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Caterpillar Inc. v. Entec Engine Corporation and Clyde C. Bryant

CATERPILLAR INC.'S COMPLAINT FOR DECLARATORY RELIEF

EXHIBIT "A"
Part I

US006279550B1

(12) **United States Patent**
Bryant

(10) **Patent No.: US 6,279,550 B1**
(45) **Date of Patent: Aug. 28, 2001**

(54) **INTERNAL COMBUSTION ENGINE**

(76) Inventor: **Clyde C. Bryant**, 410 Trammel Dr., Alpharetta, GA (US) 30004

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/863,103**

(22) Filed: **May 23, 1997**

Related U.S. Application Data

(63) Continuation-in-part of application No. 08/841,488, filed on Apr. 23, 1997, now abandoned.
(60) Provisional application No. 60/040,630, filed on Mar. 7, 1997, provisional application No. 60/029,260, filed on Oct. 25, 1996, provisional application No. 60/023,460, filed on Aug. 6, 1996, and provisional application No. 60/022,102, filed on Jul. 17, 1996.

(51) **Int. Cl.**[7] **F02B 33/00**

(52) **U.S. Cl.** **123/559.1**; 60/609; 123/562; 123/316; 123/432

(58) **Field of Search** 60/605.1, 609, 60/612; 123/316, 432, 559.1, 562

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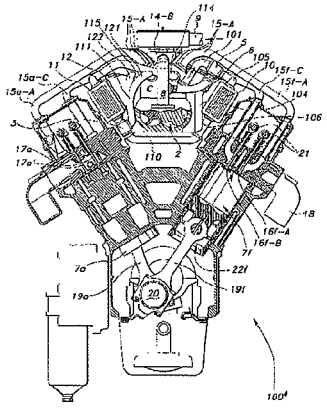
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Primary Examiner—Michael Koczo
(74) *Attorney, Agent, or Firm*—Womble Carlyle Sandridge & Rice

(57) **ABSTRACT**

The invention is concerned with a method of deriving mechanical work from a combustion gas in internal combustion engines and reciprocating internal combustion engines for carrying out the method. The invention includes methods and apparatuses for managing combustion charge densities, temperatures, pressures and turbulence in order to produce a true mastery within the power cylinder in order to increase fuel economy, power, and torque while minimizing polluting emissions. In its preferred embodiments, the method includes the steps of (i) producing an air charge, (ii) controlling the temperature, density and pressure of the air charge, (iii) transferring the air charge to a power cylinder of the engine such that an air charge having a weight and density selected from a range of weight and density levels ranging from below atmospheric weight and density to heavier-than-atmospheric weight and density is introduced into the power cylinder, and (iv) then compressing the air charge at a lower-than-normal compression ratio, (v) causing a pre-determined quantity of charge-air and fuel to produce a combustible mixture, (vi) causing the mixture to be ignited within the power cylinder, and (vii) allowing the combustion gas to expand against a piston operable in the power cylinders with the expansion ratio of the power cylinders being substantially greater than the compression ratio of the power cylinders of the engine. In addition to other advantages, the invented method is capable of producing mean effective cylinder pressures ranging from lower-than-normal to higher-than-normal. In the preferred embodiments, the mean effective cylinder pressure is selectively variable (and selectively varied) throughout the mentioned range during the operation of the engine. In an alternate embodiment related to constant speed-constant load operation, the mean effective cylinder pressure is selected from the range and the engine is configured, in accordance with the present invention, such that the mean effective cylinder pressure range is limited, being varied only in the amount required for producing the power, torque and speed of the duty cycle for which the engine is designed.

26 Claims, 34 Drawing Sheets



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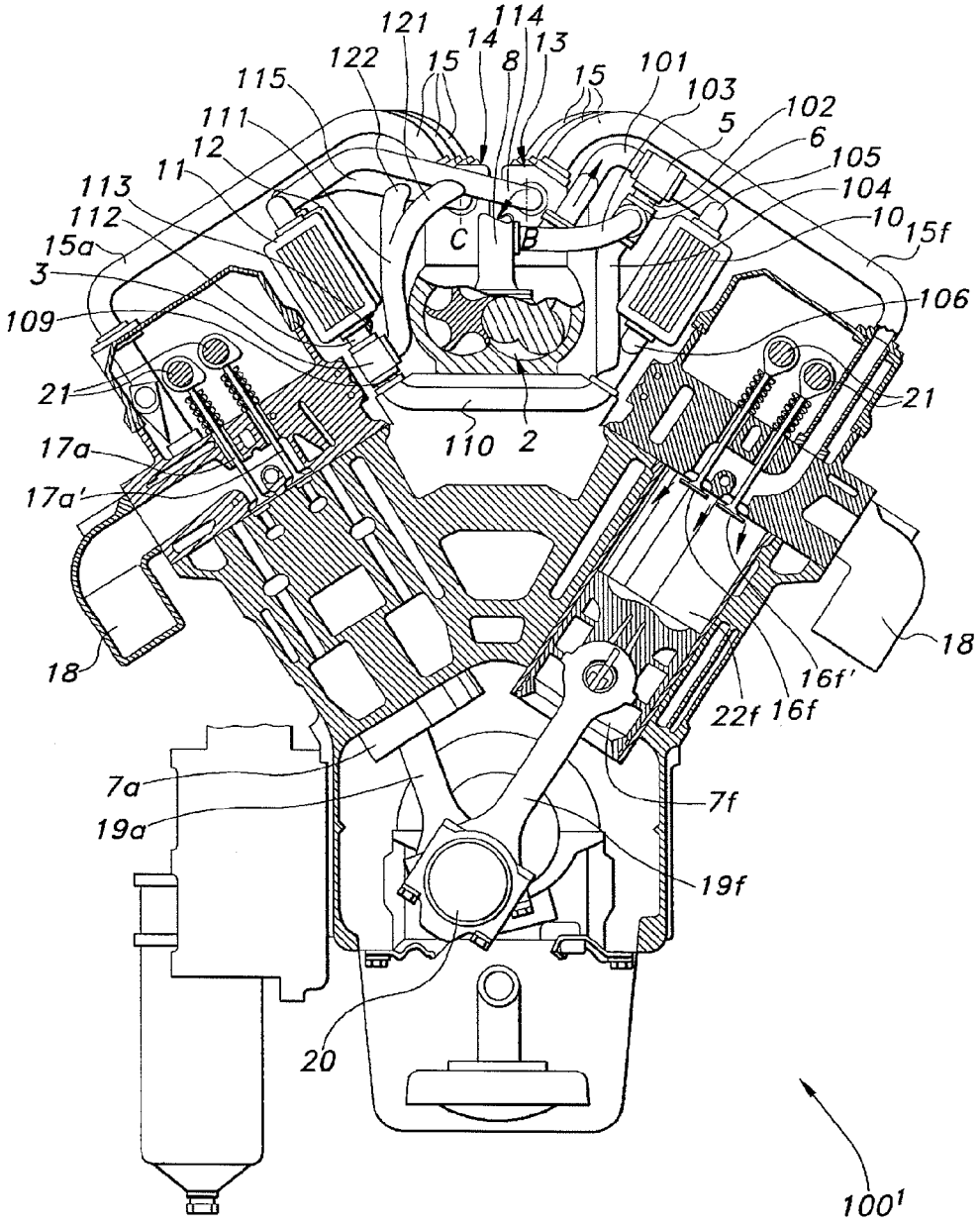

121
114
122
14
15
8
13
15
101
115
103
111
5
102
12
6
11
105
113
104
112
10
15f
15a
C
B
3
106
109
21
21
110
2
17a
17a'
18
18
16f'
22f
16f
7a
7f
19a
19f
20
100'

FIG 1

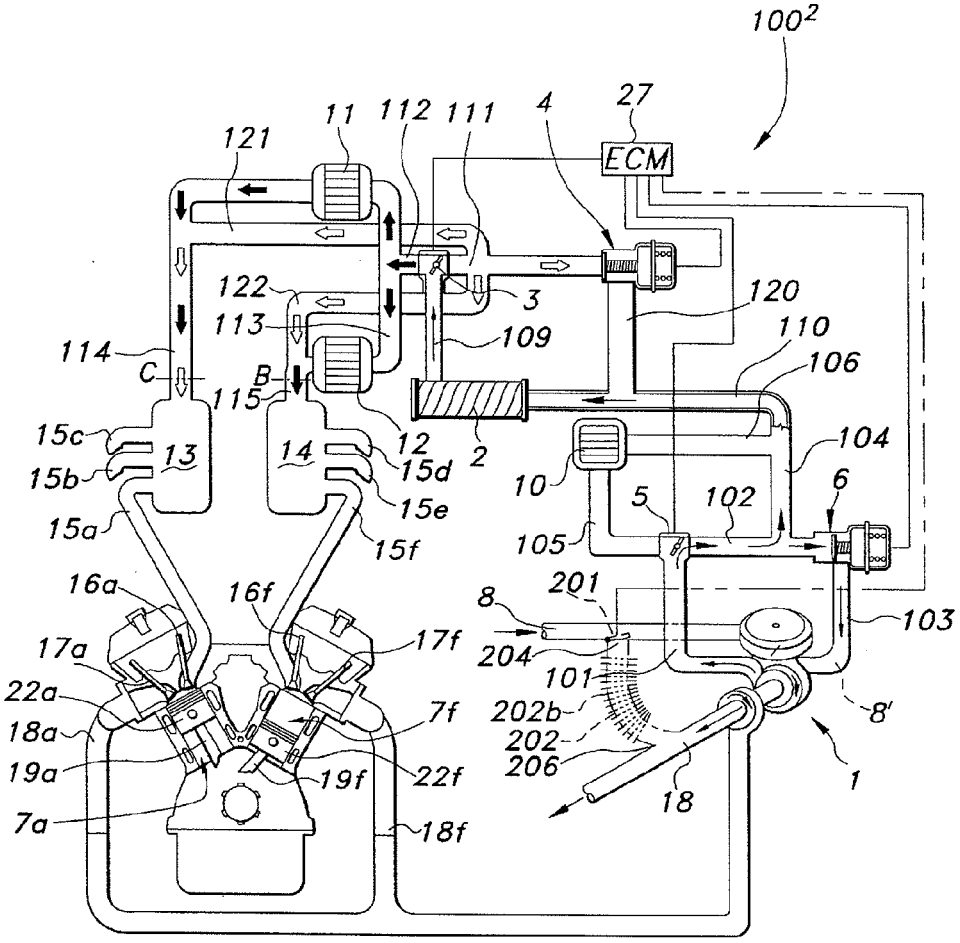

100²
ECM
27
4
11
112
111
121
122
113
3
109
120
110
106
114
C
B
115
15c
15b
15a
13
14
12
15d
15e
15f
2
10
5
102
104
6
105
103
201
8
204
101
202b
202
206
8'
1
18
16a
16f
17a
17f
22a
18a
19a
7a
7f
19f
22f
18f

FIG 2

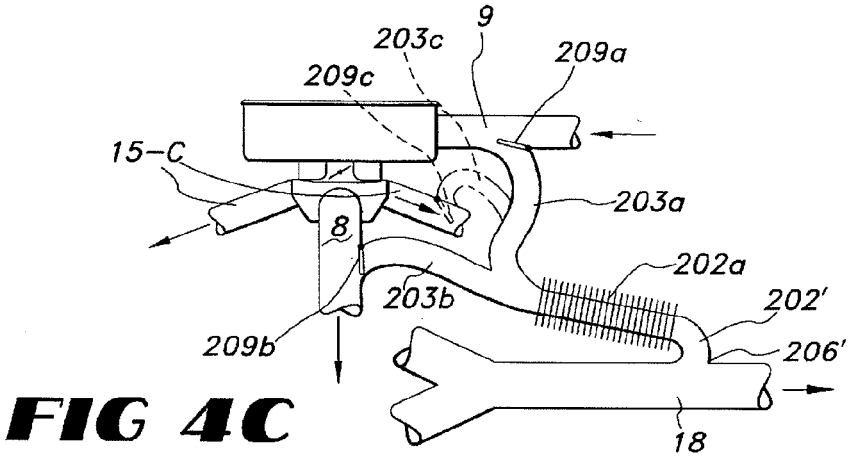

9
203c
209a
209c
15-C
203a
8
202a
203b
202'
209b
206'
18

FIG 4C

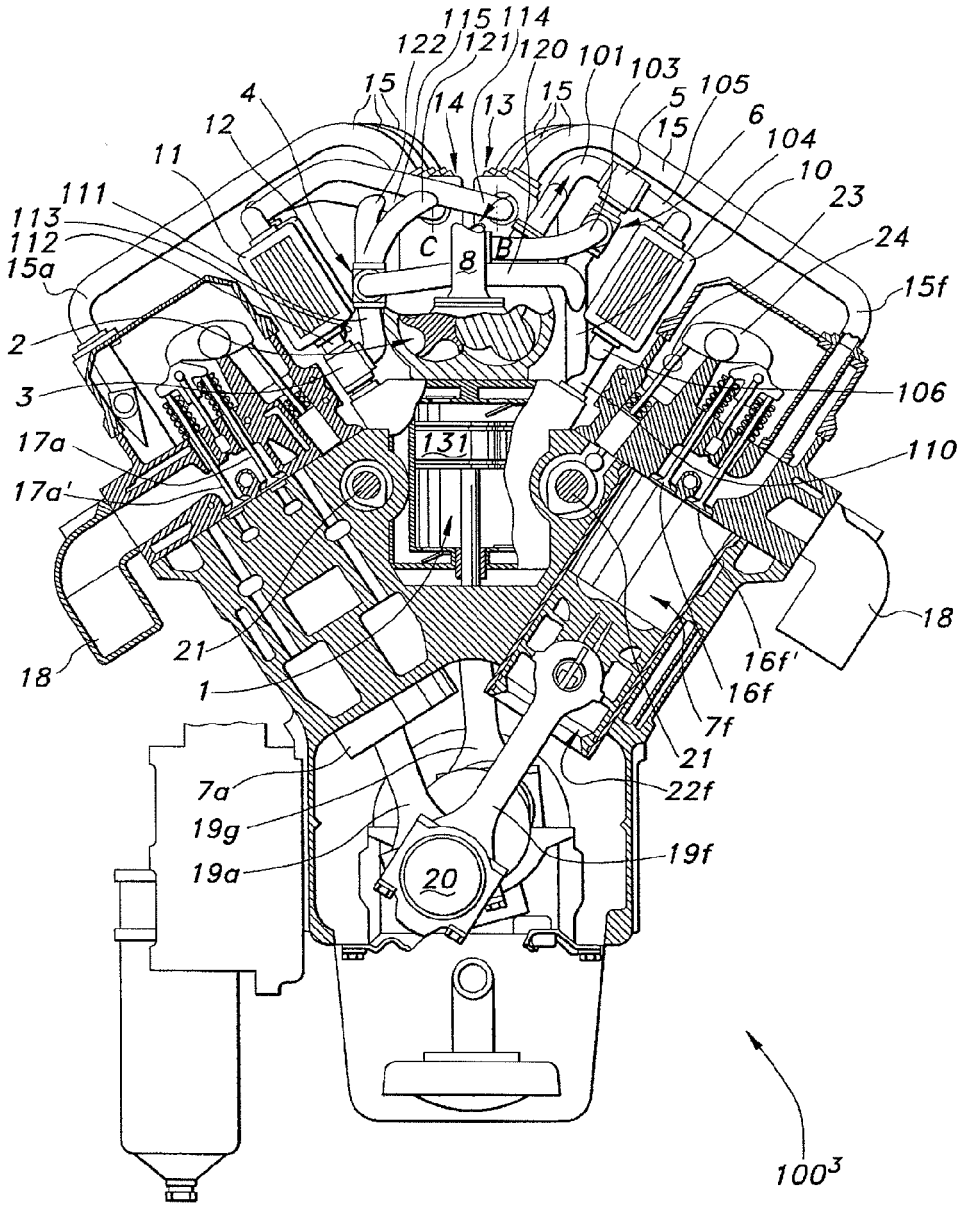

115
114
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121
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103
105
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14
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15
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6
104
10
23
24
4
12
11
111
113
112
15a
C
8
B
15f
2
3
106
131
17a
17a'
110
18
21
1
16f'
16f
7f
21
22f
7a
19g
19a
20
19f
18
100³

FIG 3

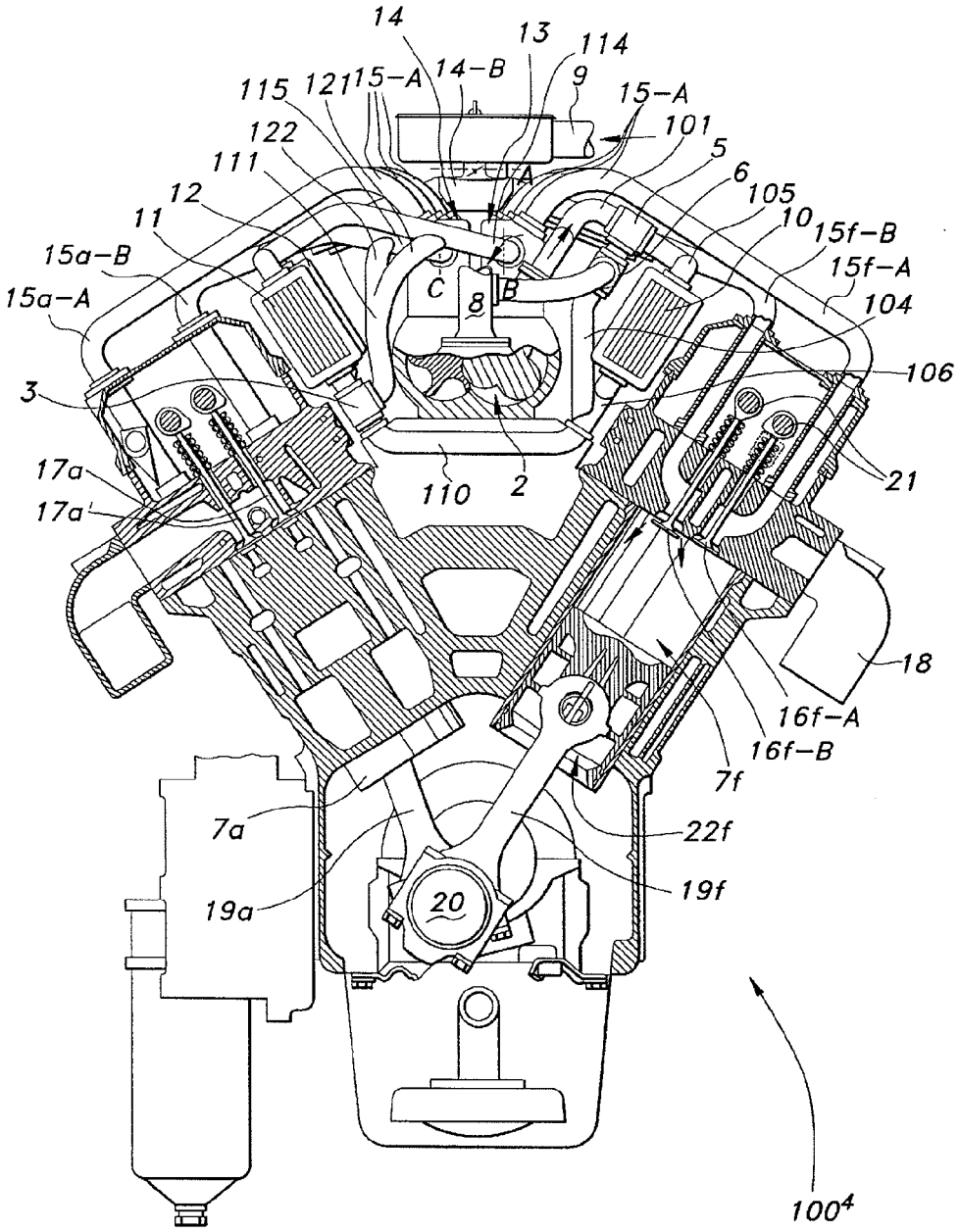

14
13
114
9
15-A
14-B
115
121
15-A
101
122
5
111
6
105
12
10
11
15f-B
15a-B
15f-A
15a-A
104
C
8
B
106
3
21
17a
17a
110
2
18
16f-A
16f-B
7f
7a
22f
19f
19a
20
100

FIG 4

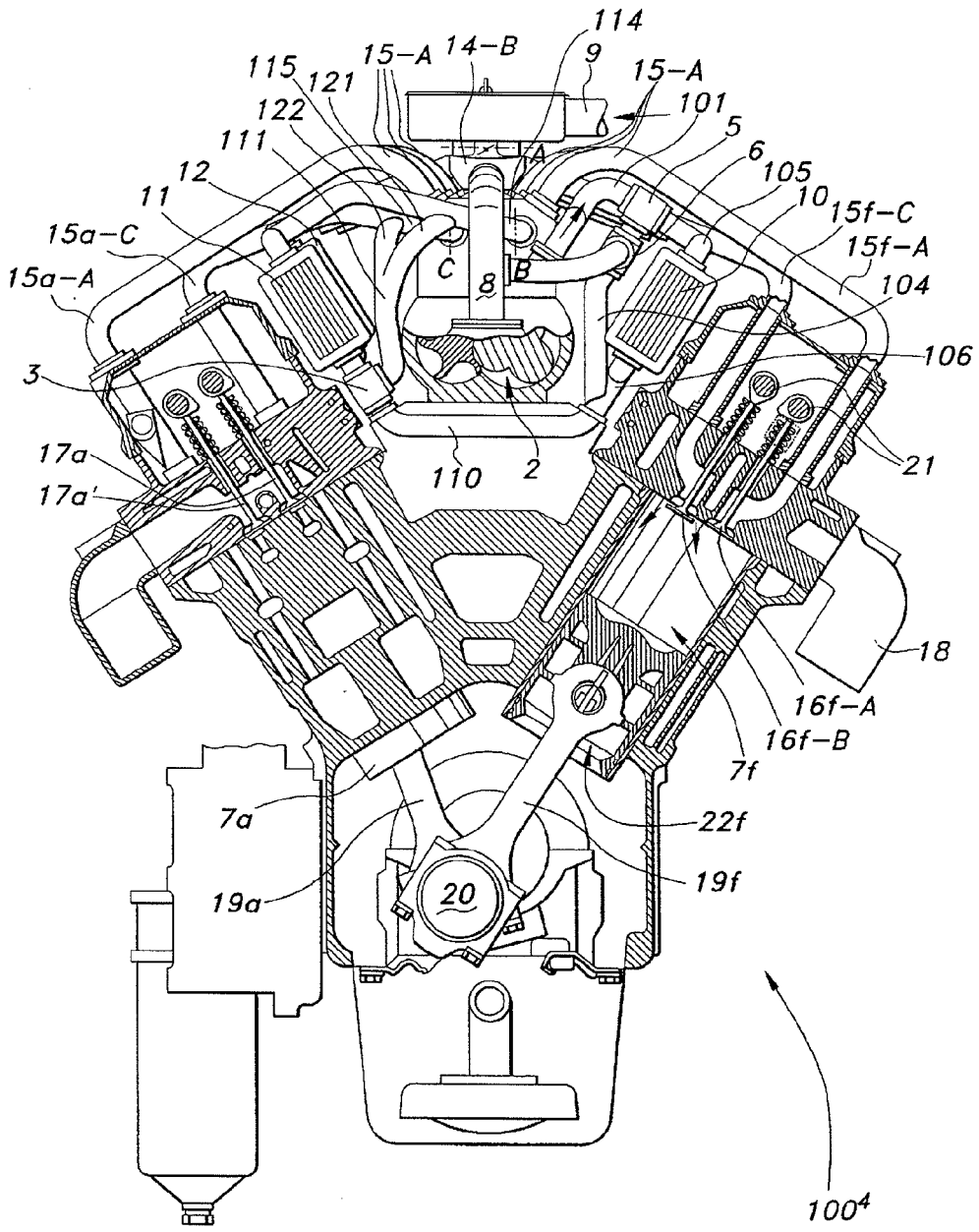

114
9
15-A
14-B
15-A
115
121
122
111
101
5
6
105
10
12
11
15f-C
15a-C
15f-A
15a-A
104
C
8
B
106
3
17a
17a'
110
2
21
18
16f-A
16f-B
7f
7a
22f
19f
19a
20
100⁴

FIG 4B

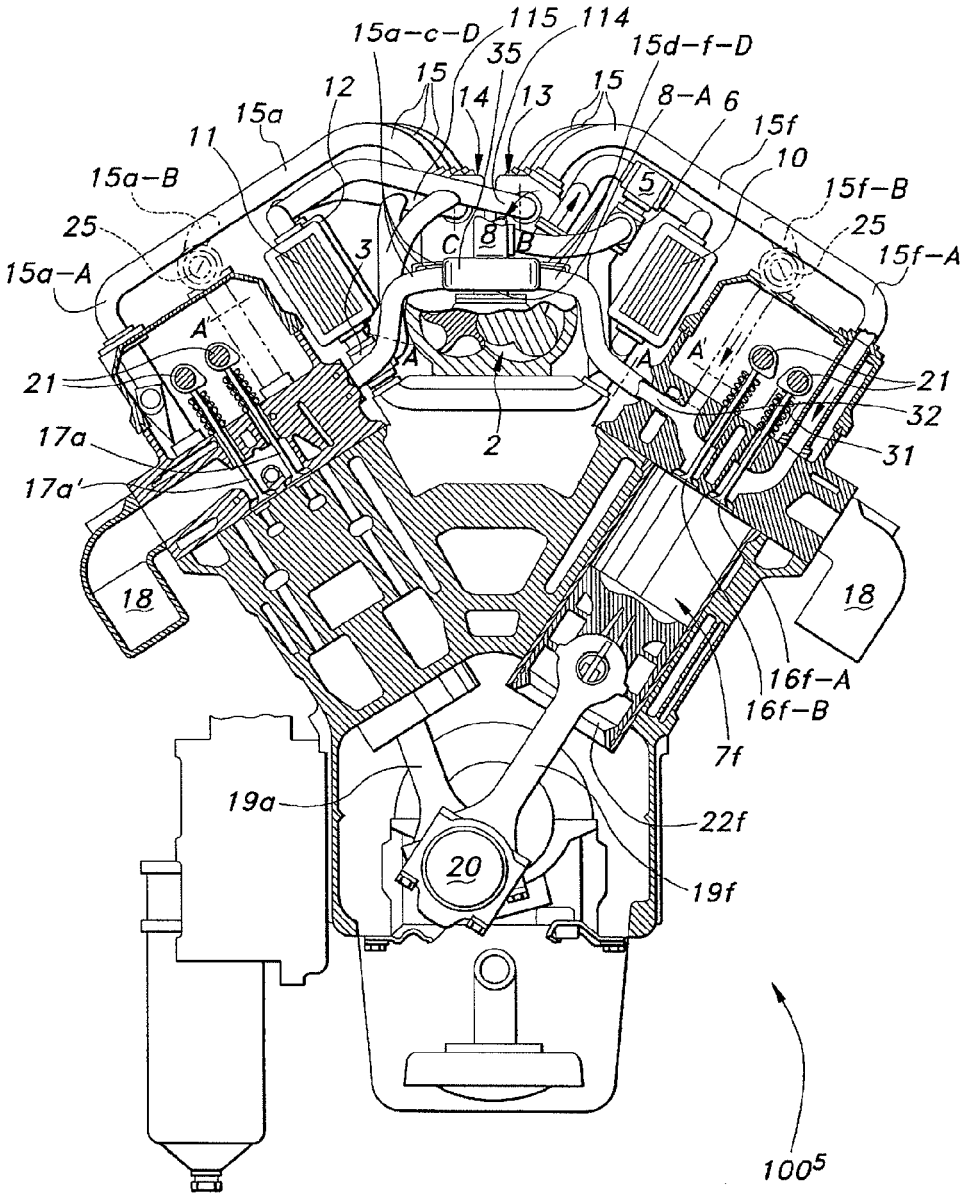

15a-c-D
115
114
15d-f-D
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15
12
14
13
15
8-A
6
15a
11
15f
10
15a-B
5
15f-B
25
3
C
8
B
25
15f-A
15a-A
A'
A
A
A'
21
21
32
17a
2
31
17a'
18
18
16f-A
16f-B
7f
19a
22f
20
19f
100

FIG 5

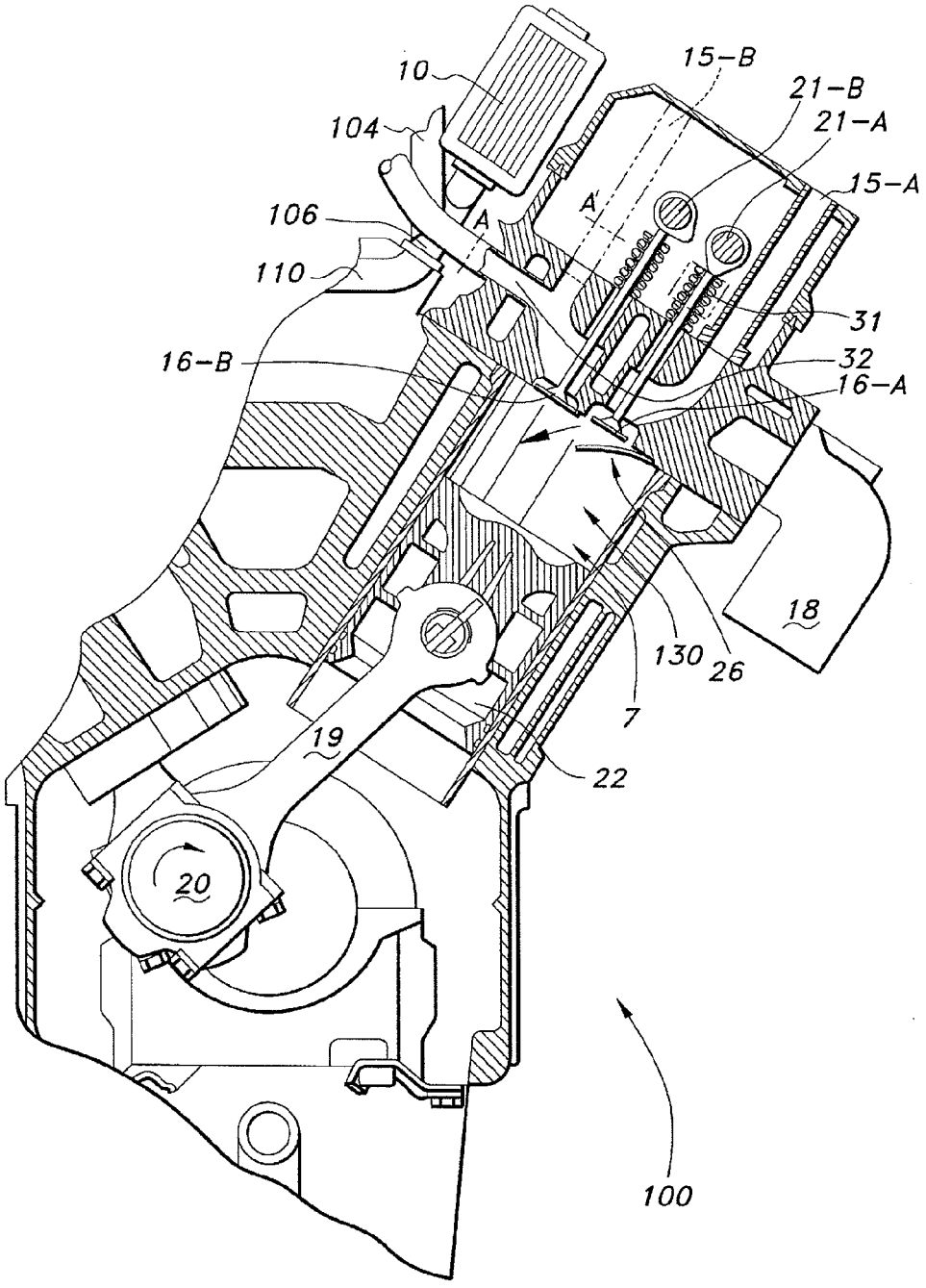

10
15-B
21-B
21-A
104
15-A
106
A
A'
110
31
16-B
32
16-A
18
130
26
7
19
22
20
100

FIG 6