PATENT SPECIFICATION 864,453

DRAWINGS ATTACHED.

Inventor :—FRANK METCALF ASPIN.

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Application Date : June 23, 1956. No. 19512/56.

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Index at Acceptance :—**Classes 7(2)**, B1B9, B2A(9A : 10B : 11B : 11C : 13B : 13C) ; **7(3)**, B2G(1B : 9M : 9S : 26) ; **and 7(6)**, B2Q(5B : 7B).

International Classification :—F02b. F02f.

COMPLETE SPECIFICATION.

Improvements in or relating to Internal Combustion Engines.

We, F. M. ASPIN ENGINES LIMITED, a British Company, of 2 St. James' Square, Manchester 2, and FRANK METCALF ASPIN, a British Subject, of Westray, Horseshoe Lane, Alderley Edge, Cheshire, 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 internal combustion engines in which the combustible fuel is supplied as a mixture of a combustion-supporting gas, such as air, and fuel metered by a carburettor or other device, as opposed to mechanical injection of neat fuel. The invention is exclusively applicable to internal combustion engines of the kind (hereinafter termed " the kind referred to "), having a rotary valve in which is formed a chamber the volume of which is a major portion of the combustion space at the moment of maximum compression. Such an engine is described in Patent Specification No. 463,412.

It is well known that the scavenging of the residual products of combustion is a desirable factor in the design of an internal combustion engine. To obtain maximum performance it is essential to provide for as complete scavenging as possible and in achieving this by adopting wide over-laps in valve timing there is a consequent loss of fuel to the exhaust gases under the varying conditions which obtain.

One known way of overcoming these losses is by the use of mechanical injection into the cylinder direct or in the inlet port, but such mechanical injection involves considerable expense and complication and has other inherent disadvantages.

The object of the present invention is to effect improved scavenging and provide greater general efficiency in a rotary valve engine of the kind referred to.

According to the invention an internal combustion engine of the kind referred to is characterised by means for supplying to the, or each, cylinder, as separate parts of the combustion volume respectively a combustion-supporting gas, such as fuelless air, and a rich mixture of fuel and gas, such as a liquid fuel suspended in air, in such manner and order of sequence that the said combustion-supporting gas is used initially for scavenging and later to combine with the rich mixture in the desired proportion for combustion, whereby loss of a proportion of the said combustion-supporting gas with the exhausting products of a preceding combustion in the cylinder can provide more complete scavenging substantially without loss of fuel, whilst turbulence due to the rotation of the combustion space in the rotary valve is induced sequentially by the separately supplied parts of the combustion volume.

The internal combustion engine aforesaid may be further characterised in that the means for admitting the rich gaseous mixture is so arranged as to delay admission until scavenging has been substantially completed ; or further characterised in that the means for admitting the rich gaseous mixture is so arranged as to delay admission until loss of such mixture to the exhaust does not occur.

The invention will be described hereinafter by way of example with reference to

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several arrangements in which the said combustion-supporting gas is fuel-less or fuel free air and the rich mixture consists of an atomised or vaporised liquid fuel in air in proportions to form a combustible but so-called rich mixture but the invention is not limited thereto. For instance, the combustion-supporting gas could be a weak but combustible mixture which could be oxygen enriched, whilst the fuel content of the rich mixture could consist of a gas ; or the liquid fuel content could be suspended in some other medium than air, which might itself be combustible as distinct from combustion-supporting. Obviously however the main application of the invention will be with the use respectively of fuel-less or fuel free air and a rich mixture of a liquid fuel suspended in air.

In the drawings filed with, and accompanying, the Provisional Specification :—

Fig. 1 is a diagrammatic section of one example of a 4-stroke internal combustion engine and fuel metering device made in accordance with the present invention ;

Fig. 2 is a diagrammatic section at right angles to Fig. 1 ;

Fig. 3 is a diagrammatic plan of the rotary valve and metering device of the engine shown in Fig. 1 ;

Fig. 4 is a section on line A—A showing the rotary valve fully open to exhaust ;

Figs. 5, 6, 7, 8, 9 and 10 are sections showing further positions of the rotary valve ;

Fig. 11 is a diagrammatic sectional plan of valve gear and fuel metering device for two adjacent cylinders of a multi-cylinder engine ;

Figs. 12, 13, 14, 15, 16 and 17 are sectional views similar to Figs. 5 to 10, but showing a modification of the invention.

As shown in Figs. 1 to 3 the engine comprises a cylinder 10, crankshaft 11, piston 12 and connecting rod 13. At the top of the cylinder is a rotary valve (rotor) 14 housed in a plug-like member (stator) 15, the piston being shown in the top dead centre position. In the rotor 14 is the combustion chamber 16 representing the major portion of the combustion space at maximum compression, the chamber however being shown for the inlet period in communication with the induction pipe 17. A carburettor 18 is shown connected to the induction pipe having separate passages 19 and 20, for fuel-less air and for a rich mixture of fuel and air respectively. The separation of these passages within the carburettor by the partition 21^1 (Fig. 2) is continued in the induction pipe by a partition 17*a* and in the induction passage of the stator by the partition 15*a*. The carburettor shown includes diagrammatically a float chamber 21, fuel jet 22 and dual butterfly valve 23*a*, 23*b*. In the stator is also shown the exhaust passage 24. The means for driving the rotary valve are shown diagrammatically including a shaft 25.

In operation, Fig. 4 shows exhaust fully open and Fig. 5 shows the rotor in its position prior to the commencement of the inlet period. Fig. 6 shows the rotor in top-dead-centre position with relative overlap through the combustion chamber between the fuel-less air passage 19 and the exhaust so that scavenging is in full process. Fig. 7 shows the end of scavenging with the chamber closed to the exhaust port and about to open to the passage 20 for the rich fuel/air mixture. Figs. 8, 9 and 10 show further progressive stages in the position of the rotor to the end of the inlet period, the fuel-less air passage having been closed in Fig. 9.

As will be obvious, the initial admission of fuel-less air enables scavenging to be effected so that contamination is substantially reduced whilst loss of fuel to the exhaust is substantially eliminated. This gives possibilities for an increase of power and reduced tendency to detonation. Also, whereas in a multi-cylinder engine the induction manifold is heated to assist distribution, cold air can be used for the major portion of the ultimate charge and therefore a greater volumetric efficiency can be obtained. At the same time the rich fuel/air mixture can be heated to assist distribution without the same proportionate loss of volumetric efficiency.

Fig. 11 is a diagram for the rotors 26, 27 of adjacent cylinders supplied by an induction manifold 28 from a single carburettor 29.

As shown in Figs. 12 to 17 inclusive the rotor 30 in the stator 31 is the same as the rotor 14, but the stator inlet passage is divided additionally to provide a central rich mixture passage 32 and fuel-less air passages 33, 34 on each side thereof. As can be seen from the sequence of figures, not only is fuel-less air provided for scavenging, but also during the last part of the induction period which normally passes bottom-dead-centre and at which stage, under certain quite normal conditions, " blow-back " through the carburettor occurs with loss of fuel. The " cut-off " of the rich mixture results in the last part of the induction volume being fuel-less and therefore any " blow-back " will be substantially fuel-less.

Although in the drawings, the division of the passages is shown as if parallel to the axis of the rotor, and the passages of equal cross section, the above can be varied in shape and area of passage to suit any particular conditions and any such modification is so obviously possible and simple as to require no detailed description or illustration.

WHAT WE CLAIM IS :—

1. An internal combustion engine of the kind referred to characterised by means for supplying separately to the, or each,

cylinder combustion volume parts comprising respectively a combustion-supporting gas, such as fuel-less air, and a rich mixture of fuel and gas, such as a liquid fuel suspended in air, in such manner and order of sequence that the said combustion-supporting gas is used initially for scavenging and later to combine with the rich mixture in the desired proportions for combustion whereby loss of a proportion of the said combustion-supporting gas with the exhausting products of a preceding combustion in the cylinder can provide more complete scavenging, substantially without loss of fuel, whilst turbulence due to the rotation of the combustion space in the rotary valve is induced sequentially by the separately supplied combustion volume parts.

2. An internal combustion engine according to Claim 1 further characterised in that the passage for admitting the rich mixture is so arranged as to delay admission until scavenging has been terminated and the exhaust port is fully closed.

3. An internal combustion engine according to Claim 1 or 2 further characterised in that complementary inlet ports in the rotary valve and its housing are overall generally trapezoidal in shape and the housing port is sub-divided by a partition running in the direction of the axis of rotation of the valve.

4. An internal combustion engine according to Claim 3 further characterised in that the said complementary inlet port in the housing is divided into two ports, one for each separate supply.

5. An internal combustion engine according to Claim 4 further characterised in that the partition is substantially medially arranged.

6. An internal combustion engine according to Claim 3 further characterised in that the complementary inlet port in the housing is subdivided substantially by axial partitions into three areas to provide a medial area for the rich mixture and side areas for the combustion-supporting gas.

7. A multi-cylinder internal combustion engine according to any of the preceding claims characterised in that at least two of the cylinders are supplied from a common carburettor.

8. In combination with an internal combustion engine as claimed in any of the preceding claims a carburettor having separate passages for mixture and fuel-less air with throttle mechanism in each coupled the one to the other for movement by a common control.

9. An internal combustion engine constructed, arranged and adapted to operate substantially as herein described with reference to and as illustrated in Figs. 1 to 10 of the drawings accompanying the Provisional Specification.

10. A multi-cylinder internal combustion engine constructed, arranged and adapted to operate substantially as herein described with reference to and as illustrated in Fig. 11 of the drawings accompanying the Provisional Specification.

11. An internal combustion engine constructed, arranged and adapted to operate substantially as herein described with reference to and as illustrated in Figs. 1 to 3 and as modified in Figs. 12 to 17 of the drawings accompanying the Provisional Specification.

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Chartered Patent Agents,
57 Market Street, Manchester 1.

PROVISIONAL SPECIFICATION.

Improvements in or relating to Internal Combustion Engines.

We, F. M. ASPIN ENGINES LIMITED, a British Company, of 2 St. James' Square, Manchester 2, and FRANK METCALF ASPIN, a British Subject, of Westray, Horseshoe Lane, Alderley Edge, in the County of Chester, do hereby declare this invention to be described in the following statement:—

This invention relates to internal combustion engines of the kind in which the combustible fuel is supplied as a mixture of air and fuel metered by a carburettor or other device, as opposed to mechanical injection of neat fuel. The invention is particularly though not exclusively, applicable to internal combustion engines of the kind described in Patent No. 463,412 having a rotary valve in which is formed a chamber the volume of which is a major portion of the combustion space at the moment of maximum compression.

It is well known that the scavenging of the residual products of combustion is a desirable factor in the design of an internal combustion engine. To obtain maximum performance it is essential to provide for as complete scavenging as possible and in achieving this by adopting wide over-laps in valve timing there is a consequent loss of fuel to the exhaust gases under the varying conditions which obtain.

One known way of overcoming these losses is by the use of mechanical injection into the cylinder direct or in the inlet port, but such mechanical injection involves considerable expense and complication and has other inherent disadvantages.

The object of the present invention is to effect improved scavenging and provide greater general efficiency in an internal combustion engine.

According to the invention an internal combustion engine of the kind referred to is characterised in that means for supplying separately to the cylinder, respectively fuel-less air and a rich mixture of fuel and air in such manner that the fuel-less air is used for scavenging and to combine with the rich mixture in the desired proportion for combustion.

The internal combustion engine aforesaid may be further characterised in that the means for admitting the rich mixture is so arranged as to delay admission until scavenging has been substantially completed; or further characterised in that the means for admitting the rich mixture is so arranged as to delay admission until loss of such mixture to the exhaust does not occur.

In the accompanying drawings :—

Fig. 1 is a diagrammatic section of one example of a 4-cycle internal combustion engine and fuel metering device made in accordance with the present invention ;

Fig. 2 is a diagrammatic section at right angles to Fig. 1 ;

Fig. 3 is a diagrammatic plan of the rotary valve and metering device of the engine shown in Fig. 1 ;

Fig. 4 is a section on line A—A showing the rotary valve fully open to exhaust ;

Figs. 5, 6, 7, 8, 9 and 10 are sections showing further positions of the rotary valve ;

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Figs. 12, 13, 14, 15, 16 and 17 are sectional views similar to Figs. 5 to 10, but showing a modification of the invention.

As shown in the drawing the engine comprises a cylinder 10, crankshaft 11, piston 12 and connecting rod 13. At the top of the cylinder is a rotary valve (rotor) 14 housed in a plug-like member (stator) 15, the piston being shown in the top dead centre position. In the rotor 14 is the combustion chamber 16 representing the major portion of the combustion space at maximum compression, the chamber however being shown for the inlet cycle in communication with the induction pipe 17. A carburettor 18 is shown connected to the induction pipe having separate passages 19 and 20, for fuel-less air and rich mixture respectively. The separation of these passages within the carburettor by the partition 21^1 is continued in the induction pipe by a partition 17*a* and in the induction passage of the stator by the partition 15*a*. The carburettor shown includes diagrammatically a float chamber 21, fuel jet 22 and dual butterfly valve 23*a*, 23*b*. In the stator is also shown the exhaust passage 24. The means for driving the rotary valve are shown diagrammatically including a shaft 25.

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Fig. 11 is a diagram for the rotors 26, 27 of adjacent cylinders supplied by an induction manifold 28 from a single carburettor 29.

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Although in the drawings, the division of the passages is shown as if parallel to the axis of the rotor, and the passages of equal cross section, the above can be varied in shape and area of passage to suit any particular conditions.

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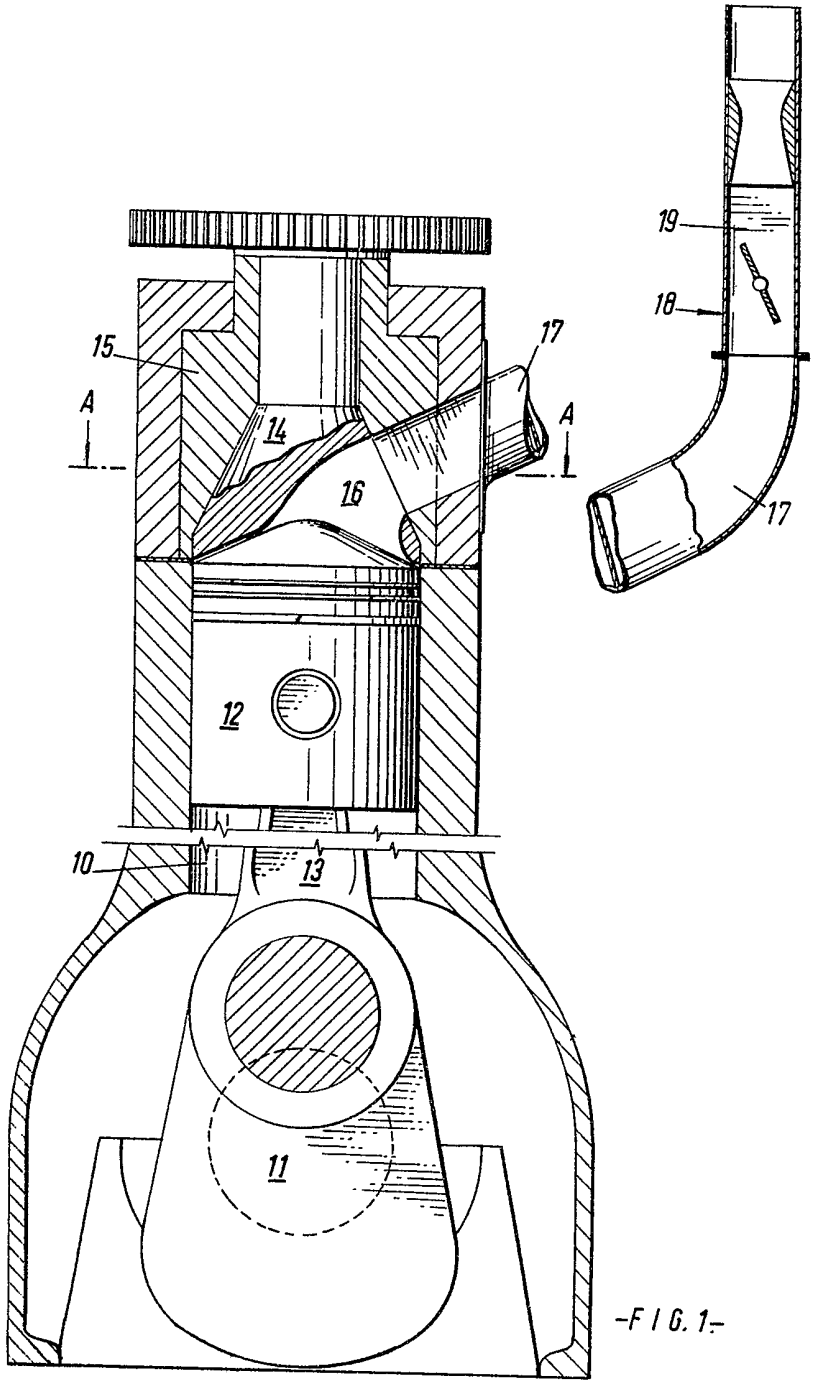
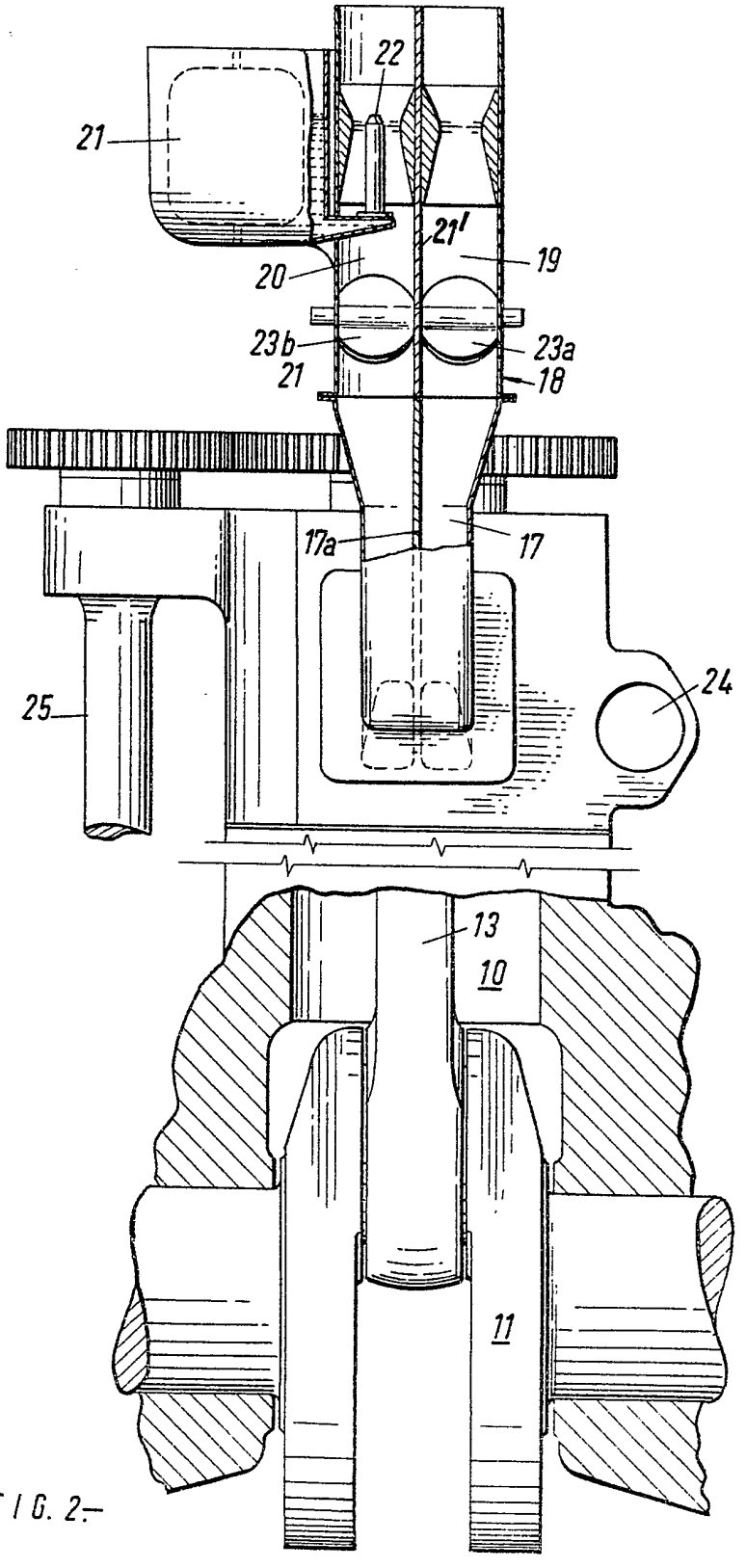
864,453 PROVISIONAL SPECIFICATION
5 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEET 1



-F I G. 1-



-FIG. 2-

864,453 PROVISIONAL SPECIFICATION
5 SHEETS

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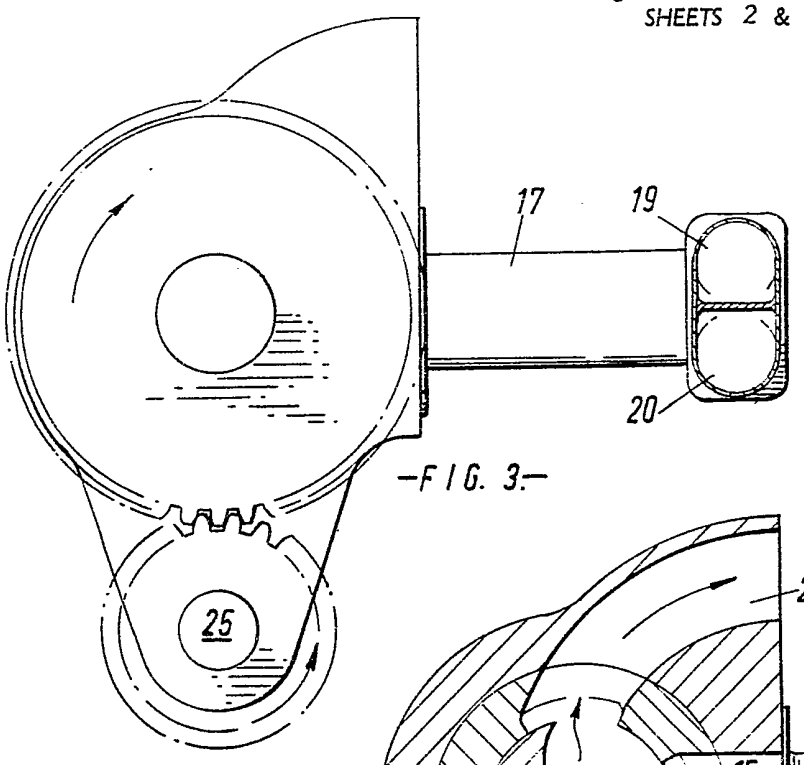
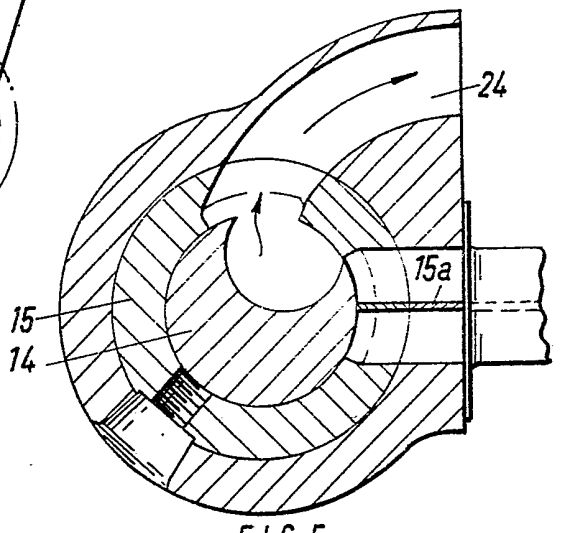
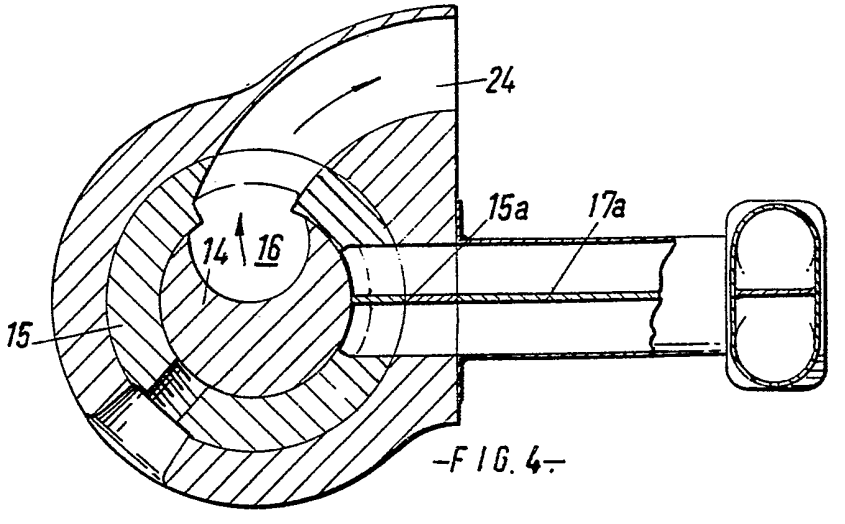
SHEETS 2 & 3



—FIG. 3.—



—FIG. 5.—



—FIG. 4.—

864,453 PROVISIONAL SPECIFICATION
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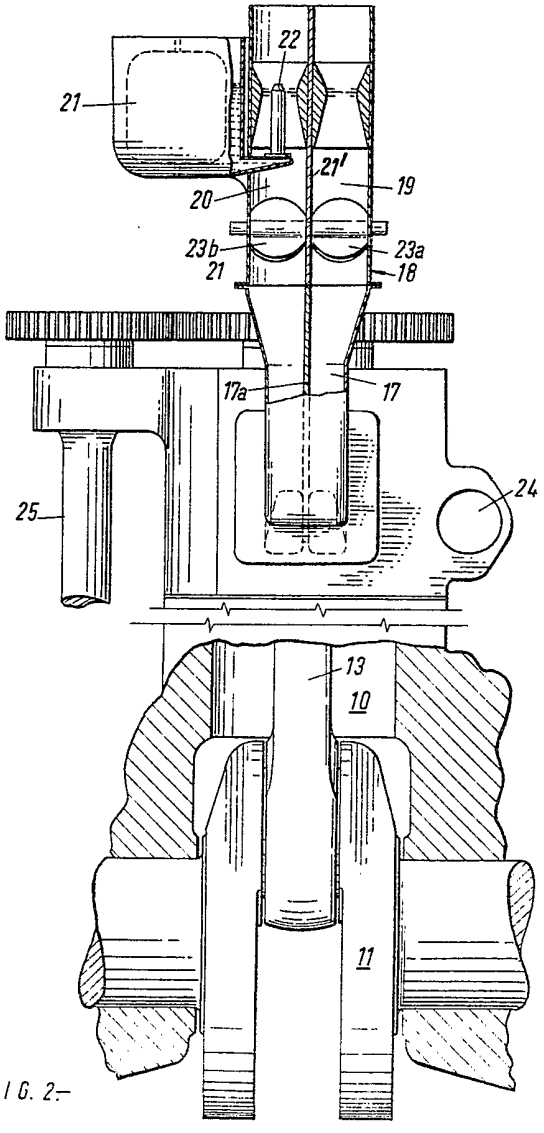
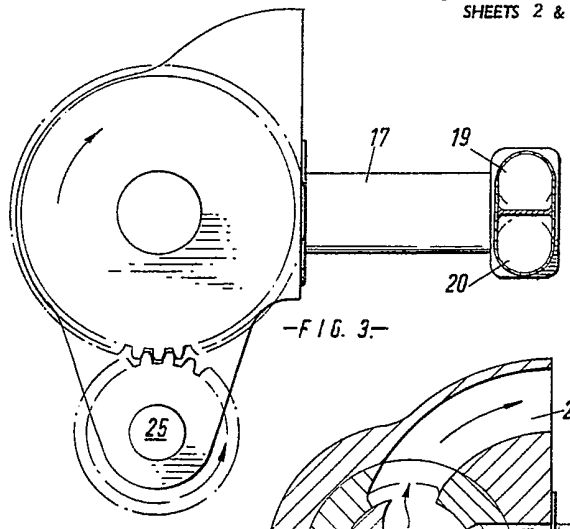
SHEETS 2 & 3



-F I G. 2.-



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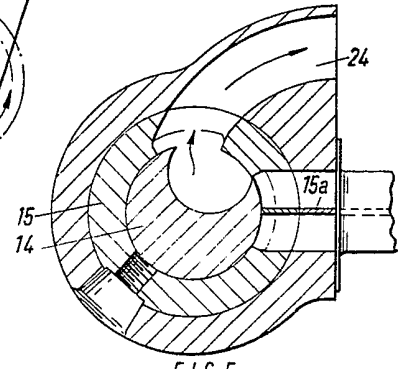
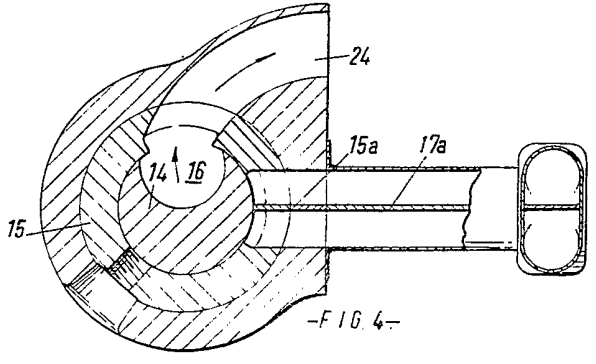
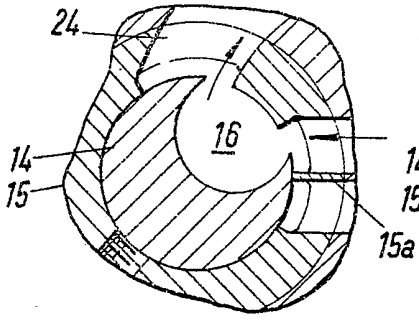


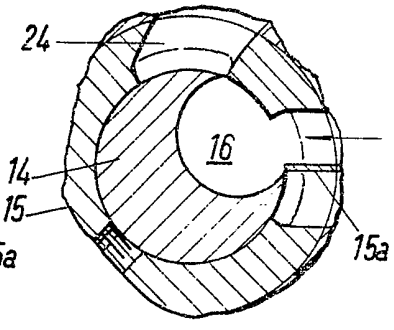
-F I G. 5.-



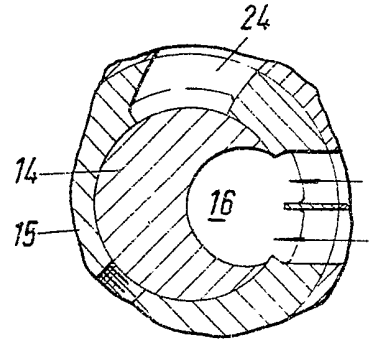
-F I G. 4.-



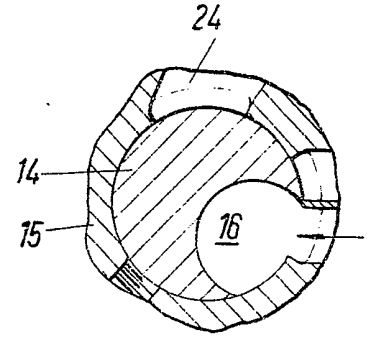
-FIG. 6.-



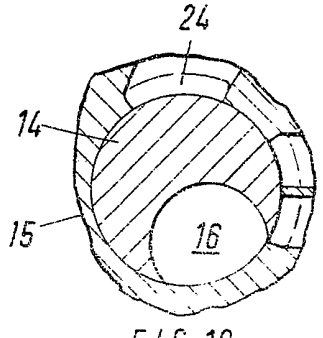
-FIG. 7.-



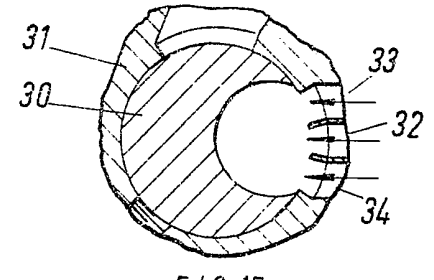
-FIG. 8.-



-FIG. 9.-



-FIG. 10.-



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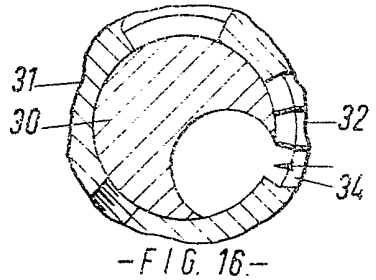
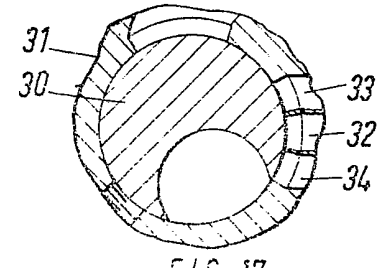


-FIG. 16.-



-FIG. 17.-

864,453 PROVISIONAL SPECIFICATION
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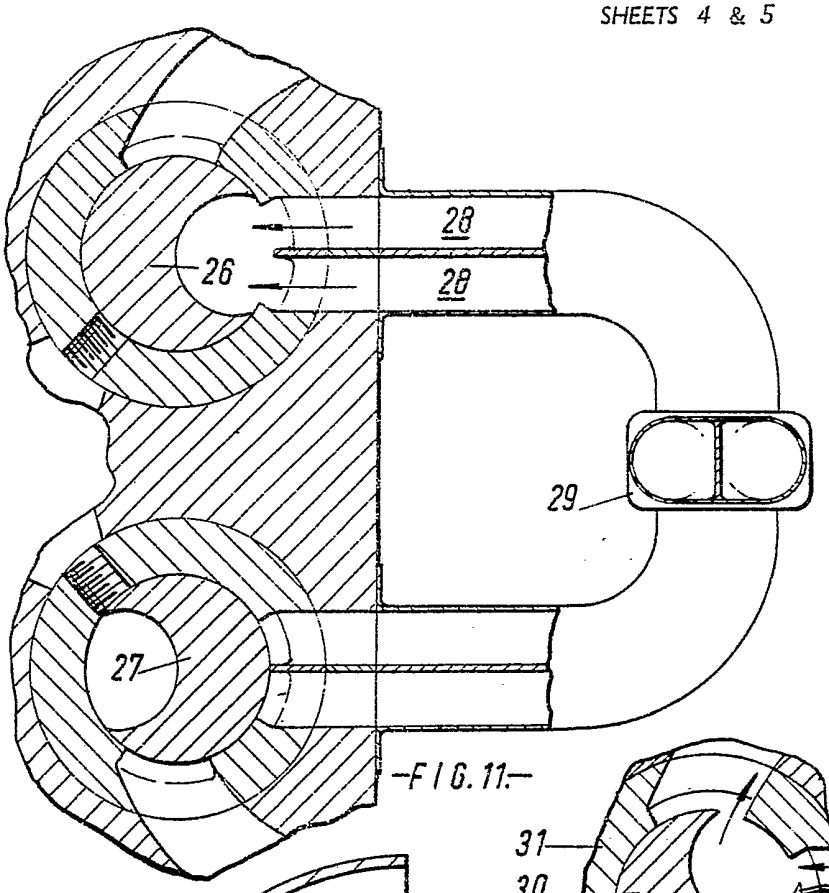
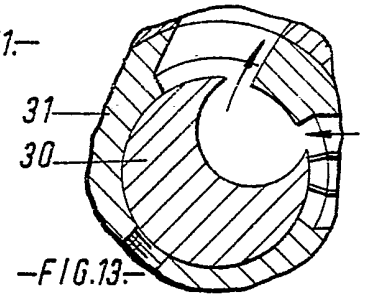
SHEETS 4 & 5

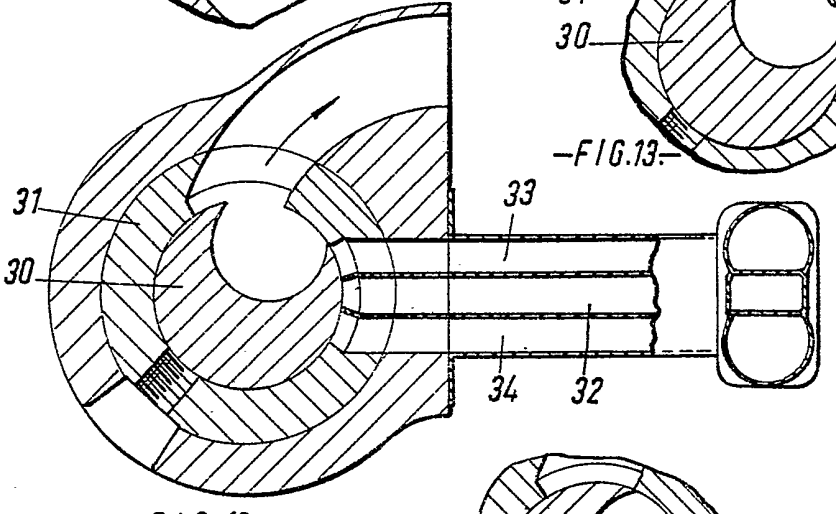


-FIG. 11.-



-FIG. 13.-

33
32
34



-FIG. 12.-

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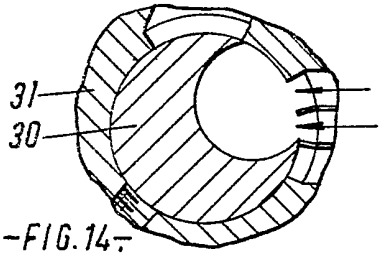
-34



-FIG. 14.-

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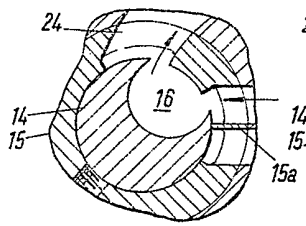
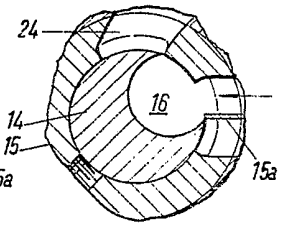
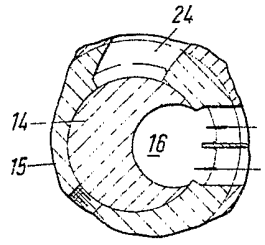


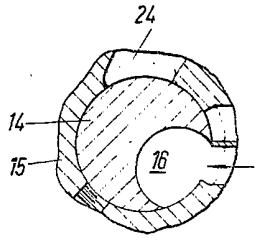
-FIG. 6.-



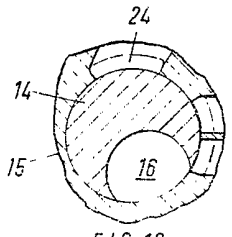
-FIG. 7.-



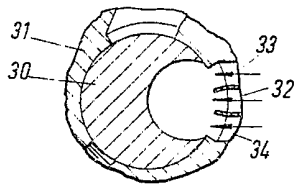
-FIG. 8.-



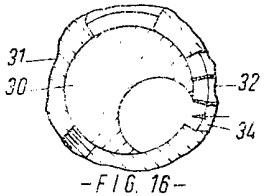
-FIG. 9.-



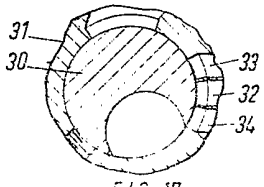
-FIG. 10.-



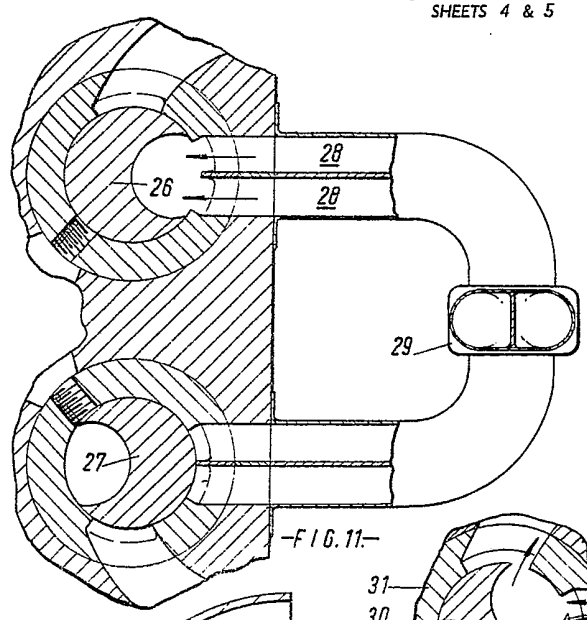
-FIG. 15.-



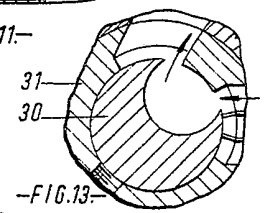
-FIG. 16-



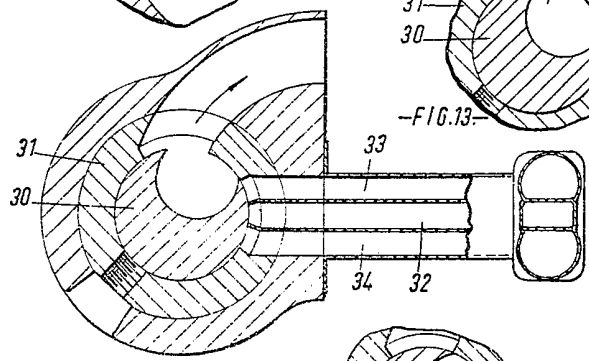
-FIG. 17.-



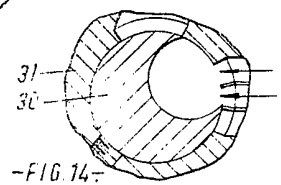
-FIG. 11.-



-FIG.13.-



-FIG. 12.-



-FIG. 14.-