Dec. 26, 1939. E. M. TUCKER 2,184,820

INTERNAL COMBUSTION ENGINE

Filed Aug. 23, 1938 3 Sheets-Sheet 1

Fig. 1

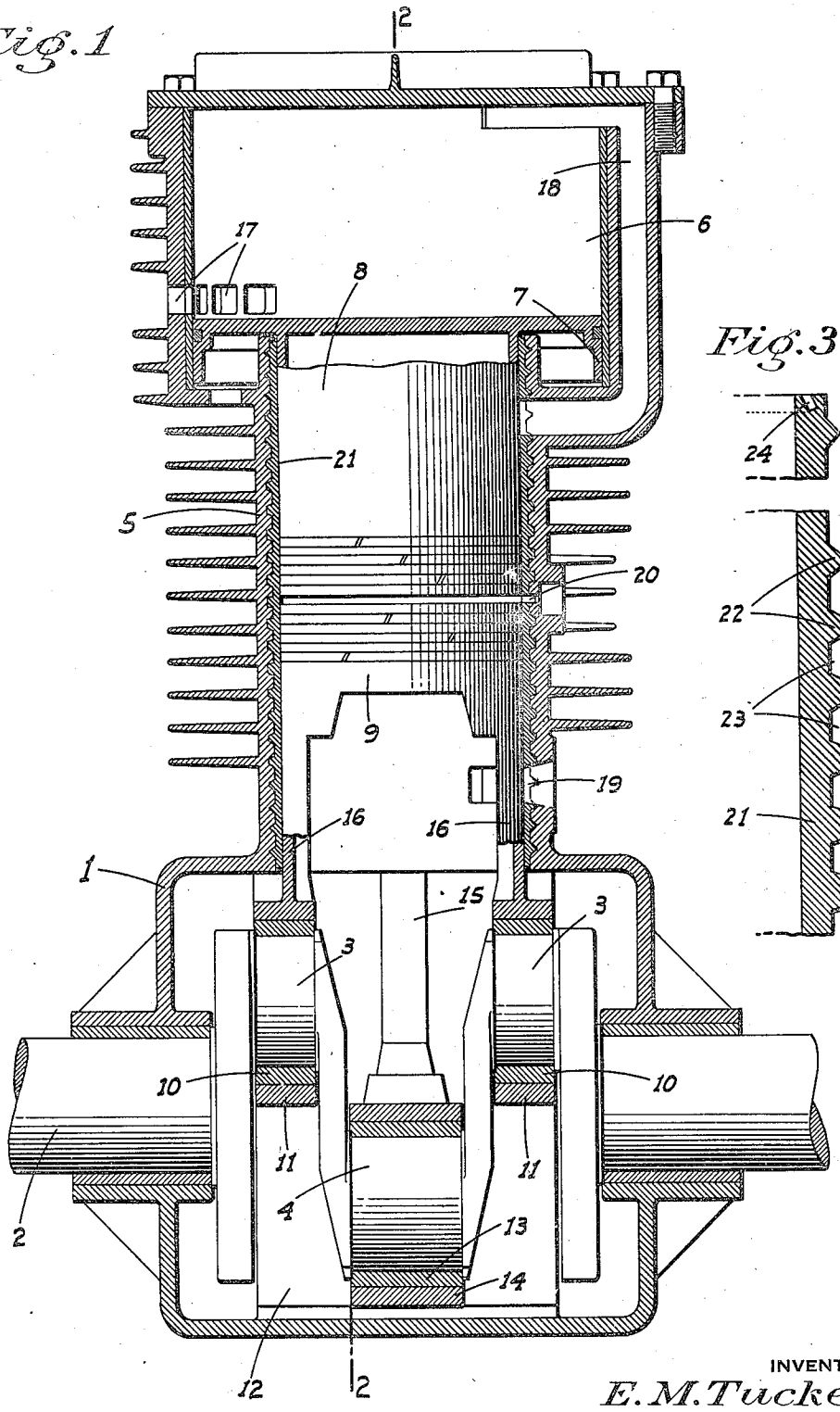

Fig. 3

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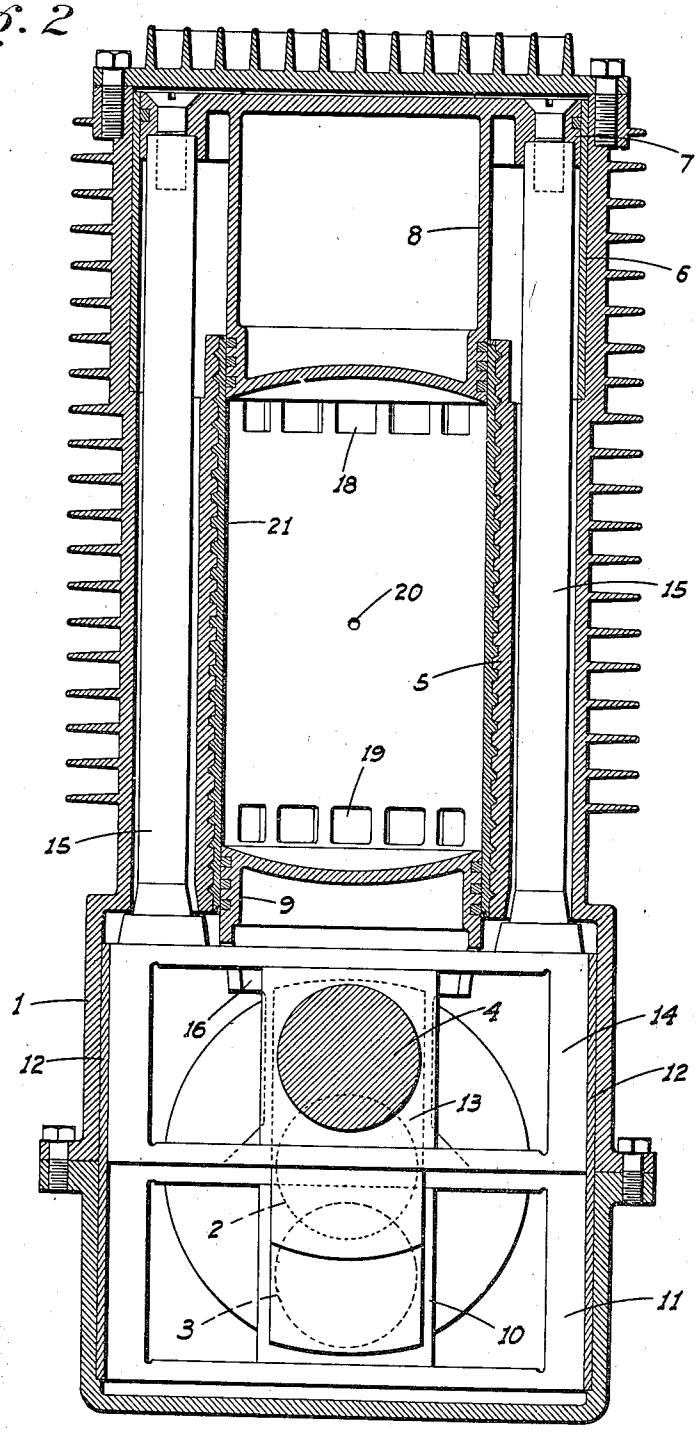
Fig. 2



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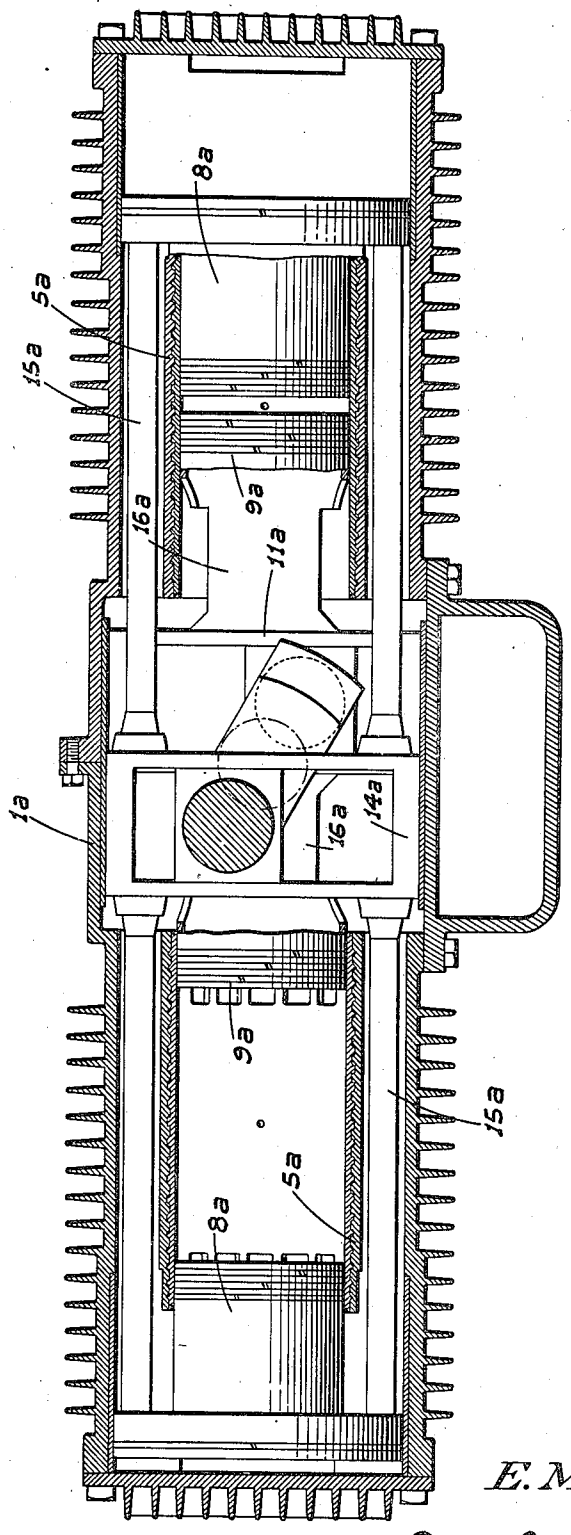

Fig. 4

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2,184,820

INTERNAL COMBUSTION ENGINE

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Application August 23, 1938, Serial No. 226,300

3 Claims. (Cl. 123—51)

This invention relates to an internal combustion engine, and particularly to one of the two-cycle Diesel type.

One of the objects of my invention is to provide an operating connection between the crank pins and pistons arranged so that all side thrust on the pistons is eliminated, thus avoiding the wearing of the cylinders out of round as frequently occurs.

Due to this feature of construction, I am able to use light aluminum cylinders, with wear resisting liners cast therein for the pistons to contact. In connection with these liners, it is a further object of my invention to so form the liners, and secure them in the cylinder, that the liners are kept light irrespective of the inevitable differences in cylinder temperature at different points in the length of the cylinders.

A further object is to provide a piston connecting structure arranged so that it may be used with single piston engines, as well as with opposed pistons, and with opposed or tandem cylinder arrangements having either a single or opposed pistons therein.

A further object of the invention is to produce a simple and inexpensive device and yet one which will be exceedingly effective for the purpose for which it is designed.

These objects I accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings similar characters of reference indicate corresponding parts in the several views:

Figure 1 is a sectional elevation of a single cylinder engine having opposed pistons therein, the pistons being in adjacent or firing position.

Figure 2 is a transverse section on line 2—2 of Fig. 1, but showing the pistons as in the exhaust and air intake position.

Figure 3 is a fragmentary enlarged longitudinal section of a cylinder liner.

Figure 4 is a sectional elevation of a double or opposed cylinder engine.

Referring now more particularly to the characters of reference on the drawings, and particularly at present to Figs. 1 to 3, the engine comprises a crank case 1 having a crank shaft 2 provided with axially alined side cranks 3 and an intermediate central crank 4 diametrally opposed to cranks 3, the latter being relatively short in axial extent, but the throw of all the cranks being the same.

Extending from the crank case radially of the crank shaft is the main cylinder 5, integral at its outer end with a larger supercharger cylinder 6, about half as long as cylinder 5. A short piston 7 is slidable in cylinder 6, which piston is rigid or integral with a piston 8 slidable in the adjacent portion of cylinder 5. Another piston 9 is slidable in cylinder 5 between piston 8 and the crank case.

The crank pins 3 turn in blocks 10 slidable in rectangular yokes 11 arranged for movement in a direction axially of the cylinder and pistons, and guided for positive travel in said direction by wearing plates or liners 12 secured in the crank case at the sides and engaging the corresponding faces or ends of the yokes.

Similarly the central crank 4 is turnable in a block 13 which is slidable in a yoke 14 disposed between yokes 11 and also guided by the liners 12.

The yoke 14 is operatively connected to the outer piston 7 by a pair of rods 15. These extend from rigid connection with the yoke 14 adjacent its ends in parallel relation to each other and to cylinder 5 on the outside of the same, but inwardly of cylinder 6, to a rigid connection with the piston 7 on opposite sides thereof. This connection being made at the bottom or non-working end of cylinder 6, and being entirely clear of power cylinder 5 and piston 8, there is no chance of gases leaking past the pistons if their rings are in good condition. In order that the cylinder 6 may be as short above cylinder 5 as possible, the piston 7 is hollow from its under side, outwardly of piston 8, so that it may overlap the top of cylinder 5 when piston 8 is in its lowermost or firing position, as shown in Fig. 1.

The yokes 11 are connected to piston 9 by side skirts 16 on the latter, the piston between the skirts being cut away so as to give clearance for yoke 14 and thus reduce the overall height of the engine as much as possible.

It will thus be seen that due to the use of the positively guided crank-actuated yokes, the pistons are relieved of all side thrusts, and not only is wear greatly reduced, but the engine may be made very light without loss of strength.

Ports 17 open to atmosphere communicate with cylinder 6 just above the lowest position of piston 7, as shown in Fig. 1. A passage 18 leads from cylinder 6 at the top to cylinder 5 just below the topmost position of piston 8, as shown in Fig. 2. Exhaust ports 19 lead from cylinder 5 just above the lowermost position of piston 9. The cylinder 5 is also provided with a fuel injection opening 20 positioned substantially midway of the length of the cylinder, or so as to lie

between the pistons when the latter are in their closest or firing position as shown in Fig. 2.

As will be clear from the above, the pistons are arranged in such relation to their respective cranks that they travel in opposite directions either toward or from each other. As the pistons separate on a power stroke after an injection of fuel, the supercharger piston 7 is compressing air taken in at the beginning of said stroke through ports 17. As soon as the piston 8 uncovers the adjacent end of passage 18, this compressed air rushes into cylinder 5 between pistons 8 and 9 (the fired charge being now exhausted through ports 19) and such air is further compressed as the pistons again approach each other on their compression stroke, until the fuel is injected through opening 20 at the proper moment.

Due to the use of the guided yokes, I am able to use aluminum for the cylinders. It is therefore necessary to line the cylinder with a more wear resisting material. I therefore cast a liner 21 of iron into the cylinder, which liner extends the full length of the cylinder. In order to lock the liner in place, it is formed on the outside with annular beads 22 forming intermediate grooves 23. In order to compensate for differences in expansion between the aluminum and iron due to differences in cylinder temperature at various points in its length, the sides of the grooves are cut on increasing angles in both directions from the hottest point, which in this case is at the center of length of the liner. This has the effect of maintaining the liner tight at all times. The groove and bead arrangement also provides for better radiation of heat from the liner than would otherwise be had. At each end, the liner is formed with an annular recess or groove 24 which has the effect of causing the liner to wedge in place when cool, and prevents carbon and compressed air from possibly starting to work between the cylinder and liner.

In the form of horizontal engine shown in Fig. 4, the general features of construction and operation are the same as in the engine above described. While there is still only one set of crank yokes 11*a* and 14*a*, there are two axially alined and opposed cylinders 5*a*, connected to the one crank case 1*a*. Each cylinder has a pair of the pistons 8*a* and 9*a* therein, the pistons 8*a* being connected to the one central yoke 14*a* by rods 15*a*, while the pistons 9*a* are connected to the one pair of yokes 11*a* by the piston skirts 16*a*.

With this arrangement, it will be seen that when the pistons in one cylinder are separated, or in exhausting positon, those in the other cylinder are in adjacent or firing relationship and vice versa.

It will be understood that while I have here shown and described engines of the two cycle type, the various novel features may be incorporated in four cycle engines as well, as well as in other cylinder and piston machines.

From the foregoing description it will be readily seen that I have produced such a device as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

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

1. In combination, a crank shaft having a pair of axially alined but separated crank pins, a cylinder radial with the shaft, a piston slidable in the cylinder, blocks in which the crank pins are turnable, yokes in which the blocks are slidable, and skirts depending from the piston on opposite sides thereof and rigidly secured on the adjacent edges of the corresponding yokes.

2. In an engine, a crank-shaft having a pair of axially alined but separate crank pins and a central diametrally opposed crank pin, blocks in which all the pins are turnable, yokes in which the blocks are slidable, a crank-case in which the yokes are guided for rectilinear movement, an open ended cylinder projecting from the crank case radial with the crank shaft and alined with the central crank pin and yoke, an enlarged cylinder outwardly and forming an extension of the first named cylinder, pistons in the cylinders connected as a unit, another piston in the first named cylinder radially inward of the first named pistons and rigidly connected to the yokes of the first named crank pins, rods parallel to the axis of the cylinder connected to the central yoke on opposite sides of the crank shaft and first named cylinder, said rods extending radially out close to the side walls of said cylinder and being rigidly secured on the bottom of the piston of the enlarged cylinder and enclosures about the rods formed with the cylinders and extending from the crank-case to the bottom of said enlarged cylinder.

3. In an engine, a crank-shaft having a pair of axially alined but separate crank pins and a central diametrally opposed crank pin, blocks in which all the pins are turnable, yokes in which the blocks are slidable, a crank-case in which the yokes are guided for rectilinear movement, an open ended cylinder projecting from the crank case radial with the crank shaft and alined with the central crank pin and yoke, an enlarged cylinder outwardly and forming an extension of the first named cylinder, pistons in the cylinders connected as a unit, another piston in the first named cylinder radially inward of the first named pistons and rigidly connected to the yokes of the first named crank pins, rods parallel to the axis of the cylinder connected to the central yoke on opposite sides of the crank shaft and first named cylinder, said rods extending radially out and being secured on the piston of the enlarged cylinder; the side wall of the radially innermost piston being cut away on opposite sides of the crank-shaft to receive the central yoke in relatively close relation to the head of said piston when the crank pins are disposed in one dead center position.

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