Aug. 26, 1952 T. H. MORGAN ET AL 2,608,081

LIGHTER MECHANISM

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Fig. 1.

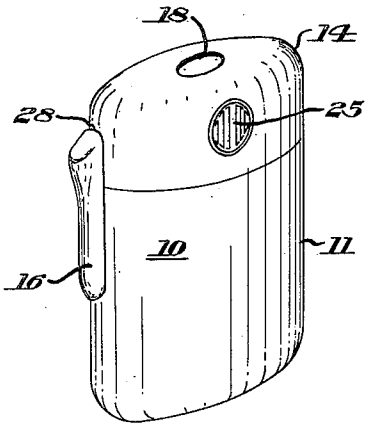

Fig. 2.

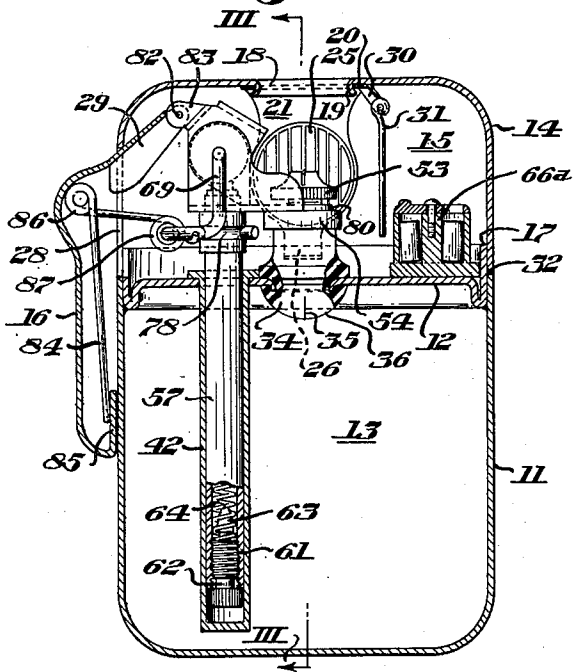

Fig. 3.

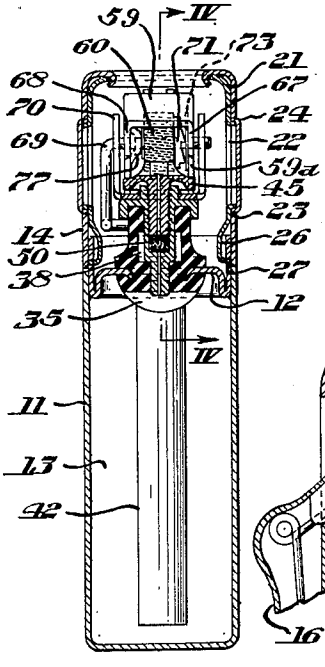

Fig. 5.

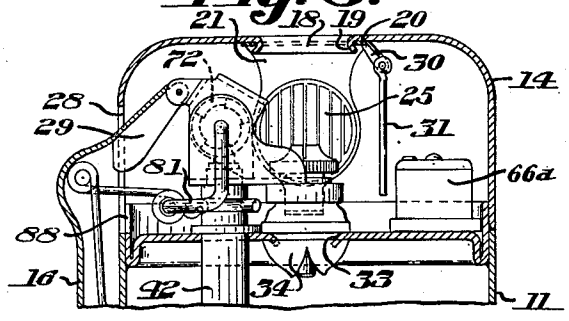

Fig. 6.

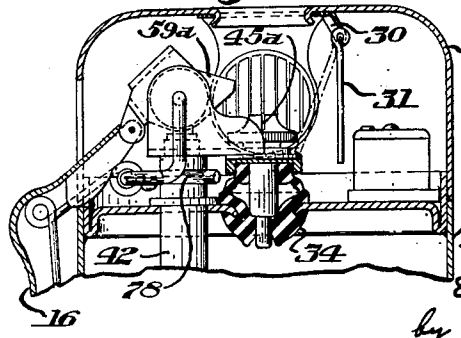

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Fig. 4.

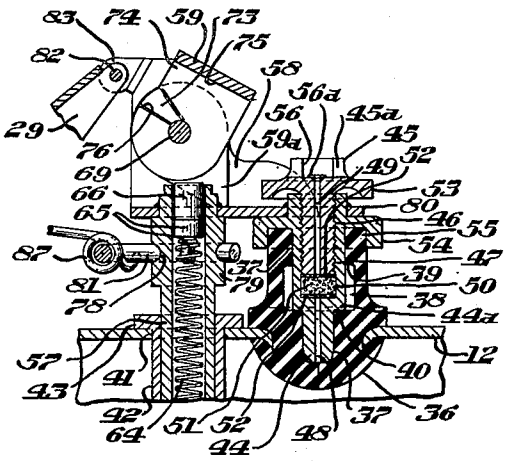

Fig. 13.

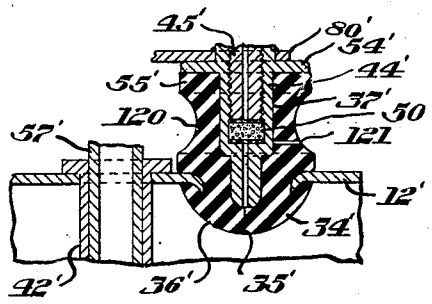

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Fig. 7.

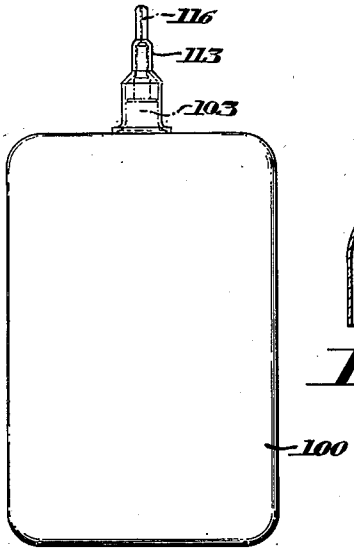


Fig. 8.

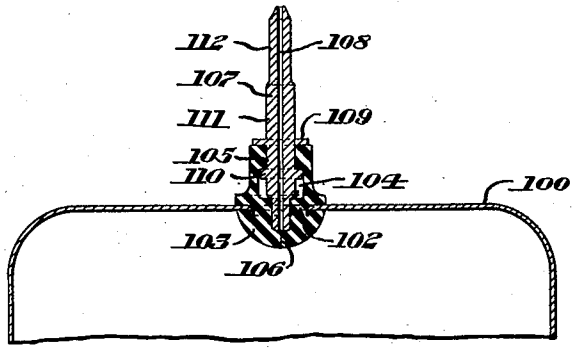


Fig. 11.

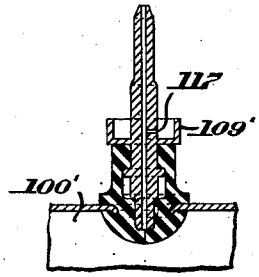


Fig. 12.

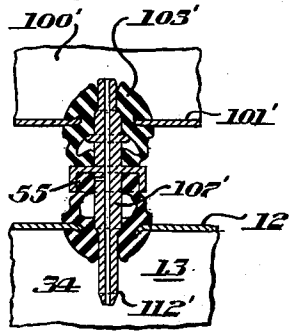


Fig. 9.

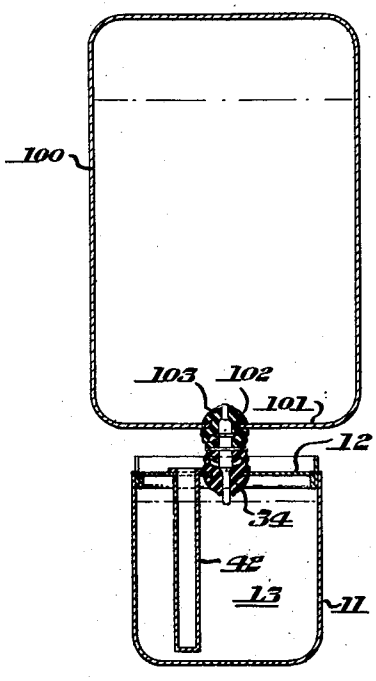
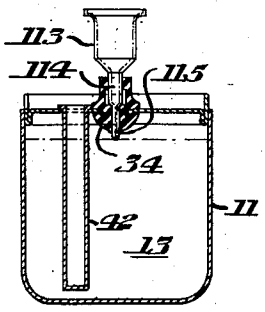


Fig. 10.



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UNITED STATES PATENT OFFICE

2,608,081

LIGHTER MECHANISM

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Application August 29, 1950, Serial No. 181,956

12 Claims. (Cl. 67—7.1)

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This invention relates to a portable pocket or table lighter for smokers. More particularly, it pertains to lighter mechanism employing butane, propane or the like and capable of use for prolonged periods. Still further, this invention relates to filler mechanism for such lighter mechanism.

Ordinary pocket and table lighters for cigars, cigarettes and pipes employ many forms of mechanism in common use at this time. The so-called lighter fluid used therein is a hydrocarbon liquid at normal temperatures and pressures. This lighter liquid is frequently drawn to the ignition zone by means of a fibre wick. Such lighters ordinarily cannot be used more than a few days before requiring filling. Further, unless such lighter liquid is of relatively high quality so as to readily vaporize, it may not ignite easily without careful sheltering when the flint is struck to ignite it. In addition, in many such lighters the capacity of the lighter is reduced in that considerable lighter liquid may be present even though a new refilling is required.

More recently, lighters have appeared on the market using a normally gaseous fluid such as commercial butane. The burning of such a fuel in a popular table lighter has many advantages. Thus, such fuel is readily stored under pressure as a liquid, readily vaporizes upon release to atmosphere, readily ignites and burns in a smokeless manner. Because such a lighter fluid as commercial butane can readily be stored as a liquid, a single portable lighter mechanism can be provided, the capacity of which will furnish enough lights for an average smoker to last him for several months. In this way, there is no necessity for either carrying a supply of lighter fluid as is frequently done with older lighters using lighter liquid or for frequent replenishment. However, controlling the flow of normally gaseous lighter fluid such as commercial butane or commercial propane presents difficulties. Thus, in one form of such a more recent lighter two hands have to be used to supply and ignite the fuel. In addition, the replenishment of such a normally gaseous fuel has in some cases required either the return of the lighter to a central agency for refilling or the replacement of an insert containing at least that portion of the mechanism in which the fuel is stored. Moreover, such lighters operating on normally gaseous fuels may be subject to imprecise operation with the result that too large a flame or too rapid or too slow a flow of fuel is obtained. When the fuel flow is too fast or to slow, the user may get no light.

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In this invention a new lighter mechanism is provided which burns commercial butane, commercial propane and the like without giving rise to the difficulties manifested by prior constructions. In addition, as and when the lighter mechanism of this invention requires refilling, it may readily be done by anyone using the novel refill mechanism of this invention. This new lighter mechanism not only safely stores the normally gaseous fuel when the lighter is not in use but when it is operated produces a controlled flame for the desired period of operation. Further, the pocket and table lighters of this invention may be operated by one hand with the application of no more pressure than that used today in the operation of lighters using normally liquid fuel for lighters. Not only is the new lighter mechanism of this invention capable of prolonged normal use over several months without refilling but it is also adjustable not only with respect to the character of flame desired but also with respect to the climatic zone in which it may happen to be used. Still further, the lighter needs only to be actuated to light and automatically returns itself to its inoperative position extinguishing the flame.

Other objects and advantages of this invention will be apparent from the following description and the following drawings, which are illustrative only, in which

Figure 1 is a perspective view of the exterior of an embodiment of a lighter mechanism of this invention;

Figure 2 is a vertical section through the longer axis of the lighter mechanism shown in Figure 1, illustrating interior parts in inoperative or starting position;

Figure 3 is a vertical section through the shorter axis of the lighter mechanism shown in Figure 1, as indicated by the line III—III of Figure 2, illustrating interior parts in inoperative or starting position;

Figure 4 is an enlarged view in section taken along line IV—IV of Figure 3 with the sparking wheel and cap removed;

Figure 5 is a view similar to Figure 2 showing the operating lever and sparking wheel assembly depressed opening the valve so gaseous fuel can flow therethrough;

Figure 6 is a view similar to Figure 5 at a more advanced stage showing the further depression of the operating lever striking sparks for the ignition of the fuel flowing through the valve;

Figure 7 is a view in elevation of a filler mechanism embodiment of this invention including a regulator cap;

Figure 8 is an enlarged vertical section through the longer axis of the top part of the filler mechanism shown in Figure 7 with the cap removed;

Figure 9 is a view in vertical section of the operation of a filler mechanism of this invention with the cap removed filling a lighter mechanism of this invention with the actuator assembly removed;

Figure 10 is a view of a regulator cap such as is shown in Figure 7 regulating the level of the fuel in the lighter mechanism shown in Figure 9 after the filler mechanism has been removed;

Figure 11 is a view in vertical section of a portion of a filler mechanism employing a modified transfer nozzle;

Figure 12 is a view in vertical section of the operation of filling the reservoir of a lighter mechanism of this invention using the transfer nozzle of Figure 11; and

Figure 13 is a vertical section through a modified form of a valve made in accordance with this invention.

Referring to the drawings, a lighter mechanism **10** made in accordance with this invention is provided with a preferably seamless case **11** of any suitable material such as stainless steel, German silver or others. In some cases, the case may be made of a plastic material where it is of sufficient strength. In the mechanism shown, the case **11** is elliptical in horizontal cross section but may be round or otherwise formed to suit the taste of the user. Further, case **11** is provided with a partition **12** across the upper side thereof. Thus, case **11** including partition **12** welded thereto, forms a chamber or reservoir **13** for a normally gaseous lighter fuel such as commercial butane or commercial propane. In a conventional pocket size, the reservoir **13** may contain enough fuel in liquid form under pressure to provide 2000 lights, more or less, enough to last an average cigarette smoker as long as two months or more.

The exterior of lighter mechanism **10** is completed by a top cap **14** enclosing and defining an ignition and combustion space **15** above partition **12**, and an operating lever **16** extending vertically alongside the lighter mechanism. Cap **14** is provided, in the embodiment shown, with the same horizontal cross section as case **11** and forms a part of the entire case of lighter mechanism **10**. As shown in Figures 2 and 3, the lower edge of cap **14** frictionally engages an upstanding flange **17** on partition **12**. The exterior of cap **14** may be made flush with the exterior of case **11**.

The top of cap **14** is provided with a circular flame opening **18**, the edge **19** of which is flared downwardly and outwardly to hold a ring **20** having two integral spring steel sides **21** extending downwardly along the inside of the sides of cap **14**. Each side **21** is provided with an opening **22** and an outwardly cylindrically extending flange in registry with an opening **23** in each side of cap **14**. A louver plate **24** is integrally formed or welded to the flange on each side **21** around the edge of the opening **22** so that the outer part of each plate **24** projects outwardly beyond the sides of cap **14** by a slight amount. The vanes **25** in the plates **24** may be arranged vertically and inwardly diverging about the vertical centerline of the respective plates **24**. In this way, combustion air may enter the ignition and combustion space **15** between the vanes **25** in the louver plate **24** in a relatively diffused manner.

The lower end of each side **21** is provided with an integral L-shaped latch **26**. The out-turned edge of each latch **26** engages a horizontal slot **27** in the sides of flange **17** to lock cap **14** in place when it is fitted over flange **17**. To remove top cap **14**, the louver plates **24** may be pressed or pinched inwardly between thumb and forefinger disengaging the latches **26** from the slots **27** and permitting cap **14** to be lifted off flange **17**. A slot **28** in one end of cap **14** extends over an inwardly extending arm **29** integral with lever **16**. To replace cap **14** these steps are reversed.

A lug **30** is integral with ring **20** to provide a hinge or pivotal connection for a freely swingable pendent rod **31**, the purpose of which will be described later. The lower edge of top cap **14** may be chamfered around the inside thereof at **32** to facilitate replacement thereof on the flange **17**.

Partition **12** is provided with an opening **33**. This opening is sealed by a normally closed resilient slit valve **34**. The edge of partition **12** around opening **33** is actually embedded in the body of valve **34** to effect a seal and prevent any communication between reservoir **13** and combustion space **15** except through the slit **35**. Valve **34** may be made of any resilient material such, for example, as neoprene or a silicone elastomer which is resistant to deterioration when in constant contact with substances such as commercial butane or commercial propane. As a usual matter, it will not be desirable to cement the body of valve **34** to the edge partition **12** around opening **33**. So mounted without being cemented, valve **34** will act as a safety plug or grommet in addition to its valving function. Thus, if through mischance the lighter mechanism of this invention should be accidentally heated generating a relatively unsafe pressure within the fuel reservoir, the valve of this invention would be blown out of the opening, such as opening **33**, before any dangerous pressure were reached. Such a blow-out of the valve would allow all of the fuel in the reservoir to rapidly vaporize relieving the excessive pressure without harming anyone or damaging any surrounding material. In most cases the valve can be replaced by the user and the lighter would be ready for reuse upon refilling the reservoir with fuel.

Further, the cylindrical drop-shaped construction of valve **34** as shown in Figure 4 is such that it normally maintains slit **35** closed. When the spherical or convex surface **36** of valve **34** extending below partition **12** into chamber **13** is subjected to the pressure of the fuel in chamber **13**, such pressure assists in making the closure of the slit opening **35** pressure tight and in the sealing of valve **34** around the edge of opening **33**. In substantially all of the figures the actuator parts and the valve are larger than they will be in the manufactured articles.

Valve **34** is provided with an axial recess **37** having a widened portion **38** intermediate the ends thereof. Widened portion **38** results in the formation of internal annular shoulders **39** and **40** in the recess **37**. Preferably, slit **35** extends upwardly from the bottom of valve **34** to a distance just above the lower end of recess **37** with, however, all of slit **35** being within chamber **13**.

There is another opening **41** in partition **12** intermediate opening **33** and operating lever **16**. A cylindrical guiding well **42** having a flanged upper edge **43** extends through opening **41** and into chamber **13** in a direction parallel to the axis of valve **34**. Guiding well **42** is welded to partition **12** to seal the opening **41** between the reservoir **13** and the space **15**.

A core assembly or thrust member consists of a conduit fitting **44** and a flame tip **45** which two parts are in interfitting relation. Thus, fitting **44** is provided with an internally threaded recess **46** engaging a threaded stem **47** on flame tip **45**. An axial conduit or passage **48** is drilled in fitting **44** and is in alignment with a conduit or passage **49** drilled axially through tip **45**. The passages **48** and **49** are joined into a continuous passage by the circular space between the bottom of stem **47** and of recess **46** which may be termed a variable orifice portion **50**. In this portion, a plurality of resilient nodules **51** are placed. The interstices between the nodules **51** provide an orifice joining the passages **48** and **49**, which orifice is labyrinthine in that the paths along the interstices in the space **50** are tortuous. These nodules may be made, for example, of neoprene or other resilient material which is resistant to deterioration when in contact with the fuel to be used, such as commercial butane. Above and below the nodules **51** there is provided a porous disc separator **52** which may be made, for example, of a suitable paper or ceramic filter material. These separators serve to contain the nodules **51** within the portion **50** and to prevent any of them from entering the passages **48** or **49**. A cylindrical pellet of intermixed wood pulp fibers and ground neoprene may be used in place of the nodules **51** and separators **52**. In effect, therefore, passages **48** and **49** form with the portion **50** a continuous conduit having a labyrinthine portion therein. The voids in this labyrinthine portion **50**, which is on the low pressure side of valve **34**, may be varied by the relative axial movement of the respective parts **44** and **45**. Axial movement of the parts **44** and **45** toward each other compresses the nodules **51** in space **50** between the separators **52** and thereby varies the aggregate orifice through space **50** by reducing the interstices between the nodules **51**. Conversely, movement of the parts **44** and **45** away from each other correspondingly increases the size of such interstices and enlarges the aggregate orifice joining the passages **48** and **49**. Having the metering portion **50** on the low pressure side of slit **35** insures against any possibility of a pocket or slug of fuel in liquid form being blown out of the tip **45** when the lever **16** is depressed. However, if lighter mechanism **10** is operated when turned so liquid fuel in reservoir **13** is against valve slit **35**, a long jet of flame will issue which is very useful, for example, in lighting pipes.

The edge **53** of the head of tip **45** may be knurled or milled so that it can be turned relative to fitting **44**, thereby changing the effective cross section of the voids comprising the orifice in portion **50**. In this way, flame regulation can be obtained. For example, when tip **45** is screwed into fitting **44** further compressing the portion **50**, the height of the flame issuing from the top of tip **45** will be shortened, and vice versa. Moreover, in warmer climates in which, for example, the vapor pressure of a fuel such as commercial butane may be markedly greater than it is in more temperate climates, the adjustment of the interfitting parts **44** and **45** to vary the orifice area through portion **50** can be used to counteract the increase in pressure of the fuel in chamber **13** induced by the climate. Thus, in such hotter climates a further compression of the orifice portion **50** will regulate the fuel flow and flame character to the user's needs and desires.

An annular flange **54** overlies the upper part

55 of valve **34**. Slit **35** in valve **34** is opened as may be seen in Figures 5 and 6 by the axial depression of the core assembly **44—45**. When slit **35** is so opened, fuel from the source in reservoir **13** will flow as a gas through slit **35** and passage **48—50—49** to a recess **56** in the head of tip **45**. The frictional fit between the exterior of fitting **44** within recess **37** and the surface of recess **37** in contact therewith is sufficient to make a seal and prevent any leakage of fuel around the outside of fitting **44**. This recess **56** may be used to protect from drafts the base of the flame or light produced when the fuel issuing from passage **49** is ignited by the sparking wheel assembly. An inner ring **56***a* integral with the bottom of recess **56** may be provided immediately around the top of passage **49**. Then, if there should be any oily material, for example, in the fuel issuing through passage **49**, it would tend to collect around the outside of ring **56***a* between it and the side of recess **56**, thereby avoiding running down the insides of the passage **49**. A notch or kerf **45***a* is provided across the head of tip **45** to facilitate the initial assembly of the thrust member **44—45** by the use, for example, of a screwdriver point inserted in the kerf **45***a*. At the same time, the kerf **45***a* will serve to drain away any such oily matter which may collect around the outside of ring **56***a*.

During the opening of slit **35** by moving the thrust member **44—45** from inoperative or starting to operative or valve-open position toward reservoir **13**, flange **54** bears against the top outer portion **55** of valve **34** and the annular shoulder **44***a* on fitting **44** bears against shoulder **40** on valve **34**. Thus, in addition to the frictional fit as shown in Figure 4 between the surfaces of thrust member **44—45** and the internal recess **37** of valve **34**, the respective shoulders **44***a* and **40** also assist in sealing the space between recess **37** and conduit fitting **44**. The dependent cylindrical side of flange **54** overlies and surrounds part **55** of valve **34** and may help to prevent any undue bulging thereof during the depression of the thrust member. Hence, upon axial movement of the core assembly toward the reservoir, the valve **34** will open as shown in section in Figures 5 and 6 and the fuel flowing out of reservoir **13** as a consequence will pass only through conduit passage **48—50—49**.

Moreover, if lighter mechanism **10** is tipped toward operating lever **16**, when core assembly **44—45** is depressed, rod **31** will swing into the dotted position shown in Figure 6 allowing the lighter **10** to be passed around among a number of smokers without anyone having to hold the operating lever **16** down in its depressed position. Otherwise, a new lighting cycle must be initiated for each instance of use. After being passed around, the lighter can be shut off by a slight depression of lever **16** and tilting it away from such lever allowing the rod **31** to swing back to the full-line position shown in Figures 5 and 6, clearing the corner of the flange **54**.

The sparking wheel assembly comprises an axially movable flint tube **57**, a yoke **58** welded or upset riveted to the top thereof, a rotatable pawl housing **59** pivotally mounted in yoke **58**, a steel sparking wheel **60** pivotally mounted about the same axis as the housing **59** and their associated parts. Thus, flint tube **57** is in slidable engagement with the interior of guide **42**. Further, tube **57** is hollow and internally threaded at the bottom **61** thereof. A cap screw **62** is adapted to be screwed hand-tight into the bottom of tube **57**. Screw **62** is provided with a rounded

nose 63 of reduced diameter which fits inside of a flint positioning spring 64. Flint positioning spring 64 presses against a soft metal plug 65 which in turn supports the bottom of a conventional flint 66. Flint 66 is maintained by spring 64 in constant contact with the underside of sparking wheel 60. The axis of tube 57 is slightly to the right of, as shown in Figures 2 and 4 to 6, the axis on which pawl housing 59 and sparking wheel 60 are mounted. As a consequence, when sparking wheel 60 is rotated sparks will fly at an angle intersecting the axis of core assembly 44—45 between tip 45 and flame opening 18. A flint safe 66a may be fastened on partition 12 to provide for an extra supply of flints 66 in lighter mechanism 10.

Pawl housing 59 is a saddle shaped piece spanning the sparking wheel 60 and having the respective parallel sides 67 and 68. Aligned openings in these sides allow a pin 69 to pass therethrough and through aligned openings in the upright sides 70 of the yoke 58. A crown ratchet wheel 71 integral with sparking wheel 60 is journaled on pin 69. Ratchet wheel 71 is provided with circumferential serrations or teeth 72 adapted for successive engagement by a radial spring steel pawl 73 integral with a flat base 74 the outside of which bears against the inside of side 67. Base 74 is also journaled on pin 69 and has a straight edge 75 in abutment against the underside of the cross-over piece of pawl housing 59 so that as housing 59 is turned, base 74 and pawl 73 are correspondingly turned. The bent up radial pawl 73 is bent inwardly toward the teeth 72 adjacent thereto. Hence, as pawl housing 59 is rotated or rocked through an arc in a counterclockwise direction as shown in Figure 4, the edge 76 of pawl 73 engages the nearest crest of a tooth 72 spaced in a counterclockwise fashion therefrom, thereby rotating sparking wheel 60 and its axially toothed circumference across the top of flint 66 to create the sparks shown in Figure 6. Side 68 of pawl housing 59 is provided with an inwardly stamped portion 77 to keep the parts in fairly close relative position between the sides 70 of the yoke 58. Washers may be employed between the sides of the housing 59 and the insides of the respective sides 70 if required. As shown in Figures 3 and 4, pin 69 is continued and bent down along one side of yoke 58 and then bent horizontally again at 81 to partially encircle and clasp a circumferential recess 78 in a boss 79 integral with the upper part of tube 57 above flange 43. Yoke 58 is welded or otherwise affixed to tube 57 adjacent the top of boss 79.

Yoke 58 is substantially U-shaped, the bottom 80 of which extends between the sides 70 and also toward core assembly 44—45 so as to completely encircle fitting 44 above flange 54 but below the head of tip 45. A surface portion of fitting 44 is swaged or upset riveted over the extension of bottom 80 which surrounds it so as firmly to attach yoke 58 to conduit fitting 44. Instead of such swaging or riveting, yoke 58 may be welded to fitting 44. As shown in Figure 4, the normally closed position and the inherent strength of valve 34 is sufficient to maintain core assembly 44—45 and the sparking wheel assembly in starting or inoperative position as shown in Figure 4 unless and until operating lever 16 is depressed.

Operating lever 16 is formed in the shape of a hood as shown in Figure 1 so as to present lighter mechanism 10 with a smooth unbroken surface when taken together with case 11 and top 14. A narrower bent arm 29 extends upwardly and inwardly into space 15 through slot 28. The upper end of arm or link 29 is pivotally connected at 82 between two lugs 83 integral with the respective sides of pawl 59. A bent spring 84 is positioned between a tab end pocket 85 of lever 16 alongside case 11 and a loop of portion 81 of the extension of pin 69. Spring 84 is coiled at 86 and at 84 with the ends of the coils 87 caught beneath the portion 81. The preloading of spring 84 is such as to normally hold lever 16 against the lighter case and in its uppermost position as shown in Figure 2.

When the lighter mechanism is not in use, it looks as it appears in Figure 1 and the component parts thereof of the embodiment shown are as they appear in Figures 2 to 4 inclusive. When, however, a light is desired, the user holding the case 11—14 in one hand will depress operating lever 16 with the thumb of that hand. In the first portion of that depression as shown by the relative positions of the parts in Figure 5, the angle between bent arm 29 and the lugs 83 of pawl housing 59 substantially remains unchanged but the downward movement of operating lever 16 has transmitted to yoke 58 and member 44—45 through pin 69 and portion 81 the same downward movement. This downward movement opens slit 35 and the valve 34 so that gaseous fuel produced by the liquefied commercial butane or commercial propane in chamber 13 will flow upwardly through passage 48—50—49 and be ready for ignition. At the same time this portion of the depression of operating lever 16 seats the bottom of boss 79 on a flange 43 halting the downward sliding movement of flint tube 57 relative to guide 42 and the downward movement of core assembly 44—45. The continued depression of operating lever 16 changes the angle between the bent arm 29 and the lugs 83 through the pivot 82 tending to bring them into alignment, as shown in Figure 6, and rotates pawl housing 59 in a counterclockwise direction engaging sparking wheel 60 and striking sparks as shown to ignite the fuel issuing from tip 45. A kerf 88 is cut in flange 17 in alignment with slot 28 so as not to hinder the end of the downward movement of operating lever 16. In actuality the depression of lever 16 is a single continuous movement substantially simultaneously effecting fuel flow and ignition of that fuel.

When the user releases his thumb, spring 84 will return operating lever from the position shown in Figure 6 to that shown in Figure 5, if pendent member 31 has not been swung to the position shown in dotted outline in Figure 6 so as to catch against the top of flange 54. Such clockwise movement of pawl housing 59 moves radial pawl 73 clockwise and since it and its support 74 are made of spring steel, it will flatten sufficiently to pass the crest of the next succeeding tooth 72 in a clockwise direction, thereby ratcheting relative to the sparking wheel 60. From the position shown in Figure 5 to that shown in Figures 2 to 4, the restoration of the lighter mechanism to starting or inoperative position as shown in Figures 2 to 4 is achieved by the inherent tendency of valve 34 to close the slit 35. If desired, a conical helical spring (not shown) may be provided around valve 34 between partition 12 and the underside of flange 54, to maintain or return thrust member 44—45 and the sparking wheel assembly in or to their upper-

most position when there is no pressure on lever 16 to depress it.

The respective sides 67 and 68 of pawl 59 may be provided with integral extensions 59a which act as stops against the top of bottom portion 60 of yoke 58. When the user's thumb is removed from operating lever 16, the mechanism 10 will shut off automatically assuming that rod 31 is out of the path of flange 54. This snap action is produced by the preloading of spring 84 urging operating lever 16 upwardly in the course of which the stops 59a strike portion 80 before operating lever 16 reaches its uppermost position. The upwardly moving mass effect so generated assists in completing the return of the actuator assembly to starting or inoperative position with lever 16 in such uppermost position.

After the prolonged period of use which is possible with the lighter mechanism of this invention, the refilling of reservoir 13 with commercial butane or commercial propane or the like will become necessary. Preparatory to initial filling or such refilling, the louver plates 24 may be pressed inwardly unlocking the top 14 and permitting it to be pulled off. Then the actuator assembly comprising the operating lever 16, the sparking wheel assembly and the core assembly can be lifted out between thumb and forefinger while grasping the sides of the yoke 58. The core assembly 44—45 is removed by the fixed attachment between the extension end of the bottom 60 and fitting 44. Since core assembly 44—45 only frictionally fits in axial recess 37, its removal is readily performed. Similarly, flint tube 57 simply slides out of guide well 42, enabling the flint 66 to be replaced at the same time if it is required. The remaining portion of the lighting mechanism is as shown in the lower part of Figure 9 and comprises case 11, partition 12, guide 42 and valve 34.

For filling and refilling, a wholly enclosed filler can 100 is provided which may be of elliptical cross section for attractive appearance. One end 101 thereof is provided with an opening 102 in sealed relation to and supporting a normally closed resilient valve 103. Opening 102 and valve 103 correspond in general construction and in functioning to opening 33 and valve 34. A widened portion 104 intermediate the ends of an axial recess 105 in valve 103 again correspond to portion 38 and recess 37 of valve 34. A slit 106 in valve 103 functions in the same manner as slit 35 in valve 34. A transfer nozzle 107 is provided with an axial passage 108 throughout the entire length thereof. Intermediate the ends of nozzle 107 an integral annular flange 109 is provided which seats against the top of valve 103. The portion of nozzle 107 below flange 109 as viewed in Figure 8, frictionally fits axial recess 105 in the same manner that conduit fitting 44 fits axial recess 37 except that nozzle 107 is provided with a circumferential boss 110 which bears against the uppermost shoulders formed by the widened portion 104. The portion of nozzle 107 on the side of flange 109 away from valve 103 is stepped down from the diameter of portion 111 to the reduced diameter of extreme portion 112.

The portions 111—112 of nozzle 107 are constructed to fit axial recess 37 with the broadened portion between parts 111 and 112 bearing on the shoulders shown just as the annular shoulder between the extremity and upper end of fitting 44 bear against shoulder 40 in the lighter mechanism 10. The extremity 112 of transfer nozzle 107 extends through slit 35 when initial filling or refilling of chamber 13 is to be done. In such filling or refilling, the can 100 and the lighter mechanism less the top 14 and actuator assembly are in the position shown in Figure 9. In such position, commercial butane or commercial propane or the like in liquid form in can 100 under pressure feeds as a liquid by gravity into and fills chamber 13. After a suitable interval, which may be about 5 seconds, to assure filling, can 100 is withdrawn, thereby withdrawing transfer nozzle 107 and allowing valve 34 to close slit 35. At the same time, such withdrawal allows valve 103 to close slit 106. The refilling of reservoir 13 may be facilitated if desired by chilling the outside of case 11. Such chilling may be effected by depressing the transfer nozzle 107 toward filler can 100 while pointing the nozzle toward case 11 to spray fuel thereon until it becomes cold to the touch. Moreover, the valve 103 may be made of a slightly greater hardness than the hardness of the valve 34 so that when assembled together as shown in Figure 9, the transfer nozzle 107 will penetrate into chamber 13 at the same time as or immediately prior to the opening of valve 103 by bringing case 11 and filler can 100 toward each other. In using valves of neoprene, it has been found that a hardness of 45 to 50 for valves such as valve 34 and a hardness of 60 to 70 for valves such as valve 103 are satisfactory, such hardness being in the units measurable by a standard Type "A" Shore durometer.

In the use of normally gaseous fuels of such character it is usually desirable to regulate the amount of liquefied fuel in chamber 13 immediately after any filling or refilling to about 90% of the total volume of the chamber. This regulation may readily be done by means of a regulator cap 113 which may be made of a material such as hard rubber or a suitable plastic such as "Lucite" or white metal. Cap 113 is cylindrical in shape and has the appearance of a hollow stepped cone. Its intermediate portion 114 and extremity 115 have a passage 116 therethrough communicating with the space in the center of the cap. Further, the portions 114 and 115 fit axial recess 37 in valve 34. Hence, when regulator cap 113 is pushed by hand into recess 37 with case 11 upright and with the extremity 115 passing through slit 35, liquid above the level of the tip of extremity 115 will pass into passage 116 and vaporize. When the person filling or refilling chamber 13 observes no more liquid blowing out through passage 116, the regulator cap 113 is instantly withdrawn whereupon slit 35 and valve 34 will close. At that point the liquid in chamber 13 will fill about 90% of the entire volume in the reservoir. In addition to its function as a regulator cap, cap 113 is so dimensioned that the lower portion of cap 113 away from extremities 114 and 115 fits against the outside of valve 103 on the outside of can 100. This fit is sufficient to hold cap 113 in place as shown in Figure 7 until it is pulled off by the user. In this way, the filler can 100 can be transported readily without concern about loss of contents owing to any accidental axial movement of transfer nozzle 107 in a direction tending to open slit 106. A single medium-sized can 100 which is preferably seamless and made of a material sufficient to stand the pressures engendered by the liquid storage of normally gaseous fuels like commercial butane or commercial propane may readily contain enough fuel for at

least a year's normal supply for an average smoker.

A modification of the transfer nozzle 107 is illustrated in Figures 11 and 12. In that modification, those parts having the same general construction and function are given the same reference numerals with the addition of a prime. In addition, transfer nozzle 107' is provided with a vent 117. In filling reservoir 13 through valve 34 vent 117 is closed as shown in Figure 12 by the upper part 55 of valve 34. Flange 109' is provided with a depending cylindrical side which will fit around part 55 similar to the side of flange 54. When however, the filling or refilling interval is over, the partial withdrawal of supply can 100' closes valve 103' and withdraws nozzle 107' a sufficient distance above the top of valve 34 to open vent 117 to atmosphere while at the same time extremity 112' is in communication with reservoir 13 through slit 35. The cylindrical side of a flange 109' may afford some shielding to the outlet end of vent 117. When so vented, the liquid level in chamber 13 will be lowered since the lowermost tip of portion 112' will be in communication with chamber 13. Liquid will flow out through vent 117 and be followed by gas at which moment the person using filling can 100' will immediately withdraw the entire transfer nozzle 107' closing valve 34.

A modified form of a valve made in accordance with this invention is shown in Figure 13 in vertical section. Those portions of this modified form of valve similar in general construction and function to corresponding parts of valve 34 are given the same reference numerals with the addition of a prime, as are the corresponding parts of a lighter mechanism used with valve 34'. Thus, in the modified valve 34', an axial recess 37' is provided which has no widened portion corresponding to portion 38 of valve 34. Instead, a conduit fitting 44' is in surface frictional sealing contact with axial recess 37' throughout the entire length thereof. Moreover, valve 34' is provided with a necked portion 120 of reduced diameter intermediate its top portion 55' and partition 12'. Then, as and when core assembly 44'—45' is moved axially toward slit 35', the surface of recess 37' in contact with the exterior of the core assembly in the region of the necked portion 120 will press against the exterior of conduit fitting 44' therein sealing off any normal possibility of the leakage of fuel between the surface of recess 37' and the exterior of the conduit fitting 44' therein. In some cases, where the actuator assembly may not be precisely made, the distance between the axis of the flint tube 57' and the axis of the core assembly 44'—45' may not correspond exactly to the distance between the axis of guide well 42' and the axis of recess 37'. Such an imprecision might affect the alignment or fit between the exterior of fitting 44' and the surface of recess 37' so that when core assembly 44'—45' is depressed a minute amount of fuel may pass around the outside of fitting 44'. In these latter cases a leakage vent in the form of a pinhole 121 may be provided in valve 34' to bleed or tap off any such minute amount of fuel and avoid any possibility of unduly bulging the valve. Such venting of fuel through vent 121 will not affect the operation of the lighter mechanism of this invention and if present will be in a quantity too slight to ignite. A similar leakage vent may be provided in cases of such misalignment for valves of the type of valve 34, extending between widened portion 38 of recess 37 and the outside of valve 34 above partition 12. In all possible cases manufacturing tolerances and supervision will be such that no vent corresponding to vent 121 will have to be provided and, moreover, irrespective of any such imprecision or misalignment, there is no leakage of fuel through the valves of this invention when they are closed.

This invention includes various changes that may be made without departing from the scope of the appended claims.

We claim:

1. In a lighter mechanism for butane or the like, an enclosed fuel chamber having a partition across one side thereof, said partition having an opening therein, a resilient valve positioned in said opening and normally preventing any flow of fuel from said chamber, said valve having a normally closed slit opening therein extending between said chamber and a recess in the body of said valve, a thrust member fitting said recess in frictional engagement therewith, said thrust member having interfitting parts movable relative to each other, and a plurality of resilient nodules within said thrust member forming a labyrinthine passage variable in area of the voids therethrough by the relative movement of said parts, said thrust member further having a passage therethrough in series communication with said labyrinthine passage, whereby when said thrust member is moved relative to said valve so as to open said slit, fuel for ignition will issue through said thrust member.

2. In a lighter mechanism for butane or the like, an enclosed fuel chamber having a partition across one side thereof, said partition having an opening therein, a resilient valve positioned in said opening and normally preventing any flow of fuel from said chamber, said valve having a normally closed slit opening therein extending between said chamber and a recess in the body of said valve, a thrust member fitting said recess in frictional engagement therewith, said thrust member having interfitting parts movable relative to each other, a plurality of resilient nodules within said thrust member forming a labyrinthine passage variable in area of the voids therethrough by the relative movement of said parts, said thrust member further having a passage therethrough in series communication with said labyrinthine passage, and porous separators between said nodules and said second-mentioned passage, whereby when said thrust member is moved relative to said valve so as to open said slit, fuel for ignition will issue through said thrust member.

3. In a lighter mechanism for butane or the like, a fuel reservoir, a flame tip outside said reservoir, a normally closed valve interposed between said reservoir and said tip to control the flow of fuel therebetween, means for moving said assembly toward said reservoir to open said valve, a cap enclosing a space around said assembly and valve against the outside of said reservoir, said cap having a flame opening in alignment with said assembly, and a pendent member suspended inside said cap, said pendent member being adapted in one position to hold said assembly in its valve opening position.

4. In a lighter mechanism for butane or the like, an enclosed fuel chamber, an ignition and combustion chamber adjoining said fuel chamber, a partition separating said chambers, said partition having an opening therein, a valve positioned in said opening normally preventing any

communication between said chambers, a thrust member substantially in said ignition and combustion chamber adapted to open said valve by pressing thereagainst, a yoke connected to said thrust member and adapted to move it to open said valve, a sparking wheel mounted in said yoke, an operating lever adjacent to at least one of said chambers connected to said yoke, said operating lever being adapted to move said yoke and said sparking wheel, a guide controlling the direction of movement of said yoke, and means for returning said operating lever and thrust member to inoperative position.

5. In a lighter mechanism for butane or the like, an enclosed fuel chamber, an ignition and combustion chamber adjoining said fuel chamber, a partition separating said chambers, said partition having an opening therein, a valve positioned in said opening normally preventing any communication between said chambers, a thrust member substantially in said ignition and combustion chamber adapted to open said valve by pressing thereagainst, a yoke connected to said thrust member and adapted to move it to open said valve, a sparking wheel mounted in said yoke, a flint tube connected to said yoke, means in said tube for holding a flint against said sparking wheel, a guiding well projecting into said fuel chamber for said flint tube, an operating lever alongside of at least one of said chambers, a ratcheting pawl connecting said operating lever and said yoke, resilient means to maintain said operating lever in its starting position, and resilient means to maintain said thrust member in its starting position, said starting positions coinciding with the normally closed position of said valve, whereby when said operating lever is pressed it substantially simultaneously strikes a spark from said flint through said pawl and sparking wheel and moves said thrust member against said valve to open it.

6. In a lighter mechanism for butane or the like, an enclosed fuel chamber, an ignition and combustion chamber adjoining said fuel chamber, a partition separating said chambers, said partition having an opening therein, a valve positioned in said opening normally preventing any communication between said chambers, a thrust member substantially in said ignition and combustion chamber adapted to open said valve by pressing thereagainst, a yoke connected to said thrust member and adapted to move it to open said valve, a sparking wheel mounted in said yoke, a flint tube connected to said yoke, means in said tube for holding a flint against said sparking wheel, the axis of said sparking wheel being offset from the axis of said flint to direct the sparks produced therebetween toward the axis of and above said thrust member, a guiding well projecting into said fuel chamber for said flint tube, an operating lever alongside of at least one of said chambers, a ratcheting pawl connecting said operating lever and said yoke, resilient means to maintain said operating lever in its starting position, and resilient means to maintain said thrust member in its starting position, said starting positions coinciding with the normally closed position of said valve, whereby when said operating lever is pressed it substantially simultaneously strikes a spark from said flint through said pawl and sparking wheel and moves said thrust member against said valve to open it.

7. In combination, an enclosed lighter reservoir for butane or the like, a normally closed resilient slit valve connected to said reservoir, said slit valve having an axial recess therein on the low pressure side thereof, a supply can, a second normally closed resilient slit valve connected to said supply can, said second slit valve having an axial recess therein, a transfer nozzle connected to said supply can and fitting in said recess of said second valve, said nozzle further having a projecting end adapted to fit into the recess of said first-named valve, whereby when said projecting end is inserted into said first-named valve, the relative movement of said supply can toward said reservoir will open both said valves and fill said reservoir with fuel.

8. In a lighter mechanism for butane or the like, an enclosed fuel chamber having a partition across one side thereof, said partition having an opening therein, a resilient valve positioned in said opening and normally preventing any flow of fuel from said chamber, said valve having a normally closed slit opening therein extending between said chamber and a recess in the body of said valve, a thrust member fitting said recess, said thrust member having interfitting parts movable relative to each other, at least one resilient member within said thrust member forming a passage variable in area by the relative movement of said parts, said thrust member further having a passage therethrough in series communication with the passage formed by said resilient member, whereby when said thrust member is moved relative to said valve so as to open said slit, fuel for ignition will issue through said thrust member.

9. In a lighter mechanism for butane or like fuel, in combination, a fuel reservoir having an opening thereinto, a resilient slit valve positioned in said opening with its slit normally closed but openable inwardly toward said reservoir, said valve having a recess adjacent the side of the slit away from said reservoir, a flame tip thrust member removably positioned in said recess adjacent the side of said slit away from said reservoir but depressible toward said slit to press said slit open, said member having a generally axial passage therethrough for the passage of fuel from the reservoir when the member is depressed to open said slit, a yoke attached to said member, a sparking wheel rotatably mounted on said yoke and generally movable with the movement of said member, guiding means connected to said yoke and movable in a direction generally parallel to the movement of said member, and a common operating means to depress said member and operate said sparking wheel, said member, yoke, sparking wheel, guiding means and operating means comprising an actuator assembly removable from said valve and said mechanism when said fuel reservoir is to be refilled through said valve.

10. In a lighter mechanism for butane or like fuel, comprising, in combination, a fuel reservoir having an opening thereinto, a resilient slit valve positioned in the opening with its slit normally closed but openable inwardly toward said reservoir, a flame tip thrust member normally positioned adjacent said slit on the side thereof away from said reservoir but depressible toward said slit to press the slit open, the member having a passage therethrough for the passage of fuel from the reservoir when the member is depressed to open said slit, said member terminating in a flame tip at the end of said passage away from said reservoir, said flame tip being movable with said thrust member, and a sparking wheel mounted on the flame tip thrust member and movable

therewith, whereby the sparking wheel and the flame tip remain in substantially the same relative positions regardless of movement of the flame tip thrust member.

11. In a lighter mechanism for butane or like fuel, in combination, a fuel reservoir having an opening thereinto, a resilient slit valve positioned in the opening with its slit normally closed but openable inwardly toward said reservoir, a flame tip thrust member normally positioned adjacent said slit on the side thereof away from said reservoir but depressible toward said slit to press said slit open, said member having a generally axial passage therethrough for the passage of fuel from the reservoir when the member is depressed to open said slit, said member terminating in a flame tip at the end of said passage away from said reservoir, said flame tip being movable with said thrust member, a sparking wheel mounted on the flame tip thrust member and movable therewith, and an operating lever connected to said thrust member and said sparking wheel to depress said member and operate said sparking wheel while said flame tip and sparking wheel remain in substantially the same relative positions regardless of movement of the flame tip thrust member.

12. In a lighter mechanism for butane or like fuel, in combination, a fuel reservoir having an opening thereinto, a resilient slit valve positioned in said opening with its slit normally closed but openable inwardly toward said reservoir, a thrust member normally positioned adjacent said slit but depressible toward said slit to press said slit open, said member having a conduit fitting and a flame tip in axially adjustable connected relation to each other, said fitting and said tip having a passage extending through each thereof in spaced relation determined by said adjustment, and a compressible part positioned in the space and engaged by said fitting and said tip between the adjacent ends of their respective passages and across the same, said compressible part having at least one orifice therethrough which may be varied by an axial adjustment between said fitting and said tip, whereby in different seasons and climates the pressure of the fuel issuing through the respective axial passages may be regulated by the compression of said part.

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