

[54] INTERNAL COMBUSTION ENGINE

[76] Inventor: **Louis E. Kramer**, 5323 Elk Creek Rd., Madison Township, Butler County, Ohio 45042

[22] Filed: **Mar. 30, 1973**

[21] Appl. No.: **346,705**

[52] U.S. Cl. **123/51 B**, 123/51 BA, 123/51 BC, 123/51 BD, 123/59 BS, 123/71 R, 123/73 CC

[51] Int. Cl. **F02b 25/08**, F02b 75/28

[58] Field of Search..... 123/51 R, 51 B, 51 BD, 123/51 BA, 51 BC, 65 A, 53 R, 71 R, 73 CC, 65 S, 59 BS

[56] References Cited

UNITED STATES PATENTS

835,908	11/1906	Jensen.....	123/51 B
2,090,709	8/1937	Steiner.....	123/51 B
2,246,701	6/1941	Steiner.....	123/51 B
3,189,010	6/1965	Isley.....	123/41.35

3,557,761 1/1971 Wenzel 123/71 R X

Primary Examiner—Charles J. Myhre

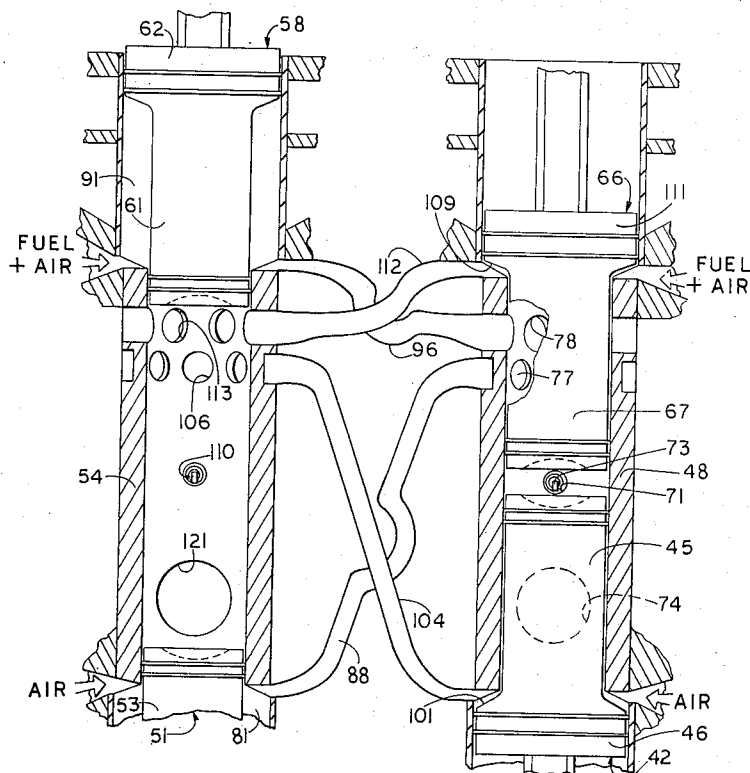
Assistant Examiner—Tony Argenbright

Attorney, Agent, or Firm—James W. Pearce; Roy F. Schaeperklaus

[57] ABSTRACT

An internal combustion engine including a pair of compound cylinder assemblies in each of which two pistons operate. Each piston includes a head and an enlarged section. Each cylinder assembly includes a central tube in which heads of the pistons operate and outer sections of increased diameter which serve as compressor sections and in which enlarged sections of the pistons operate. Air is compressed in one compressor section of each assembly and a charge is compressed in the other compressor section of each assembly. The compressed air clears products of combustion from the central tubes.

3 Claims, 11 Drawing Figures



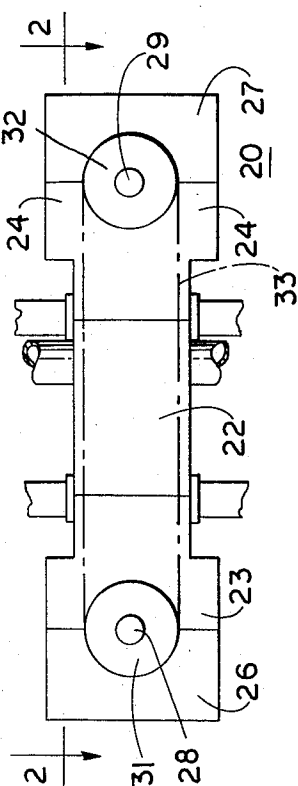
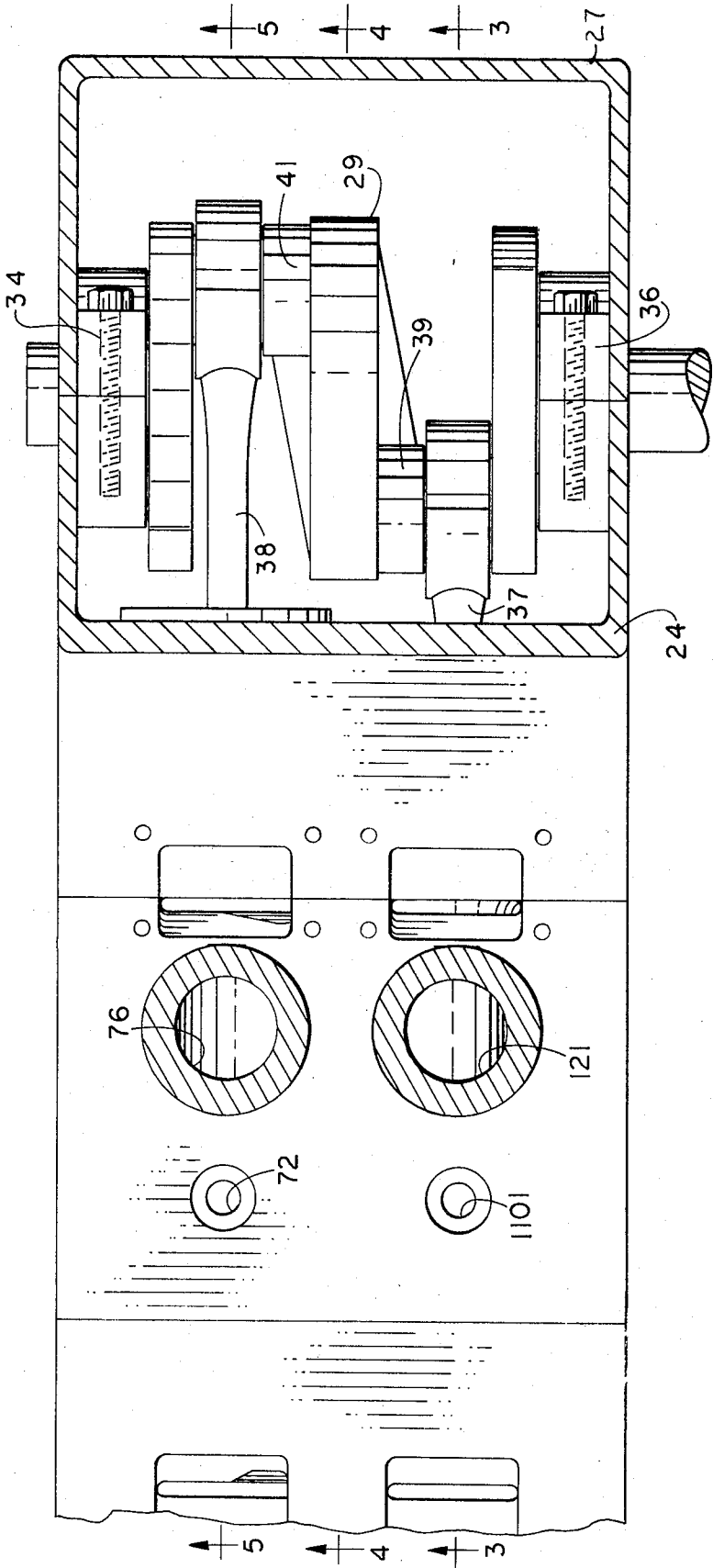


FIG. 1



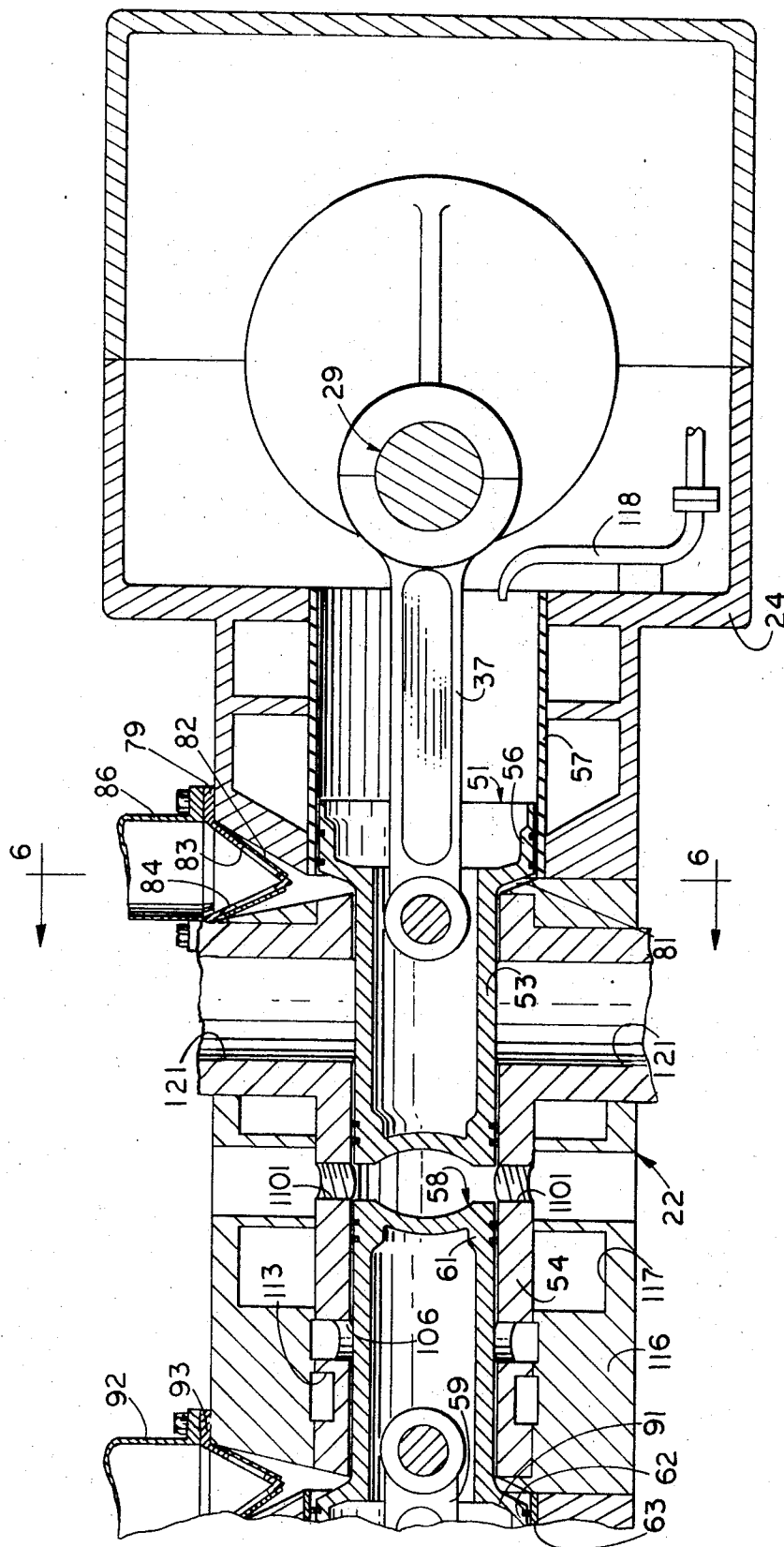
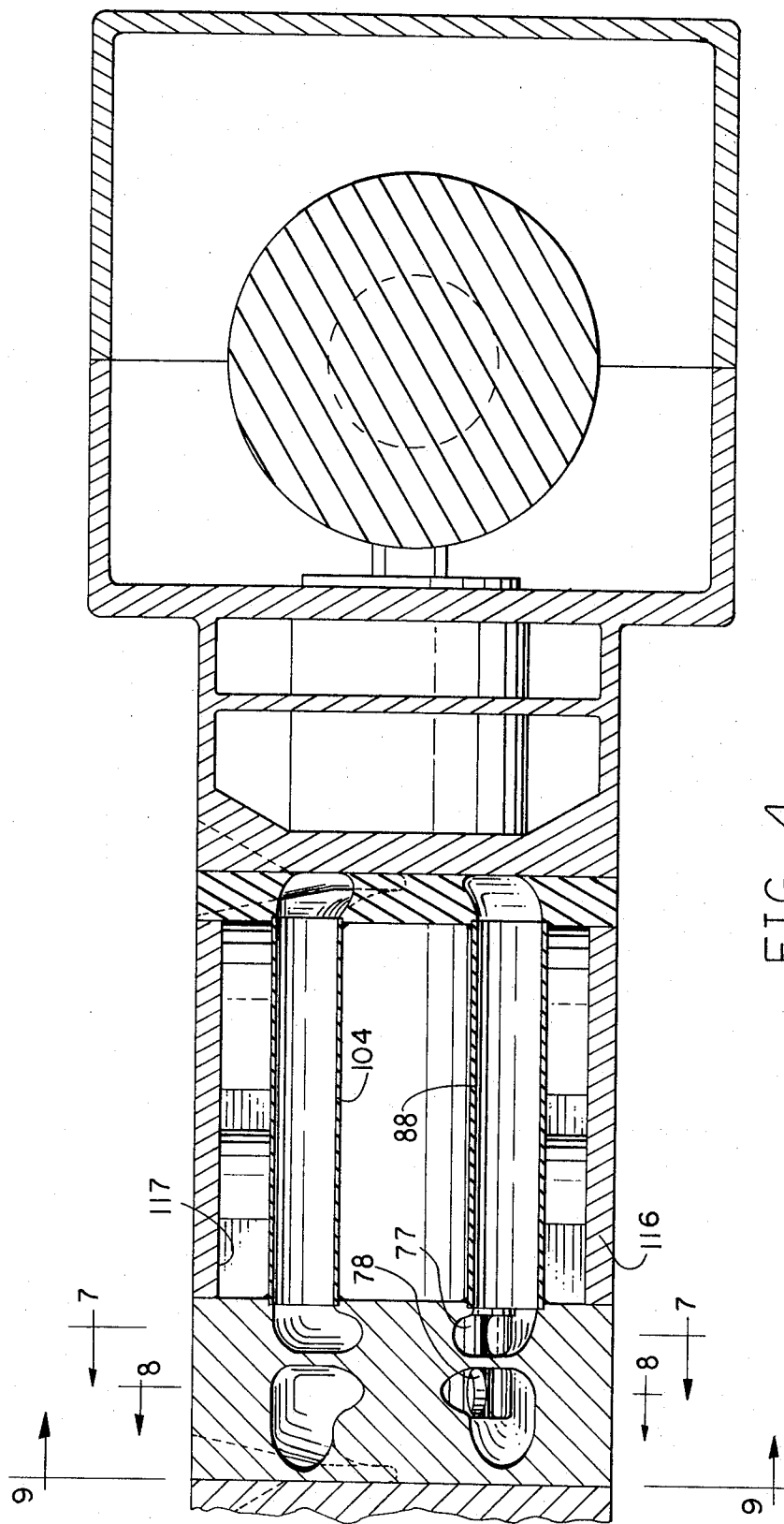


FIG. 3



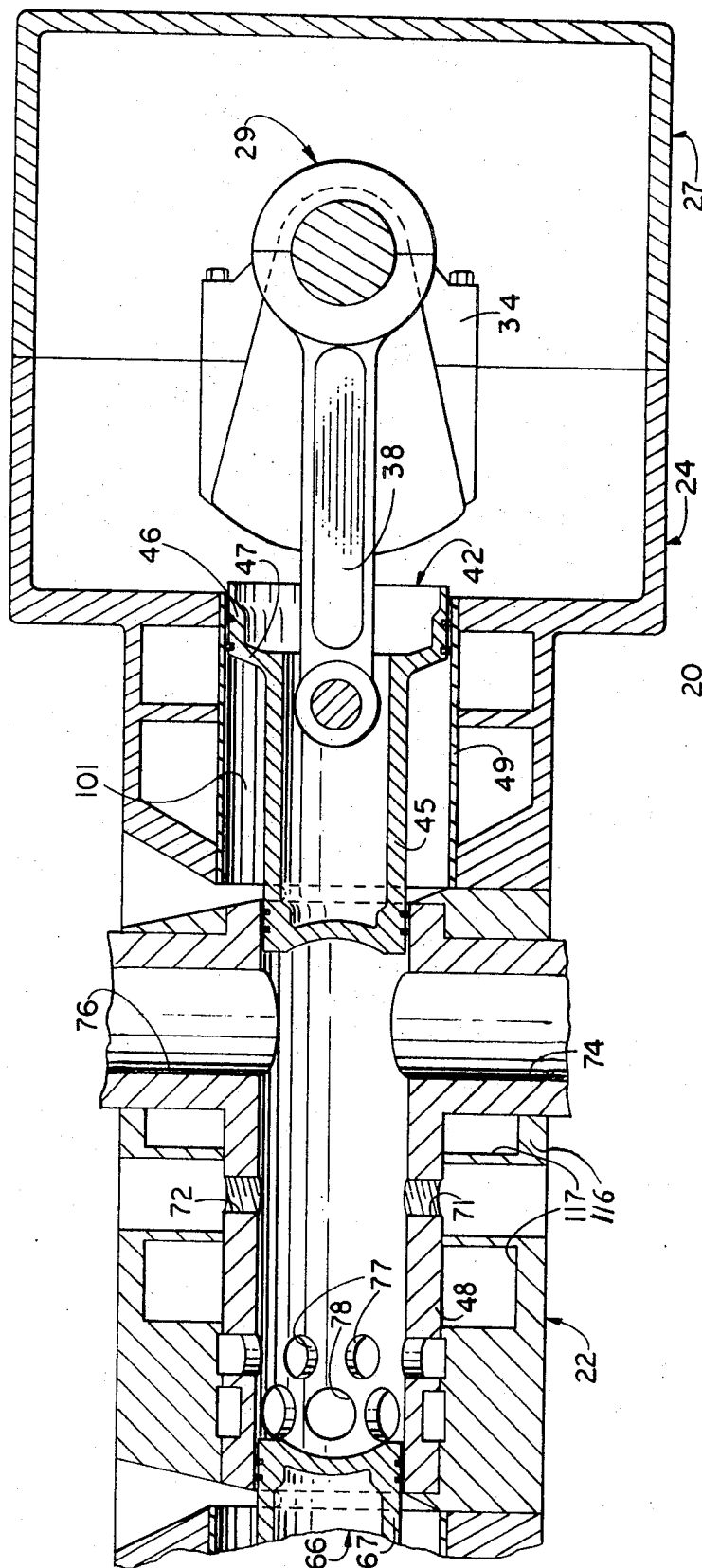
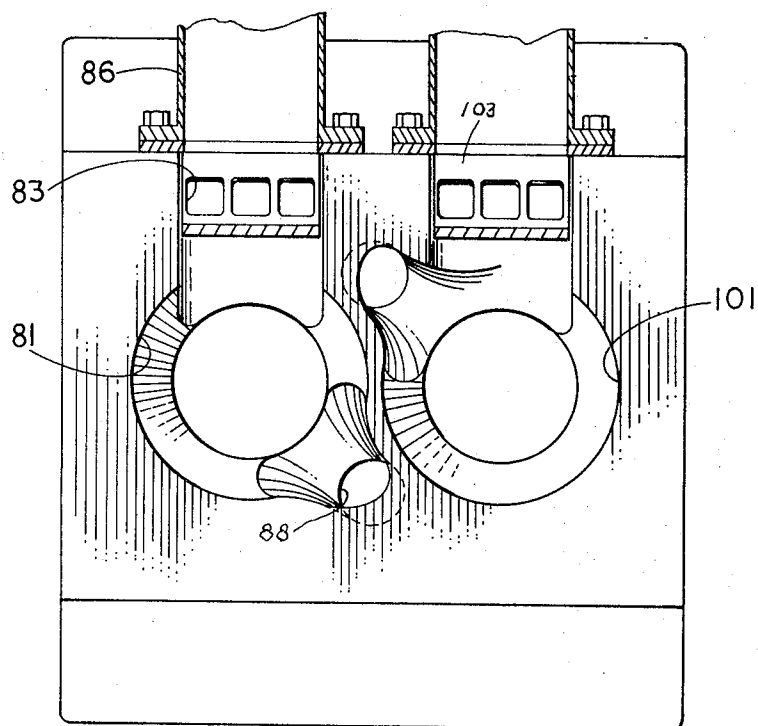
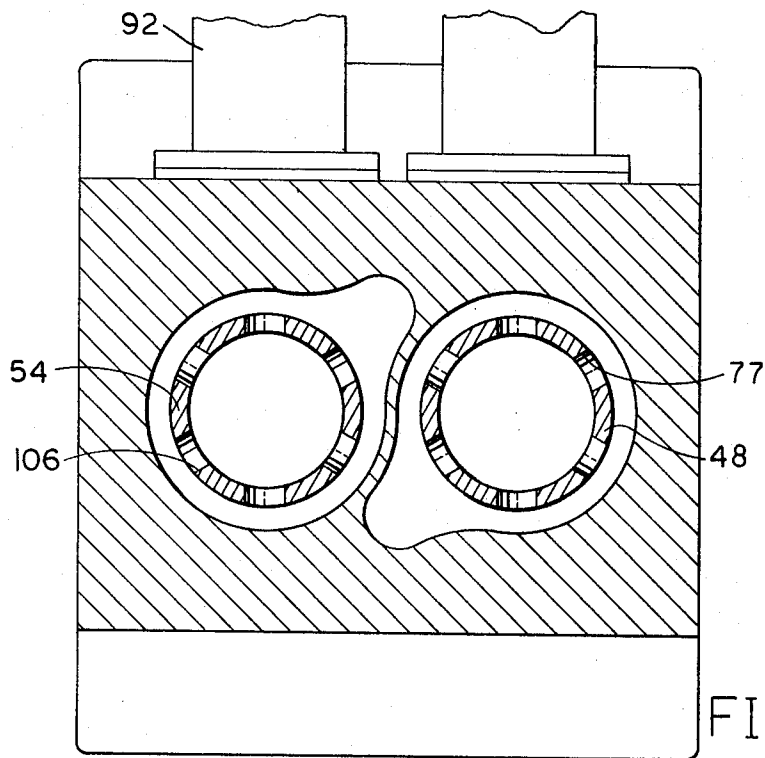
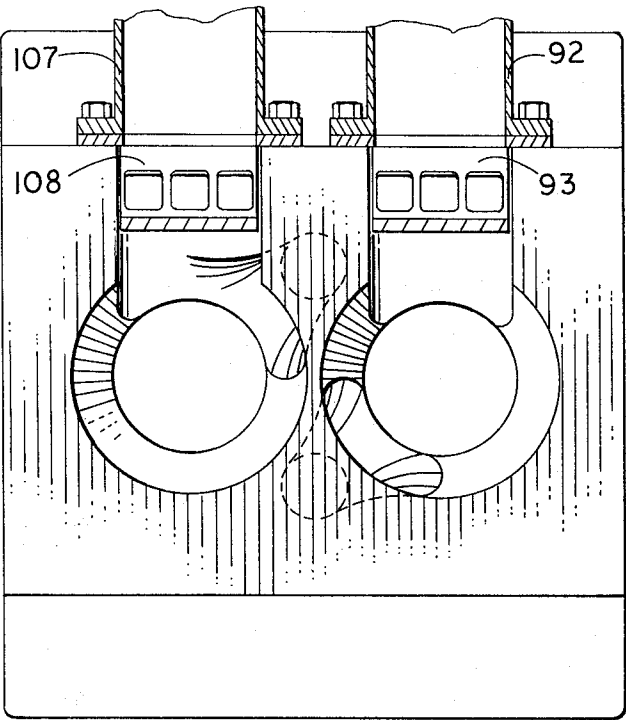
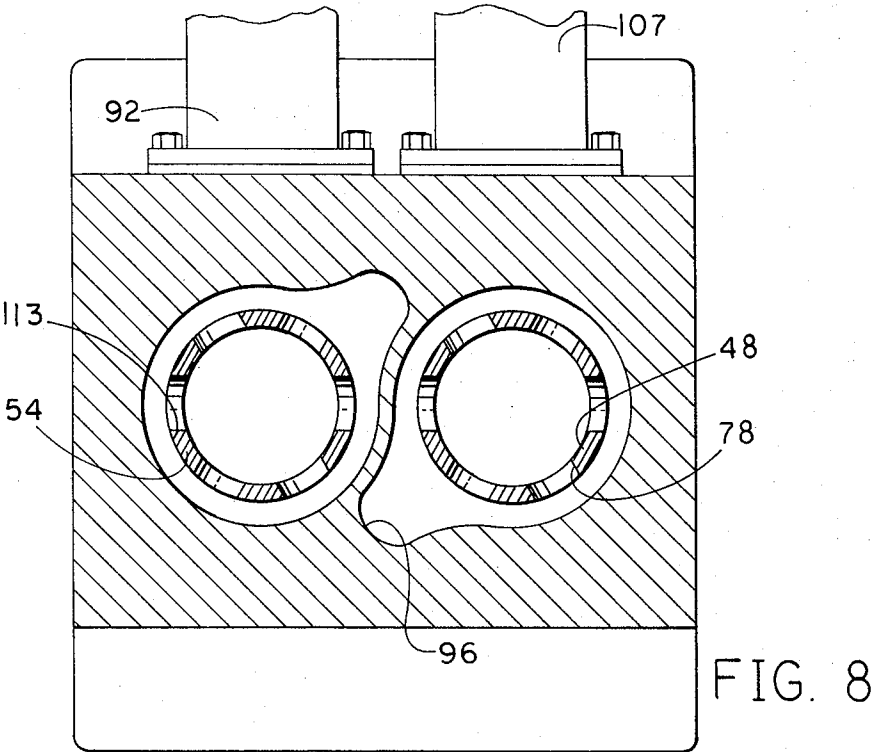


FIG. 5





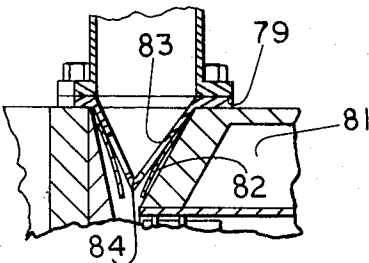


FIG. 10

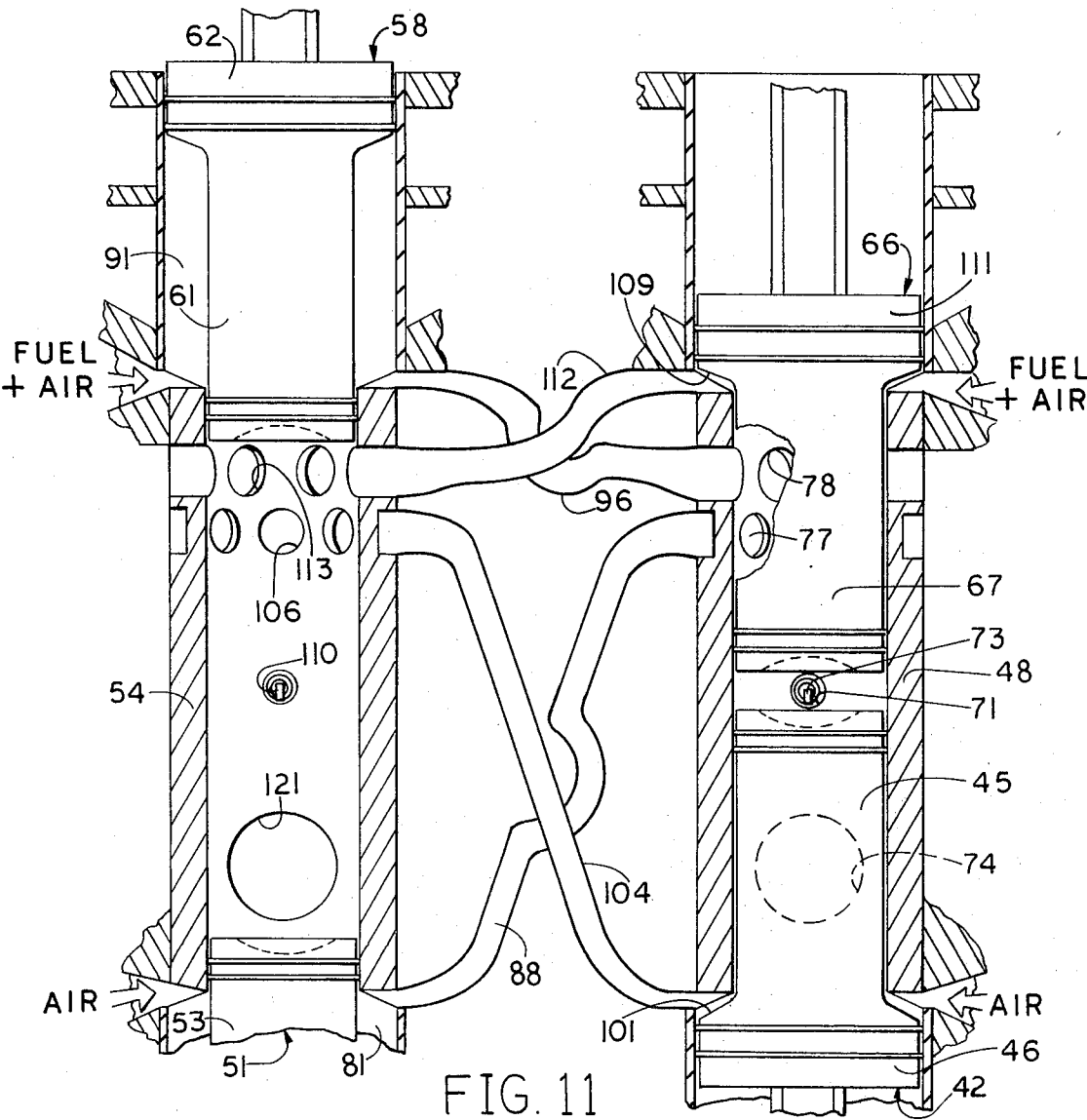


FIG. 11

INTERNAL COMBUSTION ENGINE

This invention relates to an internal combustion engine.

An object of this invention is to provide an internal combustion engine in which products of combustion of one cycle are blown out of a central tube before a new charge enters the central tube.

A further object of this invention is to provide such an internal combustion engine in which each piston has a compression section and also a power section.

Briefly, this invention provides an internal combustion engine which includes a pair of compound cylinder assemblies in each of which two pistons operate. Each cylinder assembly includes a central section or tube in which a charge fires and outer sections of increased diameter which serve as compressor sections. Each piston includes a portion which operates in the central tube of the associated cylinder assembly and an enlarged portion which operates in one of the outer sections thereof. Air is compressed in one compressor section and a charge is compressed in the other compressor section of each cylinder assembly. When one of the cylinder assemblies has fired and the products of combustion in the central tube of the other cylinder assembly have been released through an exhaust, compressed air is directed into the central tube from the other cylinder assembly to purge products of combustion. Then a charge is released into the central tube from the other cylinder assembly to be fired as the cycle advances.

The above and other objects and features of the invention will be apparent to those skilled in the art to which this invention pertains from the following detailed description and the drawings, in which:

FIG. 1 is a view in side elevation of an internal combustion engine constructed in accordance with an embodiment of this invention;

FIG. 2 is an enlarged view in section taken on the line 2—2 in FIG. 1, air and fuel valves being omitted for clarity;

FIG. 3 is a view in section taken on the line 3—3 in FIG. 2;

FIG. 4 is a view in section taken on the line 4—4 in FIG. 2;

FIG. 5 is a view in section taken on the line 5—5 in FIG. 2, air and fuel valves being omitted for clarity;

FIG. 6 is a view in section taken on the line 6—6 in FIG. 3;

FIG. 7 is a view in section taken on the line 7—7 in FIG. 4;

FIG. 8 is a view in section taken on the line 8—8 in FIG. 4;

FIG. 9 is a view in section taken on the line 9—9 in FIG. 4;

FIG. 10 is a fragmentary view in section taken on the same line as FIG. 3 but showing an intake valve in open position; and

FIG. 11 is a schematic sectional layout view of the engine.

In the following detailed description and the drawings, like reference numbers indicate like parts.

In FIG. 1 is shown an internal combustion engine 20 constructed in accordance with an embodiment of this invention which includes a central body 22, housings 23 and 24 at opposite ends of the central body 22, and crank case covers 26 and 27 at outer ends of the housings 23 and 24, respectively, all of which are held in as-

sembled relation by appropriate fastenings, not shown in detail. Crank shafts 28 and 29 are rotatably mounted in the housings 23 and 24, respectively. The crank shafts 28 and 29 are similar in construction, and only the crank shaft 29 and its associated housing 24 and crank case cover 27 will be described in detail. The crank shafts 28 and 29 carry sprockets 31 and 32, respectively, on which a chain 33 runs to cause the crank shafts 28 and 29 to turn in unison.

As shown in FIG. 2, the crank shaft 29 is rotatably mounted in bearings 34 and 36 mounted on the housing 24. Connecting rods 37 and 38 are rotatably mounted on offset portions 39 and 41 of the crank shaft 29. A piston 42 (FIG. 5) is connected to the connecting rod 38. The piston 42 includes a first cylindrical portion or head 45 and a second cylindrical portion 46 of greater diameter, which are separated by a shoulder 47. The head 45 operates in a cylindrical central tube 48, which is a part of the central body 22. The second or enlarged cylindrical portion 46 operates in a cylinder 49 mounted in the housing 24. In a similar fashion, a piston 51 (FIG. 3) is mounted on the connecting rod 37. A head 53 of the piston 51 operates in a cylindrical central tube 54 of the central body 22. An enlarged second portion or skirt 56 of the piston 51 operates in a cylinder 57 mounted in the housing 24.

Another piston 58 mounted on a connecting rod 59 includes a first or head portion 61 which also operates in the central tube 54 and a second portion 62 of larger diameter, which operates in a cylinder 63, which is mounted in the housing 26. The connecting rod 59 is mounted on the crank shaft 28 (FIG. 1) in the same manner as the connecting rods already described are mounted on their associated crank shaft 29.

As shown in FIG. 5, a piston 66 has a first or head portion 67 which also operates in the central tube 48. The piston 66 is otherwise similar to the pistons already described and is mounted in a similar fashion.

The pistons 42 and 66, which have heads which operate in the central tube 48, move toward each other and away from each other in unison. Similarly, the pistons 51 and 58 (FIG. 3), which have heads which operate in the central tube 54, move away from each other and toward each other in unison. However, the pistons 42 and 66 move outwardly while the pistons 51 and 58 move inwardly, and vice versa.

The central tubes 54 and 48 (FIG. 5) are similar in construction, and only the central tube 48 and connections thereto will be described in detail. At the midsection of the central tube 48 are located threaded openings 71 and 72 which receive spark plugs 73 (FIG. 11). Appropriate timing mechanism (not shown) is associated with one of the crank shafts for firing the spark plugs when the piston 42 and 66 are adjacent their inner position as shown in FIG. 11. Exhaust ports 74 (FIG. 5) and 76 in the central tube 48 are open when the pistons 42 and 66 are at their outer positions as shown in FIG. 5. The exhaust ports 74 and 76 are closed by the head 45 of the piston 42 when the pistons are at their inner position. As the head 67 of the piston 66 moves outwardly after opening of the exhaust ports 74 and 76, the head 67 exposes a row of air injection openings 77 shortly after the exhaust openings 74 and 76 have been opened. Air that is injected through the openings 77 acts to clear the products of combustion from the central tube through the exhaust ports 74 and

76. Then, as the head 67 moves farther outwardly, it exposes a row of fuel injection openings 78.

The air which is injected through the openings 77 is compressed by the enlarged portion 56 (FIG. 3) of the piston 51. The air enters through a one-way valve 79, which communicates with a space 81 in which the enlarged portion 56 operates. In FIG. 3, the one-way valve 79 is shown in closed position in which reeds 82 thereof close openings 83 in a casing 84 thereof. When the piston 51 moves outwardly, air is drawn through the one-way valve 79 from an air supply conduit 86, and the reeds open as shown in FIG. 10 to permit the air to enter the space 81. However, when the piston 51 (FIG. 3) moves inwardly, the reeds 82 close to prevent escape of the air. The space 81 communicates with the openings 77 (FIG. 4) through a tube 88. A fuel-air mixture, which is injected through the openings 78, is compressed by the enlarged portion 62 (FIG. 11) of the piston 58. The air-fuel mixture is formed in an appropriate carburetor (not shown) and enters a space 91 in which the enlarged portion 62 operates through a conduit 92 (FIG. 3) and a one-way valve 93. The fuel-air mixture is drawn into the space 91 (FIG. 11) as the piston 58 moves outwardly and is compressed as the piston 58 moves inwardly. When the openings 78 are opened the air-fuel mixture passes from the space 91 through a conduit 96 (FIG. 8) and through the openings 78 into the interior of the central tube 48.

In a similar manner, air enters a space 101 (FIG. 5) in which the enlarged portion 46 of the piston 42 operates through a one-way air valve 103 (FIG. 6) and, after being compressed in the space 101, is injected along a conduit 104 (FIG. 4) and through air-injection openings 106 (FIG. 11) in the central tube 54. An air-fuel mixture from the carburetor (not shown) travels through a conduit 107 (FIG. 9) and a one-way valve 108 into a space 109 (FIG. 11) in which an enlarged portion 111 of the piston 66 operates. When the air-fuel mixture has been compressed in the space 109, it is released along a conduit 112 to enter the central tubular portion 54 through fuel injection openings 113.

As shown in FIGS. 3, 4, and 5, a jacket 116 surrounds the central tubes 48 and 54. A coolant liquid can be circulated through coolant passageways 117 between the jacket 116 and the central tubes 48 and 54 to cool outer walls of the central tubes 48 and 54. As shown in FIG. 3, a nozzle 118 is directed into the interior of the cylinder 57 in which the enlarged portion 56 of the piston 51 operates. Both the head 53 and the enlarged portion 56 of the piston 51 are hollow. Coolant oil can be projected through the nozzle 118 into the hollow interior of the piston 51 to cool the piston 51. Similarly, other nozzles, not shown, can be provided to project coolant oil into the other pistons.

Operation of the engine can be most clearly understood by reference to FIG. 11. As the pistons 51 and 58 move outwardly toward the position shown in FIG. 11, air is drawn into the space 81, and an air-fuel mixture is drawn into the space 91. As the pistons 51 and 58 return inwardly, the air in the space 81 is compressed and the air-fuel mixture in the space 91 is also compressed. As the pistons 51 and 58 move inwardly, the pistons 42 and 66 move outwardly following ignition of a charge in the central tube portion 48. As the piston 45 reaches the exhaust openings 74 and 76 (FIG. 5), products of combustion in the central tube 48 are released. Then,

as the piston 66 reaches the air-injection openings 77, air is injected from the space 81 (FIG. 11) through the conduit 88 and the openings 77. The air clears products of combustion from the interior of the central tube 48. Then, as the piston 66 moves farther outwardly to open the fuel-injection openings 78, the air-fuel mixture in the space 91 is injected through the conduit 96 and the openings 78 into the central tube 48 to form a charge for the next cycle. Similarly, as the pistons 42 and 66 move outwardly, air is drawn into the space 101 and an air-fuel mixture is drawn into the space 109. As the pistons 42 and 66 move inwardly, the contents of the spaces 101 and 109 are compressed. As the pistons 51 and 58 move outwardly following ignition of a charge by spark plugs 110 mounted in central openings 1101 (FIG. 3); exhaust openings 121 are opened to release the products of combustion. Then the air-injection openings 106 are opened and air from the space 101 (FIG. 11) is injected through the conduit 104 and the openings 106 to clear products of combustion from the interior of the central tube portion 54. Then, when the openings 113 are opened, the air-fuel mixture from the space 109 is injected through the conduit 112 and the openings 113 into the interior of the central tube portion 54 for ignition on the next cycle.

The clearing of the products of combustion from the central tubes after each cycle minimizes the development of hot spots inside the central tubes. The engine has been shown with ignition by use of spark plugs. However, various modifications can be made as by revising the cycle to a diesel type operation, and the engine is subject to various structural modifications without departing from the spirit and scope of the appended claims.

Having described my invention, what I claim as new and desire to secure by letters patent is:

1. An internal combustion engine which comprises a pair of central tubes, a pair of pistons associated with each central tube, heads of the pistons operating in the central tubes, each of the pistons including an enlarged body portion, cylinders in which the enlarged body portions of the pistons operate, means for connecting the pistons in each central tube to move toward each other and away from each other in unison and for causing the pistons associated with one central tube to move toward each other as the pistons associated with the other central tube move away from each other, exhaust ports in the central tubes which are opened when the pistons associated therewith are in a partly retracted position, air-injection openings in the central tubes which are opened when the pistons associated therewith are in a further retracted position, and fuel-injection openings in the central tubes which are opened when the pistons associated therewith are in a still further retracted position, means for connecting the air-injection openings of each central tube with one of the cylinders associated with the other central tube, means for connecting the fuel-injection openings of each central tube with the other of the cylinders associated with the other of the central tubes, means for permitting air to enter the cylinders which are connected to the air injection openings but for preventing exit of the air therefrom, and means for permitting a fuel-air mixture to enter the cylinders which are connected to the fuel-injection openings and for preventing exit of the fuel-air mixture therefrom, whereby the air is compressed in the cylinders connected to the air-injection openings and is in-

5

jected into the central tubes after the exhaust openings have been opened to clear the products of combustion from the central tubes, and the air-fuel mixture is compressed in the cylinders connected to the fuel injection openings and is injected into the central tubes after the products of combustion have been cleared therefrom.

2. An internal combustion engine as in claim 1 wherein the head and the body portion of each piston

6

is hollow and means is provided for projecting coolant into the hollow interiors of the pistons.

3. An internal combustion engine as in claim 1 wherein in each central tube, the exhaust opening is closed by one of the piston heads and the air-injection opening and the fuel-injection opening are covered by the other piston head when the pistons are in an advanced position.

* * * * *

10

15

20

25

30

35

40

45

50

55

60

65