PATENT SPECIFICATION

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658,894

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COMPLETE SPECIFICATION

Improvements in or relating to Connecting Rod Assemblies for Multi-Cylinder Reciprocating Engines having Two or More Cylinders or Rows of Cylinders Angularly Displaced About a Crank Shaft

We, D. NAPIER & SON LIMITED, a Company registered under the Laws of Great Britain, of 221, Acton Vale, London, W.3, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to connecting rod assemblies for reciprocating engines having two or more cylinders or rows of cylinders angularly displaced about the axis of rotation of a crank shaft and of the kind comprising a connecting rod, hereinafter for convenience termed the master rod connected to a piston in one of two angularly displaced cylinders and having a big end which constitutes or carries a bearing surrounding a crank pin on the crank shaft and at least one other connecting rod, hereinafter for convenience called the subsidiary rod connected to a piston in another of the angularly displaced cylinders and having a big end which constitutes or carries a bearing surrounding a journal pin rigidly connected to the master rod.

An object of the invention is to provide a connecting rod assembly of the above kind which will not only be mechanically satisfactory but will tend to reduce the dimensions of the parts associated with the connection of the subsidiary rod to the master rod so as to reduce the clearances which have to be left around the master rod and subsidiary rod and more particularly to permit of a reduction in the width of any slot or slots which have to be provided in the inner end of the cylinder, cylinder liner or sleeve valve in which reciprocates the piston to which the subsidiary rod is connected.

Hitherto it has been customary in such assemblies to provide a lateral projection on the big end of the master rod with a deep slot therein to receive the big end of the subsidiary rod and to pass a journal pin for the big end of the subsidiary rod through holes in the projection and through the bearing of the big end of the subsidiary rod. In such an arrangement the lateral projection from the big end of the master rod was necessarily of considerable dimensions with the result that where for dimensional reasons clearance slots were provided in the inner end of the cylinder, cylinder liner or sleeve valve containing the piston connected to the subsidiary rod to provide clearance for this projection these slots had to be comparatively wide and deep.

A connecting rod assembly of the kind referred to according to the present invention for a reciprocating engine having two cylinders angularly displaced from one another about the axis of rotation of a crank shaft comprises a main connecting rod having a big end carrying or constituting a bearing surrounding a crank pin on the crank shaft, and a journal member for a second connecting rod comprising a cylindrical bearing member formed at its ends with lugs adapted to be bolted or similarly secured to a pair of spaced platforms formed upon the big end of the main connecting rod.

The spaced platforms constituting the pair preferably lie on opposite sides of a groove which accommodates part of the big end of the subsidiary connecting rod, while further, the lugs on the journal member for the subsidiary connecting rod conveniently lie in locating slots or recesses in the platforms, and are formed on the ends of the journal member in such a

[*Price 2/-*]

position that their outer faces against which bear the nuts or heads of the bolts securing them to the platforms lie nearer to the axis of the crank pin to which the main connecting rod is coupled than does the axis of the journal member for the subsidiary connecting rod.

Thus, in a convenient arrangement each of the lugs on an end of the subsidiary journal member comprises a substantially rectangular base portion adapted to lie within a corresponding rectangular recess in the face of its platform and having holes therein through which pass bolts or studs by which it is secured to the platform, and a web lying in a plane at right angles to the rectangular portion and containing the axis of the journal member, this web which thus lies between the bolts or studs, extending between the outer face of the rectangular portion and the adjacent end face of the journal member. The outer face of the platform in such an arrangement conveniently lies appreciably below the axis of the journal member so that the common plane in which the outer ends of the bolt heads or studs lie extends close to but preferably not appreciably beyond the axis of the journal member.

The invention may be carried into practice in various ways but the following is a description by way of example of one construction according to the invention applicable for example to an internal combustion engine having three parallel crank shafts angularly disposed at equal intervals about a central axis and two rows of cylinders displaced by an angle of 60° about each crank shaft axis, each pair of adjacent cylinders which lie in a plane at right angles to the crank shaft axes being associated with a single crank pin upon the related crank shaft. The description is made with reference to the accompanying drawings, in which

Figure 1 is an end elevation of an engine of the kind to which the invention is particularly applicable,

Figure 2 is a cross section on an enlarged scale through one of the cylinders of the engine shown in Figure 1 in a plane containing the cylinder axis and at right angles to the axes of the two crankshafts associated with the cylinder,

Figure 3 is an elevation on an enlarged scale of one of the connecting rod assemblies according to the invention used in the construction shown in Figure 2, part being broken away and shown in cross section.

Figure 4 is a cross section through the big end portion of the connecting rod assembly shown in Figure 3 in a plane containing the axes of the big ends of the two connecting rods on a still further enlarged scale, the big end journal member for the subsidiary connecting rod being shown in elevation, and

Figure 5 is a development view of the inner surface of the big end bearing housing of the master rod on a somewhat smaller scale than Figure 4.

The internal combustion engine to which the invention is shown applied by way of example comprises, as shown in Figures 1 and 2, three crank-cases A, A^1 and A^2 each containing and supporting a crankshaft B, B^1, B^2 of the conventional six cylinder type, so that the axes of the three crankshafts B, B^1, B^2 lie at the apices of an equilateral triangle.

Extending between and connecting each adjacent pair of crank cases is a cylinder block C, C^1, C^2, containing six open ended cylinders C^3 in each of which reciprocates two pistons D connected respectively to the two crankshafts in the two crank cases. The engine operates on the two stroke cycle to which end the pistons D move towards and away from one another in each cylinder C^3 and, while one of the pistons D uncovers exhaust ports C^4 in the cylinder towards the end of its outstroke the other piston uncovers inlet ports C^5. The combustion chambers are thus constituted by the centre portion C^6 of the lengths of the cylinders. In Figure 1 the inlet manifolds which communicate with the inlet ports in the cylinders can be seen at F, F^1, F^2 and are arranged to be fed with scavenging and charging air through delivery volutes F^3 from a centrifugal compressor F^4 secured to one end of the engine and having an air intake F^5.

It will thus be seen that each crank pin B^3 on each crankshaft B, B^1, B^2 is coupled to two pistons D and this is effected by a connecting rod assembly comprising a master rod G having a big end bearing which directly engages the crank pin B^3 and a subsidiary rod H pivoted to the big end of the master rod, the arrangement being such, as shown in Figure 2 that one of the pistons D in each cylinder is connected by its gudgeon pin D^1 to a master rod G while the other is connected to a subsidiary rod H.

The construction of each connecting rod assembly, as shown in Figures 3, 4 and 5 is as follows:

The master rod G and the subsidiary rod H contain each at their small ends needle roller bearings D^2 mounted on the gudgeon pins D^1. The master rod has a big end which is conveniently split in a plane lying at approximately 60° to the longitudinal axes of the master rod to permit insertion of a split big end bearing J. The removable strap portion G^1 of the big

end lies on the side of the body of the master rod remote from the two associated pistons, so as to leave integral with the body of the rod that part of the big end which faces the subsidiary rod piston. The strap is secured to the body of the rod by means of two screwthreaded studs G^2, G^3, and co-operating nuts in usual manner.

The part of the big end of the master rod upon which the subsidiary rod is mounted is somewhat thickened radially at G^4 and this thickened portion is provided with a comparatively deep and wide slot lying in a plane at right angles to the crankshaft axis as shown in Figures 2, 3 and 4 and adapted to accommodate a part of the big end of the subsidiary rod. It will be seen thus that the radial thickening provides in effect a pair of platforms G^5, G^6, facing the subsidiary piston with the slot between them. These two platforms are formed with similar wide rectangular slots in their outer faces extending across them in a direction parallel to the crank pin axis. Displaced from the sides of each of these slots and projecting from the bases of the slots are four studs K. The studs pass through holes in rectangular lugs L^1 which are formed respectively on and project from the opposite ends of a cylindrical journal member L passing through the big end of the subsidiary rod, and are located in the slots in the platforms on the master rod to which they are rigidly secured by nuts K^1 engaging the outer ends of the studs and bearing on the outer faces of the lugs L^1. Each of the lugs L^1 is formed integral with its end of the journal member L and with a web L^2 which lies between the nuts and extends from the outer face of the lug to the adjacent end portion L^3 of the journal member.

The slot between the platforms and across which the journal member thus extends is provided in its side faces with shallow part-cylindrical recesses G^7 adapted to accommodate adjacent end portions L^3 of the journal member, the width of the big end of the subsidiary rod being somewhat less than the length of the journal member. The slot is also provided on its inner face with a part-cylindrical bearing surface G^8 engaging the outer surface of the big end of the subsidiary rod H and is continued lengthwise on both sides of the surface G^8 as shown at G^9.

The big end of the subsidiary rod is externally machined over the necessary arcuate length which bears against the face G^8 and is internally bored to receive a bearing liner H^1 which forms the outer race of twin needle roller bearings H^2 by means of which the big end is connected to the journal member L.

Lubricating oil is supplied from internal passages in the crank pin B^3 to the master rod big end bearing J, and also from this bearing through an arrangement of oil passages, to the subsidiary rod big end outer bearing surface G^8 and thence to the inner needle roller bearings H^2 and by a longitudinal drilling H^3 in the subsidiary rod to the small end bearing D^2. Oil is also supplied from the big end bearing J by a longitudinal drilling G^{10} in the master rod to the small end bearing D^2. The flow of oil to the various passages in the connecting rod assembly is provided for in the following manner:—

The split big end bearing liner J is provided with a number of ports J^1 extending round a part of a medial circumference and communicating with two passages J^2 and J^3 formed by two grooves in the inside surface of the big end, these grooves being best seen in Figure 4 and in the development of the inside surface of the big end shown in Figure 5. The liner J is formed with two pressed out tabs J^4 at each side of the line on which it is split, which project outwards into chamfered grooves J^5 so that when the strap portion G^1 of the big end is assembled the two halves of the liner are held from rotary or axial movement within the big end by the abutment of the ends of the tabs against the mating faces of the two parts of the big end.

The ports J^1 co-operate with a radial drilling in the crank pin B^3 whereby oil is intermittently delivered from the crank pin to the passages J^2 and J^3 as the crank pin rotates within the big end. The passage J^2 in the particular example shown extends over an arc of approximately $145\frac{1}{2}°$, and communicates at one end with a drilling G^{10} which supplies oil to the small end bearing D^2, while the passage J^3 has a portion J^6 which registers with some of the ports J^1 and extends over an arc of approximately 60°, while an off-set portion J^3 communicates with a slot formed between a groove J^7 in the bearing surface G^8 and the outer surface of the subsidiary rod big end through an oblique drilling J^8 in the master big end.

The groove J^7 is made sufficiently long in a circumferential direction to register at all times with a radial drilling H^6 through the big end of the subsidiary rod, the oscillating movement of this big end in its bearing being relatively small. The drilling H^6 communicates with an annular passage H^4 formed by an annular groove in the inside surface of the subsidiary rod big end, which passage delivers oil to the needle roller bearing H^2 through four radial ports H^5 in the bearing liner, and in addition communicates with the longitudinal drilling H^3 which

delivers oil to the small end bearing D^2 through a similar annular passage H^7 and ports H^8 in the small end.

Thus while the crank pin B^3 is rotating within the master rod big end bearing J oil is supplied intermittently from this bearing to both small end bearings D^2, to the subsidiary rod inner bearing H^2, and to the subsidiary rod outer bearing surface G^8.

It will be seen that with such a construction the width of any slot which is provided in the skirt portion of a cylinder or liner containing the piston to which the subsidiary connecting rod is coupled in order to provide clearance for the big end assembly during rotation can be reduced to approximately the length of the subsidiary journal member, while the depth of the part of this slot which has to accommodate this journal member can be limited to that necessary to provide clearance for the journal member itself without having to provide clearance for a part of the big end of the master rod surrounding the journal member.

It is to be understood that the invention has been described with particular reference to a construction in which the master rod or each master rod has one subsidiary rod associated therewith for convenience only and that the invention may also be applied to constructions in which two or more subsidiary rods are associated with a master rod, the big end of the master rod in this case being provided with an appropriate number of pairs of platforms angularly spaced around it.

What we claim is:—

1. A connecting rod assembly for a reciprocating engine having two or more cylinders angularly displaced from one another about the axis of rotation of a crank shaft comprising a main connecting rod having a big end carrying or constituting a bearing surrounding a crank pin and a journal member for a second connecting rod comprising a cylindrical bearing member formed at its ends with lugs adapted to be bolted or similarly secured to a pair of spaced platforms formed upon the big end of the main connecting rod.

2. A connecting rod assembly as claimed in Claim 1, in which the spaced platforms lie on opposite sides of a slot in which lies part of the big end of the subsidiary connecting rod.

3. A connecting rod assembly as claimed in Claim 1 or Claim 2, in which part of the circumference of each of two end portions of the subsidiary journal member lie in arcuate recesses in the adjacent faces of the two platforms.

4. A connecting rod assembly as claimed in any one of the preceding claims, in which each of the lugs on an end of the subsidiary journal member comprises a substantially rectangular portion adapted to lie within a corresponding rectangular recess in the face of its platform and having holes therein through which pass bolts or studs by which it is secured to the platform and a web lying in a plane at right angles to the rectangular portion between the bolts or studs and extending between the outer face of the rectangular portion and the adjacent end face of the subsidiary journal member.

5. A connecting rod assembly as claimed in any one of the preceding claims in which the big end of the main connecting rod includes at least one oil passage leading from a groove in its bearing bore adapted to receive oil from the crank shaft to a groove in a part cylindrical surface with which a part of the outer surface of the big end of the subsidiary rod makes contact, while the big end of the subsidiary rod is provided with at least one oil passage one end of which communicates with the said groove in the part cylindrical recess while its other end communicates with the bearing bore of the big end of the subsidiary rod.

6. An internal combustion engine comprising three crank cases containing crank shafts arranged with their axes on the apices of a triangle, open ended cylinders extending between each adjacent pair of crank shafts and each containing two pistons connected by connecting rods respectively to the two crank shafts in the crank cases between which the cylinder extends, in which the connecting rods constitute parts of connecting rod assemblies according to Claim 1, Claim 2, Claim 3, Claim 4 or Claim 5, the arrangement being such that of the two pistons in each cylinder one is connected to its crank shaft by a main connecting rod while the other is connected to its crank shaft by a subsidiary connecting rod.

7. A connecting rod assembly constructed and arranged substantially as described with reference to Figures 3, 4 and 5 of the accompanying drawings.

8. An engine as described with reference to Figures 1 and 2 of the accompanying drawings incorporating connecting rod assemblies substantially as described with reference to Figures 3, 4 and 5 of the accompanying drawings.

KILBURN & STRODE,
Agents for the Applicants.

PROVISIONAL SPECIFICATION

Improvements in or relating to Connecting Rod Assemblies for Multi-Cylinder Reciprocating Engines having Two or More Cylinders or Rows of Cylinders Angularly Displaced About a Crank Shaft

We, D. NAPIER & SON LIMITED, a Company registered under the Laws of Great Britain, of 211, Acton Vale, London, W.3, do hereby declare the nature of this invention to be as follows:—

This invention relates to connecting rod assemblies for reciprocating engines having two or more cylinders or rows of cylinders angularly displaced about the axis of rotation of a crank shaft and of the kind comprising a connecting rod, hereinafter for convenience termed the master rod connected to a piston in one of two angularly displaced cylinders and having a big end which constitutes or carries a bearing surrounding a crank pin on the crank shaft and at least one other connecting rod, hereinafter for convenience called the subsidiary rod connected to a piston in another of the angularly displaced cylinders and having a big end which constitutes or carries a bearing surrounding a journal pin rigidly connected to the master rod.

An object of the invention is to provide a connecting rod assembly of the above kind which will not only be mechanically satisfactory but will tend to reduce the dimensions of the parts associated with the connection of the subsidiary rod to the master rod so as to reduce the clearances which have to be left around the master rod and subsidiary rod and more particularly to permit of a reduction in the width of any slot or slots which have to be provided in the inner end of the cylinder, cylinder liner or sleeve valve in which reciprocates the piston to which the subsidiary rod is connected.

Hitherto it has been customary in such assemblies to provide a lateral projection on the big end of the master rod with a deep slot therein to receive the big end of the subsidiary rod and to pass a journal pin for the big end of the subsidiary rod through holes in the projection and through the bearing of the big end of the subsidiary rod. In such an arrangement the lateral projection from the big end of the master rod was necessarily of considerable dimensions with the result that where for dimensional reasons clearance slots were provided in the inner end of the cylinder liner or sleeve valve containing the piston connected to the subsidiary rod to provide clearance for this projection these slots had to be comparatively wide and deep.

A connecting rod assembly of the kind referred to according to the present invention for a reciprocating engine having two cylinders angularly displaced from one another about the axis of rotation of a crank shaft comprises a main connecting rod having a big end carrying or constituting a bearing surrounding a crank pin on the crank shaft, and a journal member for a second connecting rod comprising a cylindrical bearing member formed at its ends with lugs adapted to be bolted or similarly secured to a pair of spaced platforms formed upon the big end of the main connecting rod.

The spaced platforms constituting the pair preferably lie on opposite sides of a groove which accommodates part of the big end of the subsidiary connecting rod, while further, the lugs on the journal member for the subsidiary connecting rod conveniently lie in locating slots or recesses in the platforms, and are formed on the ends of the journal member in such a position that their outer faces against which bear the nuts or heads of the bolts securing them to the platforms lie nearer to the axis of the crank pin to which the main connecting rod is coupled than does the axis of the journal member for the subsidiary connecting rod.

Thus, in a convenient arrangement each of the lugs on an end of the subsidiary journal member comprises a substantially rectangular base portion adapted to lie within a corresponding rectangular recess in the face of its platform and having holes therein through which pass bolts or studs by which it is secured to the platform, and a web lying in a plane at right angles to the rectangular portion and containing the axis of the journal member, this web which thus lies between the bolts or studs, extending between the outer face of the rectangular portion and the adjacent end face of the journal member. The outer face of the platform in such an arrangement conveniently lies appreciably below the axis of the journal member so that the

common plane in which the outer ends of the bolt heads or studs lie extends close to but preferably not appreciably beyond the axis of the journal member.

The invention may be carried into practice in various ways but the following is a description by way of example of one construction according to the invention applicable for example to an engine having two rows of cylinders displaced by an angle of say 60° about the crank shaft axis each pair of adjacent cylinders which lie in a plane at right angles to the crank shaft axis being associated with a single crank pin upon the crank shaft.

A connecting rod assembly according to the invention is associated with each pair of cylinders lying in a plane at right angles to the crank shaft axis and comprises a master rod connected to the piston in one of the cylinders (hereinafter called the master rod cylinder) and having a big end carrying a bearing engaging the crank pin in the usual manner. The big end is conveniently split in a plane which lies at approximately 60° to the longitudinal axis of the master rod to permit insertion of a split big end bearing, the removable cap portion of the big end lying on the side of the body of the connecting rod remote from the two cylinders so as to leave integral with the body of the rod the part of the big end which faces the second cylinder (hereinafter called the subsidiary rod cylinder). The part of the big end of the master rod which faces the subsidiary rod cylinder is somewhat thickened radially and this thickened portion is provided with a comparatively deep and wide slot lying in a plane at right angles to the crank pin axis and adapted to accommodate a part of the big end of a subsidiary connection rod coupled to the piston in the subsidiary rod cylinder. It will thus be seen that the radial thickening provides in effect a pair of platforms facing the subsidiary rod cylinder with the slot between them. These two platforms are formed with similar wide rectangular slots in their outer faces extending across them in a direction parallel to the crank pin axis. Displaced from the sides of each of these slots and projecting from the base of the slot are two studs. Alternatively screw-threaded holes to receive bolts may be formed in the bore of each slot. The studs or bolts pass through holes in rectangular lugs which are formed respectively on and project from the opposite ends of a cylindrical journal member passing through the big end of the subsidiary connecting rod and are located in the slots in the platforms on the master rod to which they are rigidly secured in position by nuts engaging the outer ends of the studs and bearing on the outer faces of the lugs. Each of the lugs is formed integral with its end of the journal member and with a web which lies between the nuts and extends from the outer face of the lug to the adjacent face of the journal member.

The slot between the platforms and across which the journal member thus extends may be provided in its side faces with shallow part-cylindrical recesses adapted to accommodate adjacent end portions of the journal member, the width of the big end of the subsidiary connecting rod thus being somewhat less than the length of the journal member.

It will be seen that with such a construction the width of any slot which is provided in the skirt portion of a cylinder or liner containing the piston to which the subsidiary connecting rod is coupled in order to provide clearance for the big end assembly during rotation can be reduced to approximately the length of the subsidiary journal member, while the depth of the part of this slot which has to accommodate this journal member can be limited to that necessary to provide clearance for the journal member itself without having to provide clearance for a part of the big end of the master rod surrounding the journal member.

It is to be understood that the invention has been described with particular reference to a construction in which the master rod or each master rod has one subsidiary rod associated therewith for convenience only and that the invention may also be applied to constructions in which two or more subsidiary rods are associated with a master rod, the big end of the master rod in this case being provided with an appropriate number of pairs of platforms angularly spaced around it.

Dated this 11th day of April, 1949.

KILBURN & STRODE,
Agents for the Applicants.

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658,894 COMPLETE SPECIFICATION

FIG 1

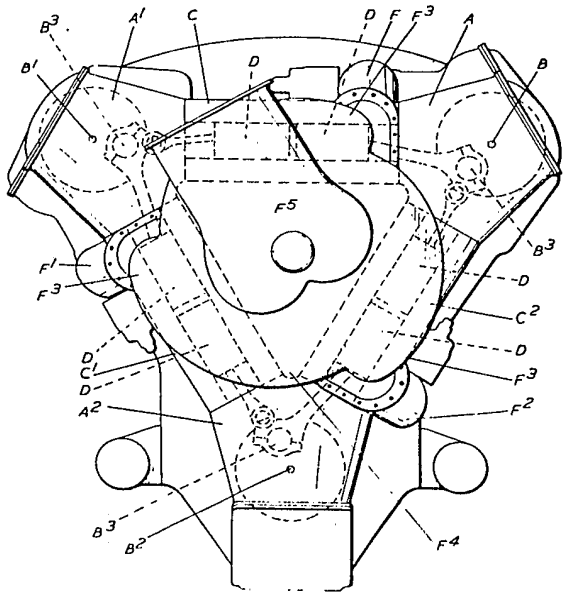
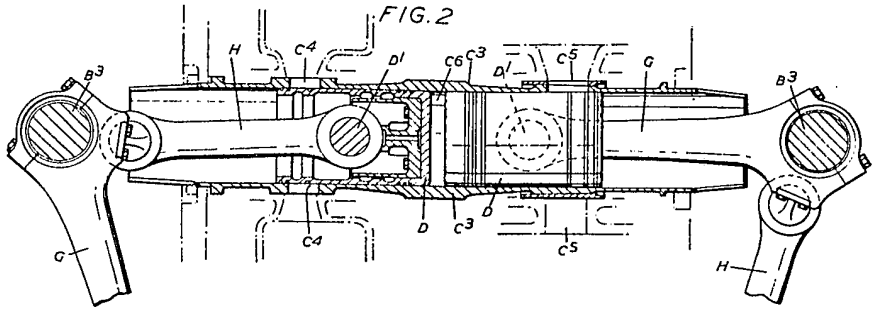
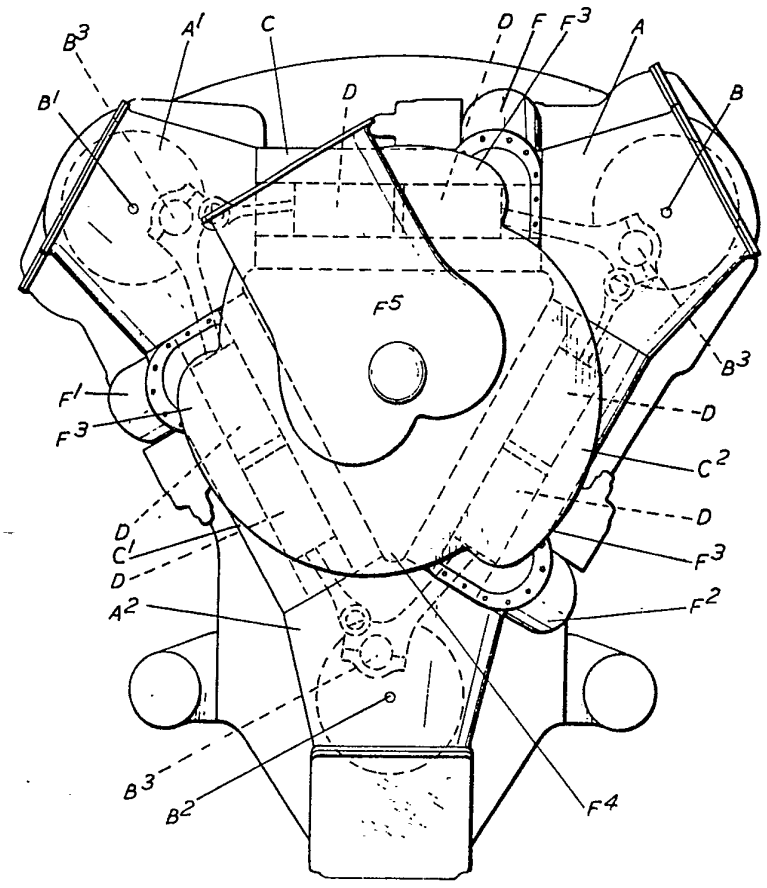


FIG. 2



H.M.S.O. (M.F.P.)

FIG. 1.



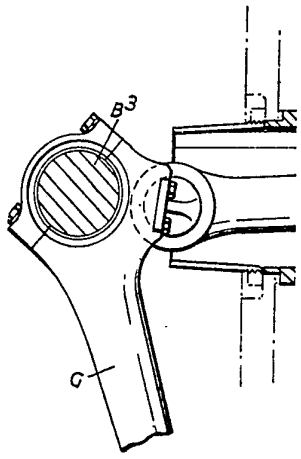
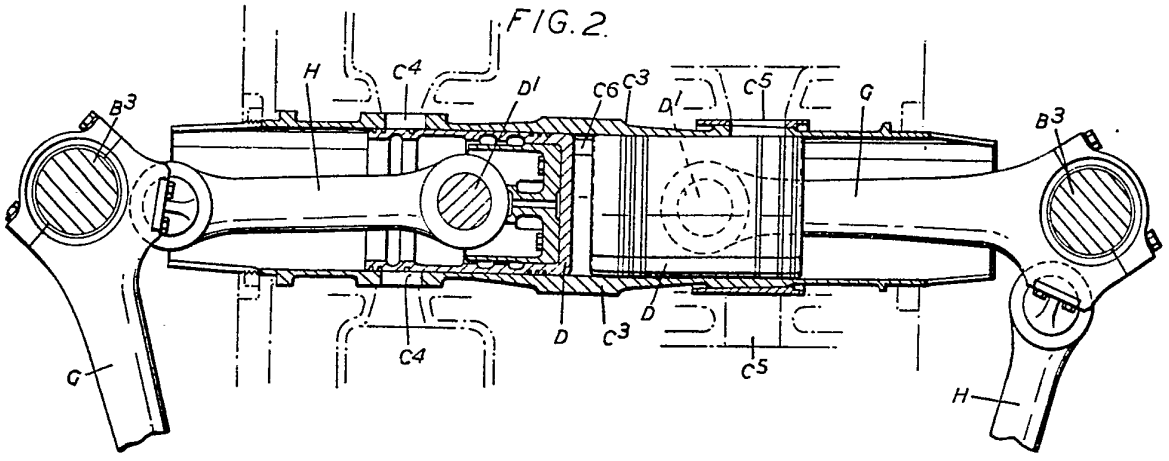


FIG. 2.



SHEET 3

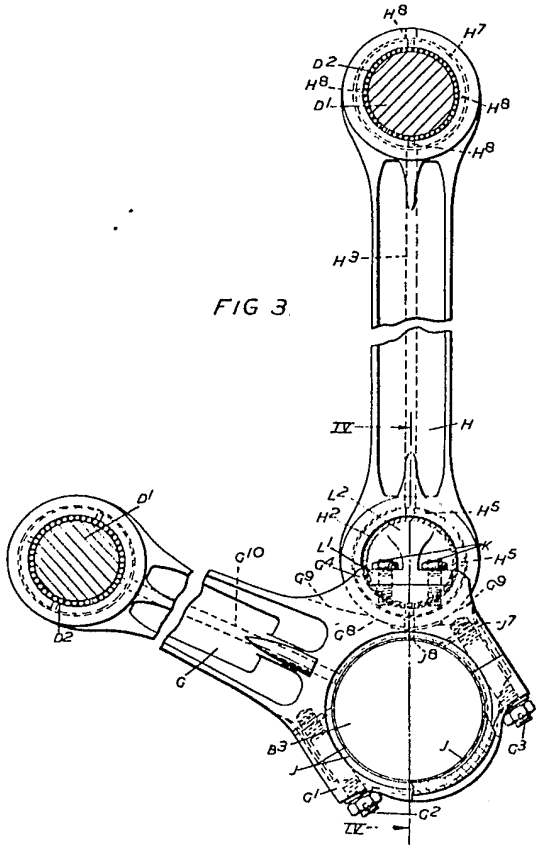


FIG 3.

SHEET 4

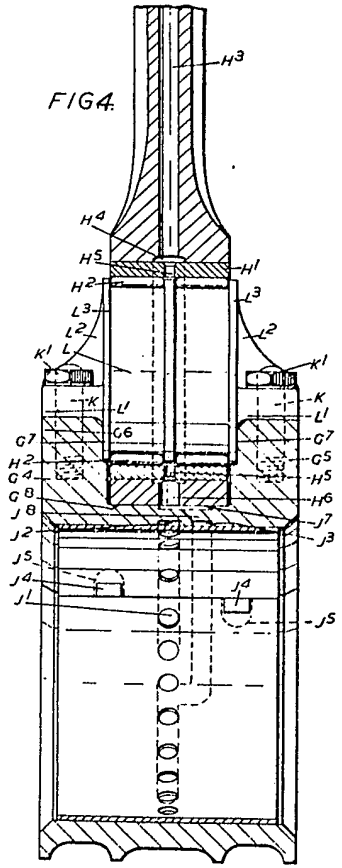


FIG.4.

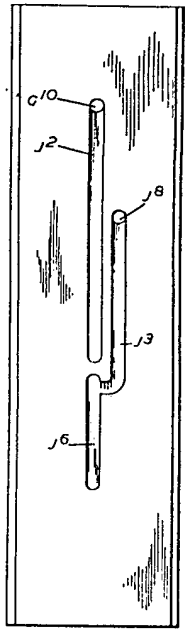


FIG.5.

H.M.S.O.(M.F.P.)

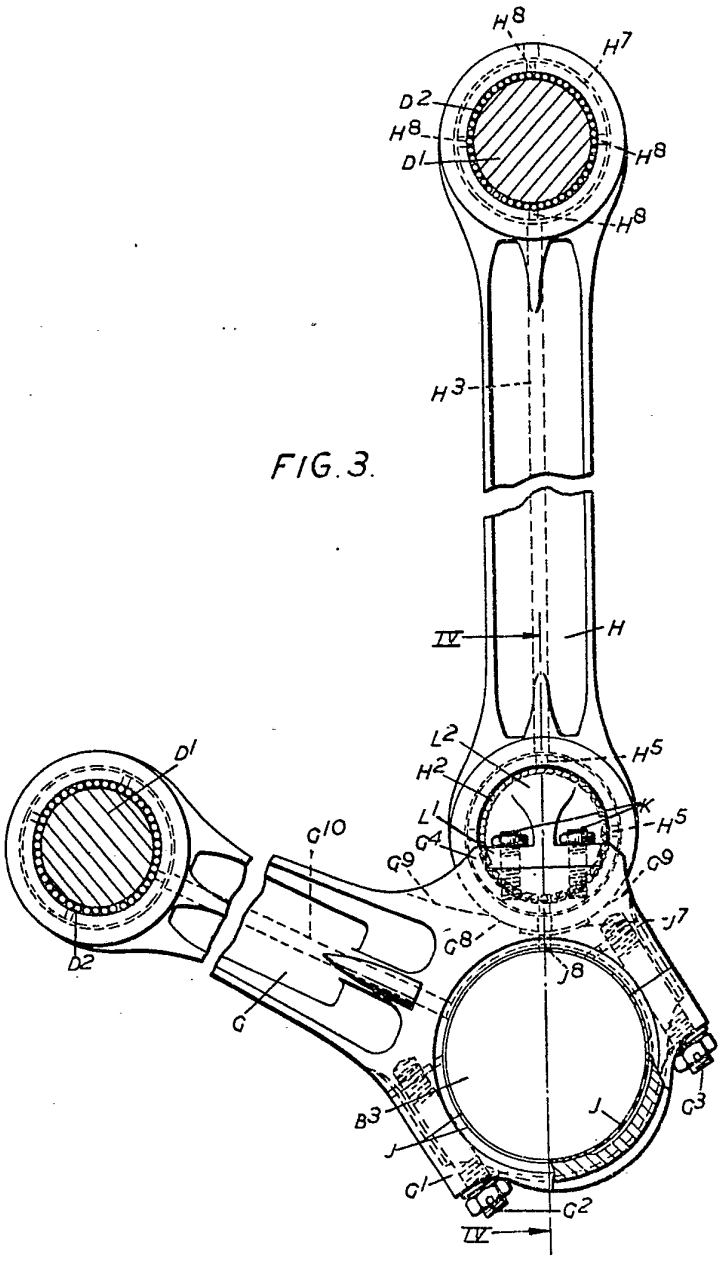
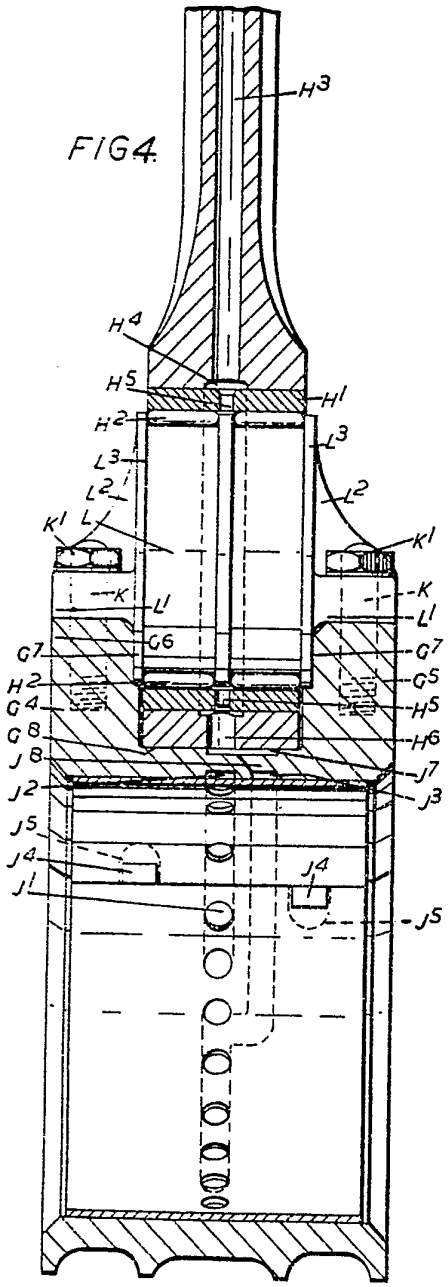


FIG. 3.

FIG4.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H4
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H1
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G6
G7
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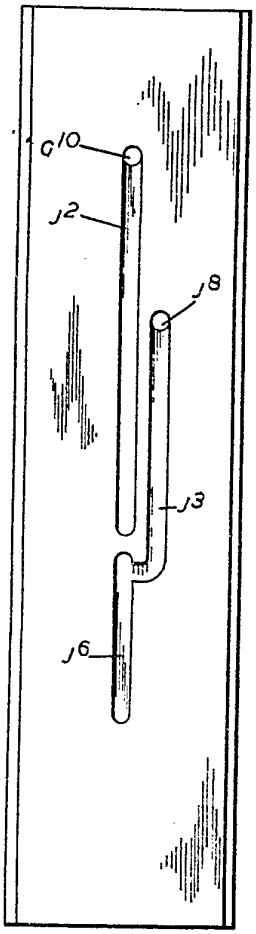
FIG.5.


G10
J2
J8
J3
J6