Oct. 23, 1923. 1,471,847

P. A. HOLLIDAY

INTERNAL COMBUSTION ENGINE

Filed July 1, 1922 3 Sheets-Sheet 1

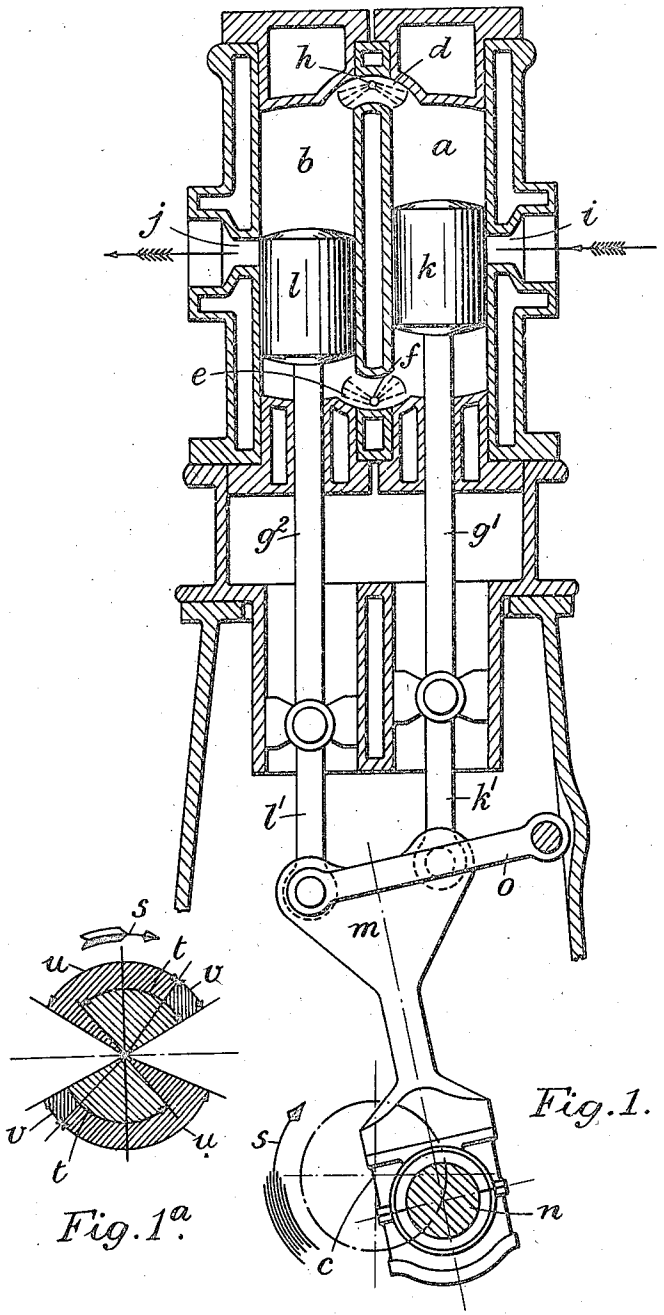


Fig.1.

Fig.1a.

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Filed July 1, 1922 3 Sheets-Sheet 2

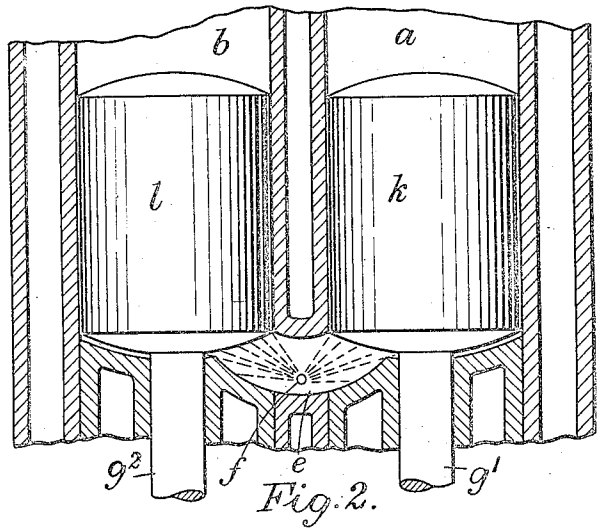


Fig. 2.

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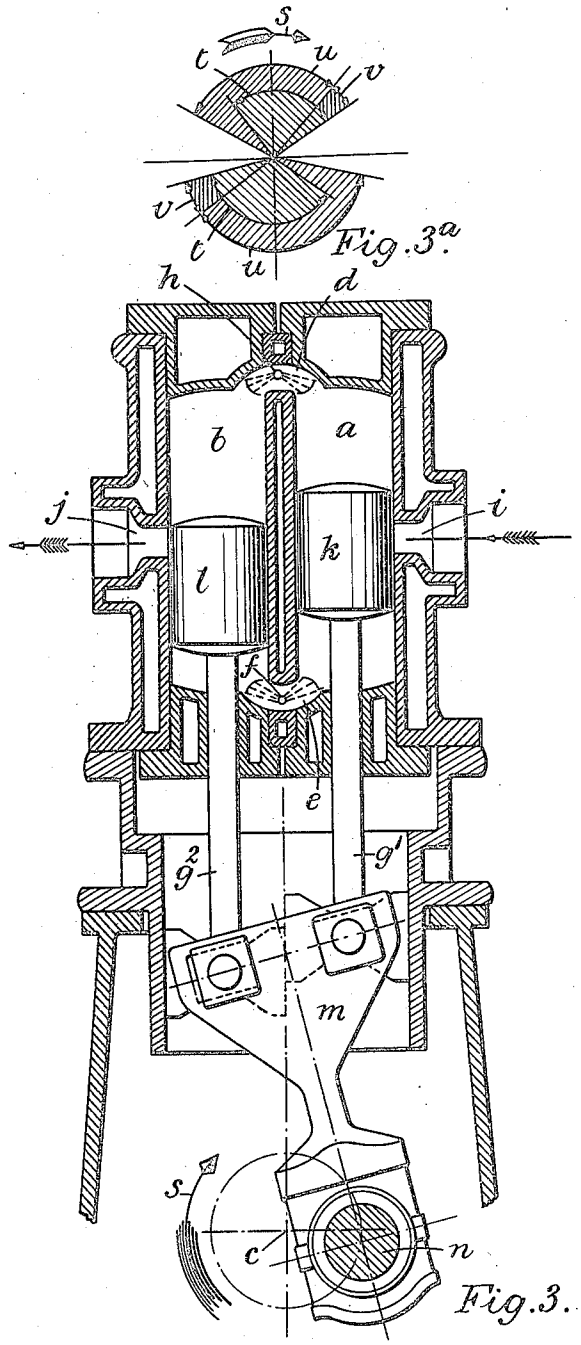


Fig. 3.

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UNITED STATES PATENT OFFICE.

PETER ALBERT HOLLIDAY, OF EDGBASTON, BIRMINGHAM, ENGLAND, ASSIGNOR TO BELLISS AND MORCOM LIMITED, OF BIRMINGHAM, WARWICK, ENGLAND, A BRITISH COMPANY.

INTERNAL-COMBUSTION ENGINE.

Application filed July 1, 1922. Serial No. 572,320.

To all whom it may concern:

Be it known that I, PETER ALBERT HOLLIDAY, subject of the King of Great Britain, residing at Fairfield, Poplar Avenue, Edgbaston, Birmingham, in the county of Warwick, England, have invented new and useful Improvements in or Relating to Internal-Combustion Engines, of which the following is a specification.

The present invention relates to internal combustion engines of the two cycle type wherein for the purpose of imparting a lead in both opening and closing to the working-piston-controlled exhaust ports over the working-piston-controlled inlet ports one set of ports is provided in one cylinder and the other set of ports is provided in another cylinder of a pair of cylinders intercommunicating at the end, and the two adjacent cylinders are arranged one on each side of an axial plane through the crank shaft, with the pistons appropriately connected thereto, and with an appropriate direction of rotation of the crank shaft.

The piston of each cylinder being connected to a single crank in common by means of a specially constructed connecting rod common to both, the lead of one piston over the other is obtained by the varying angularity of the connecting rod, the effect of which gives an earlier opening of the exhaust ports over the inlet ports on the outward stroke and an earlier closing of the exhaust ports over the inlet ports on the inward stroke without having to apply externally controlled inlet ports. A further advantage gained by this method is that the angle of closing of the exhaust ports on the inward stroke is less than the angle of opening of the same ports in the outward stroke, thus giving greater effective inward stroke for the compresson of the charge.

A modification would be to connect the pistons situated as previously described to different non-angularly separated cranks by means of independent connecting rods whereby the lead is due solely to the relative situation of the cylinders, or the different cranks in the latter instance may be angularly disposed to vary the lead obtained by the relative situation of the cylinders.

Engines of the above type as previously proposed have been of the single acting type with trunk pistons directly connected to angularly moving connecting rods.

The object of the present invention is to design an internal combustion engine of the above type which is double acting.

With a double acting engine it is necessary to provide the working piston with a piston rod operating through a packed gland, and therefore such piston rod must move in a straight line. Consequently some means must be provided to reconcile the angular movement of a connecting rod in common with the straight line movement of the piston rods of an interconnected pair of cylinders arranged astride of the crank shaft, in adapting the above described type of engine to be double acting.

For this purpose, according to the invention, the piston rods are provided with double guided crossheads connected to the common connecting rod in a manner permitting varying angularity thereof.

For example one of the crossheads is directly pivoted to the connecting rod, while the other is connected thereto by a laterally sliding connection.

By adopting for a double acting engine the above interconnected twin cylinder type of engine having the two cylinders astride of the crank shaft for the purpose of obtaining a lead of the exhaust over the inlet in both opening and closing, the objection that arises with ordinary double acting internal combustion engines that the piston rod passes through the center of the crank-shaft-adjacent combustion chamber can be avoided.

This objection is avoided in the present engine, by arranging that at the crank-shaft-adjacent end of the cylinders, the portion of the combustion chamber at which the explosion is initiated is situated in the communication between the two cylinders.

For this purpose, the fuel injection inlet or sparking plug, according to whether the engine is of the high compression or normal compression type, is located intermediately of the cylinders at the crank shaft end thereof.

Various diagrammatic views of internal combustion engines according to the inven-

tion are illustrated by way of example on the accompanying drawings, in which:—

Fig. 1 is a sectional elevation of a double acting internal combustion engine, and

Fig. 1ª is the sectional diagram of the valve setting thereof.

Fig. 2 is a fragmentary sectional elevation showing on an enlarged scale the arrangement of the fuel injection at the crank shaft end of the cylinders.

Fig. 3 is a sectional elevation of a modified double acting internal combustion engine, of which

Fig. 3ª is the valve setting sectional diagram.

a b are two adjacent working cylinders arranged across a plane through the axis *c* of the crank shaft.

The cylinders *a b* communicate at the end remote from the crank shaft by a passage *d*, at the crank-shaft-adjacent end also by a similar passage *e*.

The passages *d* and *e* constitute combustion chambers common to both cylinders *a b*. This enables, with a double acting internal combustion engine, the fuel injection inlet and sparking plug at the crank-shaft-adjacent end of the cylinders to be arranged in the passage *e* approximately at *f* intermediately between the two cylinders, so that the injected fuel is directed clear of the piston rods g^1 g^2 and their packing glands, as shown in Figs. 1, 2 and 3.

h indicates a similar approximately midway position of the fuel injection inlet and sparking plug in the passage *d* at the other end of the cylinders *a b*.

The cylinder *a* is provided with ports *i* for the admission of air for scavenging or re-charging or for the inlet of steam, and the other cylinder *b* is provided with exhaust ports *j*.

The working pistons *k l* respectively are arranged in each cylinder *a b* respectively.

The cylinders *a b* are parallel and both pistons *k l* are connected to a connecting rod *m* common to both. At the end remote from the crank *n*, means are provided for permitting varying angularity of the common connecting rod *m*. In Fig. 1 this is effected by pivoted extensions k^1 l^1 of the guided piston rods g^1 g^2 and a link *o* pivoted respectively to the engine frame and connecting rod *m*. In Fig. 3 the crosshead of the piston rod g^2 has a laterally sliding connection with the connecting rod *m*. The link *o* may be suitably extended to provide a means of operating the scavenging and recharging pumps.

The effect of the above described situation of the interconnected cylinders *a b* one on each side of the axis *c* of the crank shaft, with rotation of the latter in the appropriate direction, indicated by the arrow *s*, and the resultant varying angularity of the common connecting rod *m* is to impart a lead in both the opening and closing of the exhaust ports *j* by the piston *l* of the respective cylinder *b*, over both the opening and closing of the inlet ports *i* by the piston *k* of the respective cylinder *a*.

The above lead is shown by the diagrams Figs. 1ª and 3ª, wherein *t* indicates the inlet period, *u* the exhaust period and *v* the surcharge period due to closing of the exhaust ports prior to the inlet ports.

I claim:

1. In a double acting internal combustion engine, a crank shaft, a pair of cylinders astride of said crank shaft, passages interconnecting said cylinders at both their ends, a sparking plug in the crank shaft adjacent passage between said cylinders, an inlet port at the mid-length of one of said cylinders, an exhaust port at the mid length of the other of said cylinders, a piston in each of said cylinders uncovering said port therein, an axially extending piston rod rigid with each of said pistons, a packed gland for each of said cylinders traversed by said piston rods, a separate guided crosshead at the end of each of said piston rods, a connecting rod connecting both said crossheads to one crank of said crank shaft, and a yielding connection between said crossheads.

2. In a double acting internal combustion engine, a crank shaft, a pair of cylinders astride of said crank shaft, passages interconnecting said cylinders at both their ends with a fuel injection inlet in the crank-shaft-adjacent passage between said cylinders, an inlet port at the mid-length of one of said cylinders, an exhaust port at the mid length of the other of said cylinders, a piston in each of said cylinders uncovering said port therein, an axially extending piston rod rigid with each of said pistons, a packed gland for each of said cylinders traversed by said piston rods, a separate guided crosshead at the end of each of said piston rods, a connecting rod connecting both said crossheads to one crank of said crank shaft, and a yielding connection between said crossheads.

3. In a double acting internal combustion engine, a crank shaft, a pair of cylinders astride of said crank shaft, passages interconnecting said cylinders at both their ends, a sparking plug in the crank shaft adjacent passage between said cylinders, an inlet port at the mid-length of one of said cylinders, an exhaust port at the mid length of the other of said cylinders, a piston in each of said cylinders uncovering said port therein, an axially extending piston rod rigid with each of said pistons, a packed gland for each of said cylinders traversed by said piston rods, a separate guided crosshead at the end of each of said piston rods, a connecting rod connected to one crank of said crank shaft and directly to both of said crossheads and

a sliding connection between said crossheads.

4. In a double acting internal combustion engine, a crank shaft, a pair of cylinders astride of said crank shaft, passages interconnecting said cylinders at both their ends with a fuel injection inlet in the crank-shaft-adjacent passage between said cylinders, an inlet port at the mid-length of one of said cylinders, an exhaust port at the mid length of the other of said cylinders, a piston in each of said cylinders uncovering said port therein, an axially extending piston rod rigid with each of said pistons, a packed gland for each of said cylinders traversed by said piston rods, a separate guided crosshead at the end of each of said piston rods, a connecting rod connected to one crank of said crank shaft and directly to both of said crossheads and a sliding connection between said crossheads.

In testimony whereof I have signed my name to this specification.

PETER ALBERT HOLLIDAY.