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A. F. EVANS

INTERNAL COMBUSTION ENGINE

Filed Feb. 17, 1927

2 Sheets-Sheet

Fig. 1.

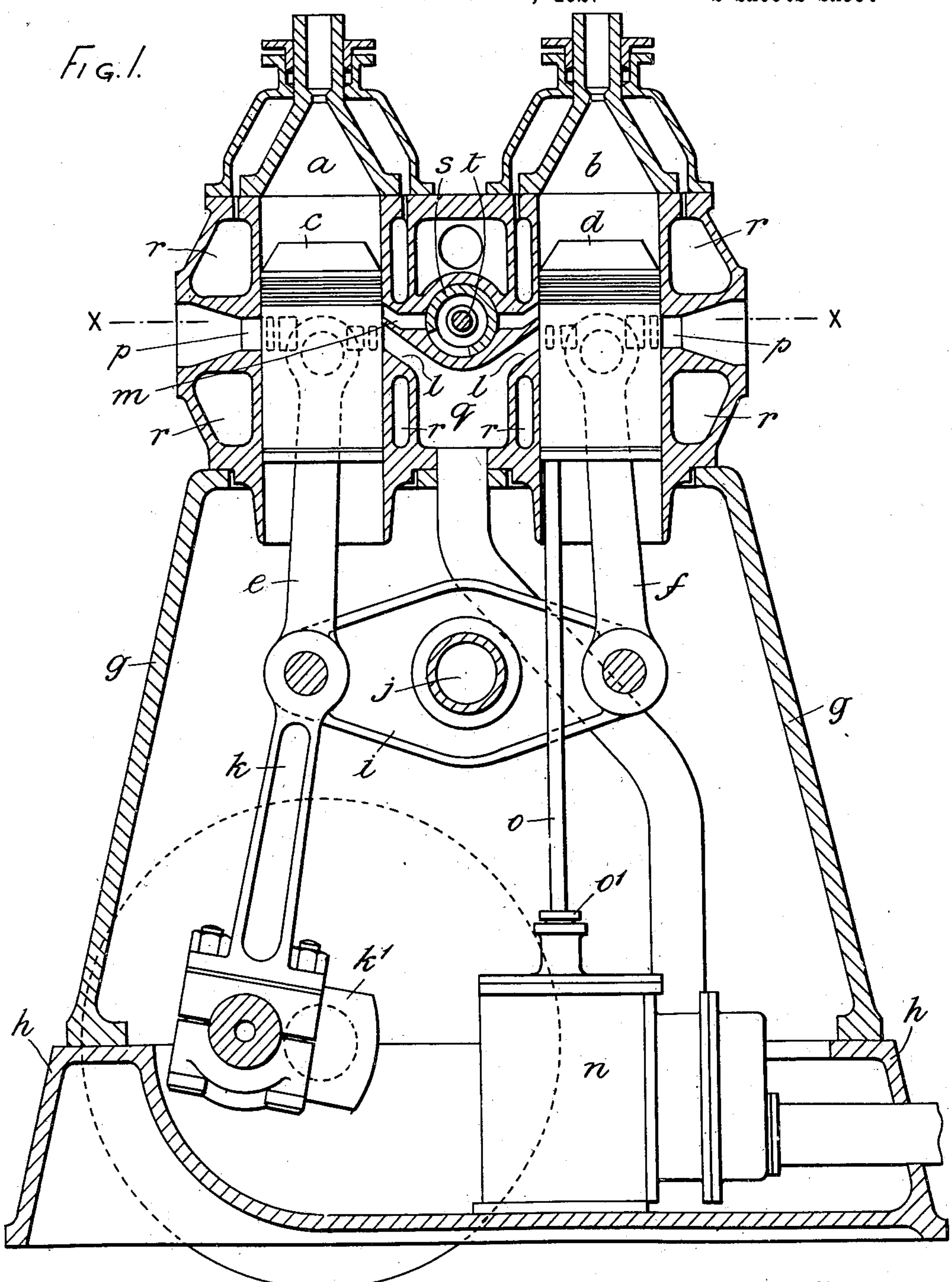

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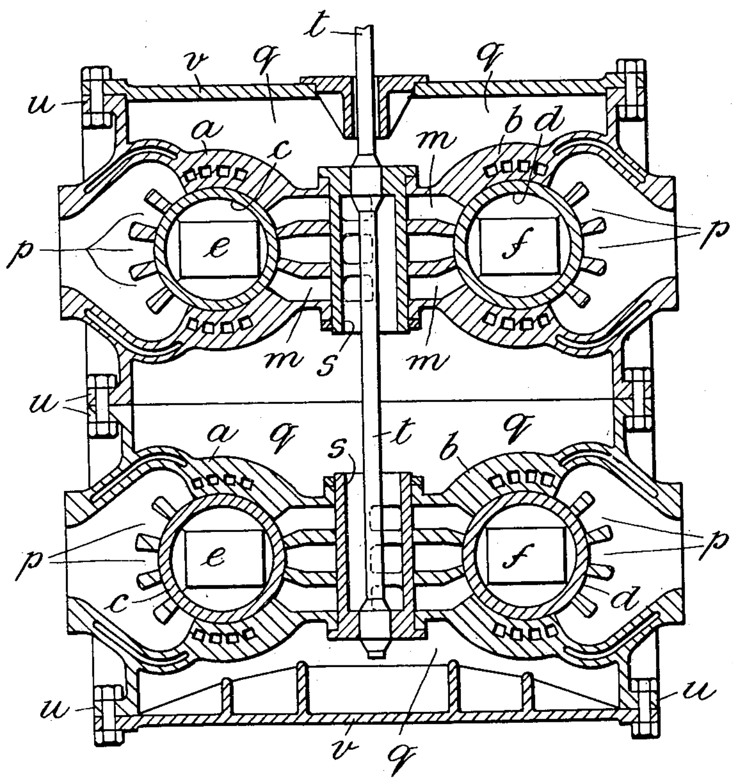
Fig. 2.



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UNITED STATES PATENT OFFICE.

ARTHUR FREDERICK EVANS, OF BARNES, ENGLAND.

INTERNAL-COMBUSTION ENGINE.

Application filed February 17, 1927, Serial No. 168,877, and in Great Britain March 3, 1926.

This invention relates to internal combustion engines of the Diesel type.

Internal combustion engines of the Diesel type and of powers below one thousand horse power for instance, have been found to be proportionally long, taking into consideration the space generally available, when applied to merchant vessels and when compared with the steam engine and boiler they are intended to replace.

In this application the amount of width available is generally more than sufficient for the needs, the main object of my invention being to provide a propelling engine of the Diesel type that can be accommodated in an engine room of much shorter dimensions than is usually required although the engine itself will be wider.

Further, in a two stroke cycle engine of this kind some provision has to be made for pumping the scavenging air and parctice has shown that the most efficient method is to arrange for separate pumping cylinders, placed in line with the working cylinders and driven from the crank shaft.

Although this is in every way satisfactory from the mechanical point of view it further increases the length of the engine and therefore in order to eliminate the space occupied and the cost of construction the provision of this efficient scavenge cylinder is often abandoned and a much less suitable method employed.

It is a further object of my invention to provide an engine so constructed as to retain or embody this feature whereby an efficient scavenging arrangement is provided and at the same time to reduce the total length of the engine, without adding to the complications or cost, thereby obtaining an engine which offers considerable advantages.

According to the present invention I employ a two cylinder engine of the inverted beam type such as hereinafter referred to, having a scavenging pump placed under that cylinder which is remote from the crank and driven directly or indirectly by the piston of this said cylinder.

Further, the cylinders are so arranged that the space between them is utilized as a scavenging air chamber in the walls of which the scavenging port and super-charge valve are located, the said super-charge valve being, for example, of the rotary or semi-rotary type operated by a through shaft.

The cylinders of the improved engine are preferably constructed in pairs forming a unit and in such manner that any number of units can be bolted together as required.

The accompanying drawings show one construction of engine embodying my invention.

Fig. 1 is a vertical section of the engine, and

Fig. 2 is a sectional plan on line X X of Fig. 1.

In the construction shown I provide two inverted two-stroke cycle cylinders *a* and *b* preferably cast in one, the cylinders containing identical pistons *c* and *d* respectively, fitted with short articulated piston rods *e f*.

The cylinders *a* and *b* are mounted in the usual manner on a wide substantial crank chamber or entablature *g*, which is in turn mounted upon a base chamber *h*, all in accordance with well known practice.

I provide a substantial rocking lever or beam *i* and pivot same at a point *j* midway between the two cylinders, this beam *i* being in duplicate for constructional purposes.

The lower end of each articulated piston rod is secured to one end of the rocking lever or beam *i*, while one end of the said beam is connected by means of a conventional connecting rod *k* to a crank *k'* of suitable throw, and placed approximately immediately under the cylinder *a*.

I prefer to make the rocking levers *i* of such a length that at no time during the stroke of the piston does the centre of the point of attachment of either articulated piston rods *e* or *f* to the rocking lever *i* pass the axis of the corresponding cylinder *a* or *b*.

The object of this arrangement is to provide for the resultant side thrust of the connecting rod on the piston to always be in one direction, and further that this side thrust may always press the piston on to the scavenging air admission port *l* and supercharge air port *m* in the cylinder, which ports it is a great advantage to always keep sealed so as to prevent the escape of scavenging air.

Another advantage of using this side of the cylinder as a guide surface is that the

inlet side of the cylinders of two-stroke cycle engines of this kind is always the coolest and best lubricated, alothough, in this connection it will be realized that the construction of this engine, owing to the small amount of the angularity of the connecting rods *e* and *f* reduces the side thrust of the pistons to a very considerable extent compared with the usual trunk piston. Thus the attachment of the piston rods *e* and *f* to the ends of a rocking lever such as *i* is a principle that has, to a very considerable measure, the advantages of the usual crosshead system.

This construction produces in effect an inverted two cylinder beam engine of the known type.

It is to be understood that I do not limit the number of units which I may employ, each consisting of a pair of cylinders *a* and *b*, rocking levers *i* and one crank *k'* forming a unit. Neither is the invention to be limited to the use of a single-acting or even a trunk-piston engine.

In applying my invention to this well known and tried mechanism I make use of the piston *d* which is remote from the crank for the purpose of driving a scavenging air pump *n* direct by placing the cylinder of such pump on the base chamber *h* and immediately under the piston *d* and connecting the said working piston *d* to the piston of the air pump *n* by means of a rigid rod *o* of any section adapted to reciprocate with the piston *d*.

The piston of the scavenging air pump *n* could be single acting which would simplify the mechanism, but it would be more convenient to make it double acting and pass the rods *o* through glands in the usual manner as shown at *o'* in Fig. 1.

This construction would allow an an air pump of ample capacity to be provided, and being double-acting there would be no great fluctuations of pressure in the air chamber.

The placing of the cylinder of the scavenging pump *n* in this position and driving it in the manner described will have the further advantage that the inertia of the piston of the scavenging air pump *n* and rods *o* and the inertia of the connecting rod *f* proper will be neutralized into a moment about the fulcrum of the rocking beam *i*.

Further, in order to provide a satisfactory and convenient scavenging air chamber I prefer to arrange the two cylinders *a* and *b* in such manner that the air inlet ports *l l*, *m m* are on the side nearest the centre line of the engine, while the exhaust ports *p p* are on the outside of the engine and as there will be a certain amount of space *q* between the water jacket *r* and the tangential walls of the cylinder structure, I make use of this space *q* as an air chamber into which the air from the scavenge pump *n* will be delivered and from which it will pass via the scavenging ports *l* and *m* into the working cylinders *a* and *b*.

As this construction offers many facilities for so doing I also prefer to make use of the well known auxiliary scavenging or super-charge valve which controls a supercharge air port situated above the usual scavenging port.

The scavenging port is opened by the piston on the down stroke after the exhaust port opens and is closed by the piston on the up stroke, the super-charging air port being, however, opened under the control of the valve, after the piston has closed the ordinary scavenging port, the effect being that the working cylinder is supercharged by air from the supercharge air port to the amount of the back pressure set up in the scavenge system or to a higher pressure from a separate receiver if such is provided.

The convienience offered by this arrangement is that this valve *s* of the rotary type, as shown, or other suitable type, can be situated in the walls of the actual scavenging air chamber *q* adjacent to and between the super-charging ports *m m* of the two cylinders, the valve thus opens directly into the scavenging air chamber *q* which is a considerable convenience as it eliminates the necessity of any pipes and obviates the waste and annoyance of any small leaks of air or oil.

The shaft *t* of the said super-charge valve *s* together with fuel pumps, air starting valves, etc., would be driven from a lay shaft (not shown) which in turn would be controlled for adjustment in the usual manner.

It will, therefore, be seen that each engine unit may consist of two cylinders *a* and *b* with their pistons *c d* and piston rods *e*, *f*, rocking beam *i*, main connecting rod *k* crank shaft with single crank *k'*, and a suitable entablature *g* and base plate *h*, complete with air scavenging pump *n*, rigid rod *o* and all necessary valves, otherwise a complete engine.

I prefer to form the cylinders *a* and *b* with a large rectangular flange *u* at both the top and the bottom and to provide two bolting flanges arranged vertically at each side and at top and bottom in such a manner that any number of pairs of cylinders can be bolted together and mounted on crank chamber sections, also bolted together, so as to form a one, two, three or four crank engine, or as may be required, and the improved construction allows this to be done very readily, for example, in a multi-crank engine, a cover plate, such as *v*, can be attached on the outside of the end pairs of cylinders and the spaces between the cylinders would form part of one common scavenging air chamber *q* while one shaft *t* would pass through the

valve chests and drive all the rotary supercharge valves *s*. Therefore the construction provides the very great convenience of allowing engines having any number of cranks or units to be built up of units entirely with the exception of the bed plates and crank shafts.

What I claim as my invention and desire to secure by Letters Patent is:—

1. A two stroke Diesel engine of the inverted beam type embodying a pair of cylinders, and inverted beam and a scavenging air pump and comprising the combination of two cylinders connected one to each end of the beam, the end of the beam under one cylinder being connected to the crank means whereby the piston of that cylinder connected to the other end of the beam is put in driving connection with the scavenging air pump independently of the beam, a scavenging air chamber formed by the space between the two cylinders and plates secured to side, top and bottom flanges on the cylinder structure, means for connecting the discharge of the scavenging air pump to said scavenging air chamber, scavenging air ports and supercharging air ports formed in the opposing walls of the adjacent pair of cylinders, a rotary valve located in the scavenging air chamber and controlling the supercharging air ports of the cylinders, a shaft passing through the scavenging air chamber and rotary valve for operating the latter, and means for operating said shaft.

2. A two stroke Diesel engine of the inverted beam type embodying a pair of cylinders, an inverted beam and a scavenging air pump and comprising the combination of two cylinders connected one to each end of the beam, the end of the beam under one cylinder being connected to the crank, means whereby the piston of that cylinder connected to the other end of the beam is put in driving connection with the scavenging air pump independently of the beam, a scavenging air chamber formed by the space between the two cylinders, means for connecting the discharge of the scavenging air pump to said scavenging air chamber, scavenging air ports and supercharging air ports formed in the opposing walls of the adjacent pair of cylinders, a rotary valve located in the scavenging air chamber and controlling the supercharging air ports of the cylinders, a shaft passing through the scavenging air chamber and rotary valve for operating the latter, and means for operating said shaft.

3. A two stroke Diesel engine of the inverted beam type embodying a pair of cylinders, a beam and a scavenging air pump and comprising the combination of two cylinders, the pistons of which are connected one to each end of the beam, the end of the beam under one cylinder being connected to the crank, a rod whereby the piston of that cylinder connected to the other end of the beam is put in driving connection with the scavenging air pump independently of the beam, a scavenging air chamber formed by the space between the two cylinders and plates secured to side top and bottom flanges on the cylinder structure, means for connecting the discharge of the scavenging air pump to said scavenging air chamber, scavenging air ports and supercharging air ports formed in the opposing walls of the adjacent pair of cylinders, a rotary valve located in the scavenging air chamber and controlling the supercharging air ports of the cylinders, a shaft passing through the scavenging air chamber and rotary valve for operating the latter and means for operating said shaft.

4. A two stroke Diesel engine of the inverted beam type embodying a pair of cylinders, a beam and a scavenging air pump and comprising a unitary structure consisting of two cylinders, the pistons of which are connected one to each end of the beam, the end of the beam under one cylinder being connected to the crank, means whereby the piston of that cylinder connected to the other end of the beam is put in driving connection independently of the beam with the scavenging air pump, a scavenging air chamber formed by the space between the two cylinders and plates secured to side, top and bottom flanges on the cylinder structure, and whereby said plates and the flanges to which they are secured permit of a plurality of the said unitary structure being bolted together and provided with a scavenging air chamber common to all the cylinders of the assembled units, means for connecting the discharge of the scavenging air pump to the scavenging air chamber, scavenging air ports and supercharging air ports formed in the opposing walls of the cylinders, a rotary valve located in the scavenging air chamber and controlling the supercharging air ports of the cylinders, a shaft passing through the scavenging air chamber and rotary valve for operating the latter, and means for operating said shaft.

5. A two stroke Diesel engine of the inverted beam type embodying a pair of cylinders, a beam and a scavenging air pump and comprising a unitary structure consisting of two cylinders the pistons of which are connected one to each end of the beam, the end of the beam under one cylinder being connected to the crank, a rod whereby the piston of that cylinder connected to the other end of the beam is put in driving connection with the scavenging air pump independently of the beam, a scavenging air chamber formed by the space between the two cylinders and plates secured to side, top and bottom flanges on the cylinder structure, and whereby said plates the flanges

to which they are secured permit of a plurality of the said unitary structures being bolted together and provided with a scavenging air chamber common to all the cylinders of the assembled units, means for connecting the discharge of the scavenging air pump to the scavenging air chamber, scavenging air ports and supercharging air ports formed in the opposing walls of the cylinders, a rotary valve located in the scavenging air chamber and controlling the supercharging air ports of the cylinders, a shaft passing through the scavenging air chamber and rotary valve for operating the latter, and means for operating said shaft.

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