US007654821B2

(12) **United States Patent**
Vitantonio et al.

(10) **Patent No.: US 7,654,821 B2**
(45) **Date of Patent: Feb. 2, 2010**

(54) **FLINT IGNITED PREMIXED LIGHTER**

(75) Inventors: **Marc L. Vitantonio**, South Russell, OH (US); **Craig M. Saunders**, Rocky River, OH (US); **Charles P. Althoff**, Cleveland Heights, OH (US); **David J. Boll**, Avon, OH (US); **Michael W. Johnson**, Port Allegany, PA (US); **Jeffrey M. Kalman**, Cleveland Heights, OH (US); **Michael P. O'Toole**, Parma, OH (US); **Ronald J. Meister**, Bradford, PA (US)

(73) Assignee: **Zippo Manufacturing Company**, Bradford, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 670 days.

(21) Appl. No.: **11/045,154**

(22) Filed: **Jan. 31, 2005**

(65) **Prior Publication Data**

US 2005/0181320 A1 Aug. 18, 2005

Related U.S. Application Data

(60) Provisional application No. 60/545,431, filed on Feb. 17, 2004.

(51) **Int. Cl.**
F23Q 2/08 (2006.01)

(52) **U.S. Cl.** **431/131**; 431/277; 431/349; 431/350; 431/354

(58) **Field of Classification Search** 431/131, 431/349–355, 277
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,734,364	A	2/1956	Peterson
2,759,345	A	8/1956	Peterson
4,466,788	A	8/1984	Nitta
4,929,174	A	5/1990	Wang
5,055,034	A	10/1991	Wang
5,308,240	A	5/1994	Lowenthal
5,310,336	A	5/1994	Segawa
5,584,681	A	12/1996	Suzuki
5,716,204	A	2/1998	Mifune
6,015,286	A	1/2000	Maruyama
6,135,761	A	10/2000	Chen

(Continued)

FOREIGN PATENT DOCUMENTS

GB	1452264	*	8/1972

(Continued)

OTHER PUBLICATIONS

Non-Final Office Action, Paper No. 20060608, mailed Jun. 21, 2006, in U.S. Appl. No. 10/974,775, 9 pp.

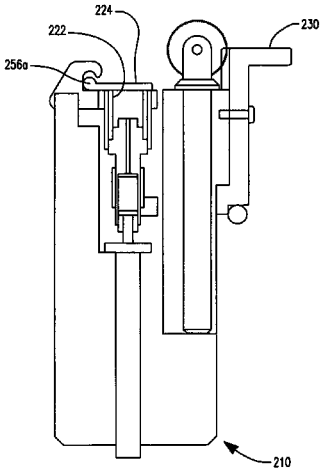
(Continued)

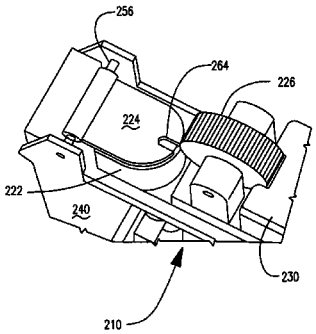
Primary Examiner—Alfred Basichas
(74) *Attorney, Agent, or Firm*—Bryan Cave LLP

(57) **ABSTRACT**

A lighter includes a butane fuel reservoir, a valve, a mixer with a choke, a movable combustion space and movable top door over the combustion space which interact to allow a wheel and flint igniter to initiate a post mix flame above the top of the combustion space followed by the opening of the top and migration of the flame into the combustion space to create a strong torch-like premixed flame thereafter.

10 Claims, 32 Drawing Sheets





U.S. PATENT DOCUMENTS

6,537,062	B1	3/2003	Wong
6,558,156	B2	5/2003	Wong
6,773,258	B1	8/2004	Wong
6,780,006	B1	8/2004	Wong
6,827,572	B2	12/2004	Wong
6,884,063	B2	4/2005	Wong
6,905,329	B2	6/2005	Wong
7,214,055	B2	5/2007	Meister et al.
2002/0187446	A1	12/2002	Wong
2002/0197579	A1	12/2002	Wong
2004/0096793	A1	5/2004	Wong

FOREIGN PATENT DOCUMENTS

GB	2 216 244	A	10/1989
GB	2 259 755	A	3/1993

OTHER PUBLICATIONS

Amendment filed on Dec. 15, 2006 via EFS-Web in U.S. Appl. No. 10/974,775, 14 pp.

Notice of Allowability, Paper No. 20070227, PTOL-37, in U.S. Appl. No. 10/974,775, 1 p.

* cited by examiner

FIG. 1

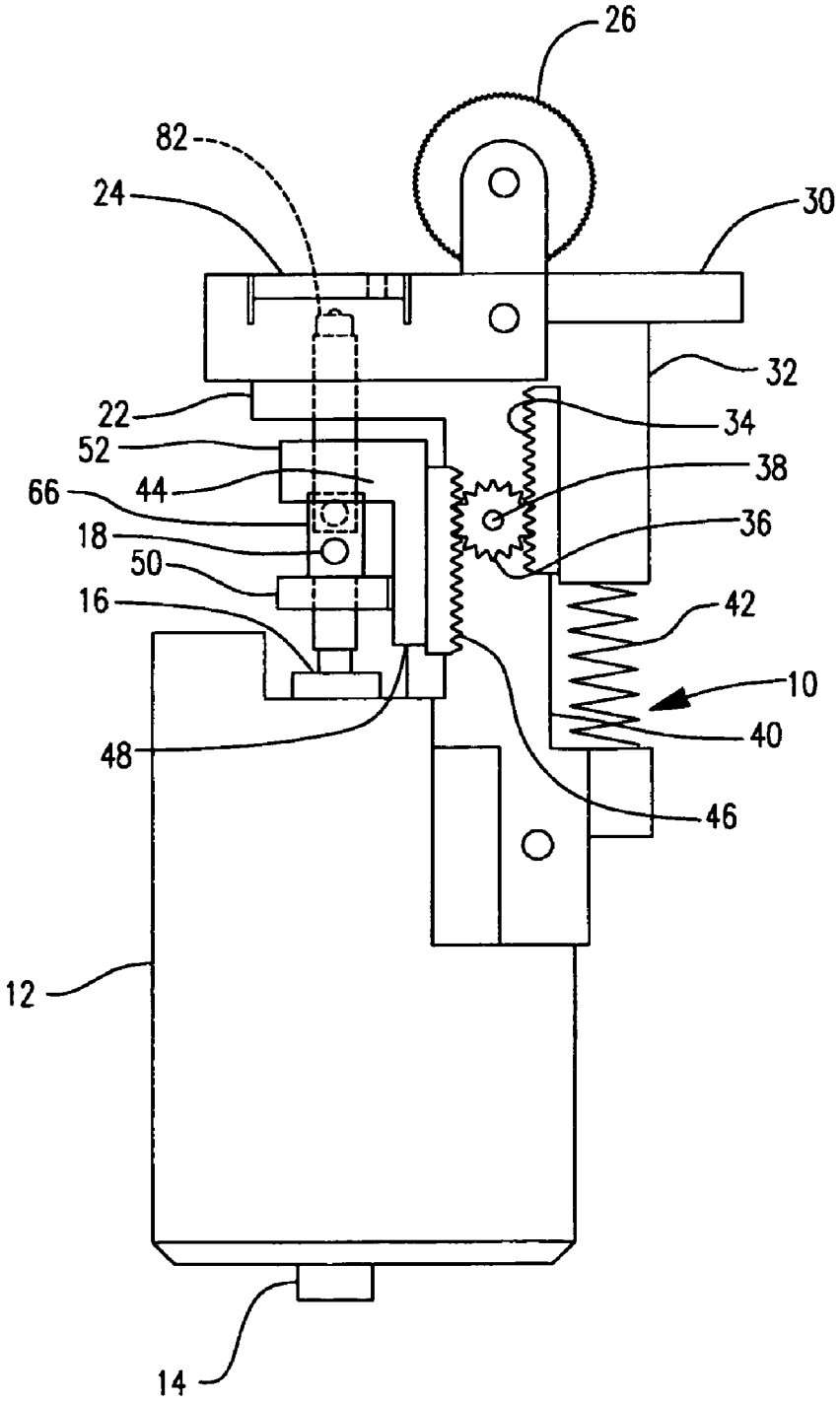


FIG. 2

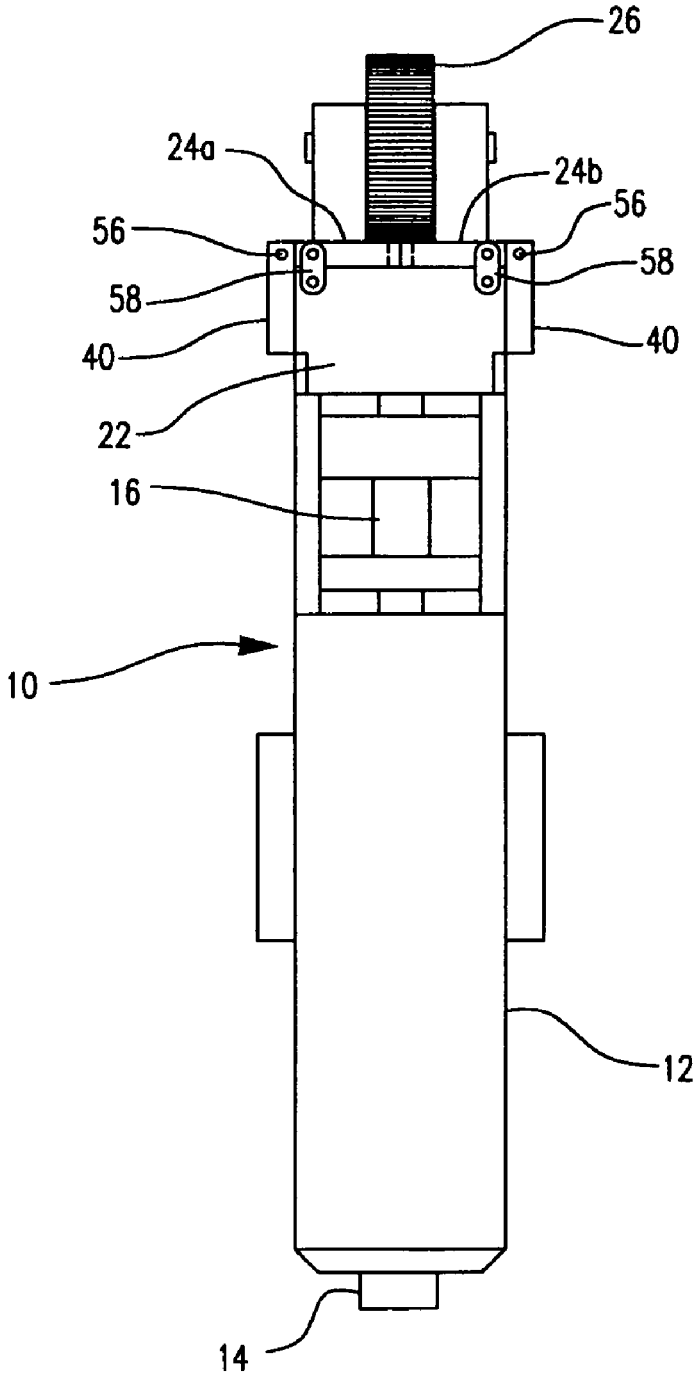


FIG. 3

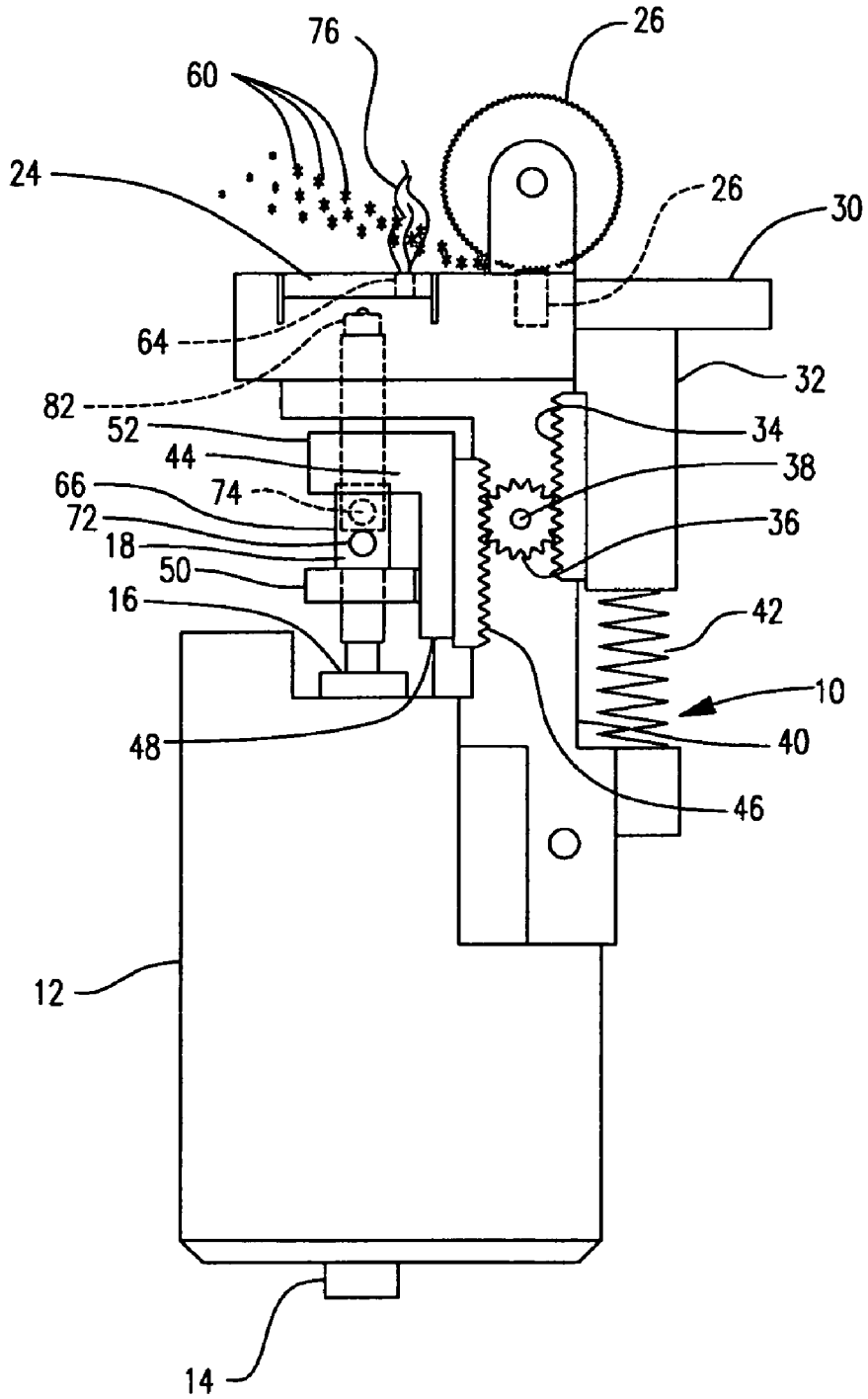

76
26
60
24
26
30
64
32
82
52
34
44
38
66
74
72
36
18
50
16
42
10
48
40
46
12
14

FIG. 4

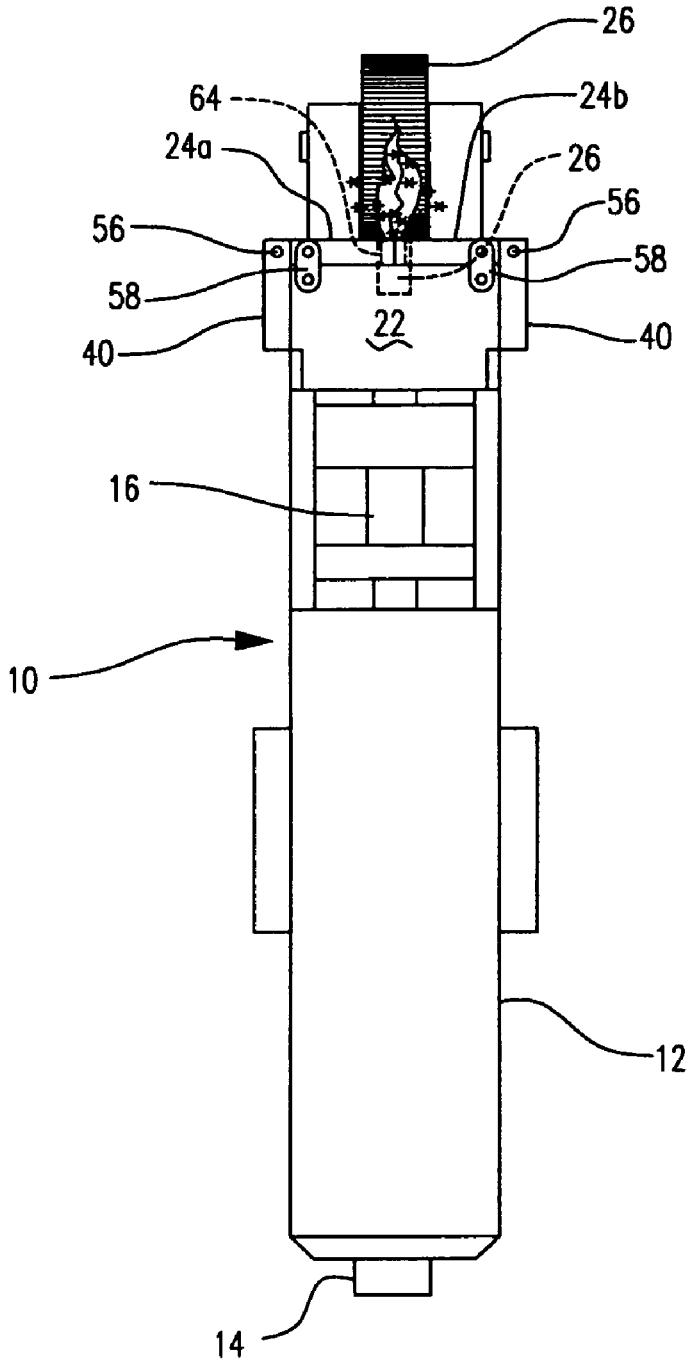


FIG. 5

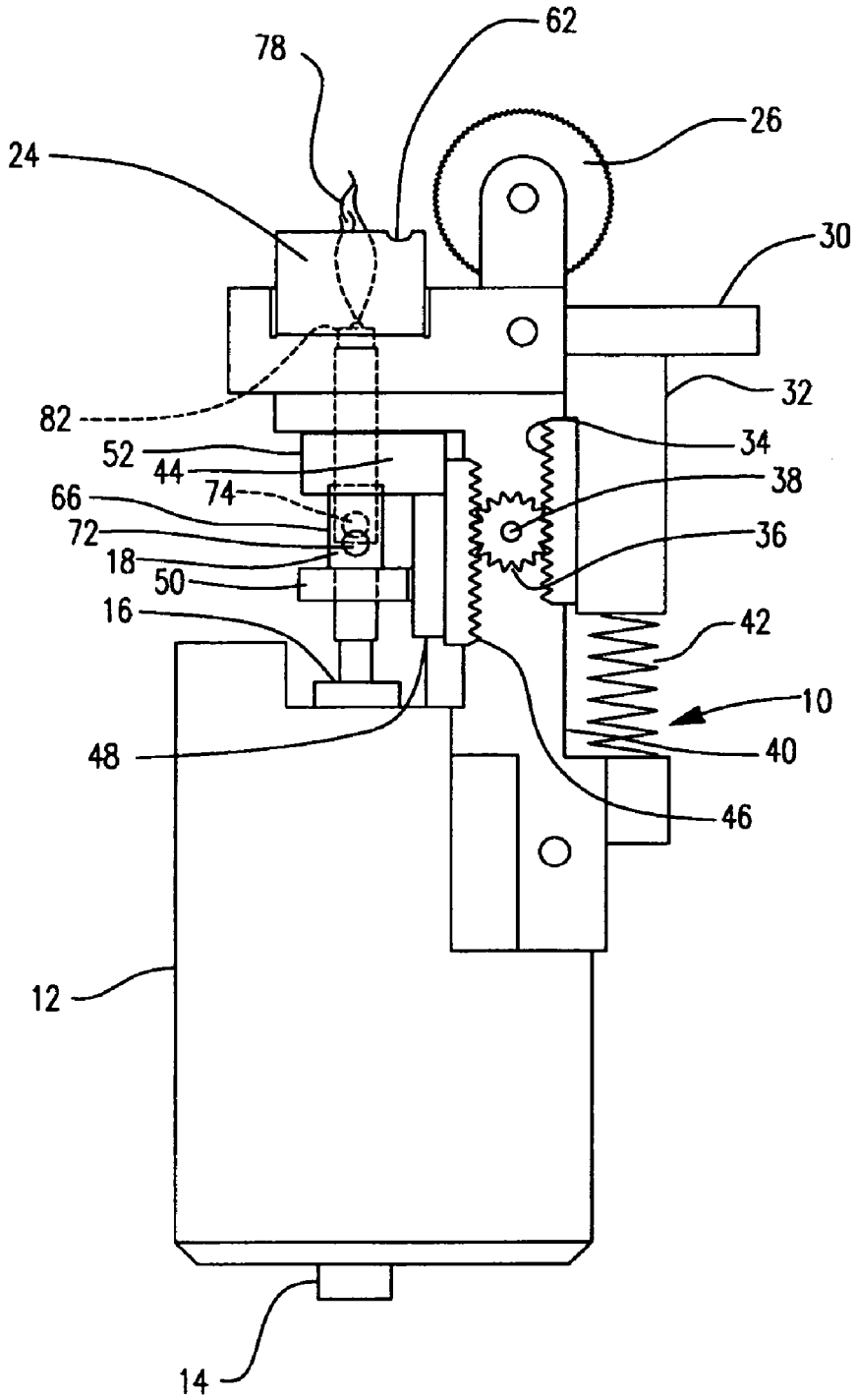

62
78
26
24
30
32
82
34
52
44
38
74
66
36
72
18
50
42
16
10
48
40
46
12
14

FIG. 6

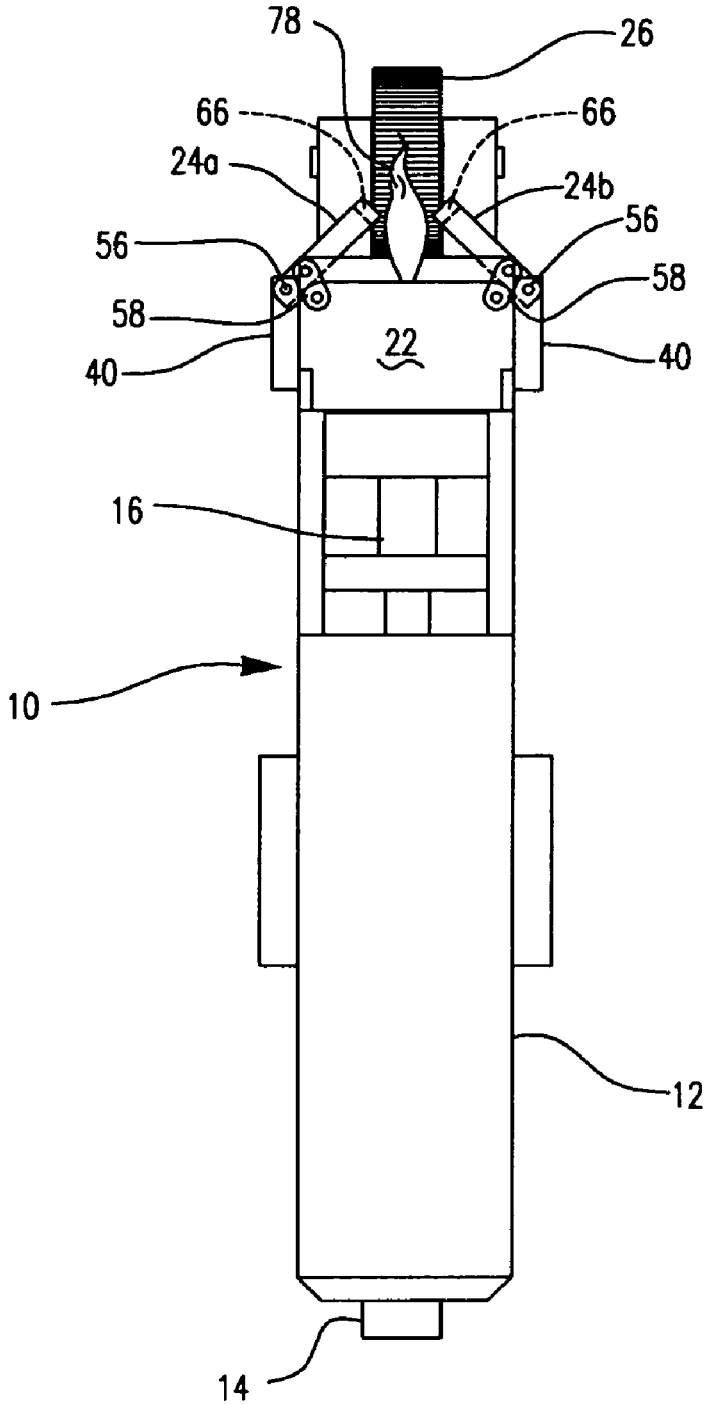


FIG. 7

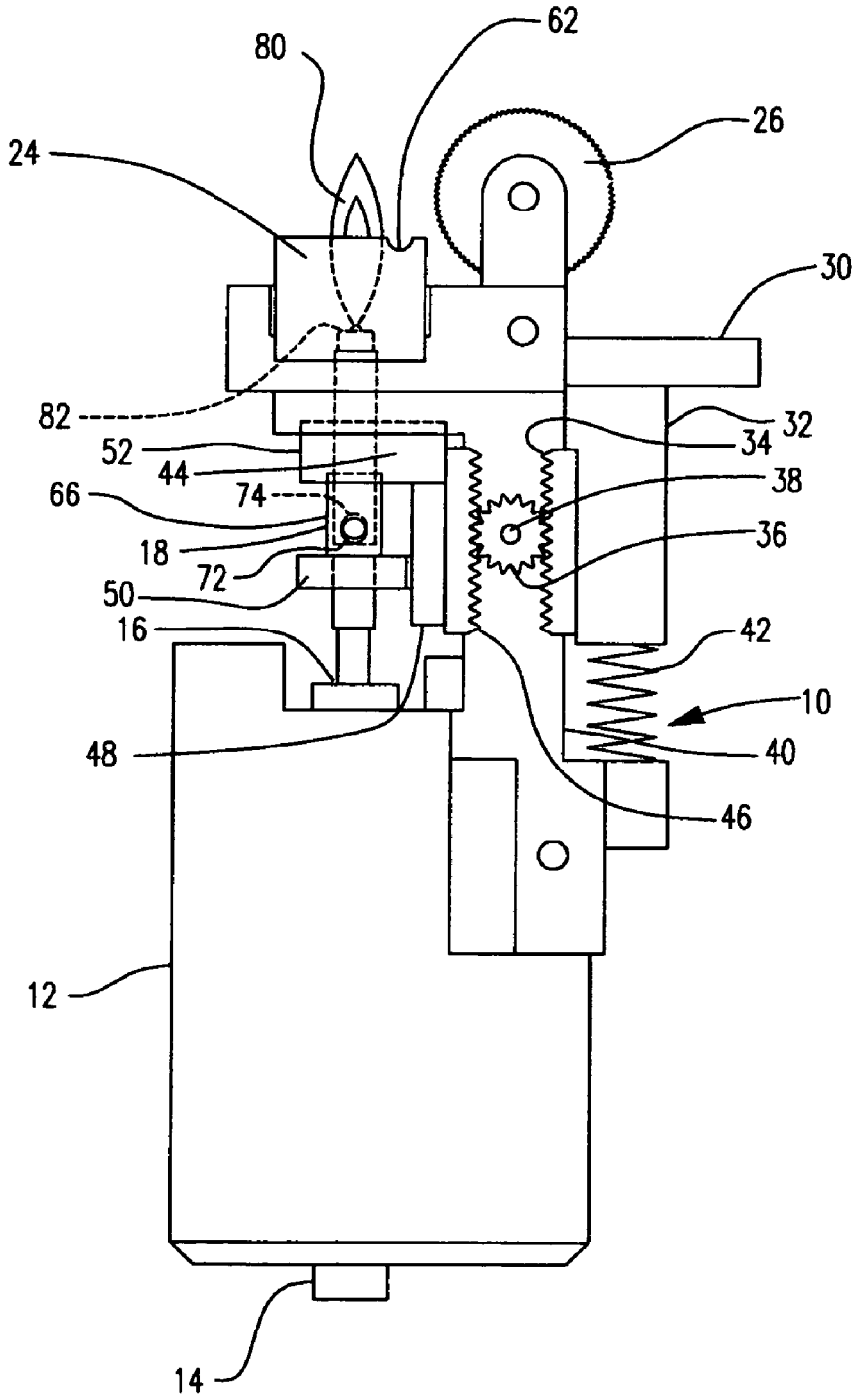

62
80
26
24
30
82
32
34
52
44
38
66
74
36
18
72
50
16
42
10
48
40
46
12
14

FIG. 8

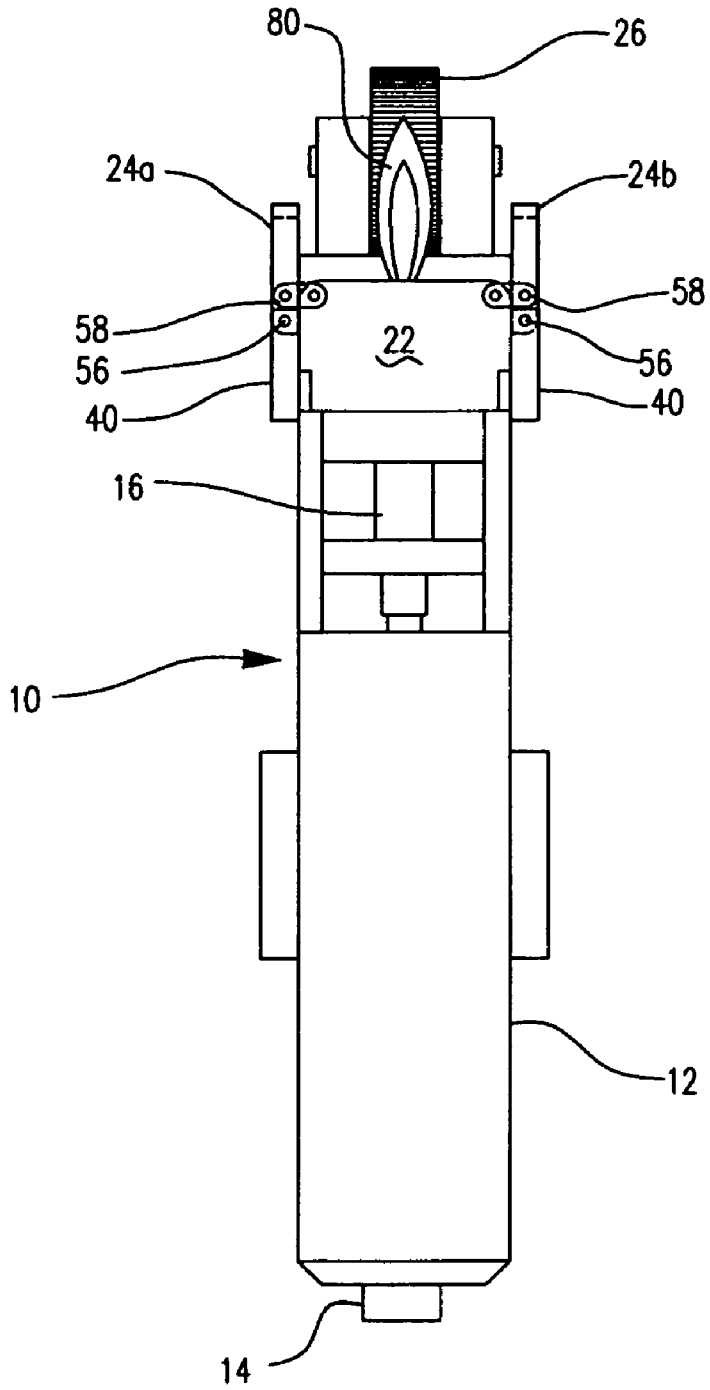


FIG. 9

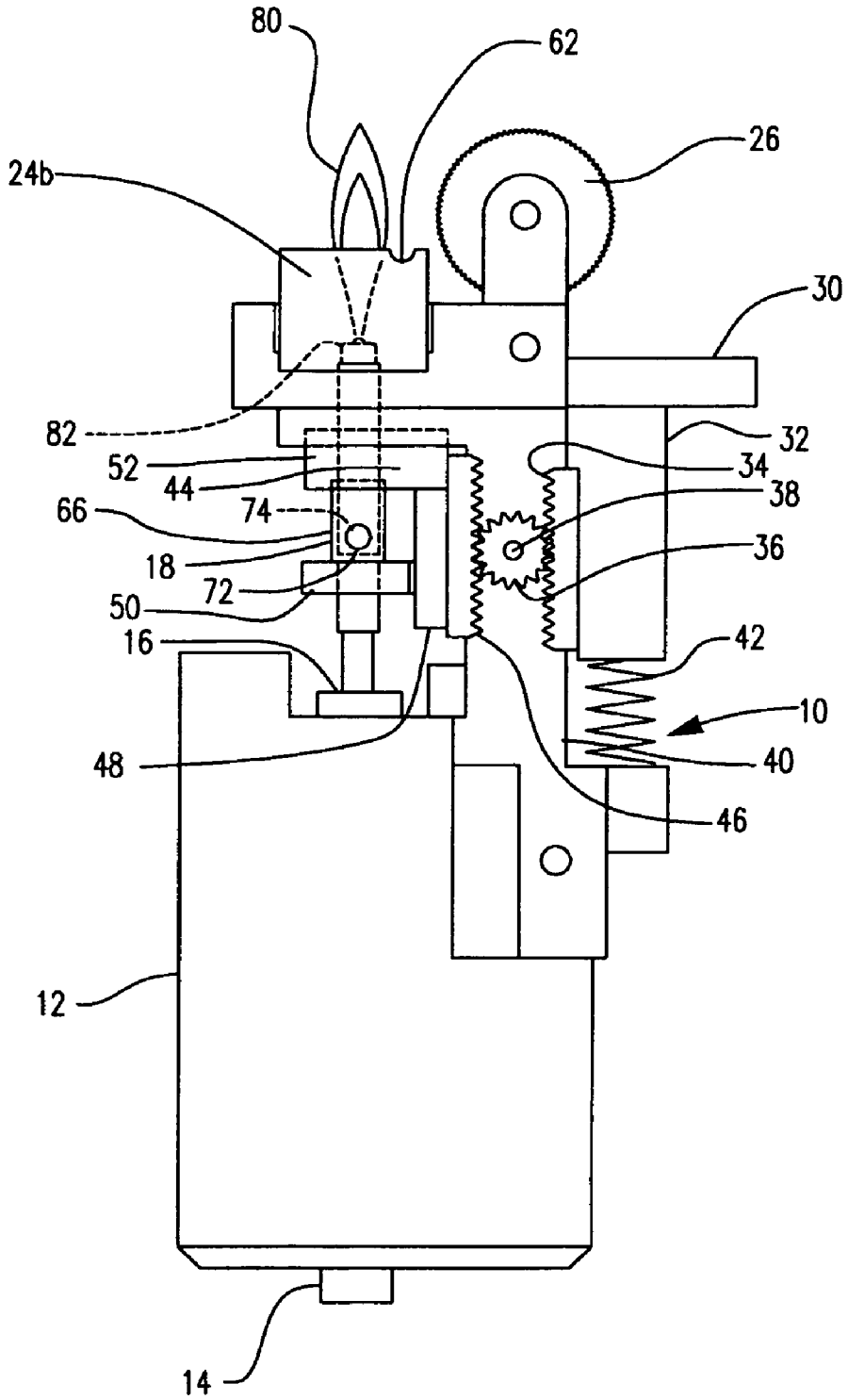

80
62
26
24b
30
82
32
52
34
44
38
74
66
36
18
72
50
42
16
10
48
40
46
12
14

FIG. 10

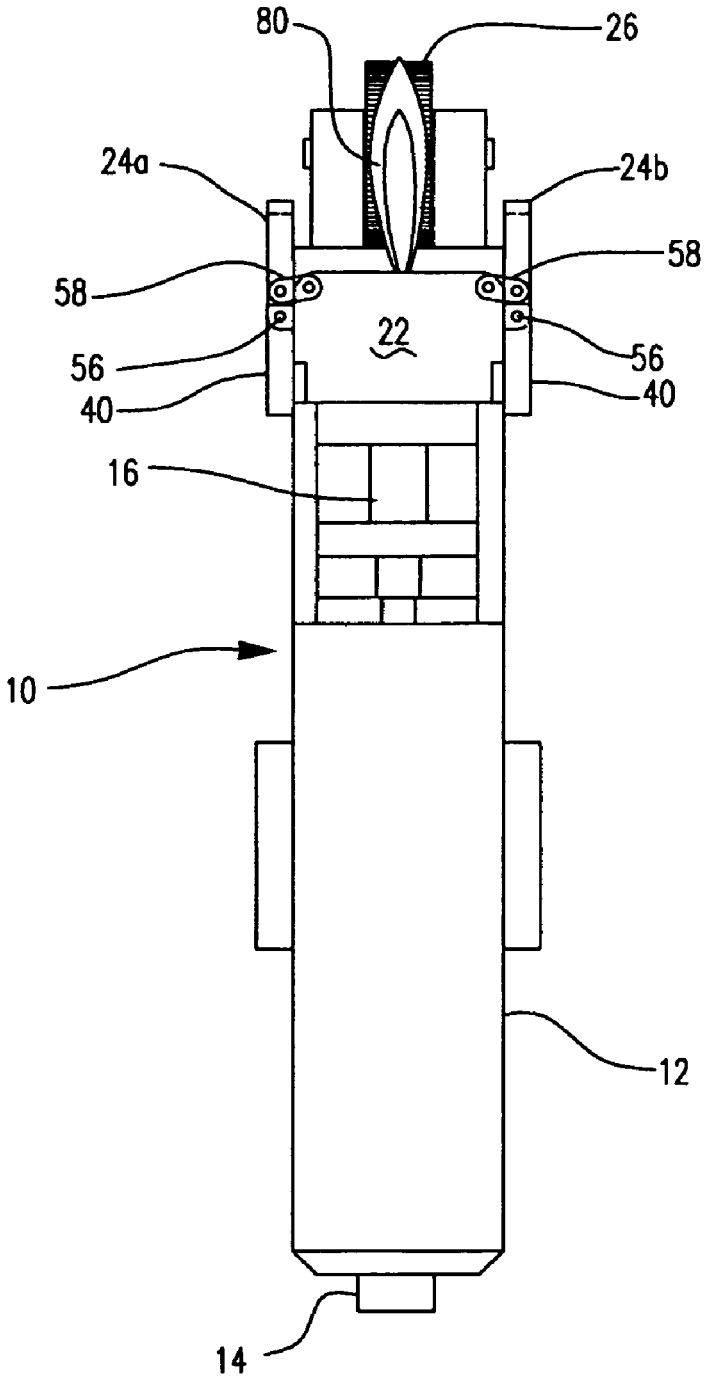


FIG. 11

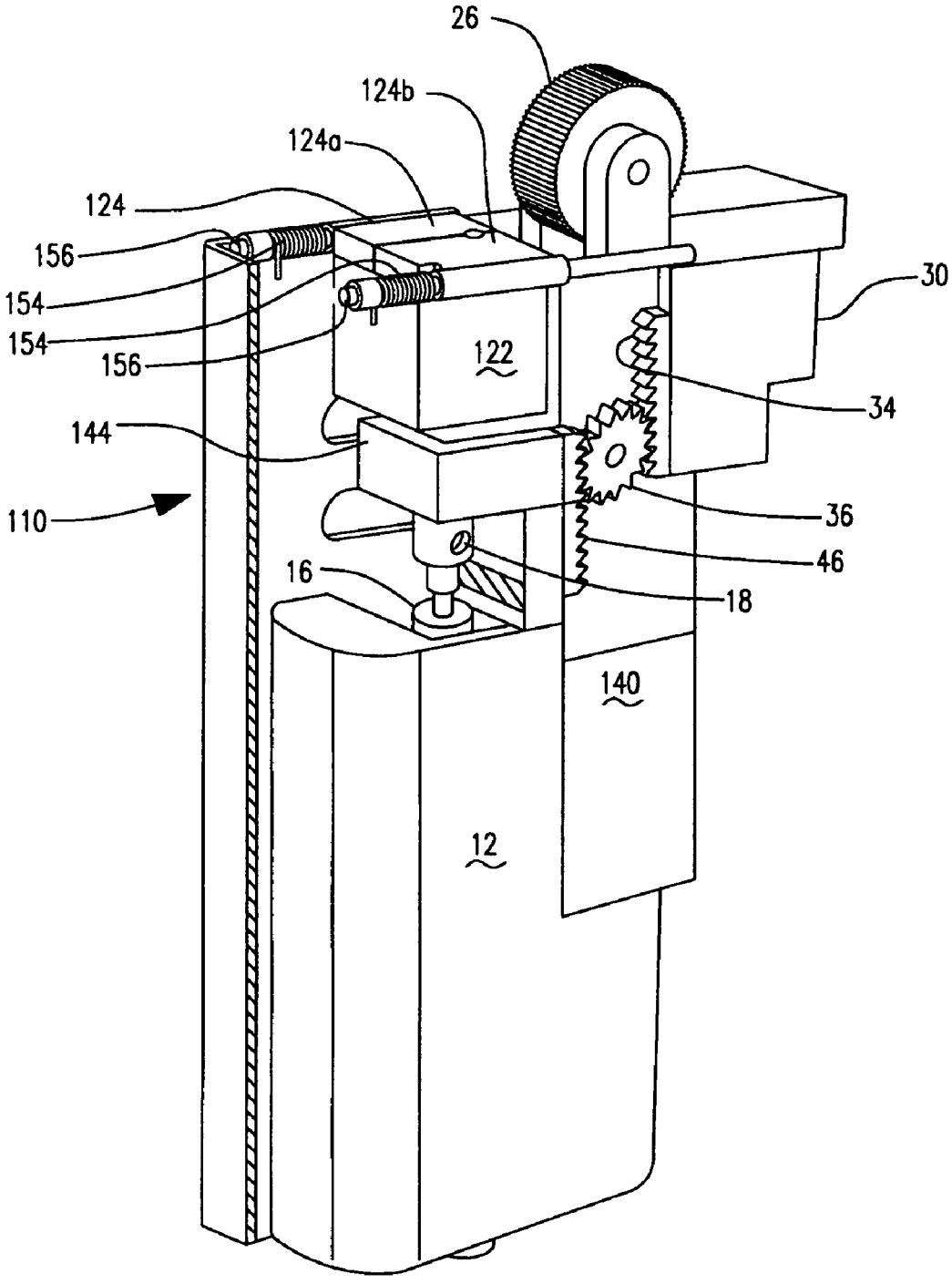

26
124b
124a
124
156
154
154
156
144
110
16
122
30
34
36
46
18
140
12

FIG. 12

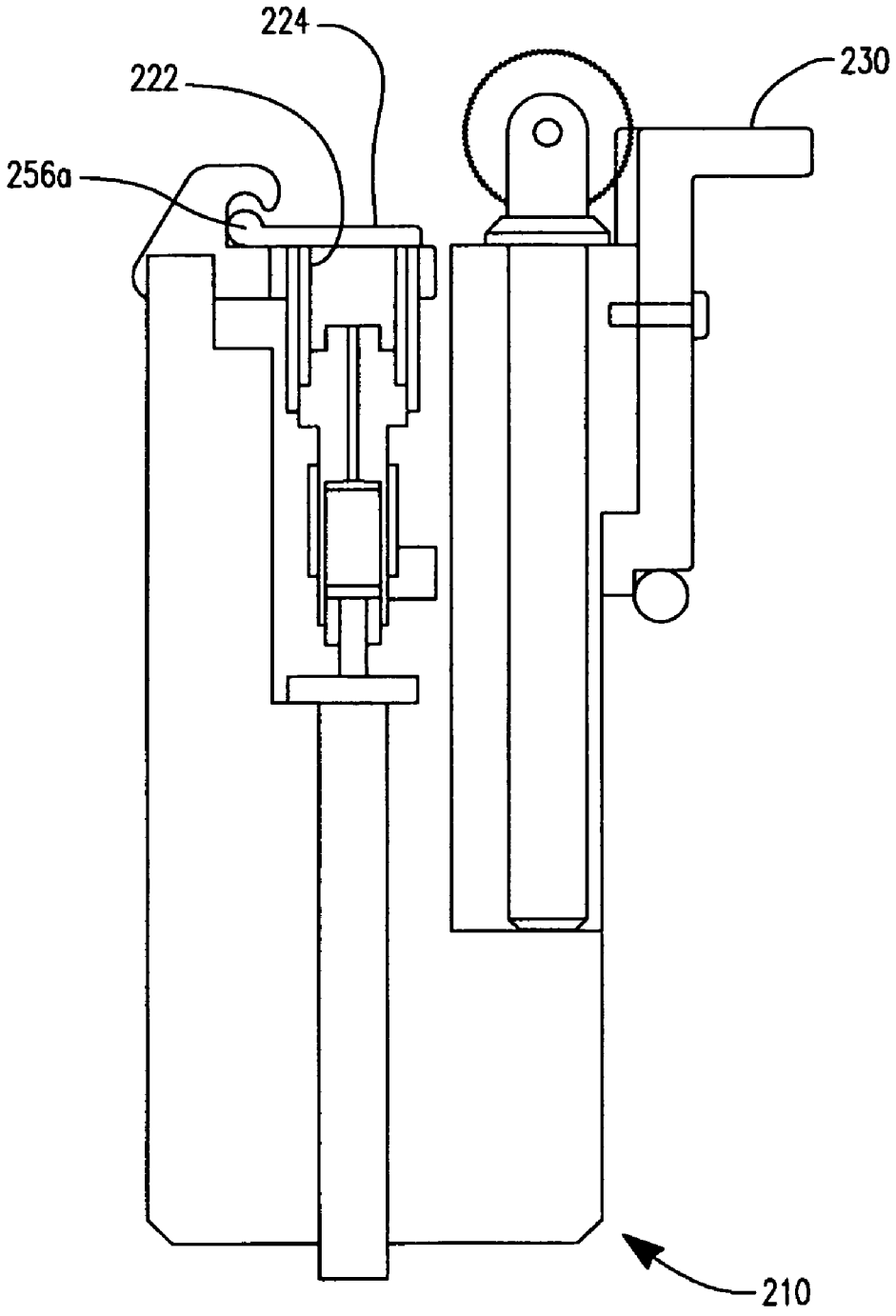


FIG. 13

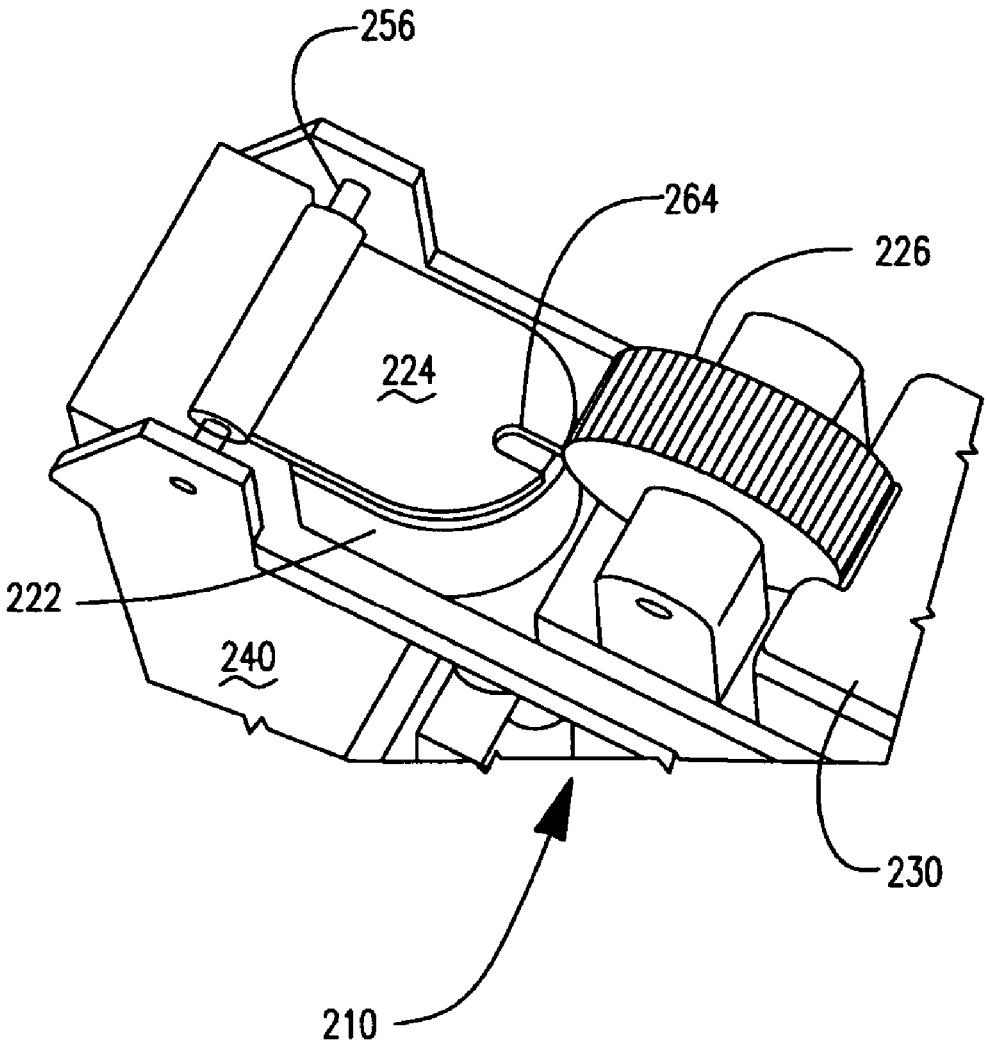


FIG. 14

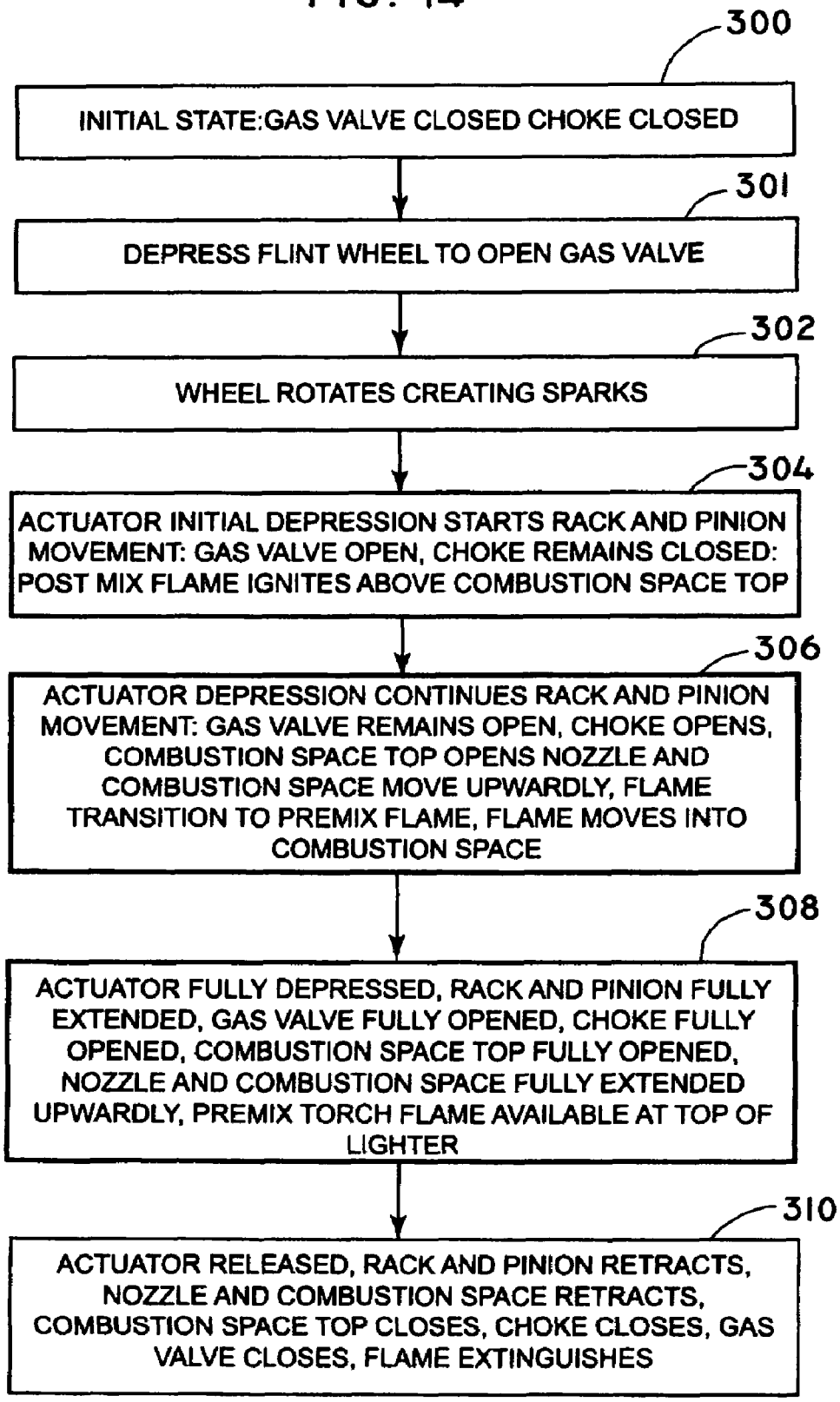

300
INITIAL STATE:GAS VALVE CLOSED CHOKE CLOSED
301
DEPRESS FLINT WHEEL TO OPEN GAS VALVE
302
WHEEL ROTATES CREATING SPARKS
304
ACTUATOR INITIAL DEPRESSION STARTS RACK AND PINION MOVEMENT: GAS VALVE OPEN, CHOKE REMAINS CLOSED: POST MIX FLAME IGNITES ABOVE COMBUSTION SPACE TOP
306
ACTUATOR DEPRESSION CONTINUES RACK AND PINION MOVEMENT: GAS VALVE REMAINS OPEN, CHOKE OPENS, COMBUSTION SPACE TOP OPENS NOZZLE AND COMBUSTION SPACE MOVE UPWARDLY, FLAME TRANSITION TO PREMIX FLAME, FLAME MOVES INTO COMBUSTION SPACE
308
ACTUATOR FULLY DEPRESSED, RACK AND PINION FULLY EXTENDED, GAS VALVE FULLY OPENED, CHOKE FULLY OPENED, COMBUSTION SPACE TOP FULLY OPENED, NOZZLE AND COMBUSTION SPACE FULLY EXTENDED UPWARDLY, PREMIX TORCH FLAME AVAILABLE AT TOP OF LIGHTER
310
ACTUATOR RELEASED, RACK AND PINION RETRACTS, NOZZLE AND COMBUSTION SPACE RETRACTS, COMBUSTION SPACE TOP CLOSES, CHOKE CLOSES, GAS VALVE CLOSES, FLAME EXTINGUISHES

FIG. 15

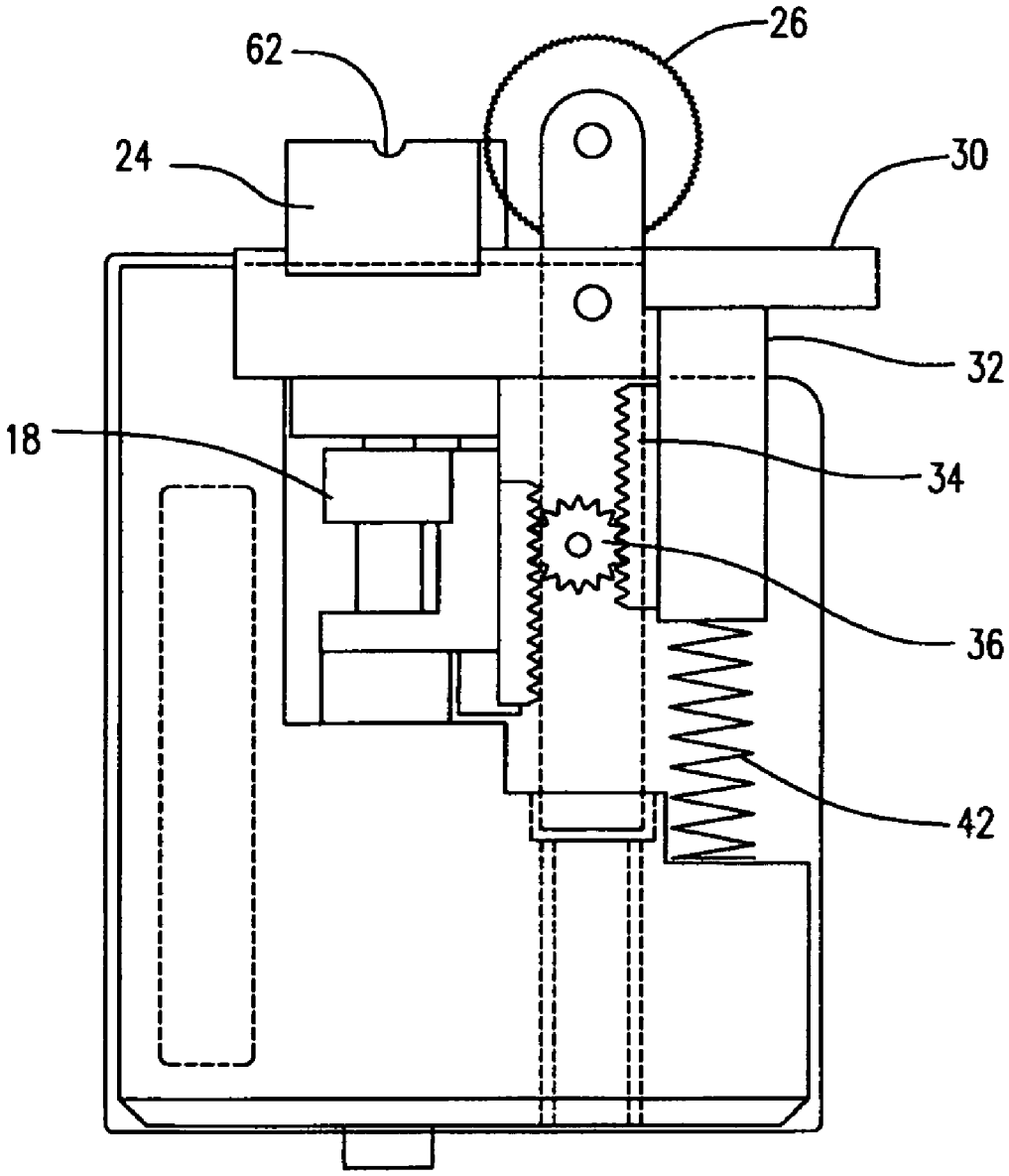


FIG. 16

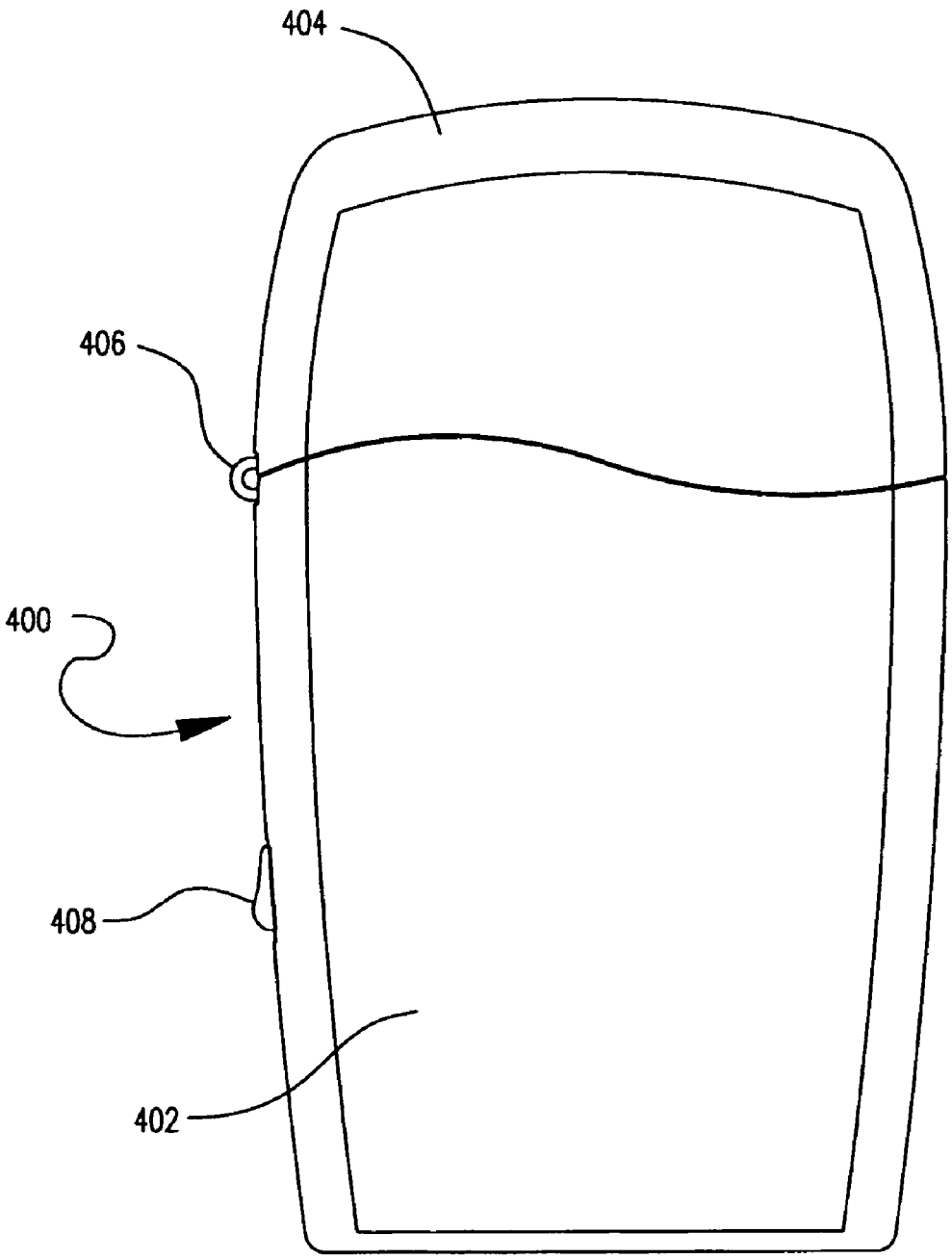


FIG. 17

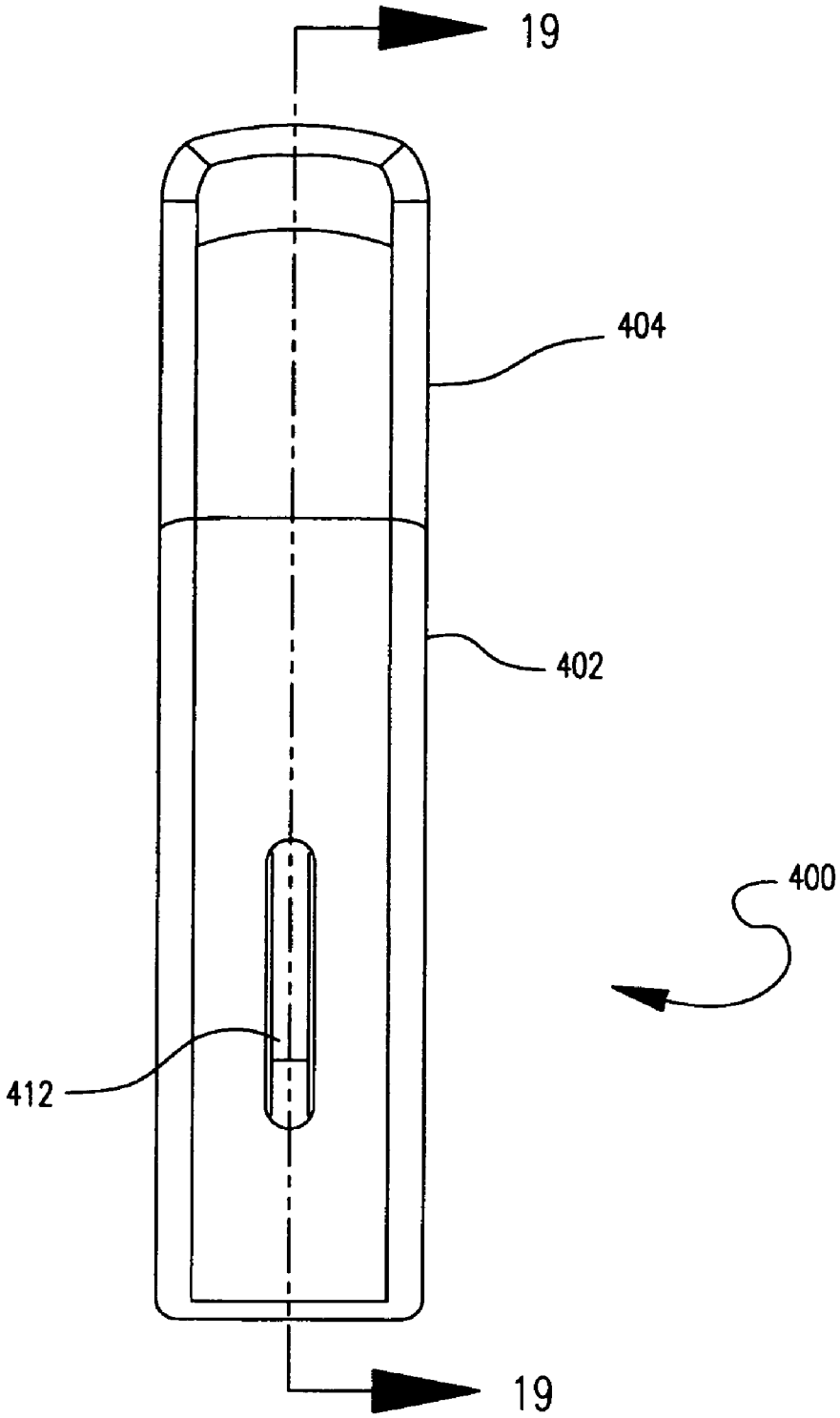
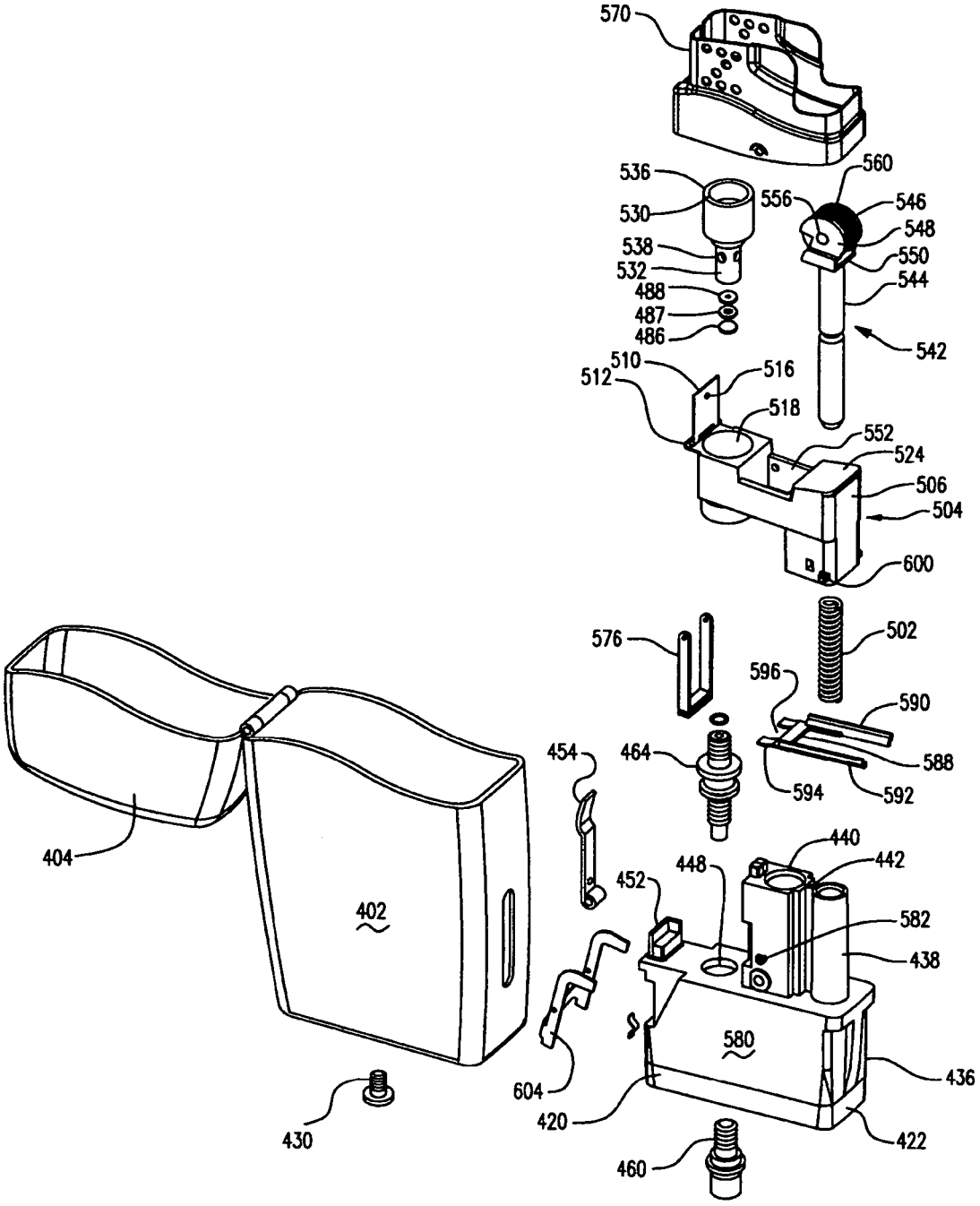


FIG. 18


570
536
530
538
532
488
487
486
560
556
546
548
550
544
542
510
512
516
518
552
524
506
504
600
576
502
596
590
588
594
592
454
464
440
442
448
452
582
438
404
402
580
436
604
420
422
430
460

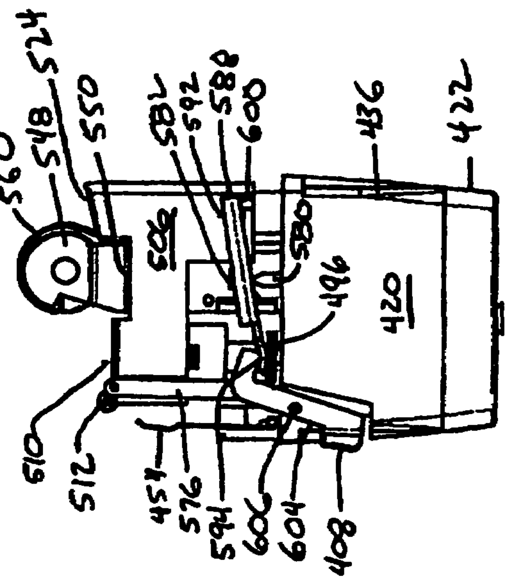

560
548
524
550
506
586
592
588
600
436
422
580
496
420
510
512
454
576
594
606
604
408

FIG 20

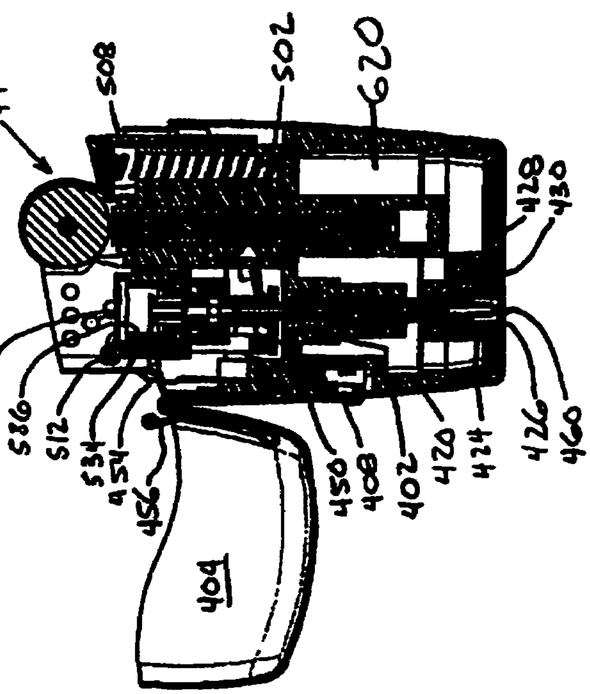

440
508
502
620
404
510
586
512
534
454
456
450
408
402
420
424
426
460
428
430

FIG 19

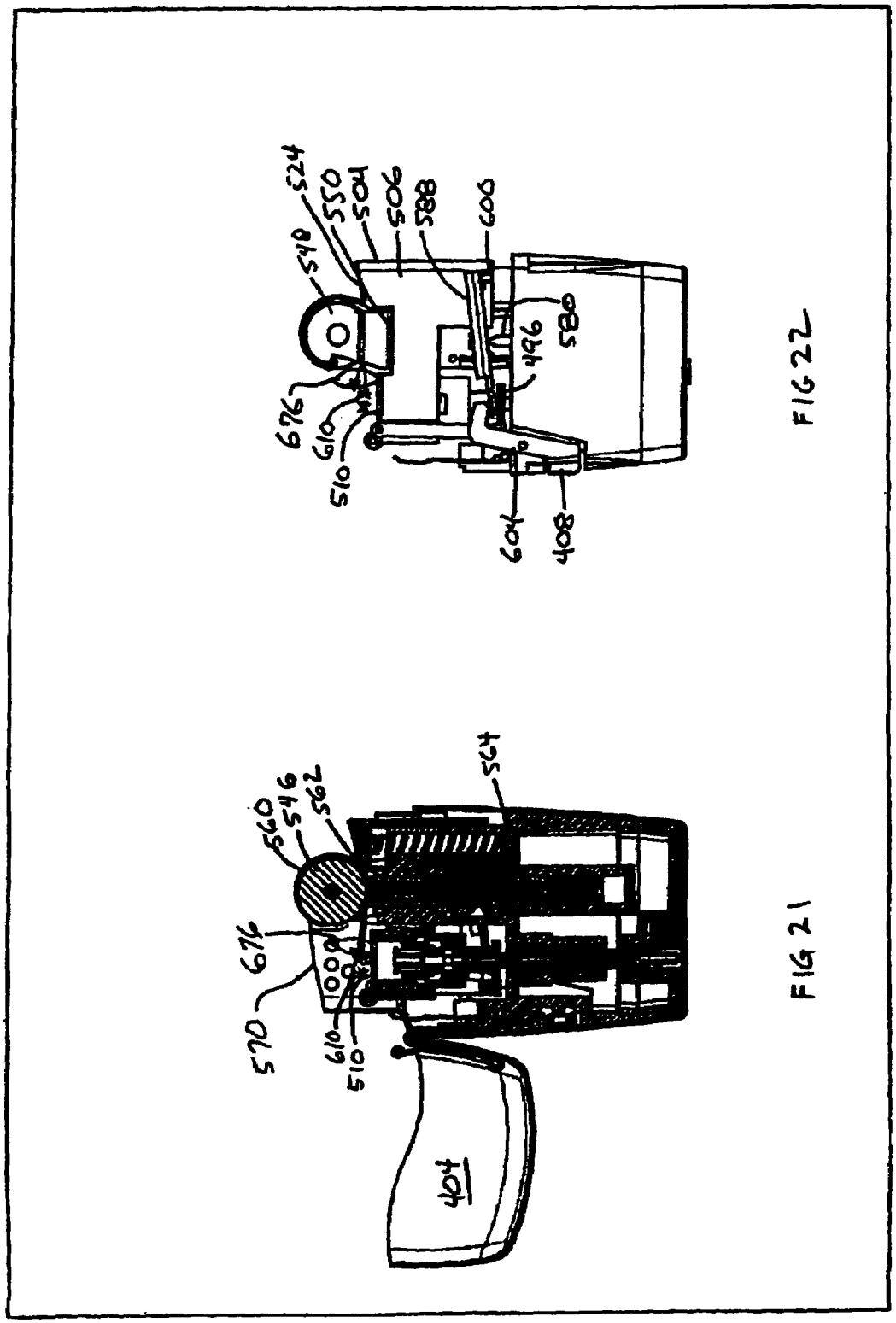

524
550
504
506
588
600
548
496
580
676
610
510
604
408
564
562
546
560
676
1008
570
610
510
404

FIG 22

FIG 21

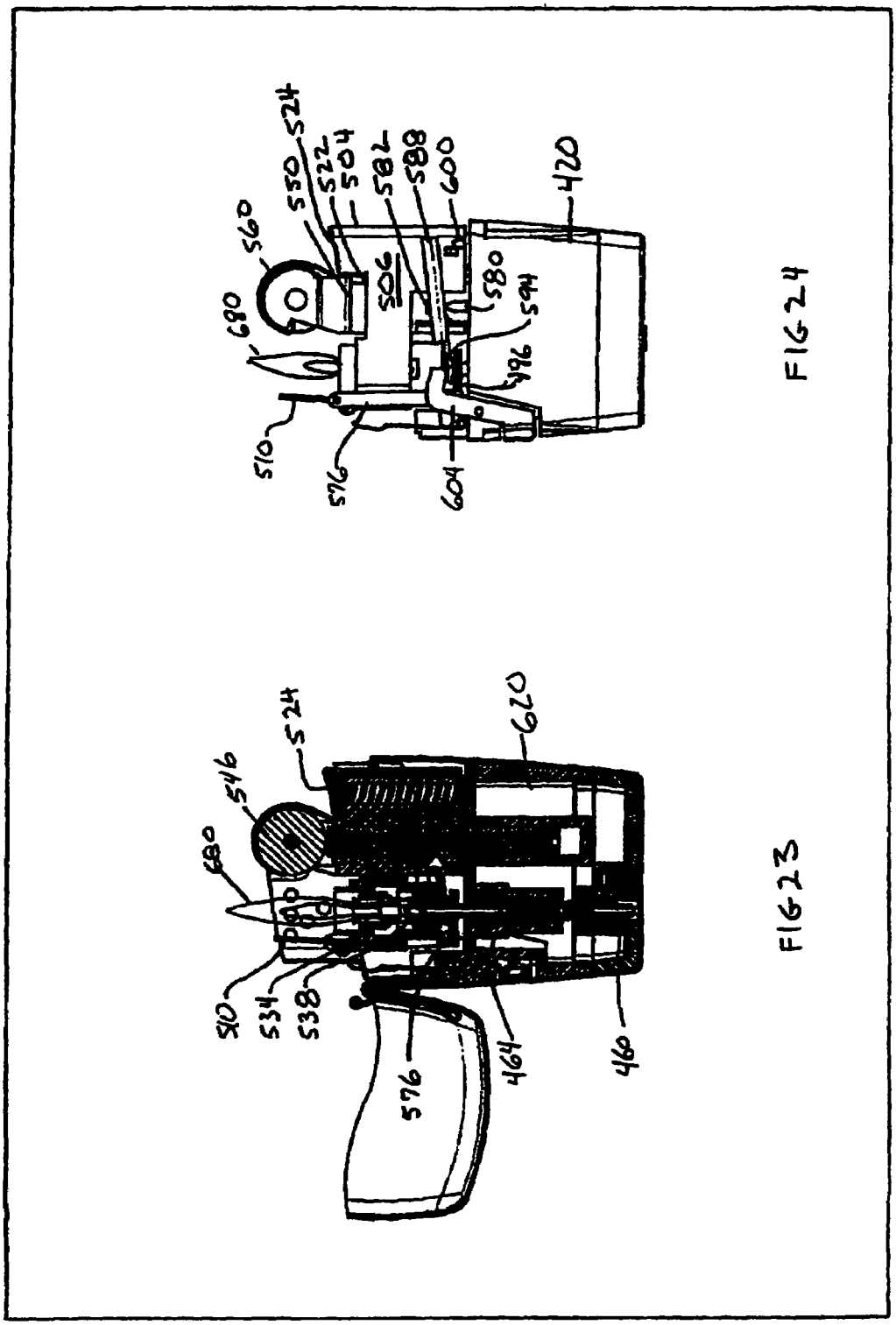
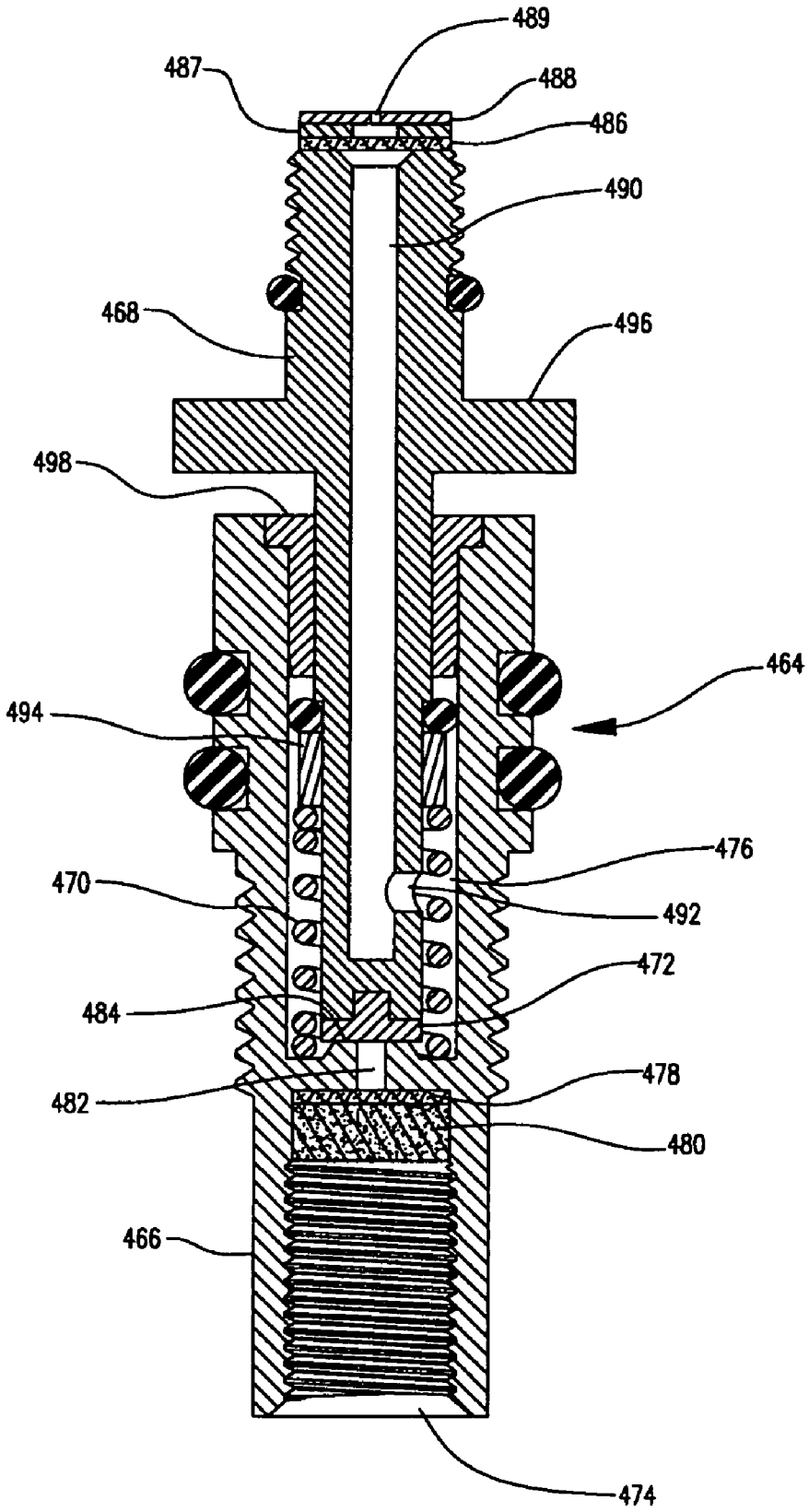

524
550
522
504
582
588
600
420
560
690
506
580
594
596
510
576
604
524
620
546
680
510
534
538
576
464
460

FIG24

FIG23

FIG. 25


489
487
488
486
490
468
496
498
464
494
476
470
492
472
484
478
482
480
466
474

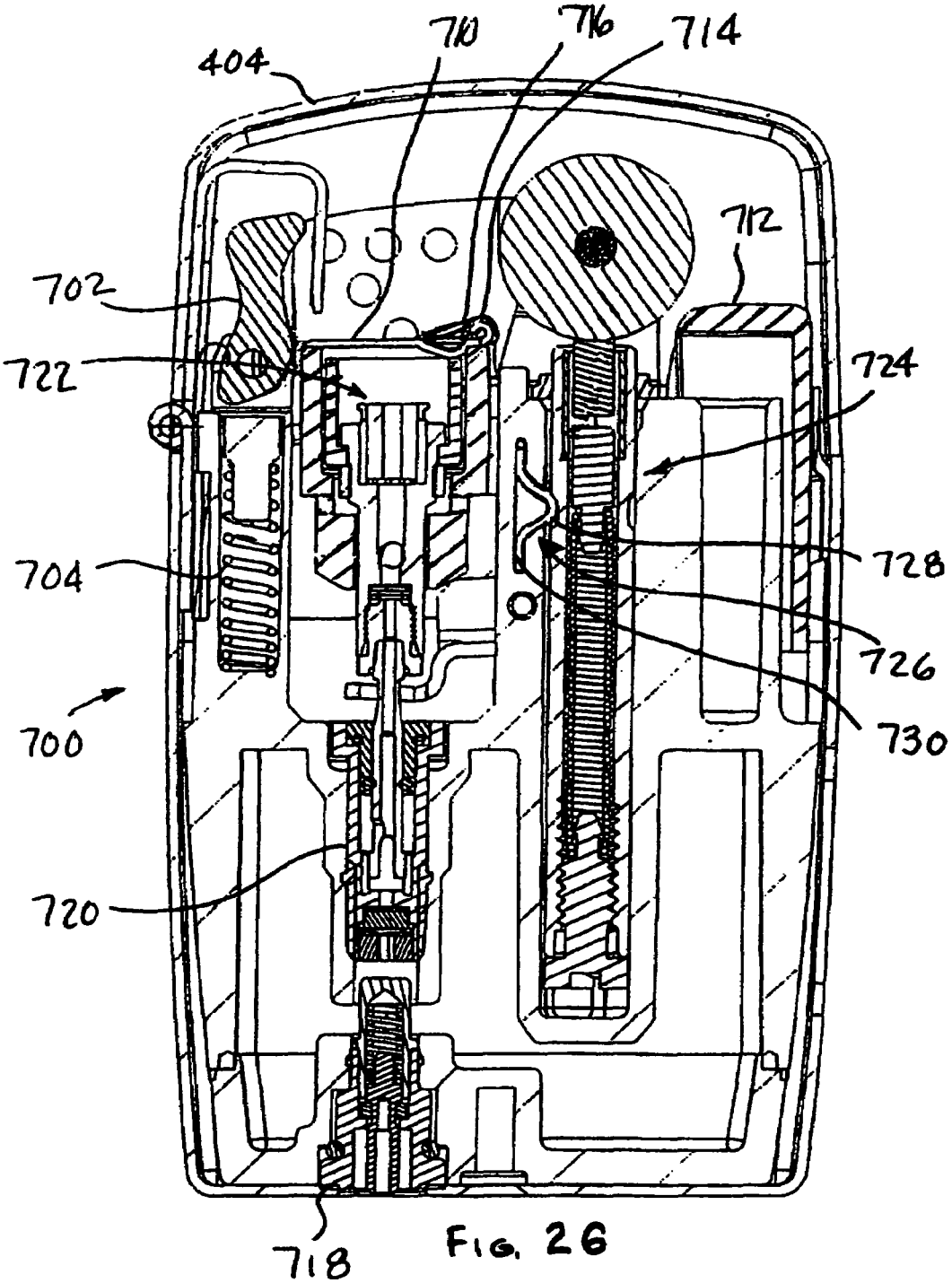


Fig. 26

FIG. 27

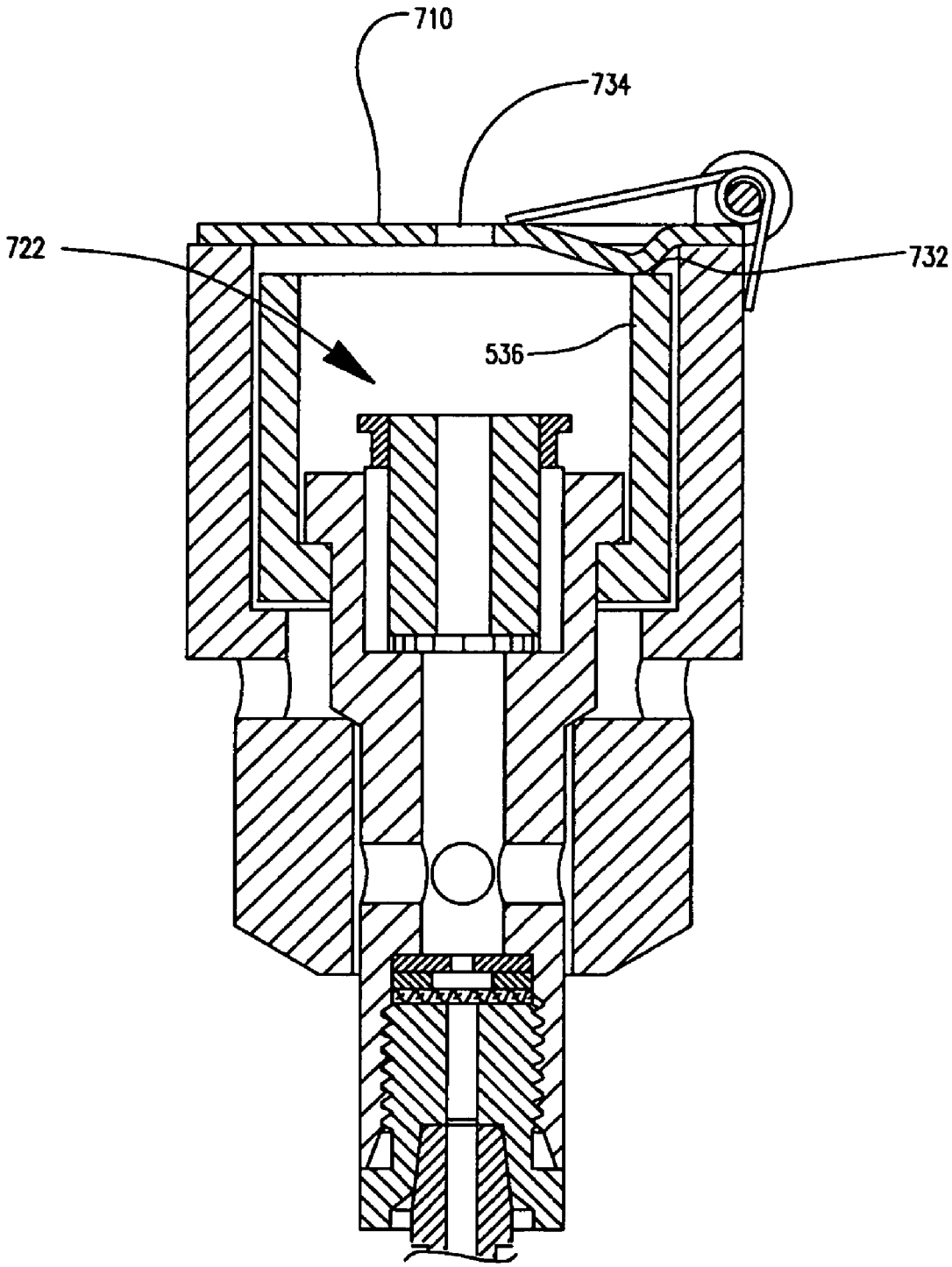


FIG. 28

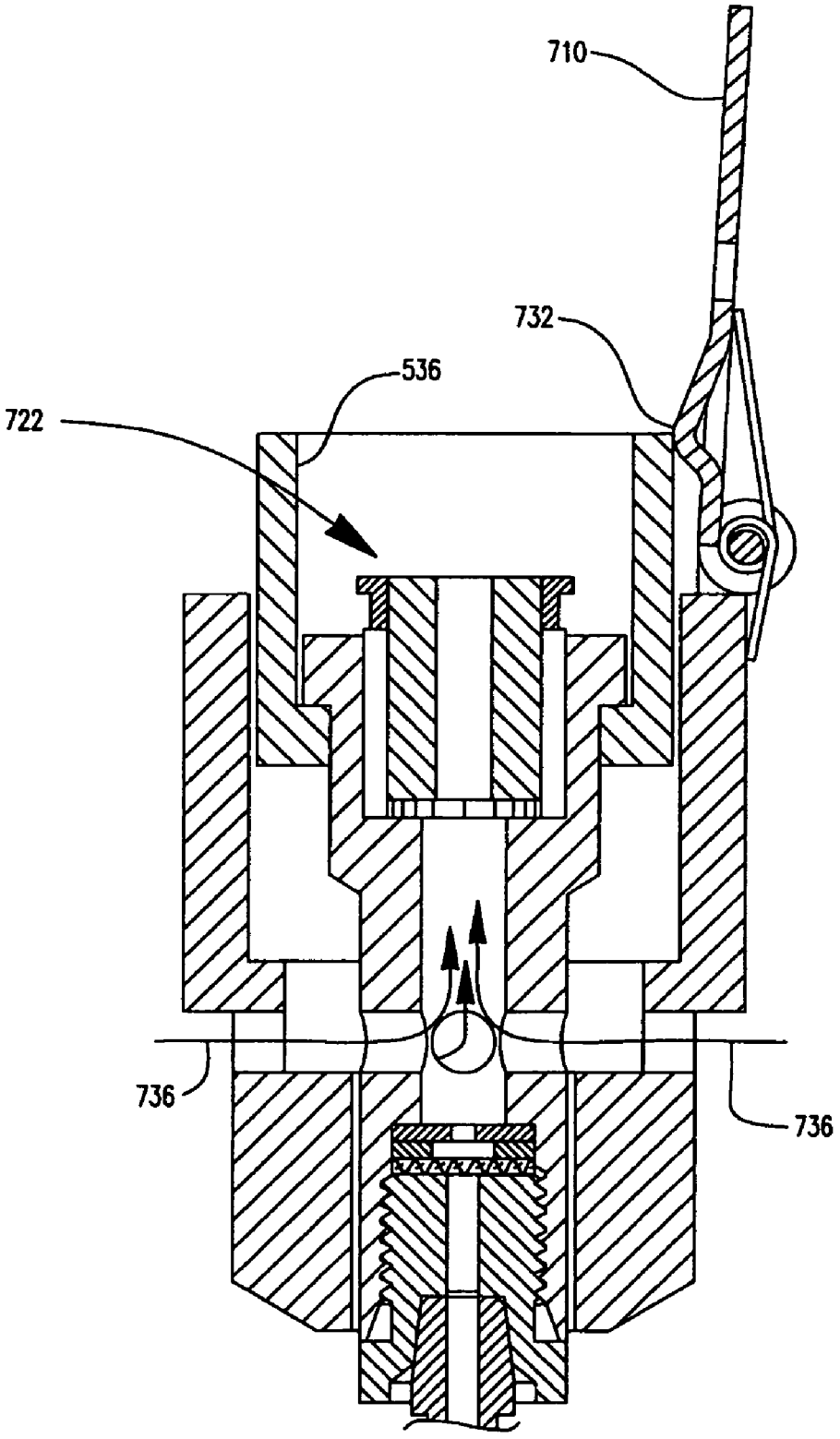


FIG. 29

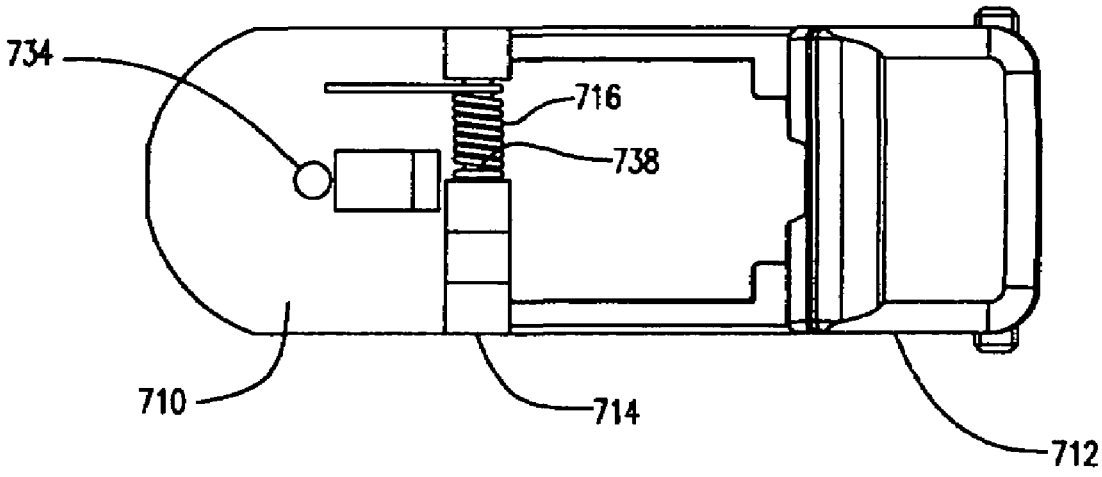


FIG. 30

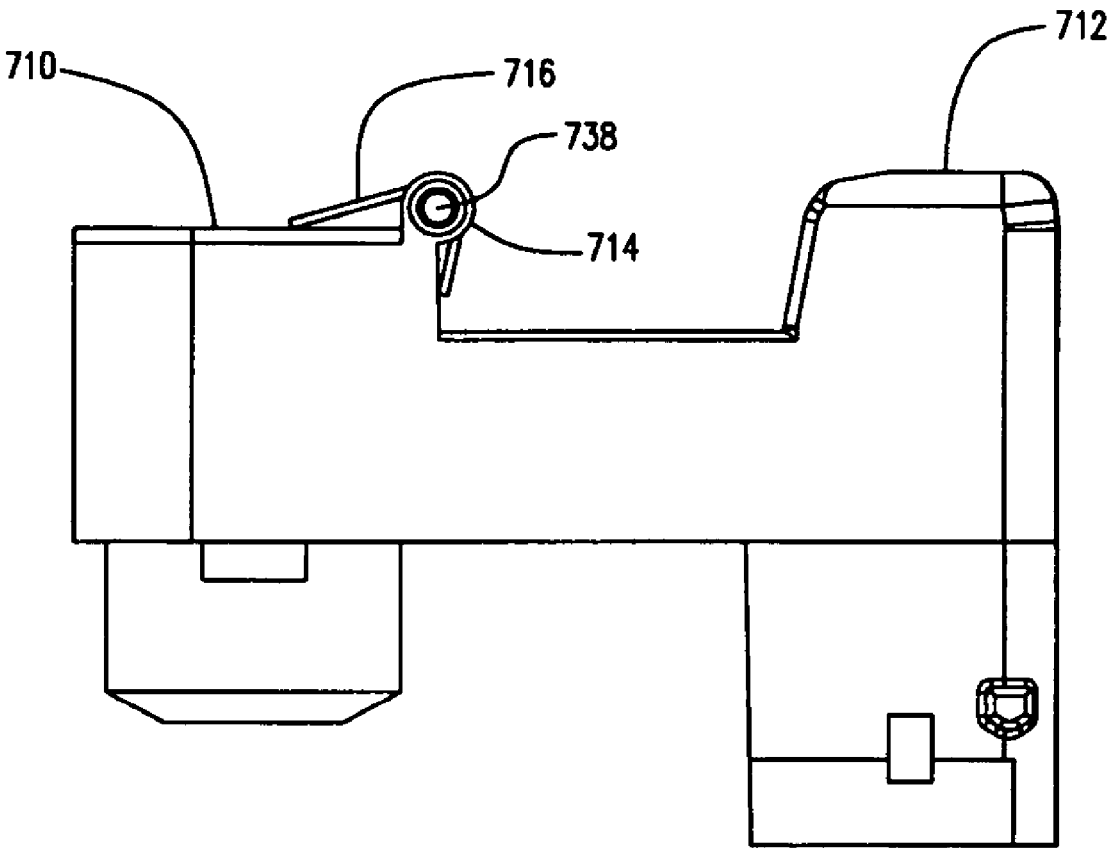


FIG. 31

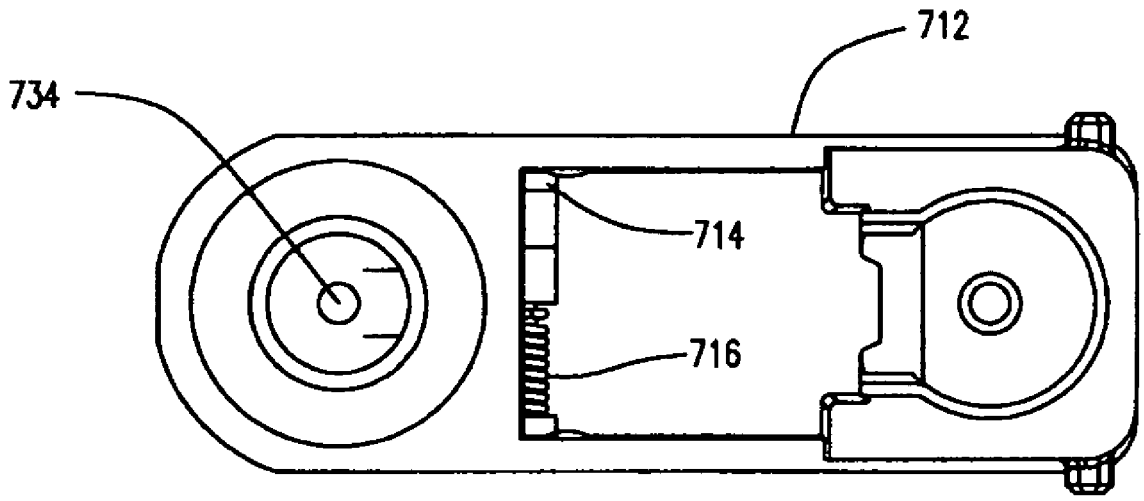


FIG. 32

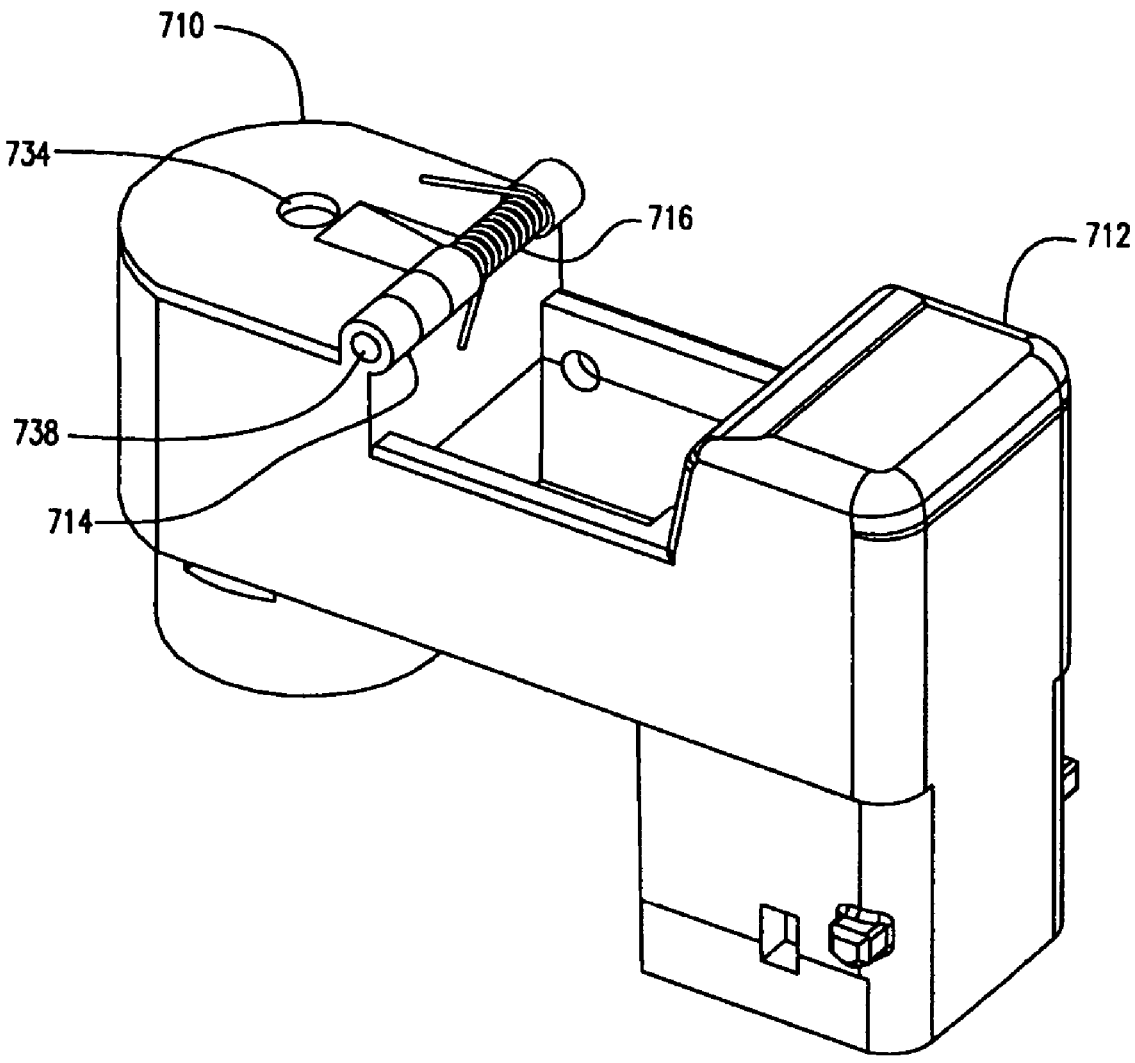


FIG. 33

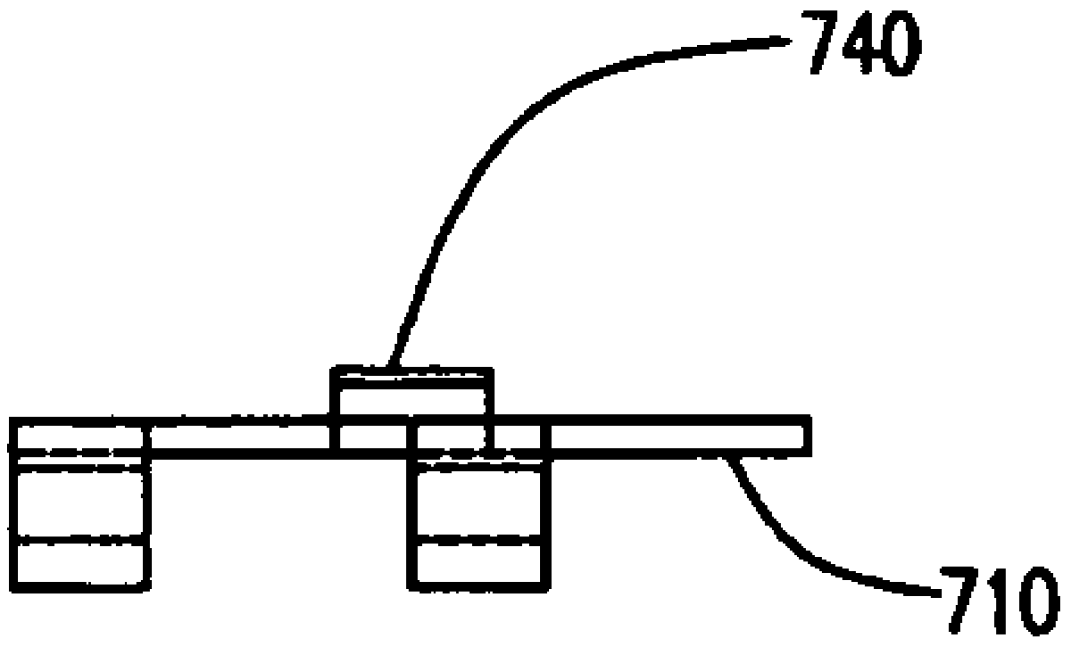


FIG. 34

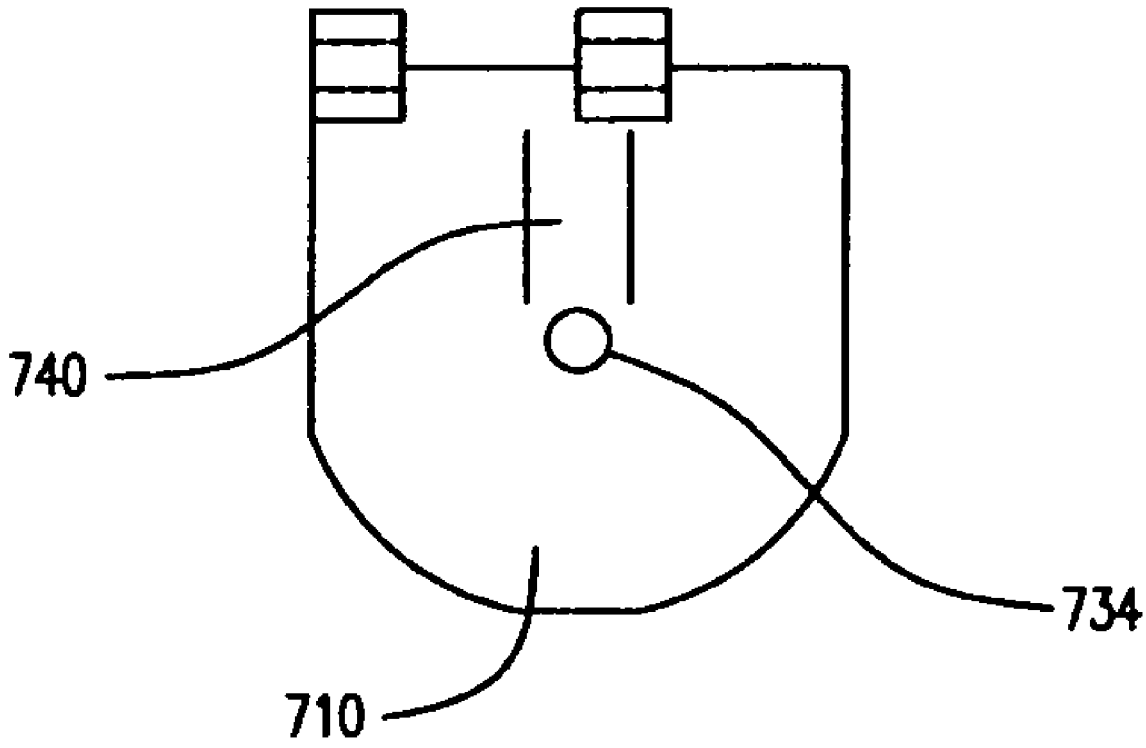
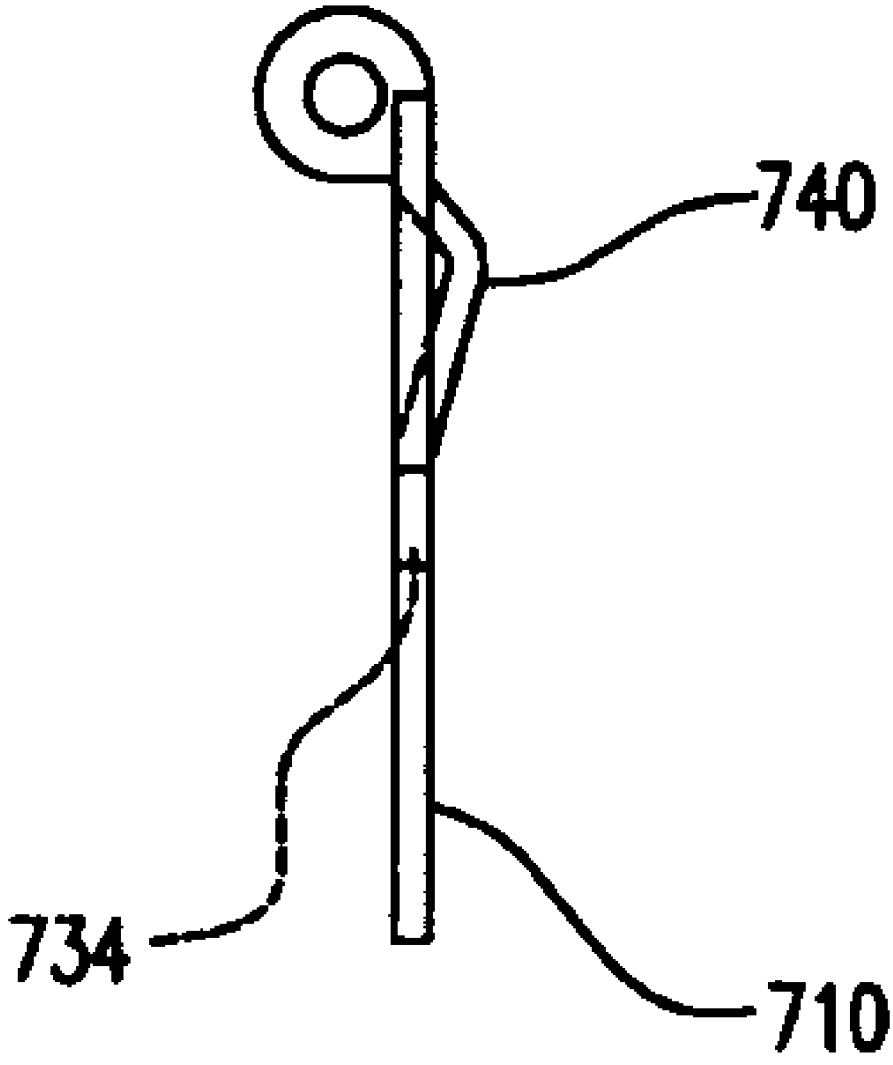


FIG. 35



FLINT IGNITED PREMIXED LIGHTER

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 60/545,431, filed Feb. 17, 2004, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

The present invention relates to a lighter of the type used by consumers to light cigarettes, cigars, and pipes and more particularly to a lighter using butane fuel to create a directed flame.

Lighters have been known and used for many years. One type of conventional lighter uses a fuel which is liquid but volatile at normally encountered environmental temperatures (about 25° F. to 90° F.). This type of lighter comprises a fiber filled fuel reservoir surrounded by a metallic case. A wick extends from the fiber filled fuel reservoir into a combustion chamber outside of the fuel reservoir which is surrounded by a wind screen. On one side of the combustion chamber, a rotatable steel wheel having a rough surface rests against a flint which is spring biased into engagement with the steel wheel. When the steel wheel is rotated, particles of the flint are separated from the flint body, become incandescent and are projected into the combustion chamber near the fuel soaked wick. Fuel vapor evaporating from the wick is ignited by the sparks created by the flint and steel at the location surrounding the wick where the fuel vapor mixes with air. This produces a flame surrounding the wick. The combustion created by this type of lighter is called "post mix" combustion because the fuel and air is mixed in the combustion chamber at the point of combustion.

The word "flint" is used herein to mean the commercially available consumer product called "flint" or in the plural, "flints". This product is not normally the historical stone "flint" but is a manufactured product including rare earth metals such as cerium and other elements. These "flints" are often sold in a package of several units formed into small cylinders for use with cigarette lighters and are widely commercially available. They will not be further described herein. It will be appreciated that the word flints and the word flint are used in the specification to mean these products, variations of these products and other commercially available products which, when abraded with a serrated steel or iron wheel, produce incandescent particles capable of initiating combustion of a fuel and air mixture.

The flint and steel or iron wheel ignition system has an advantage when compared to many other systems in that a single stroke by the thumb against the iron wheel produces many incandescent sparks of a temperature sufficient to ignite a fuel and air mixture. As many sparks are produced, the likelihood of an incandescent spark interacting with an appropriate fuel air mixture volume is high and reliable operation becomes more likely.

Another type of conventional cigarette lighter uses butane fuel. "Butane" fuel is used herein to mean a fuel which, at normally encountered atmospheric temperature and pressure, is gaseous if unrestrained. However, "butane" fuel is easily compressed into a liquid state at normally encountered atmospheric temperature and pressure conditions. Thus, butane fuel can be sold in the pressurized liquid state which is easily handled by consumers and loaded into a sealed chamber in a cigarette lighter. When a vent or nozzle on such a sealed container of butane is opened, butane gas will be released and

butane liquid within the container or reservoir will quickly turn into a gas so long as the pressure is reduced to atmospheric. The chemical butane answers this description. However, butane gas mixed with other organic chemicals in minor amounts will also meet this description. The word butane is used herein to mean commercially available lighter fuels and other available similar fuels answering the same functional description.

Many conventional butane lighters comprise a reservoir of butane fuel connected to a lever operated valve which is in turn connected to a mixing arrangement adding air to the fuel which is fed to a nozzle. A piezoelectric igniter is used. A user operates the lighter by depressing a button with a thumb which opens the fuel valve and operates the piezoelectric igniter. Fuel passes through the fuel valve into the mixer where it is mixed with air and then exits through the nozzle as a jet. The single spark created by the piezoelectric igniter then ignites the flame providing a torchlike blue flame. The flame is different from a post mix flame in that it is ignited and burns as a premixed mixture of fuel and air in the combustion chamber. The mixing of fuel and air occurs prior to combustion. The resulting combustion and flame are described as premix. This results in a more forceful directable flame. Flint and wheel igniters do not operate well with these premix flame producing structures. It is thought that the higher velocity of the gases exiting the nozzle as a jet reduces the effectiveness of flint and wheel igniters. Piezoelectric igniters create only a single spark on each actuation. Such lighters do not always ignite in response to actuation. Reliability needs improvement. However, premix lighters do provide a hotter, more directable and stable flame. The premix flame is also less likely to be extinguished by wind. Premix nozzles and burner parts are more easily clogged by dirt or debris. Piezoelectric igniters are more expensive than flint and wheel igniters.

A third type of lighter uses butane in a reservoir under pressure and a flint and wheel igniter. The butane reservoir is connected to a valve which is in turn connected to a nozzle. When the user wishes to operate the lighter, he uses a thumb to rotate the wheel and then to press a thumb button which opens the butane valve. The butane gas exits through the valve and the nozzle into a combustion chamber where it mixes with air and forms, after ignition, a post mix flame similar to what is seen with a liquid fuel lighter. The post mix gasses are ignited by the incandescent flint particles just as with a conventional liquid fuel lighter. This third type of conventional lighter uses butane gas but uses it to create a post mix flame, not a premix flame.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a lighter having the reliable ignition characteristics of a flint and steel or iron wheel igniter producing a strong premix flame.

Another object of the present invention is to provide a lighter having a forceful directable flame which can be reliably and repeatedly ignited.

It is still another object of the present invention to provide a lighter having a forceful directable flame in which the operable nozzle parts are protected from the debris created by a flint and wheel type igniter.

It is still another object of the present invention to provide a lighter which operates in a way sufficiently similar to conventional lighters to be intuitive to the end user.

It is still another object of the present invention to provide a lighter which is robust in design, easy to manufacture, operates reliably and produces a torch-like strong directable flame.

It is another object of the invention to provide a lighter which is not prone to unintended ignition.

In accordance with the present invention, there is provided a lighter comprising a fuel reservoir adapted to contain butane fuel, a fuel valve regulating an output from the fuel reservoir, a mixer receiving fuel from the fuel valve and selectably mixing the fuel with air to create a combustible air-fuel mixture, a nozzle receiving the fuel from the mixer arid directing the flow of fuel through the nozzle into a combustion space and a flint and wheel type igniter adjacent the combustion space adapted to introduce incandescent flint sparks into the path of the fuel flow initiating combustion.

Yet further in accordance with the invention, a choke is provided at the mixer, the choke having a closed position in which air is not admitted to the mixer and an open position in which air is admitted to the mixer allowing the creation of a fuel air premix in the mixer.

Still further in accordance with the invention, at least one closure element is provided adjacent the combustion space, the closure element substantially but not completely closing the combustion space when in a closed position and opening the top of the combustion space when in the opened position.

Yet further in accordance with the present invention, the closure element is a cover closing the lop boundary of the combustion space except for a small aperture through which combustion gas may pass and over which sparks from the flint and wheel igniter pass.

Still further in accordance with the invention, the combustion space cover may be a one or two piece cover having a small aperture in the closed position, and, opening to allow passage of the combustion space past the one piece cover or between the two piece cover thereby elevating the combustion space relative to the top of the lighter after initiation of a flame.

Yet further in accordance with the invention, the combustion space of a butane premixed fuel lighter is surrounded by a heat shield which moves upwardly with the combustion space when a flame is ignited.

Yet further in accordance with the invention, a butane premixed fuel lighter comprises a butane fuel reservoir having an outlet at a valve, the valve selectively supplying butane gas to a mixer with a choke which in turn supplies fuel gas and selectively air to a nozzle introducing fuel gas into a combustion chamber, a movable combustion chamber top wall having a small aperture therein and a wheel and flint igniter adjacent said combustion chamber top wall adapted to direct a stream of sparks over said small aperture and a thumb actuator button adjacent said wheel and flint igniter whereby an operator may operate the lighter by depressing the flint wheel to open the gas valve and rotating the wheel with the operator's thumb; having the thumb then depress the thumb button upon completion of the rotation of the wheel thereby actuating a rack and pinion which opens the reservoir valve, thereby directing gas through the mixer and combustion chamber and outwardly through the small aperture where it is ignited as a post mix flame; starts to elevate the nozzle in the combustion chamber, open the choke and open the combustion chamber top wall whereby the flame starts a transition into a premix flame; and, when said thumb actuator is in the bottommost position, fully open the choke and elevate the combustion space producing a fully premix torch-like flame for so long as the thumb actuator is depressed.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing objects, and others, will in part be obvious and in part be pointed out more fully hereinafter in conjunction with the written description of preferred embodiments of the invention illustrated in the accompanying drawings in which:

FIG. **1** is a schematic side elevational view of a lighter in accordance with the present invention.

FIG. **2** is an end elevational view of the lighter of FIG. **1**.

FIG. **3** is a side elevational view of the lighter of FIG. **1** just after the wheel of the lighter has been rotated and as the actuator is started to be depressed.

FIG. **4** is an end view of the lighter of FIGS. **1-3** in the configuration of FIG. **3**.

FIG. **5** is a side elevational view similar to FIGS. **1** and **3** showing the actuator further depressed and the combustion space top cover partially opened.

FIG. **6** is a an end view of the lighter of FIGS. **1-5** in the state illustrated in FIG. **5**.

FIG. **7** is a side elevational view similar to FIGS. **1**, **3** and **5** showing the rack and pinion further extended and the top cover fully opened.

FIG. **8** is a end view of the lighter of FIGS. **1-7** in the same state as FIG. **7**.

FIG. **9** is a view similar to FIGS. **1**, **3**, **5** and **7** showing the rack and pinion bottomed.

FIG. **10** is an end view of the lighter of FIGS. **1-9** in the same state as FIG. **9**.

FIG. **11** is a perspective view of an alternate embodiment of a lighter in accordance with this invention having a different top cover opening mechanism.

FIG. **12** is a side elevational view, partially cut away, of another alternate embodiment of a lighter in accordance with the present invention having a different combustion space top cover.

FIG. **13** is a downwardly looking perspective of another embodiment similar to the embodiment of FIG. **12**.

FIG. **14** is a flow diagram showing the steps in the operation of a lighter in accordance with the present invention.

FIG. **15** is a schematic side elevation of the embodiment seen in FIGS. **1-10**, partially cut away, showing the relationship of the assembled main components.

FIG. **16** is a front view of another embodiment of the invention.

FIG. **17** is a side view of the embodiment of FIG. **16**.

FIG. **18** is an exploded view of the parts and assemblies of the lights of FIGS. **16** and **17**.

FIG. **19** is a vertical sectional view taken along line **19-19** of FIG. **17** with the case opened.

FIG. **20** is a front view of the lighter seen in FIGS. **16-19** with the case removed in the rest position.

FIG. **21** is a vertical section similar to FIG. **19** showing the lighter in the primed position with a post mix flame.

FIG. **22** is a front view of the lighter similar to FIG. **20** with the lighter in the primed position with a post mix flame.

FIG. **23** is a vertical section similar to FIGS. **19** and **21** with the lighter in the torch flame position.

FIG. **24** is a front view of the lighter similar to FIGS. **20** and **22** with the lighter in the torch flame position.

FIG. **25** is a cross sectional view of the main valve assembly.

FIG. **26** is a vertical sectional view of an alternative embodiment of the present invention, shown with the cover closed.

FIG. **27** is an enlarged detail view of the burner and a portion of a carriage from FIG. **26** in a closed position.

FIG. **28** is a view of the detail of FIG. **27**, except with the burner advanced vertically to an open position.

FIG. **29** is a top plan view of the carriage and door assembly of the embodiment of the lighter of FIG. **26**.

FIG. **30** is a side elevation view of the carriage and door assembly of FIG. **29**.

FIG. **31** is a bottom plan view of the carriage and door assembly of FIG. **29**.

FIG. **32** is a perspective view of the carriage and door assembly of FIG. **29**.

FIG. **33** is an end view of the door from the embodiment of the lighter shown in FIG. **26**.

FIG. **34** is a top plan view of the door of FIG. **33**.

FIG. **35** is a side view of the door of FIG. **33**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now in greater detail to the drawings, where in the showings are for the purposes of illustrating preferred embodiments of the invention and not for the purposes of limiting same, a lighter **10** is shown in FIG. **1** in side elevation view. The lighter is shown in a somewhat exploded view to more clearly illustrate the elements comprising the lighter **10**. A fuel reservoir **12** is disposed at the bottom of the lighter **10** a knurled and slotted adjustment sleeve surrounds a butane filling port at the bottom of the reservoir **12**. The words bottom and top are used herein to refer to portions and orientations of the lighter **10** when the lighter is in a conventional orientation. It should be appreciated that the lighter can be stored and used in positions other than that described herein.

A valve **16** is positioned at or near the top of the reservoir **12**. the valve **16** communicates with a mixer **18** which in turn communicates with a nozzle (FIG. **9**). Details of an appropriate valve are shown in FIG. **25**. The valve **16** has an output orifice adapted to introduce a high velocity, low pressure jet of fuel into the mixer **18**. This low pressure jet draws air into the mixer when the air inlet is open. The nozzle is surrounded by heat shield **22** which defines the sides of a combustion space above the nozzle. A cover **24** extends over the heat shield **22** and substantially, but not completely, closes the combustion space.

Still with reference to FIGS. **1** and **2**, a striker wheel **26** is disposed at the top of the lighter **10**. The striker wheel **26** has an outer cylindrical surface which has a file-like roughened configuration. A flint **28** (FIG. **3**) is disposed below the striker wheel **26** in a flint containing column (not shown). The arrangement of the striker wheel **26** and the flint **28** is conventional with a spring in the flint **28** containing column biasing the flint **28** against the striker wheel **26** at a preselected pressure. The flint **28** is replaceable by removal of a bottom access screw which allows a user to pull out the biasing spring, replace a worn flint and replace the biasing spring. The operation of the flint and striker wheel is conventional. Flints are commercially available.

A thumb button **30** is positioned at the upper right hand corner of the lighter **10**. The thumb button **30** is connected to a thumb button shank **32** which carries a rack **34**. The rack **34** is a linear, vertical array of gear teeth rigidly fixed to the thumb button shank which moves up and down with the thumb button. A rotatable pinion gear **36** is mounted on a pin **38** fixed to the frame **40** of the lighter. The thumb button shank **32** is slidably fixed to the frame **40** by means of a dove tail or the like. The thumb button shank **32**, thumb button **30** and associated rack **34** can slide upwardly and downwardly with respect to the frame but are held laterally in place with respect to the frame **40** such that the rack **34** is always in engagement with the pinion gear **36**. A spring **42** (FIG. **3** only) biases the thumb button upwardly when it is not being manually depressed.

A lifter **44** is rigidly fixed to a second rack **46**. The lifter **44** has a vertical shank portion **48**, a lower lateral portion **50** and an upper lateral portion **52**. The lifter shank portion **48** slidably engages the lighter frame **40** by means of a dove tail or the like. The lifter **44** can move vertically with respect to the lighter frame **40** but is laterally fixed with respect to the lighter frame **40**. The lifter rack **46** engages the pinion gear **36**. Because of this, when the thumb button shank **32** is displaced downwardly, the lifter shank **48** is displaced upwardly an equal distance.

Referring now to FIG. **2**, one sees the cover **24** is split down its center into two cover halves **24**A, **24**B in this embodiment. The cover halves are generally rectangular with their outboard edges hinged to the frame **40** by means of cover hinge pins **56**. The cover halves **24**A, **24**B are each individually fixed to the heat shield **22** by means of links **58**. The links **58** are fixed at their lower ends to the heat shield **22** by means of pins and at their upper ends to the cover halves **24**A, **24**B by pins. When the heat shield **22** moves upwardly with respect to the frame **40**, the links **58** will push upwardly on the cover halves **24**A, **24**B causing them to rotate upwardly around the cover hinge pins **56**, thus opening the top of the combustion space within the heat shield **22**.

The operation of the lighter is illustrated as a sequence of paired figures, FIGS. **1** and **2**; FIGS. **3** and **4**; FIGS. **5** and **6**; FIGS. **7** and **8**; and FIGS. **9** and **10**. Additionally, the sequence of operations is described in the flow chart of FIG. **14**. It must be appreciated, that the operational sequence starts from an initial rest position seen in FIGS. **1** and **2** and proceeds through a continuous movement of elements to the fully opened operating position seen in FIGS. **9** and **10**.

Referring again to FIGS. **1** and **2**, the lighter is seen in a rest position. The main valve **16** is closed thus no fuel gas is flowing through the main valve **16** or the mixer **18**. The thumb button **30** is at its fully upwardly extended position. The combustion space cover **24** is closed. When an operator wishes to ignite the lighter, the operator proceeds with actuation similar to a conventional flint and wheel equipped lighter. The operator rotates the striker wheel **26** causing the striker wheel to abrade the flint and propel a body of incandescent sparks **60** (FIG. **3**) over the top of the closed combustion space covers **24**A, **24**B. The cover halves **24**A and **24**B each have semicircular cutouts on their inboard edges facing one another. These cutouts **62**, one of which is seen in FIG. **5**, create a circular hole **64** shown with dashed lines in FIGS. **2** and **4**. Referring now to FIG. **3**, the user's thumb slides off the striker wheel **26** and engages the thumb button **30** depressing the thumb button causing the rack and pinion arrangement to raise the lifter **44**. The upward movement of the lifter **44** opens the gas valve **16** causing high pressure gas from the reservoir **12** to immediately flow through the mixer **18**, the nozzle, the combustion space and out through the hole **64**. Because incandescent sparks are traversing the top of the hole **64**, a gas flame **76** is ignited just above the hole **64**. The incandescent spark material travels across the top of the combustion space and ignites the flame **76** while the cover halves **24**A and **24**B are closed. Debris and exhausted spark material is kept away from the nozzle and other burner components. As seen in FIG. **3**, the mixer **18** includes a choke. In this embodiment, the choke consists of an outer hole **72** in an outer sleeve and an inner hole **74** in the tube carrying the fuel gas. As seen in FIGS. **1** and **3**, the two holes are not aligned when the thumb button **30** is not depressed or just starting to be depressed. Therefore, the choke is closed and air is not admitted to the

mixer **18**. In the state seen in FIG. **3**, the gas valve **16** is opened and gas is flowing through the mixer **18**, nozzle and combustion space but no air is admitted through the choke hole **72**. Thus the flame **76** is a post mix flame. That is, air is added to the fuel gas at the location of combustion, not upstream from the location of combustion. Post mix flames are easily ignited by incandescent sparks from flints.

Referring now to FIGS. **5** and **6**, one sees the lighter further in the process of being operated. The thumb button **30** has been further depressed and the lifter **44** is further elevated. The lower lateral portion **50** of the lifter **44** has engaged the bottom of the choke sleeve **66** and pushed it upwardly allowing the choke sleeve outer hole **64** to be partially in registry with the inner hole **72**. This allows some air to enter the mixer **18** where it is entrained with the fuel gas and mixed therewith.

The upper lateral portion **52** of the lifter **44** has also engaged the heat shield **22** pushing it upwardly. As the heat shield **22** moves upwardly, the links **58** open the cover **24**. As seen in FIGS. **5** and **6**, the cover is partially opened and the flame, now a rich premix flame **78**, has migrated from the hole **62** into the combustion space surrounded by the heat shield **22**.

In FIGS. **7** and **8**, one sees the thumb button **30** further depressed thus elevating the lifter **44** further. The choke sleeve **66** has been raised so that the two choke holes **72**, **74** are in near perfect alignment operating as an air inlet and the two cover halves **24**A, **24**B are in the vertical position. The holes in the choke are sized to allow entry of sufficient air to create a strong premix, torch-like flame **80** within the heat shield **22** and extending above the heat shield **22**. The low pressure jet of fuel gas draws air through the choke by a venturi effect. A premix flame **80** is much more forceful and organized than a post mix flame as is seen in FIG. **3**. A premix flame can be directed in orientations other than straight up and substantially hold its shape. Premixed flames are visually characterized by a central core having a light blue color surrounded by a darker blue flame portion. Premix flames are stronger and hotter than post mix flames and more easily directed to ignite a pipe or cigar than a post mix flame.

FIGS. **9** and **10** show the thumb switch **30** fully depressed and the lifter **44** fully extended upwardly. The two holes of the choke, **72**, **74** remain aligned so that air is drawn into the mixer **18**. The heat shield **22** is fully extended upwardly as is the nozzle **82** positioned at the bottom of the heat shield **22**. The premix torch like flame **80** extends somewhat higher over the top of the lighter **10** as the nozzle is higher. A forceful, directed premix torch like flame **80** is provided so long as the thumb button **30** remains depressed. When the user is finished with the lighter, the thumb button **30** is released and the spring (FIG. **3**) quickly pushes the thumb button upwardly which, through the actions of the rack and pinion, lowers the lifter **44** into the position seen in FIG. **1**. This quickly closes the top cover halves **24**A, **24**B and almost simultaneously closes the choke and the fuel valve **16**. The flame is extinguished.

FIG. **11** shows a second embodiment of the lighter **110** partially cut away. The thumb button **30** drives a rack and pinion arrangement identical to that seen in the first embodiment. A lifter **144** identical to that seen in the first embodiment is used in this embodiment. However, in FIG. **11**, the lower lateral portion of the lifter is cut away to provide greater clarity. The difference between the embodiment of FIG. **11** when compared to the embodiment of FIGS. **1-10** is solely in the cover **124**. Two cover halves **124**A, **124**B are provided. As in the first embodiment, the cover halves are fixed to the side walls of the frame **140** by means of pins **156**. The pins are provided with springs **154** which bias the cover halves into the closed position. In the first embodiment, the cover halves **24**A and **24**B are opened and closed by actions of the links **58**. In this embodiment, links are not provided. Rather, the heat shield **122** opens the cover halves **124**A and **124**B by pushing upwardly on their bottom surface against the pressure of the springs **154**. At the end of use of the lighter, rather than the links **58** pulling the covers down, the springs **154** urge the covers to rotate to the closed position as the heat shield **122** is retracted.

A third embodiment of the invention is shown in FIG. **13**. The lighter **210** operates in a manner similar to the first embodiment except that the cover **24** is comprised of a single door **224** hinged on a pin **256**. The pin **256** is fixed on both of its ends to the side walls of the frame **240**. Springs (not shown) bias the cover **224** in the closed position. The operation of the third embodiment is similar to the operation of the second embodiment in that downward pressure on the thumb button **230** operates a mechanism raising the heat shield **222** surrounding the combustion space. The operating mechanism can be either a series of levers or a rack and pinion as described above. The heat shield **222** engages against the underside of the cover **224** rotating the cover into a vertical position opening the top of the combustion space within the heat shield **224**. As can best be seen in FIG. **13**, the cover **222** is provided with a hole **264** allowing creation of a post mix gas flow into the area into which sparks are injected by operation of the striker wheel **226**. Thus, the various stages of operation of the lighter **210** are identical to the stages described with references to FIGS. **1-10**.

The embodiment shown in FIG. **12** is identical to the embodiment shown in FIG. **13** except the single door **224** is provided with an integral pin **256***a* extending from both sides of the door **224** and engaging recesses in the frame sidewall.

The structure as described with respect to the preferred embodiments all use nozzles having at least one central opening and surrounding stabilization openings. Such an arrangement is conventional with respect to a premix torch flame type lighter. Other nozzles as are conventionally used to produce premix flames could also be used without changing the overall structure of the preferred embodiments. An adjustment mechanism metering the amount of gas passing through the valve **16** can also be used. All of the structures described provide a door which protects the nozzle from spark debris and allows creation of a post mix flame above the door prior to opening; and, transitioning the flame to a premix flame within a combustion space as and after the door opens in operation of the lighter. This structure and operation of this structure results in protection of the nozzle from flint spark debris and reliable ignition of a flame which transitions into a premix directable flame.

The method of operating the lighters illustrated in FIGS. **1-13** is stated in block diagram flow chart form in FIG. **14**. The steps set forth are not broken up in a manner identical to those seen in FIGS. **1-10** but describe the same process as the illustrations. In the initial state **300**, corresponding to FIGS. **1** and **2**, the gas valve **16** is closed and the lighter is in the storage position. An operator starts use of the lighter in a first actuation step **301** in which the operator depresses the flint or striker wheel **26** to open the gas valve. In step **302** the operator rotates the striker wheel **26**. Actuation continues in step **304** in which the thumb button **30** is depressed by the thumb of the user which continues movement of the rack and pinion. The thumb button depresses, continuing movement of lifter and maintaining the gas valve open. The open gas valve allows the flow of gas through the lighter and out the hole **64** resulting in the ignition of a post mix flame **76**. The state of the lighter after the actuation step **304** is seen in FIGS. **3** and **4**.

The lighter continues into step **306** in which continued downward movement of the thumb button **30** results in continued upward movement of the lifter **44** which partially opens the choke and partially opens the top over the combustion space. This starts the transition of the flame into a premix flame and moves the flame into the combustion space. The state of the lighter during this step **306** is shown in FIGS. **5** and **6** and the state of the lighter at the end of the step **306** is shown in FIGS. **7** and **8**.

A final actuation step is achieved when the thumb button **30** is fully depressed resulting in the lifter **44** being fully extended upwardly. This fully opens the choke and fully extends the combustion space within the heat shield **22** upwardly out of the top of the lighter. A premix torch-like flame is now available at the top of the lighter. The state of the lighter during this final actuation step **308** is illustrated in FIGS. **9** and **10**.

A release state **310** is initiated by a user releasing the thumb button **30** by removing the operator's thumb. The thumb button or actuator is then spring driven in an upward direction causing the lifter **44** to rapidly move to its downward rest state which closes the combustion space top, retracts the heat shield, closes the choke and closes the fuel valve extinguishing the flame. The lighter is now ready for storage or for its next use.

Another embodiment of the invention is shown in FIGS. **16-24**. FIG. **16** shows the lighter **400** in its case **402** with the case lid **404** in the closed position. The case lid **404** is joined to the case **402** by means of a hinge pin **406** as is conventional. A valve release interlock button **408** may optionally be included, and, if so, protrudes slightly from the lower left of the lighter case **402**.

With reference to FIG. **17**, a fuel level window **412** in the case **402** allows the user to see the level of butane fuel in the lighter **400**.

With reference to FIG. **18**, the lighter **400** is comprised of a number of parts and assemblies. A frame **420** is preferably fabricated in two parts of nylon 6/T or other similar plastic material adapted for containing butane, being sonically welded and being precisely formed. The frame lower half **422** has a through hole **424** opening into a fill valve retaining rube in its bottom which will be in registry with a similar through hole **426** in the case **402** (FIG. **19**). The frame lower half **422** also has a blind hole **428** accommodating a screw **430** used to fix the frame **420** to the case **402**.

The frame upper **436** has a bottom which mates with and is sonically welded to the top of the frame lower half **422**. The top of the frame upper half **436** is generally planar with several towers extending therefrom. A main spring retaining tower **438** extends upwardly from one side of the top of the frame **420**. Adjacent the main spring retaining tower is a flint and wheel igniter retaining tower **440**. The igniter retaining tower **440** has a vertically orientated central internal tube. The external surfaces of the igniter retaining tower **440** are generally planar but also support functional elements to be hereinafter described. The main spring retaining tower **438** and the igniter retaining tower **440** are interconnected by a web **442** which stiffens both structures.

Moving to the left, adjacent the igniter retainer tower **440**, the top of the frame **420** is provided with a through hole **448** opening into an interiorly directed valve retaining tube **450**. (FIG. **19**). Adjacent the through hole **448** is a case spring retaining tower **452**. A case spring **454** is retained in a slot in the case spring retaining tower **452** and extends vertically adjacent the side of the case to appoint adjacent the case hinge pin **406**. A tang **456** extends downwardly past the hinge pin **406** and interacts with the case spring **454** to hold the case lid **404** in the closed position until opened by a user.

A fill valve assembly **460** is of conventional construction and is rotatably mounted in the through hole **424** in the frame **420**. The fill valve assembly **460** is sealed to the through hole **424** by means of O-rings. The fill valve assembly **460** allows one to fill the interior space of the frame with butane and also allows one to adjust the height of the flame produced by the lighter as will hereinafter be described.

Referring again to FIGS. **18** and **19**, a main valve assembly **464** is retained in the valve retaining tube **450** and protrudes through the through hole **448** at the top of the frame **420**. The main valve assembly is shown in greater detail in FIG. **25**. With reference to FIG. **25**, the main valve assembly **464** comprises a valve body **466**, a valve stem **468**, a valve spring **470** and a valve seat **472**. The valve body **466** is generally cylindrical with a downwardly extending tubular internal chamber **474** and an upwardly extending tubular chamber **476**. The downwardly extending tubular chamber **474** is threaded over its lower portion and has a smooth sidewall near its top. A filter screen **478** is retained at the top of the downwardly extending tubular chamber by a compressible porous disk **480** some times known as a molt pran. The downwardly extending tubular chamber **474** and the upwardly extending tubular chamber **476** are interconnected by a passage **482**. The passage **482** is surrounded by a raised lip **484** where it joins to the upwardly extending tubular chamber **476**.

The valve stem **468** extends downwardly into the upwardly extending tubular chamber **476**. The valve stem **468** is generally cylindrical with a central bore **490** communicating with a side aperture **492**. The valve seat **472**, which is rubber or another elastomer, is retained at the bottom of the valve stem **468**. A stem collar **494** is immovably fixed to the valve stem **468** above the aperture **492**. A valve sleeve **498** surrounds the valve stem **468** and is press fit into the valve body **466** closing the upwardly extending tubular chamber **476** and retaining the valve stem **468**, valve spring **470** and valve seat **472** in the chamber. The spring **470** bears against the valve body **466** near the passage **482** and against the stem retaining collar **494**. The valve spring **470** therefore urges the main valve into the open condition. In this condition, gas may flow through the downwardly extending tubular chamber **474**, the passage **482**, into the upwardly extending tubular chamber **474**, through the side aperture **492** and out of the stem central bore **490**. When a sufficient downwardly acting force is applied to the valve stem **468** as at the valve stem shoulder **496**, the valve seat **472** will be urged against the lip **484** surrounding the passage **482** closing the valve.

With reference again to FIG. **25**, a screen **486**, a washer **487** and an orifice plate **488** sit on top of the valve stem **468**. The orifice plate has very fine orifice **489**, having a diameter of less than a thousandth of an inch, at its center. The main valve assembly of FIG. **25** is also usable in the embodiments of FIGS. **1-13**.

With reference to FIGS. **18** and **19** a carburetor-diffuser assembly **530** is positioned on the top of the main valve assembly **464**. The carburetor diffuser assembly comprises a tubular carburetor body **532**, a diffuser **534** at the top of the carburetor body **532** and a ceramic insulator **536** surrounding the diffuser and extending upwardly from the diffuser. The carburetor body **532**, the diffuser **534** and the ceramic insulator **536** are all permanently fixed together. The ceramic insulator is cylindrical and open in its top. It defines the burn chamber.

As can be seen in FIG. **19**, the carburetor-diffuser assembly **530** is fixed to the top of the main valve assembly **464** by means of threads on the interior lower opening of the carbu-

retor-diffuser assembly **530** mating with thread on the exterior upper surface of the valve stem **468**.

With reference again to FIGS. **18** and **19**, the main spring **502** is retained within the main spring retaining tower **438** and bears against the underside of the carriage assembly **504**. The carriage assembly **504** comprises a carriage **506** which is die cast from zinc, aluminum or other suitable material, a liner **508** of a low friction polymer such as polytetrafluroethylene, a burn chamber door **510** and a door hinge pin **512**. The door **510** is generally rectangular. It has two tabs which are bent into a circular shape having an internal opening accommodating the hinge pin **512**. The door **510** is fixed to the carriage **504** at one end by the hinge pin **512**. At the end of the door **510** remote from the hinge pin **512**, a small door hole **516** is provided. The door **510** may rotate between a horizontal position where it closes a circular opening **518** in the top of the left portion of the carriage **504**, and a vertical position where it opens this circular opening **518**.

A rectangular opening **522** is provided in the top center of the carriage **504**. the rectangular opening **522** is flanked on two sides by the side walls **504**. Adjacent the rectangular opening **522** is a thumb button surface **524**.

The carriage assembly **504** sits on the frame **420** with the thumb button surface **524** disposed above the main spring **502**. A flint cartridge igniter assembly **542** has a cylindrical flint barrel **544** extending downwardly from a striker wheel **546**. The striker wheel **546** is supported on a sheet metal bracket **548** having a rectangular base **550**. The dimensions of the rectangular base **550** are somewhat larger than the dimensions of the rectangular opening **522** in the carriage **506**. A striker wheel shroud **554** is disposed within the bracket and fixed to the bracket by means of the striker wheel rivet **556**. The striker wheel shroud **554** optionally may include two arcuate portions **560** fixed to the rest of the shroud at one end only. If included, the two arcuate portions **560** have an outside diameter slightly greater than the outside diameter of the striker wheel **546**. The two arcuate portions **560** are disposed one on each side of the striker wheel **546** and slightly radially outwardly from the outer surface of the striker wheel **546**. The portions **560** may be omitted, while still remaining within the scope of the present invention. A flint **562** and flint advancing spring assembly **564** are contained within the flint barrel **544**. The flint cartridge igniter assembly **542** is received in the flint and wheel igniter retaining tower **440** with the periphery of the rectangular base **550** resting upon the upper surface of the carriage assembly **504**.

The shroud **570** acts as a wind screen around the area of combustion in the lighter when assembled and fixed to the case **402**.

A burner door spring **576** comprises a base and two upstanding arms. The base of the burner door spring **560** is anchored to the top of the frame adjacent the case spring ring retaining tower **452**. The upwardly extending arms of the burner door spring **576** engage tabs on the burn chamber door **510**. The tabs are adjacent the hinge pin **512**. The burner door spring **576** has a serpentine portion near its base allowing some give in the fit between the top of the frame **420** and the burn chamber door **510**.

Referring again to FIG. **18**, a lower fulcrum **580** projects from the bottom of the side of the igniter retaining tower **440**. The lower fulcrum **580** has a rectangular base and a triangular upper segment terminating in a relatively pointed top fulcrum surface. Directly above the lower fulcrum **580** is an upper fulcrum **582**. The upper fulcrum **582** is triangular in shape and has its sharp end pointed downwardly at the lower fulcrum **580**. A space between the two fulcrums **580**, **582** is provided. The space is wide enough to accommodate a valve actuator lever **588**. The valve actuator lever **588** comprises two lever arms **590**, **592**. One lever arm is the mirror image of the other. The two lever arms are joined at one end by an actuator portion **594** having a U-shaped cut out **596** facing away from the lever arms.

The igniter retaining tower **440** has a second pair of fulcrums identical to the upper fulcrum **582** and lower fulcrum **580** on the opposite side of the tower **440**. As can be seen in FIG. **20**, the valve actuator lever **588** straddles the igniter retaining tower **440** and the lower extremity of the carriage **506**. A lever support tab **600** extending from the side of the carriage **506** supports the end of the valve actuator lever **588** lever arm **592** remote from the U-shaped cut out **596**. An identical lever support tab on the opposite side of the carriage **506** supports the other of the lever arms **590**. In this position, the actuator portion **594** bears against the valve stem shoulder **496** which is retained in the U-shaped cut out **596**. Thus, with the carriage **506** in the uppermost position, as biased by the main spring **502**, the valve actuator lever exerts a downwardly directed force on the valve stem **468** counteracting the force of the valve spring **470** and holding the valve closed.

A valve release lever **604** is rotatable about tabs **606** on the frame **420**. The lower end of the valve release lever **604** is the valve release button **408** seen in FIG. **16**. With the valve release button **408** in the rest position, the upper end of the valve release lever **604** rests in hollows in the actuator portion **594** of the valve actuator lever **588**. In this orientation, the valve actuator lever can not be raised adjacent the valve stem shoulder **496**. The valve is held closed. The valve release lever **604** is biased into the rest position seen in FIG. **20** by an extension of the case spring **454**. (The spring extension is not shown in the drawings). The spring extension exerts a clockwise torque valve release lever **604** resulting in a force applied to the valve system shoulder **496** larger than the opening force exerted by the valve spring **470**. The main valve assembly **464** is held closed until the valve release button is forcefully depressed. Other biasing or spring loading mechanisms can be used. An extension of the door spring **576** can replace the case spring extensions. Alternatively, a coil spring can be positioned between the valve release button **408** and the frame **420**.

FIG. **20** shows the principal elements of the lighter in the rest position. From this position, four things must be done to achieve ignition. First, the valve release button **408** must be depressed. This alone will do nothing except allow the valve actuator lever **588** to work when actuated. Secondly, the arcuate portions **560** of the striker wheel shroud **554** must be depressed so that the striker wheel **546** itself may be spun. It requires about 4 pounds of pressure to depress the arcuate portions **560** of the striker wheel shroud **554**. This alone, again, will not cause ignition as the striker must still be turned. Third, the striker wheel must be rotated creating a spark. Fourth, the carriage **506** must be depressed allowing the valve actuator lever **588** to rotate about the fulcrums **580**, **582** opening the main valve. The striker wheel shroud with its arcuate portions **560** and the valve release lever **604** are provided to prevent unintended ignition of the lighter or use by unauthorized persons.

The operation of the lighter in achieving a torch-like frame is hereinbelow described.

With reference to FIGS. **19** and **20**, the lighter **400** is seen in the rest position. The main valve is closed and no fuel is reaching the burn area. Referring now to FIGS. **21** and **22**, the valve release button **408** has been depressed rotating the valve release lever **604** and freeing the actuator lever **588**. An initial downward force has also been applied to the striker wheel **546** and shroud **554** and the striker rotated somewhat. The down-

ward force on the striker wheel moves the carriage **506** down slightly. This moves the lever support tab **600** down slightly allowing the valve actuator lever **588** to rotate slightly in a clockwise direction. The valve spring **470** opens the main valve assembly **464** allowing butane gas to flow through the main valve, through the orifice **489** through the carburetor-diffuser assembly **530** and out the small door hole **516** in the burn chamber door **510**. At this point, the butane gas is not mixed with air and the sparks **610** created by rotation of the striker ignite this gas into post-mix flame **676**.

As the user's thumb slides off the striker wheel, it will depress the thumb button surface **524** on the carriage **506**. The carriage **506** moves downwardly. Because the burner door spring **576** is fixed with relation to the frame **420**, this will force the burn chamber door **510** to open as seen in FIG. **23** and FIG. **24**. Additionally, the circular opening **518** and the stepped tube **520** below it move downwardly with respect to the carburetor-diffuser assembly **503** which the stepped tube surrounds. This exposes four lateral holes **538** in the carburetor body **532**.

As described previously, the top of the main valve stem **468** is covered by an orifice plate **488** having an extremely small orifice in its center. The flow of gas below the orifice plate **488** is a high pressure, low velocity flow. The orifice **489** creates a low pressure, high velocity flow of fuel above the orifice plate. A high velocity low pressure jet of butane gas exits this orifice just below the four lateral holes **538** thereby creating a venturi effect and drawing air into the lateral holes **538**. The same or similar structures are used in the embodiments of FIGS. **1-13** to achieve mixing of fuel and air. The butane gas and entrained air are mixed and formed into jets in the diffuser **534** forming a premix flame **680**, the base of which is surrounded by the ceramic insulator **536** and a portion of which is surrounded by the shroud **570**. For so long as the thumb button surface **524** is held in the depressed position, a torch-like premix flame will be maintained.

The size of the flame may be adjusted by turning the fill valve assembly **460**. As the fill valve assembly **460** is threaded into the bottom of the main valve assembly **464**, turning it in one direction will move it upwardly compressing the compressible disk **480**. The compressed disk will admit less fuel into the main valve making for a smaller flame. Turning the fill valve assembly **460** in the opposite direction decompresses the compressible disk admitting more fuel into the main valve resulting in a larger flame.

Fuel is contained in the irregularly shaped volume **620** within the frame **420**. It reaches the main valve through the downwardly extending tubular chamber **474** of the main valve assembly **464**. The threaded connection of the chamber **474** to the fill valve assembly **460** is not gas tight.

When a user releases the thumb button surface **524**, the main spring **502** urges the carriage assembly **504** in an upward direction which brings the lever support tabs **600** into contact with the valve actuator lever **588** thereby depressing the shoulder **496** on the valve stem **468** closing the valve and extinguishing the flame **680**. At the same time, the burn chamber door **510** swings into the closed position. When the valve release button **408** is released, the valve release lever **604** swings back to the locked position. The lighter is now ready for stowage by closing the lid or another ignition by repeating the sequence described above.

The burn chamber door **510** covers and protects the carburetor-diffuser assembly **530** from flint debris when the striker wheel abrades the flint. Thus, flint particles, after performing their function of igniting a flame, either are retained on the top of the door **510** or fly completely across the top surface of the door. The small openings of the diffuser are not clogged. The carburetor-diffuser assembly **530** and the main valve assembly **464** are kept clean and operational.

Referring now to FIGS. **26-35**, various details of a further embodiment of the present invention may be seen. In FIG. **26** lighter **700** has a cam **702** driven by a spring **704** to hold the case lid or cover **404** in the closed position as shown. In this embodiment a carriage **712** has a hinge **714** for door **710** located on the igniter side of the burner opening in the carriage **712**. A spring **716** urges door **710** to the closed position when the lighter is not in use. This embodiment has a fill valve **718** and a gas valve **720** similar to those of the prior described embodiments. Lighter **700** has a carburetor diffuser assembly **722** corresponding to the assembly **530** described supra. A wheel and flint cartridge **724** is held in lighter **700** by a spring detent **726**. Spring detent **726** includes a spring **728** biased toward the cartridge **724** and reacting against a wall **730**.

Referring now most particularly to FIGS. **27** and **28**, detail views of the carburetor diffuser assembly **722** along with a portion of the carriage **712** are shown with the door **710** in a closed position in FIG. **27**, and with the door **710** in an open position in FIG. **28**. Door **710** is opened by contact with an upper surface **732** of the ceramic piece **536** forming the burn chamber surrounding the assembly **722**. It is to be understood that spring **716** keeps door **710** closed when the ceramic piece **536** is retracted (when the lighter is not in use, and initially, when ignition takes place, before the carburetor diffuser assembly is advanced, all as shown in FIG. **27**. Once ignition has occurred, the carburetor diffuser assembly is advanced to the position shown in FIG. **28**, elevating the ceramic insulator **536**, opening the door **710**.

Similarly to the embodiment of FIGS. **18** and **19**, door **710** has a hole or aperture **734** through which fuel may exit when the door **710** is closed, permitting ignition of a post mix or yellow flame with the parts as shown in FIG. **27**. Once door **710** opens, air is admitted in a pre mix configuration (as indicated by arrows **736** in FIG. **28**) corresponding to the operation described above with respect to FIGS. **23** and **24**, and a blue flame combustion occurs with the configuration shown in FIG. **28**.

Referring now to FIGS. **20-35**, various views of the carriage **712** and door **710** may be seen. It is to be understood that door **710** and spring **716** are held to the hinge **714** of carriage **712** by a hinge pin **738**. Door **710** may have a protrusion **740** formed therein to contact the upper surface **732** of the ceramic piece, so that the door **710** is held further away from the flame in the open position than would otherwise be the case.

The invention has been described with reference to preferred embodiments. It will be appreciated that modifications and alterations could be made without deviating from the present invention. For instance, the rack and pinion arrangement described could be replaced by a lever or levers depressed at one end by the thumb button and elevating the elements raised by the lifter at the other end. Such modifications and alterations will occur to others upon the reading and understanding of the specification. It is intended that all such modifications and alterations be included in so far as they come within the scope of the appended claims or the equivalents thereof.

Having thus described the invention, it is claimed:

What is claimed is:

1. A lighter comprising:

a fuel reservoir adapted to contain a volatile fuel;

a fuel valve communicating with said fuel reservoir, said fuel valve having a closed state and an open state;

a mixer communicating with said fuel valve and adapted to receive fuel from said fuel valve and air from the surrounding atmosphere when said fuel valve is in the open state;

a combustion space communicating with said mixer, the combustion space having a top and a combustion space movable cover over the top of the combustion space; and

a wheel and flint igniter adapted to direct incandescent sparks adjacent said combustion space whereby fuel and air from said combustion space is ignited, initiating combustion in said combustion space,

wherein the wheel and flint igniter is mechanically coupled to said mixer and the lighter automatically provides fuel substantially unmixed with air when the wheel and flint igniter is operated and further wherein the lighter automatically provides fuel mixed with air following operation of said wheel and flint igniter while said fuel valve is in said open state; and wherein the combustion space movable cover has only a single aperture allowing the flow of gas from inside said combustion space to outside said combustion space when said top is closed.

2. The lighter of claim **1** further comprising an actuator positioned adjacent said wheel and flint igniter such that an operator's thumb will engage said actuator subsequent to initiating rotation of a wheel of said wheel and flint igniter, said actuator maintaining said fuel valve in the open state.

3. The lighter of claim **1** wherein said mixer has air inlets having an open state and a closed state and said mixer is adapted to draw air through said air inlets by a venturi effect when said air inlets are in said open state.

4. The lighter of claim **3** wherein an orifice is provided adjacent said air inlets, said orifice adapted to emit a narrow high speed jet of fuel gas when said fuel valve is in said open state thereby enhancing said venturi effect.

5. A lighter comprising:

a frame having a bottom and a top;

a fuel compartment in said frame;

a fuel fill valve disposed in said frame;

a fuel valve having an opened state and a closed state, the fuel valve dispensing fuel from said fuel compartment when in said opened state;

a fuel mixer having at least one air inlet having an opened state and a closed state, said fuel mixer receiving fuel from said fuel valve when said fuel valve is in said opened state and mixing said fuel with air when said at least one air inlet is in said opened state;

a burn chamber in fluid communication with said fuel mixer;

a flint and wheel igniter assembly proximate said burn chamber and directing sparks adjacent said burn chamber when actuated; and,

a carriage, said carriage engaged by said flint and wheel igniter assembly when said carriage is in a rest position, said carriage having a thumb button surface proximate said flint and wheel igniter assembly and wherein said carriage is biased away from said frame, said carriage opening said fuel valve when said flint and wheel igniter assembly is actuated thereby initiating a postmix flame, and said at least one air inlet is opened when said thumb button surface is depressed toward said frame resulting in a premix flame.

6. The lighter of claim **5** wherein said fuel valve is normally biased to the opened state and said lighter further comprises an actuator urging said fuel valve into the closed state when said thumb button surface of said carriage is not depressed.

7. The lighter of claim **6** further comprising a main spring biasing said carriage into said rest position.

8. The lighter of claim **7** wherein said actuator is a valve actuating lever engaging said fuel valve at a valve actuating lever first end and being engaged at a valve actuating lever second end when said carriage is in said rest position whereby said fuel valve is held in said closed state.

9. The lighter of claim **8** wherein said lighter further comprises a valve release lever having a manually actuated valve release button at a valve release lever first end and engaging said valve actuating lever at a valve release lever second end, said valve release lever holding said valve actuating lever and said fuel valve in a closed state when said valve release button is not depressed and enabling the release of said valve actuating lever and said fuel valve when said valve release button is depressed.

10. A lighter comprising:

a fuel reservoir adapted to contain a volatile fuel:

a fuel valve communicating with said fuel reservoir, said fuel valve having a closed state and an open state;

a mixer communicating with said fuel valve and adapted to receive fuel from said fuel valve and air from the surrounding atmosphere when said fuel valve is in the open state;

a combustion space communicating with said mixer, the combustion space having a top and a combustion space movable cover over the top of the combustion space; and

a wheel and flint igniter adapted to direct incandescent sparks adjacent said combustion space whereby fuel and air from said combustion space is ignited, initiating combustion in said combustion space,

wherein the wheel and flint igniter is mechanically coupled to said mixer and the lighter automatically provides fuel substantially unmixed with air when the wheel and flint igniter is operated and further wherein the lighter automatically provides fuel mixed with air following operation of said wheel and flint igniter while said fuel valve is in said open state; and wherein the combustion space movable cover has only a single aperture adjacent thereto allowing the flow of gas from inside said combustion space to outside said combustion space when said top is closed and said wheel and flint igniter directs incandescent sparks over said combustion space movable cover adjacent said single aperture.

* * * * *