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(54) THERMOELECTRIC GENERATOR

(54) GENERATEUR THERMOELECTRIQUE

(57) Abstract:

BE IT KNOWN that HOWARD J. FINDLEY, a citizen of the United States of America, residing in Shaker Heights, Ohio, U.S.A., Engineer, having made an invention entitled

THERMOELECTRIC GENERATOR

the following is a full, clear and exact disclosure of the nature of the said invention and of the best mode of realizing the advantages thereof.

This invention relates to thermoelectric generators and aims to provide an improved, compact and simplified construction for a device of this kind. The improved generator can be constructed in the form of a manually portable self-contained unit which can be used for storage battery charging and various other purposes. The housing of the improved generator includes a base which contains a fuel tank and burner and which also forms a mounting for supporting the thermopile so as to receive heat from the burner. A movable housing section cooperates with the base so that while in its closed position it houses and protects the thermopile and fuel burning means and while in its open position affords access to the fuel burning means and forms a stack or flue.

In the accompanying sheets of drawings,

Fig. 1 is an elevational view, with portions broken away, showing a thermoelectric generator embodying the present invention;

Fig. 2 is another elevational view with portions thereof broken away and with the lid and housing members in open position;

Fig. 3 is a transverse sectional view taken on the line 3-3 of Fig. 2;

Fig. 4 is a detached longitudinal sectional view of the burner assembly;

Fig. 5 is a fragmentary longitudinal sectional view of the burner showing the same on a larger scale;

Fig. 6 is a partial vertical sectional view taken through the fuel tank at a point to show the fuel supply line to the burner;

Fig. 7 is a detached view, on an enlarged scale and with portions in section, showing fuel deflecting means associated with the burner;

Fig. 8 is a similar view taken at right angles to Fig. 7;

Fig. 9 is a detached view, with portions in section, further illustrating an igniting device associated with the burner;

Fig. 10 is a partial vertical sectional view, on an enlarged scale, showing means for connecting the housing member with the base;

Fig. 11 is another partial vertical sectional view showing locking means for the lid member, and

Fig. 12 is a diagram showing a load circuit connected with the thermoelectric generator.

Proceeding with a more detailed description of the present embodiment, the drawings show the improved thermoelectric generator as having a hollow base 10 upon which the device may rest or stand and a thermopile 11 supported by the base extending thereabove so as to receive heat from a fuel burning means or burner assembly 12 contained in the base. A tubular housing member 13 surrounds the thermopile 11 and is movable axially thereof from a closed position as shown in Fig. 1, to an open position as shown in Fig. 2.

The lower end of the housing member 13 has an enlarged portion or flared skirt 13a thereon which, in the closed position of the housing member, forms an upper section of the hollow base 10. The lower section of the base is formed by a ring-shaped

fuel tank 14 adapted to contain gasoline or other liquid fuel. The hollow base also includes a tapered section or hood member 15 having its larger end supported on and fastened to the tank 14 and having a transverse wall 16 at its upper end which supports the upright thermopile 11. This hood member has a plurality of openings 17 in its side wall which admit air to the burner assembly for combustion purposes and through which various fuel control members are accessible or accommodated as will be further explained hereinafter. In addition to forming a support for the thermopile 11, this hood member houses and protects the burner assembly and the fuel control members.

The thermopile 11 may be of any suitable construction and may be of the type comprising an elongated combustion chamber 18 defined by a tube or sleeve 19 formed of refractory and electrically insulating material, and a plurality of thermocouple groups 20 carried by such refractory sleeve. Each of the groups 20 may comprise a number of series-connected individual thermocouples of any suitable construction and disposed with their hot junctions 21 in the combustion chamber 18 and their cold junctions 22 outside of the combustion chamber and in the annular space or passage 23 extending between the sleeve 19 and the housing member 13. The thermocouple groups 20 may be connected with each other in series, parallel or series-parallel relation.

The thermopile 11 may be connected with the base 10 by being clampingly held between a spider 24 and the transverse wall 16 of the hood member 15. Screws or tie rods 25 extend through the spider and the transverse wall 16 of the hood member for this purpose. The lower end of the refractory sleeve 19 may be seated in a recessed portion 16a of the transverse wall so as to surround an opening 16b thereof through which the upper end of the burner

assembly 12 extends.

The burner assembly 12 comprises a burner tube 28, whose upper end communicates with the combustion chamber 18, and a burner body 29 adjacent the lower end of the burner tube. The burner body carries a nozzle 30 which is in substantially coaxial relation with the burner tube and refractory sleeve 19. The burner assembly also includes a vaporizer 31 having a vaporizing chamber surrounding the burner tube, and a priming cup 32 surrounding the burner body 29. The lower end of the burner assembly extends more or less into the ring opening 33 of the fuel tank 14 and may be supported in the hollow base by means of one or more arms 34 connecting the same with the hood member 15.

As best shown in Figs. 4 and 5 the burner nozzle 30 has a delivery opening or orifice 35 at its upper end which is controlled by a rotatable and axially movable burner pin 36 having a threaded connection with the burner body at the point 37. The outer end of the pin has a tip 38 of reduced size for cleaning the orifice and a tapered portion or valve element 39 which cooperates with the orifice in forming a fuel control valve. Rotation is imparted to the burner pin 36 by means of an actuating stem or spindle 40 carrying a knob 41 at its outer end and having its inner end connected with the pin through the bevel gears 42 and 43.

The gear 42 may be pinned or otherwise connected to the spindle 40 and the gear 43 may be connected with the burner pin 36 by means of a plurality of radially disposed pins 44. The pins 44 are carried by a washer 45 and their inner ends extend through the gear 43 and engage in axial slots or keyways 36a of the burner pin 36. This connection between the gear 43 and

the burner pin 36 permits the latter to move axially in the burner body and in the gear 43 while the latter remains continuously in mesh with the gear 42. The spindle 40 extends through, and is journaled in an extension 46 of the burner body 29. The extension 46 extends upwardly and outwardly over the fuel tank 14 and projects through one of the openings 17 of the hood member 15. The lower end of the burner body 29 is closed by inner and outer screw plugs 26 and 27 which are removable to afford access to the burner pin 36 from the ring opening 33 of the fuel tank.

Fuel is supplied from the tank 14 through the pipe 48 to the chamber of the vaporizer 31 and then through the pipe 49 to a recess or chamber 50 of the burner body which is located just inwardly of the orifice 35. The delivery of fuel to the burner assembly from the tank 14 is obtained by maintaining a pressure in the fuel tank. For this purpose air may be forced into the fuel tank by means of the manually operable pump 51 which projects through another of the openings 17 of the hood member 15. If desired the fuel tank may be provided with a gauge housing 52 containing a suitable pressure gauge for indicating the pressure in the fuel tank and a suitable fuel gauge for indicating the amount of fuel in the tank. The gauge housing 52 is located on the tank 14 at a point to be readily visible through one of the openings 17 of the hood member.

The priming cup 32 which surrounds the burner body 29 is adapted to contain a quantity of liquid fuel which can be ignited and burned for the purpose of preliminarily heating the burner body and the vaporizer 31. The fuel for priming the burner is obtained from the tank 14 by opening the fuel control valve so as to permit liquid fuel to be discharged through the

orifice 35. The prevent such liquid fuel from being squirted into the combustion chamber 18, a deflector 53 is provided which is movable to a position over the orifice and deflects the stream so that the fuel runs down and collects in the cup 32.

The deflector 53 is best shown in Figs. 7 and 8 and is carried by a shaft 54 having an actuating knob 55 disposed outside of the hood member 15. A compression spring 56 disposed around the shaft 54 normally holds the deflector 53 in a retracted position removed from the burner nozzle, as shown in dotted lines in Fig. 7. Just before opening the fuel valve by rotation of the knob 41, the knob 55 is pulled out to its full line position thereby moving the deflector 53 to a position in front of the nozzle orifice. After the desired amount of fuel has been collected in the priming cup 32 the fuel valve is closed and the knob 55 is released.

The fuel in the priming cup is then ignited as by means of a match, or preferably, by means of an igniting device 57 having a flint 58 disposed adjacent the cup 32 and an actuating member 59 located outside of the hood member 15. The shaft 60 of the igniting device carries a knurled sparking wheel 61 which cooperates with the flint 58, the latter being held against the wheel by pressure supplied by the spring-actuated arm 62.

As above indicated my improved thermoelectric generator is of a portable nature and is adapted to be manually carried from one point of use to another. For this purpose there is provided a suitable carrying means which in this instance is in the form of a bail-type handle 64 pivotally connected with the housing member 13 adjacent its upper end. When the housing member 13 is in its closed position, as shown in Fig. 1, its enlarged lower end 13a surrounds the fuel burning means and the fuel control members

and seats against the fuel tank 14 to form a smooth continuation of the hollow base 10 and a relatively tight closure which will prevent rain, dust and other foreign matter from reaching the fuel burning means and thermopile. To enable the device to be carried by the handle 64, the housing member 13 can be connected with the base 10 and for this purpose I provide the housing member with a plurality of fasteners 65 which are rotatably mounted on the enlargement 13a at spaced points therearound and areadapted for locking cooperation with brackets 66 projecting from the hood member 15 at correspondingly located points.

When the thermoelectric generator is to be placed in operation the fastening members 65 are unlocked and the housing member 13 is lifted to its open position as shown in Fig. 2. The housing member is retained in this open position by means of pivoted stops or pawls 67 which are carried by channel members 68 depending from the spider 24 and are adapted to swing or drop to a load-carrying position as shown in Fig. 2. When the housing member is to be lowered to its closed position the pawls 67 are swung inwardly to lie in the recesses or grooves of the channel members 68 and in which position they do not interfere with the downward movement of the housing member 13.

The upper end of the housing member 13 is closed by a lid member 69 which is adapted to be lifted to an elevated position as shown in Fig. 2. The lid member 69 is carried by annularly spaced channel-shaped rods or posts 70 which are frictionally slidable in channel-shaped guides 71 which are attached to the inside of the housing member 13 at correspondingly spaced points. When the lid member 69 is in its closed position it may be locked to the housing member 13 by means of the laterally movable latch 72.

When the housing member 13 has been moved to its open position, as just described above, it uncovers the fuel control members so that they are accessible for observation and manipulation. An important function of the housing member while in its elevated position is that it forms a stack or flue for the combustion gases which pass upwardly through the combustion chamber 18. Since these gases emerge from the upper end of the combustion chamber with considerable velocity and are in a heated condition, an ejector action will be produced within the stack and will cause cool air to be drawn into the lower end of the housing member. This cool air entering the housing member will flow across the thermocouples 20 and will maintain the outer junctions 22 relatively cool.

From Figs. 1 and 3 it will be noted that the spider 24 at the upper end of the thermopile has a plurality of openings 73 which permit the escape of the heated gases from the combustion chamber 18 and has another group of openings 74 which permit the cooling air to pass upwardly in the housing member 13 after flowing over the thermocouples 20. If desired, a spreader 75 may be mounted on the spider 24 so as to extend downwardly into the combustion chamber 18 for a suitable distance. This member serves to spread the flame and heated combustion gases so that they will come into more direct contact with the hot junctions 21 of the thermocouples.

Reverting to the starting operation, it will be understood that when the housing member 13 and lid member 69 have been moved to their open position and a quantity of fuel has been collected in the priming cup 32 and ignited, as above explained, the burning fuel heats the burner and vaporizer and this generates

vapor pressure in the vaporizing chamber 31. When the priming charge has been nearly consumed the fuel control valve is reopened and the fuel vapor which issues from the nozzle 30 will be ignited and a sustained flame or blast will thereafter be directed into the combustion chamber 18 by the nozzle and the heating of the junctions 21 will result in an electric current being generated in the thermopile.

As before indicated the improved thermoelectric generator can be used to generate electric current for various purposes and, in Fig. 12 the thermopile 11 is shown connected with an external load circuit 76 containing a storage battery 77 to be charged. A reverse-current cutout or relay 78 may be provided in the circuit for preventing the battery from discharging through the thermopile when the device is not operating as a generator. The reverse-current cutout comprises the usual shunt and series coils 79 and 80 and a pair of contacts 81 and 82 in the load circuit. When the thermoelectric generator is placed in operation, as above explained, the current produced by the thermopile first energizes the shunt coil 79 which causes closing of the contacts 81 and 82. As soon as these contacts are closed, charging current is supplied to the battery 77 and in passing through the series coil 80 acts to maintain the contacts 81 and 82 closed. When the operation of the generator is to be discontinued, the fuel control valve is closed whereupon the charging current ceases and as soon as current from the battery 77 flows in a reverse direction through the series coil 80, the contacts 81 and 82 are automatically opened to break the circuit and prevent the battery from becoming discharged.

From the foregoing description and accompanying drawings,

it will now be readily understood that the present invention provides an improved, simplified and compact thermoelectric generator which can be manually carried from one point of use to another. It will be seen also that in the improved generator the burner assembly and fuel control members are all housed in the hollow base and while the device is being transported the housing member covers and protects the thermopile and forms a tight closure with the base. It will be seen furthermore that when the thermoelectric generator is to be placed in operation the housing member can be quickly and easily opened to expose the fuel control members and, while in its open position, forms a stack for the combustion gases and for inducing a flow of cool air over the thermocouples.

Having regard to the foregoing disclosure, the patent of which this specification forms part confers, subject to the conditions prescribed in the Patent Act, 1935, the exclusive right, privilege and liberty of making, constructing, using and vending to others to be used, the invention as defined in claims submitted by the patentee as follows:

1. In a thermoelectric generator, a hollow base, a fuel burning means in said base, an upright thermopile extending above said fuel burning means to receive heat therefrom, and a housing member surrounding the thermopile and the lower end of which member forms a portion of said hollow base, said housing member being movable to an open position affording access to said fuel burning means and permitting an inflow of cool air around the thermopile.

2. In apparatus of the character described, a base, a fuel burning means in said base, an elongated thermopile having a tubular combustion chamber aligned substantially with said fuel burning means, and a tubular housing member surrounding said thermopile, said housing member being movable to a position in which it extends beyond said combustion chamber as a stack.

3. In apparatus of the character described, a base, a fuel tank in said base, a fuel burner in the base adapted to receive fuel from said tank, an elongated upright thermopile supported by said base and having a tubular combustion chamber aligned substantially with said burner, and a tubular housing member surrounding said thermopile, said housing member being movable axially of the thermopile to a position in which it extends above said combustion chamber as a stack.

4. In a thermoelectric generator having a base, a fuel tank forming the bottom section of said base, an upright thermopile, a burner adapted to be supplied with fuel from said tank and to deliver heat to the thermopile, a housing member surrounding the thermopile and having a flared lower end, and means housed by said flared lower end for controlling the supply of fuel to the burner from said tank, said housing member being movable axially of the thermopile to an open position affording access to the fuel control means and permitting an inflow of cool air around the thermopile.

5. In a thermoelectric generator having a base, a ring shaped fuel tank in said base, an upright thermopile supported by said base and extending thereabove, and a burner extending at least part way into the ring opening of the fuel tank and adapted to deliver heat to the thermopile.

6. An upright thermoelectric generator comprising, a base upon which the device is adapted to stand, an upright thermopile supported by said base and extending thereabove, fuel burning means on said base and adapted to supply heat to said thermopile, a housing member having a tubular portion surrounding said thermopile and an enlarged lower portion which engages said base when said housing member is in a closed position, said housing member being liftable to an open position in which said enlarged lower portion is spaced above said base to permit an inflow of cool air around the thermopile and said tubular portion forms a stack extending above the thermopile, and means for supporting said housing member in its open position.

7. An upright thermoelectric generator comprising, a base upon which the device is adapted to stand and containing a tank for liquid fuel, an upright thermopile supported by said base and extending thereabove, liquid fuel burning means on said base and adapted to receive fuel from said tank and to supply heat to said thermopile, a housing member having a tubular portion surrounding said thermopile and an enlarged lower portion which engages said base when said housing member is in a closed position, said housing member being liftable to an open position in which said enlarged lower portion is spaced above said base to permit an inflow of cool air around the thermopile and said tubular portion forms a stack extending above the thermopile, and means for supporting said housing member in its open position.

8. An upright thermoelectric generator comprising, a base upon which the device is adapted to stand and containing a tank for liquid fuel, an upright hollow thermopile supported by said base and extending thereabove, a burner on said base and adapted to be supplied with liquid fuel from said tank, said burner being disposed so as to direct burning fuel upwardly into the lower end of said hollow thermopile, a housing member having a tubular portion surrounding said thermopile and an enlarged lower portion which engages said base when said housing member is in a closed position, said housing member being liftable to an open position in which said enlarged lower portion is spaced above said base to permit an inflow of cool air around the thermopile and said tubular portion forms a stack extending above the thermopile, and means for supporting said housing member in its open position.

9. An upright thermoelectric generator comprising, a base upon which the device is adapted to stand and containing a ring shaped tank for liquid fuel, an upright hollow thermopile supported by said base and extending thereabove, a burner on said base and adapted to be supplied with liquid fuel from said tank, said burner being located at least in part in the opening of said ring shaped tank and disposed so as to direct burning fuel upwardly into the lower end of said hollow thermopile, a housing member having a tubular portion surrounding said thermopile and an enlarged lower portion which engages said base when said housing member is in a closed position, said housing member being liftable to an open position in which said enlarged lower portion is spaced above said base to permit an inflow of cool air around the thermopile and said tubular portion forms a stack extending above the thermopile, and means for supporting said housing member in its open position.

10. A manually portable upright thermoelectric generator comprising, a base upon which the device is adapted to stand and containing a ring shaped tank for liquid fuel, a hollow hood member supported on said tank and extending thereabove, an upright hollow thermopile supported by said hood member and extending thereabove, fuel burning means located in said hood member and opening of said ring shaped tank and adapted to be supplied with liquid fuel from said tank, said fuel burning means being disposed so as to direct burning fuel upwardly into the lower end of said hollow thermopile, a housing member having a tubular portion surrounding said thermopile and an enlarged lower portion which surrounds said hood member and engages said base when said housing member is in a closed position, said housing member being liftable to an open position in which said enlarged lower portion is spaced above said base to permit an inflow of cool air around the thermopile and said tubular portion forms a stack extending above the thermopile, means for connecting said housing member with said hood member when the housing member is in its closed position, carrying means connected with said housing member, and means for supporting said housing member in its open position.

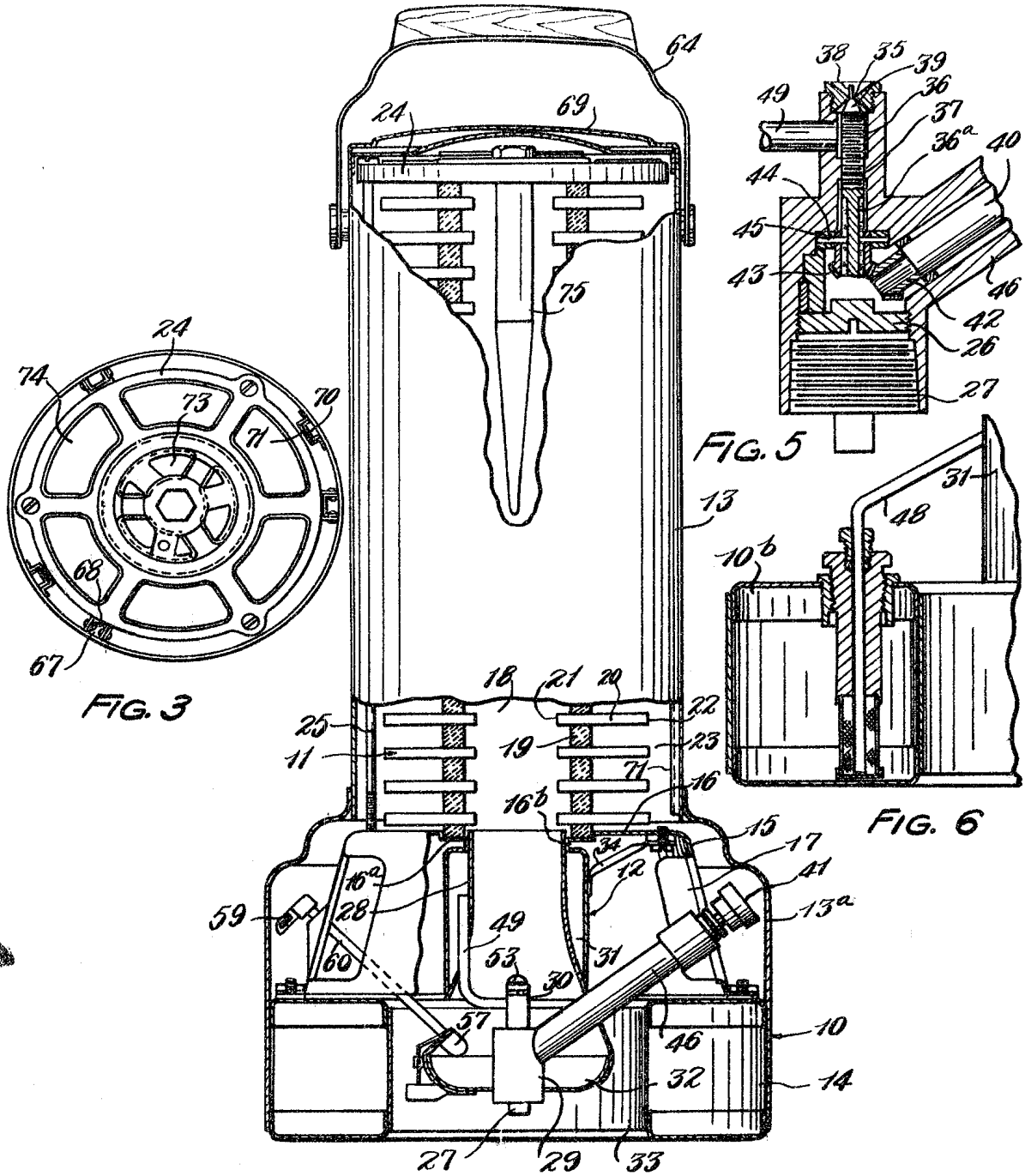

FIG. 3

FIG. 5

FIG. 6

FIG. 1

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Certified to be the drawings referred to in the specification hereunto annexed.

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March 1st., 19 44

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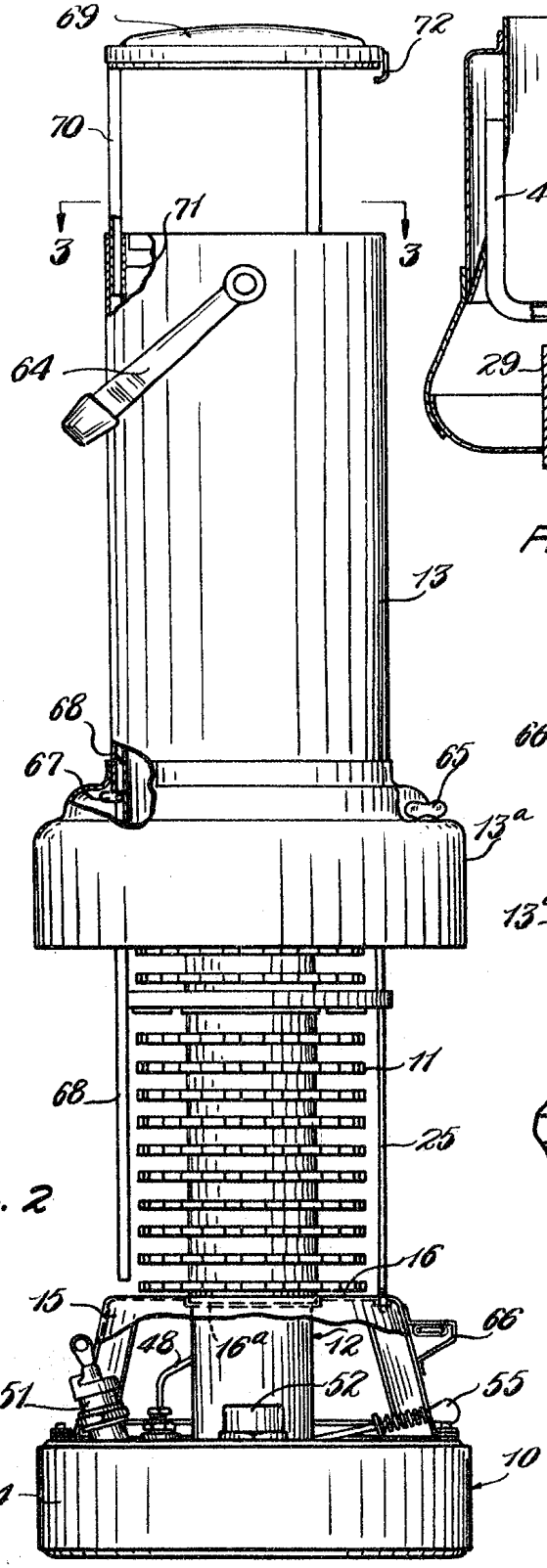

FIG. 2

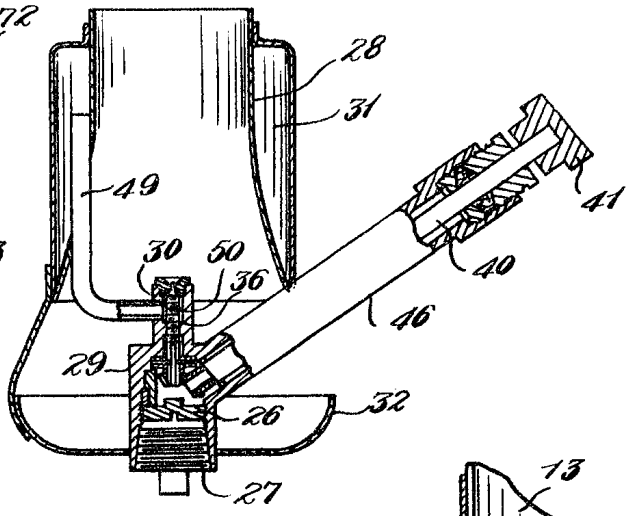

FIG. 4

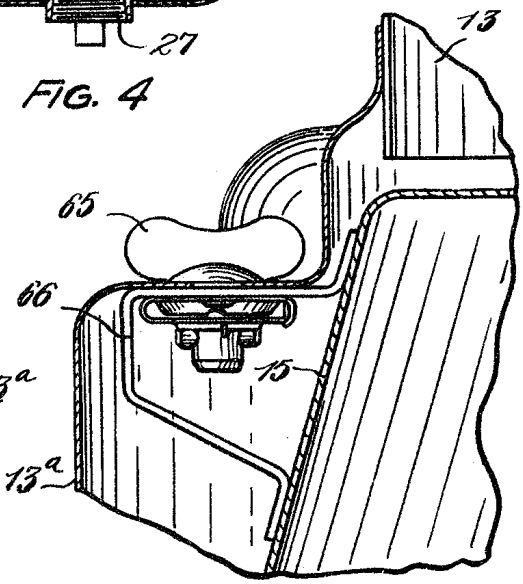

FIG. 10

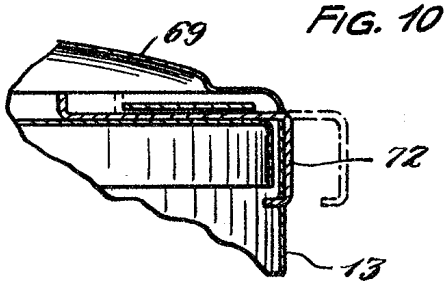

FIG. 11

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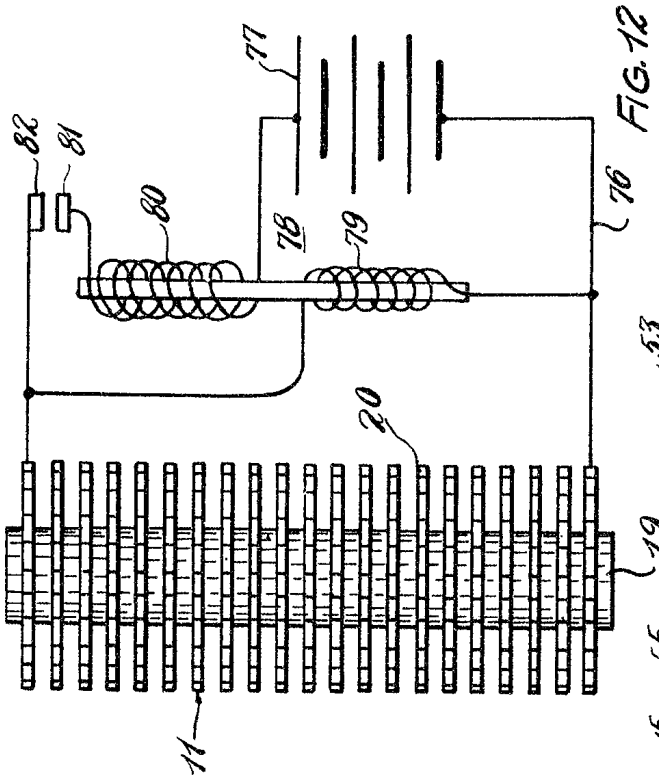

FIG. 12

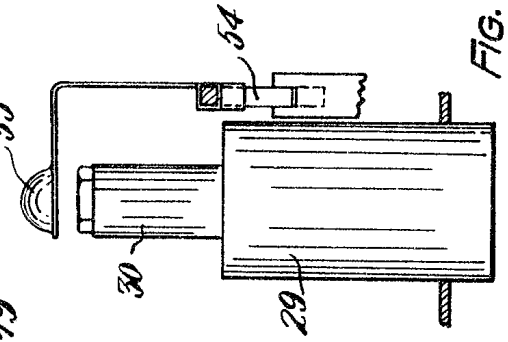

FIG. 8

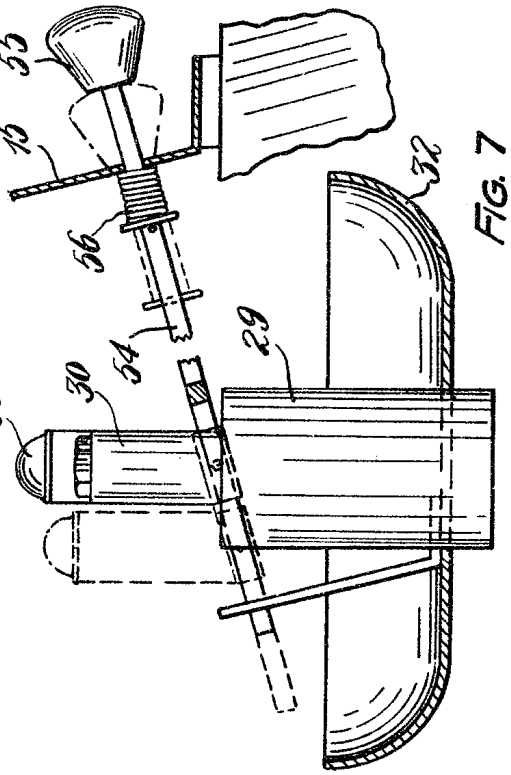

FIG. 7

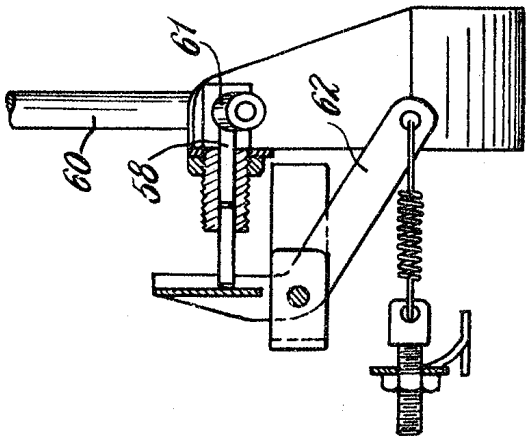

FIG. 9

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