of the opposed cylinders are directly tied together through the opposed cylinders and reinforcing webs thus eliminating the conventional heavy casting for uniting the heads and permitting the use of a light weight, sheet metal

casing functioning in the main to carry the cooling medium and lubricating oil but practically none of the stresses.

Another object of the present improvement is to provide an improved light weight engine of the aforementioned character which is additionally characterized by its more rigid bearings for withstanding impacts from explosions normally transmitted to the crankshaft.

A still further object of my invention is to provide a relatively inexpensive fabricated engine of light weight yet sufficiently rigid and strong to withstand relatively heavy duty in all applications.

The foregoing and other objects are attained in the preferred embodiment of the present improvement which is illustrated in the accompanying drawing. While the showings depict the preferred embodiment, it is to be understood that the invention can be exemplified in a plurality and variety of forms and it is to be understood that I am not to be limited to the precise embodiment shown nor to the precise arrangement of parts depicted.

Referring to the drawing:

Figure 1 is an end elevational view, partly in section, of a preferred embodiment of the invention, this view showing portions pulled apart to illustrate the mode of assembly, and being broken away to illustrate the interior connections.

Figure 2 is a perspective view of one portion of the preferred embodiment of the invention, with valve guides omitted.

In its preferred form, the light weight engine of my present improvement preferably comprises a plurality of pairs of cylinders; the cylinders of each of said pairs being arranged in opposed, spaced relationship, a cylinder head on one end of each of said cylinders, a pair of reinforcing webs united to opposite sides of the skirts of each of said cylinders; the webs on each side of each pair of said opposed cylinders being in alignment, means for rigidly connecting said webs together on each side of each pair of said opposed cylinders, a half-bearing on each of side webs; said half-bearings defining complete crankshaft bearings with respect to aligned, connected webs on each side of said cylinders, together with a sheet metal casing for the engine including a pair of tanks for the reception of a cooling medium; each of said tanks being united to said cylinders adjacent said heads, and a pair of crank-cases; each of said crank-cases being united to said cylinders and to said tanks and also being united to said reinforcing webs.

As particularly illustrated in Figure 1 of the accompanying drawing depicting an end sectional elevation of the preferred embodiment of

the present improvement, the opposed cylinders are mounted with their axes in horizontal alignment, and it is to be observed that either a two, four, six or twelve cylinder engine may be fabricated in accordance with this improvement or, in fact, any number of pairs of cylinders can be employed. As shown, each cylinder comprises a sleeve 11 of drawn metal tubing which is preferably formed from a steel alloy, such as an alloy of chromium and molybdenum, having great strength but of relatively light weight. Each of the cylinder sleeves 11 is provided with a head 12 which preferably is formed by welding together complementary halves stamped from a relatively strong metal, such as steel or so-called k-Monel metal, and which includes suitable apertured bosses 13 and 14, either singly or in pairs and spaced apart as shown, for the reception of conduits in the form of elbows 16 and 17 which serve to conduct intake and exhaust gas to and from the cylinders. The sides of each of the heads 12 are conveniently provided with threaded, apertured bosses 18 and 19 for receiving and supporting suitable spark plug bushings 21, the bosses being in pairs for the reason that dual ignition is contemplated in the embodiment of the invention depicted. All heads 12 are temporarily united by means of spot welding to a corresponding cylinder sleeve 11. Each of the elbows 16 and 17 is provided with a valve seat, not shown, which is faced with a hard facing metal, such as stellite, and the elbows are fitted to and temporarily spot welded to the bosses 13 and 14 of the heads. Moreover, each elbow is provided with, preferably integrally, a valve guide 23 which are so arranged on the elbows as to be axially aligned with the valve seat of the corresponding elbow. It is to be understood that the predetermined number of pairs of cylinder sleeves 11, together with the above described heads spot welded thereto, are conveniently assembled and aligned on any suitable jig.

In accordance with the present invention, I provide a pair of tanks or water jackets 26 and 27 for the reception of a suitable cooling medium which, in aircraft adaptations of the engine, is preferably ethylene glycol. Each of the tanks 26 and 27 preferably is formed from relatively thin, light weight material of great strength, such as from k-Monel metal or from a steel alloy of chromium and molybdenum, and extends longitudinally of the engine. As shown, each tank is disposed adjacent to the head ends of the cylinders and includes a pair of sides 28 and 29 having suitable openings therein for passing the spark plug bushings 21 as well as for passing the elbows 16 and 17. Moreover, the bottoms 31 of each of the water jackets 26 and 27 are formed with relatively large openings at spaced intervals for passing the cylinder sleeves 11, the edges of each of the latter openings being turned back to provide annular flanges 32 which afford appreciable welding surfaces for uniting the tanks to the outer surfaces of the cylinder sleeves. The engine of the present embodiment also includes cover plates 33 which also are fabricated from the same material as the tanks 26 and 27 and which are formed with turned-over flanges or locking seams 34 on each lateral extremity thereof for effecting interlocking engagement with the sides 28 and 29 of the water jackets 26 and 27. It is clear from the showing of Figure 1 that the jackets and cover plates constitute portions of the en-

gine casing, per se. Moreover, it is clear that these jackets form hermetically sealed compartments and while I have specified that a liquid cooling medium can be contained therein, it is clear that by virtue of such hermetically sealed compartments a refrigerating unit can be utilized with either liquid or gas as the refrigerant for maintaining the desired temperature values around the heads. In addition to the foregoing portions, the engine casing includes a pair of crankcases 36 and 37 each of which includes tapering sides 38 and 39 joined by a bottom 41, the crankcases serving, of course, to receive a suitable engine lubricating oil. The bottoms 41 of each crank-case are formed with relatively large openings therein at spaced intervals, for passing cylinder sleeves, which are in alignment with the openings in the bottoms of the water jackets; the edges of these openings in bottoms 41 of the crank-cases likewise being turned outwardly to provide annular flanges 42 of appreciable welding surfaces to which the cylinder sleeves are united. The annular flanges 32 of the water jackets 26 and 27 abut and are welded to the annular flanges 42 of the crank-cases 36 and 37, as clearly illustrated in Figure 1 of the drawing.

In accordance with my improvement, I provide means in the engine for effectively taking care of internal loads and stresses set up by the explosion of combustible charges in the cylinders, as well as for affording rigid crankshaft bearings for handling impacts from such explosions. These means preferably comprise sets of reinforcing webs 46, 47, 48 and 49 which extend transversely of the engine and which not only are united to the cylinder sleeves 11 but also are united to the inner surfaces of the sides 38 and 39 of the crank-cases 36 and 37. Reference, in this connection, is made to Figure 2 of the drawing wherein is depicted, in perspective, one pair of opposed cylinders provided with heads 12 of the character described, valve guides being omitted, together with the sets of reinforcing webs, thereby affording a united integral internal structure which may be termed the internal hook-up of the engine. Each of the reinforcing webs preferably comprises complementary halves stamped from relatively strong, light weight sheet metal and welded together to provide a structure having a pair of channels 51 therein on each side of a central channel 52, all channels being lined with copper wire, not shown, for purposes of permanent uniting of parts preferably in a suitable hydrogen-copper brazing furnace. Each reinforcing web is formed with a relatively flat surface at its outer end, and a pair of tapering sides 53 and 54 which conform to the taper of the sides 38 and 39 of the crank-cases; the webs each carrying half crankshaft bearings 56 at their inner ends. Two reinforcing webs 46 and 47 of each set are united to opposite sides of the skirt of one cylinder sleeve 11 of a set of opposed cylinders, and the remaining reinforcing webs 48 and 49 of each set are united to opposite sides of the skirt of the other cylinder sleeve 11 of the opposed cylinders thereby providing two webs 46 and 48 on one side of the opposed cylinders and two webs 47 and 49 on the other side of the opposed cylinders of each set or pair of cylinders.

In Figure 1 of the drawing, two of the webs on one side of opposed cylinders are depicted prior to connecting the same together and prior to permanently uniting the same to the cylinders,

Upon bringing the webs together, the half crankshaft bearings define a complete crankshaft bearing, as shown in Figure 2, for rotatably mounting of a single crankshaft 55 for the engine, and I preferably join the two webs on each side of each cylinder together by means of screw bolts 57 which are passed through the aligned channels 51 of the two webs. In order to provide webs of increased strength, the same are ribbed as at 58 and 59, and to lighten the weight thereof, openings 60 may be formed therein. It is to be appreciated that the ribs 59 of the webs are arcuately formed on their outer surfaces and serve as welding surfaces for uniting the webs directly to the skirts of the cylinders. It also is to be appreciated that in embodiments of the engine having a plurality of pairs of opposed cylinders, one pair of webs 46 and 48 not only are united to one set of opposed cylinders on one side thereof but also are united to an adjacent set of opposed cylinders. Thus, the engine fabricated in accordance with my invention includes united internal structures or hook-ups end to end, the united structures including in each case the cylinder heads of each set of opposed cylinders, the cylinder sleeves of such set, together with the reinforcing webs on each side of the skirts of the opposed cylinders. Moreover, each integrally united structure is tied to an adjacent structure of similar elements so that the engine is tied together end to end. Furthermore, I provide for the uniting of the sides 53 and 54 of all of the webs with the sides 38 and 39 of the two crank-cases and to this end coat the sides of the webs and the crank-cases with a suitable copper paste enabling the permanent uniting of these parts together when the engine, as so assembled, is treated in a suitable hydrogen-copper brazing furnace. Moreover, the ends of the reinforcing webs adjacent the bottoms 41 of the crank-cases are similarly coated with copper paste for effectively uniting the cases to the webs at such points. The crank-cases 36 and 37 are provided with apertured flanges 61 extending from each side thereof and the cases 36 and 37 connected together at these flanges by suitable screw bolts 62, thus providing an oil tight case.

The engine of my present improvement not only is relatively inexpensive to manufacture but also relatively easy to fabricate and assemble. It is contemplated, as above indicated, that the assembled and temporarily united engine be disposed in a hydrogen-copper brazing furnace in order permanently to unite the combination of non-moving parts of the engine hereinabove described. Accordingly, suitable copper rings are connected at the joints between certain elements, wherever practicable. Similarly, copper wires are threaded through certain other elements wherever desirable or practicable, and in many instances where neither rings or lengths of copper wire can properly be placed, the parts are coated with copper paste, thus to prepare the parts in their entirety for the furnace. It is appreciated that the two crank-cases 36 and 37 can be applied as final elements of the fabricated engine, or that these portions of the engine casing can be mounted prior to mounting and temporarily uniting the water jackets 26 and 27 which may be the final assembling step. Because of the internal united structures that take care of the

internal stresses and loads, the engine casing, per se, carries little of the stresses and thus considerable saving in engine weight is afforded without sacrificing strength or rigidity.

Prior to the permanent uniting of the cover plates 33, the crankshaft, connecting rods, pistons, valves, cam shafts and other valve actuating mechanism are assembled. Moreover, the conventional lubricating oil connections including necessary stand-pipes, circulating pipe and conduits are installed. Upon completing the assembly of these parts and uniting of cover plates 33 to the water jackets, cooling radiators may be fitted at desired portions of the casing, and the engine is heat treated in the usual manner for hardening the cylinders for wear and increased strength and the conventional minor work is carried out to provide the necessary tolerances.

It is to be understood that the appended claims are to be accorded a range of equivalents commensurate in scope with the advance made over the prior art.

I claim:

1. A light weight engine comprising a pair of cylinders of drawn metal tubing mounted in opposed, spaced relationship with their axes in horizontal alignment, a pair of reinforcing webs united to opposite sides of the skirts of each of said cylinders; said webs on each side of said opposed cylinders being in alignment, a half-bearing on the inner end of each web, means for rigidly connecting said webs together on each side of said opposed cylinders to bring said half-bearings in registry and defining thereby complete crankshaft bearings on each side of said opposed cylinders, and a casing for the engine including a pair of tanks and a pair of crank-cases; each of said tanks including a bottom having an opening therein for passing said cylinders, and each of said crank-cases including a bottom having an opening therein in registry with the openings in the bottoms of said tanks; the edges of all of said openings being turned back to provide flanges to which said cylinders are united.

2. A light weight internal combustion engine comprising a pair of cylinders of drawn metal tubing mounted in opposed, spaced relationship, a pair of reinforcing webs united to opposite sides of each of said cylinders adjacent the skirts thereof; said webs on the same side of each of said cylinders being in alignment and each web having spaced channels therethrough, screw bolts extending through said channels for rigidly connecting together the aligned webs on each side of said opposed cylinders, a half-bearing on each web; said half bearings defining complete crankshaft bearings for a single crankshaft for the opposed cylinders, a casing for the engine comprising a first pair of tanks for the reception of cooling medium; each of said first pair of tanks including a bottom having an opening therein for passing a cylinder, the edges of said openings being turned back to define flanges to which the cylinders are united, and a second pair of tanks defining crankcases for the engine; each of said second pair of tanks including a bottom having an opening therein for passing the cylinders, the openings being turned back to define flanges to which the cylinders are united.

LLOYD M. TAYLOR.