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LIQUID FUEL BURNER WITH MIXING AND IGNITING MEANS

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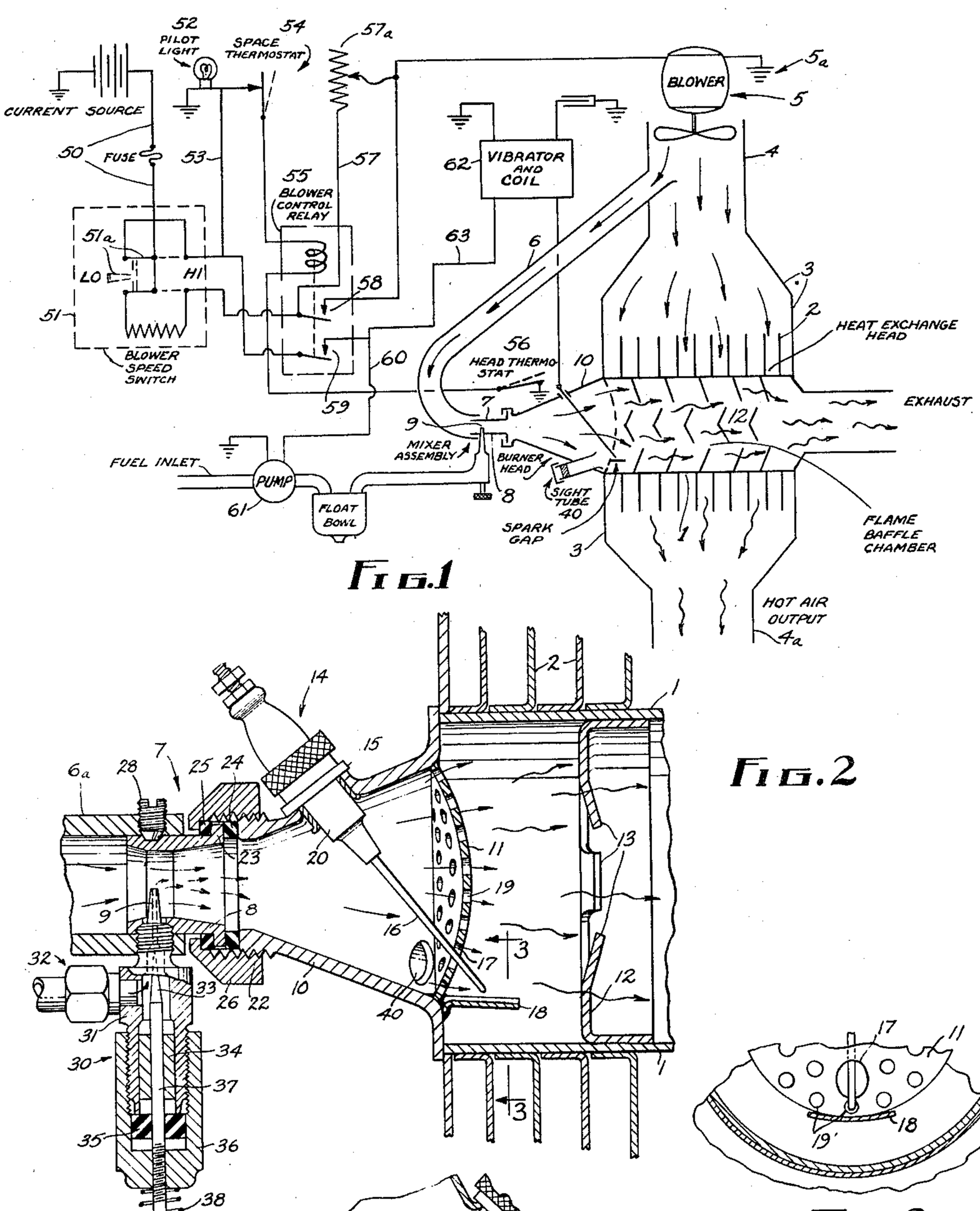

FIG. 1

FIG. 2

FIG. 3

FIG. 4

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LIQUID FUEL BURNER WITH MIXING AND IGNITING MEANS

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6 Claims. (Cl. 158—28)

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The invention relates to an improved heater system and apparatus of the portable, spark-ignited, liquid hydrocarbon burner class.

The apparatus, in the form shown, is for use in truck cabs, busses, auto-trailers, motor boat and other cabins, airplane cockpits and the like; and is applicable to water heaters and boilers particularly of the portable type for vehicle and relatively small capacity installations.

A specific object is to provide a hydrocarbon burner head adapted for electrical spark ignition of injected fuel and with effective provision for protection against overheating of the necessary spark terminal apparatus and against excessive heating of critical parts of the mixer chamber and connected apparatus for atomizing the fuel.

A further object is to provide a hydrocarbon injector, mixer chamber and burner head assembly having several improved features in respect to ignition of the fuel and protection of the injector apparatus against vapor lock and undesirably noisy or inefficient operation resulting therefrom or connected causes.

In the drawing, Fig. 1 is a diagram showing typical electrical controls and mechanical arrangements for attaining the above and other objectives. Fig. 2 is a fragmentary central longitudinal sectional view of the injector and burner head apparatus. Fig. 3 is a detail sectional view thereof as indicated on Fig. 2. Fig. 4 is a fragmentary view of part of the burner head apparatus as applied to water heater or boiler use.

Figs. 1 and 2 show the heat exchange head or portions thereof in typical form, comprising a flame tube 1 having radiating fins 2 within an air-chamber-forming casing 3 having an air inlet duct portion 4 and hot air outlet or discharge duct 4*a* communicating in suitable fashion (not show) with the space to be heated (or aerated and heated). A power blower is diagrammatically indicated at 5 comprising an electric motor and fan. That and other portions of the apparatus, so far as applicable, may be in accordance with Robert H. Hunter, Patent No. 2,410,881, issued November 12, 1946.

A portion of the blower apparatus (usually an impeller separate from that supplying the duct 4) forces atomizing and/or combustion-complementing air, as through a duct 6, to a fuel and air mixer and injector assembly 7 including a fuel pickup or mixer Venturi tube 8 and fuel jet 9. The burner head includes a burner cone 10 in sealed connection with the mixer assembly and with the inlet end of the flame tube 1.

Air from the tube 6 is blown through the Venturi tube 8 with sufficient force to atomize fuel introduced at the tip of the nozzle, and the atomized fuel and air flows through the metal burner cone 10, the larger (outlet) end of which is partially blocked or baffled by an atomized-fuel-distributing screen wall or partition member 11, preferably of shallow dome shape and connected at its peripheral edges (as by welding) with the flame tube 1 and/or heat exchange casing 3. Combustion takes place inside the flame tube 1 and to retard the flame velocity and secure an efficient rate of heat exchange a series of flame baffles 12 (see Hunter patent) is arranged inside the tube and connected to its wall. The baffles preferably comprise cup-shaped sheet metal elements in stacked self-spacing arrangement and with maze-effecting fingers 13 in partially overlapped arrangement at the central part of the flame tube (not fully illustrated).

An important feature is that the spark ignition means includes a terminal-supporting and insulating plug 14, essentially of conventional form and purpose, supported by the burner cone 10 for thermal protection of its insulation and having its spark terminal so positioned as to assure igniting contact of the spark with fuel at a point such as will normally provide adequate protection against premature ignition and blow-back of flame into the burner cone.

The plug 14 extends through a wall of the burner cone, being removably secured to said wall by conventional means at 15 (not illustrated in detail, being well known); and the terminal conductor 16, as shown in Fig. 2, extends through an elongated, i. e. elliptical, opening 17 in the screen wall 11 to the sparking point.

In a horizontal installation such as shown by Fig. 2 the spark terminal conductor 16 extends adiacent a fuel-film-supporting ground plate 18 connected to the flame tube assembly and in position to tend to collect and retain a thin film of fuel thereon exposed to the terminal for ignition by the spark. For effective collection of fuel to form such film, the top side of the ground plate 18 is dished (e. g. cylindrically concave on its upper side as suggested by Fig. 3) and its top face is put into communication with such fuel as may condense on the burner cone 10 through the lowermost ones 19′ of the perforations 19 in the screen 11. The opening 17 is made sufficiently large so that the conductor 16, although it may become bent somewhat during installation or may be supplied in bent or warped condition, will be closer at its tip to the ground plate 18 than to the periphery of the opening at any point. In

some cases the conductor is purposely bent and the insulation body (porcelain) 20 of the plug is then rotated in the receiving opening therefor of the cone 10 so as to select the most desirable or effective spark gap. The enlarged opening 17 enables such rotation without likelihood of sparking directly against the screen wall 11. When the desired spark gap is attained, the usual, or a suitable, threaded connector sleeve of the plug assembly is tightened to hold the terminal in place.

The condition or amplitude of the spark and the combustion state can be observed through a sight tube 40 mounted (e. g.) on the burner cone 10 and generally directed toward the spark gap region.

The outer or smaller end of the burner cone 10 is threaded at 22 for removable attachment of the atomizer or mixer tube assembly. The mixer tube 8 is removable from the mixer inlet tube 6*a* so as to enable selection of different sizes and/or shapes of mixer throats for optimum mating with different installations; and partly for that reason the discharge end of the tube 8 is flanged at 23 and the flange is clamped between heat barrier (low-heat-conductive) gaskets or washers 24 and 25 inside the threaded attachment sleeve nut 26 which is screwed tightly onto the threads 22 of the burner cone. The heat barrier connection, in addition to its main purpose viz: prevention of vapor-lock or explosions in the mixer throat due to overheating by conduction, enables the mixer block assembly to be secured in any desired relatively turned position on the burner head (cone 10), thereby facilitating connection of fuel and air supply conduits thereto in various angular relationships as may be required in different models.

The mixer tube 8 is secured in properly installed position in the tube 6*a* by a set screw 28 and the fuel introduction nozzle or jet assembly 30 is attached to the tube at a different side, e. g. the opposite side as shown. Said assembly 30 comprises a fitting 31 having a lateral fuel-supply connection 32 and a needle valve plug 33. The plug 33 extends through a closely embracing sleeve 34 in a counterbore of the fitting 31 to align the plug point with its conventional metering aperture in the fitting. An air-stop seal 35 surrounds the plug stem and occupies a supporting sleeve 36 which is internally threaded to carry the operating stem 37 of the plug. A locking spring 38 around the stem reacts on the sleeve and a needle valve adjusting head-piece 39.

Referring to the controls (Fig. 1), a line 50 connected to the current source incorporates a safety fuse and leads to a blower-motor speed-control switch 51 of the double-pole, double-throw type, the movable element 51*a* of which is shown in "low speed" position. Closing of the switch 51 in either of its operating positions starts the motor of blower 5; the circuit established thereto in either position flowing through a line 57 to a variable resistance 57*a*, thence to the motor and ground 5*a* thereof. Regardless of the position of the switch element 51*a*, closing of it supplies a pilot light 52 to indicate that the heater supply circuit has been established. Via the line 53 leading to the pilot light a thermostat switch 54, in the space to be heated, controls current supply to a relay 55 and therethrough to another (grounded) thermostat switch 56 in thermo-sensitive relation to the burner head. The thermostat switch 56 is normally closed; opens when the burner starts to function, and then remains open until the burner cools down. Thus, closing of the space thermostat switch 54 energizes the relay 55 thereby closing two normally open switches 58 and 59.

Closing of the switch 58 by-passes the resistance 57*a* and supplies current to the blower motor at fuel-pick-up speed in relation to the mixer assembly 8, 9 through tube 6, and the motor meanwhile forces air over the flame tube and fin assembly. Concurrently the closing of the relay switch 59, through line 60, starts operation of a fuel pump 61 (or opens a fuel valve if the heater unit has a service supply tank) so that fuel is fed to or maintained in communication with the nozzle or jet 9; and, by energization of a vibrator and coil assembly 62 connected in the circuit at 63 supplies high voltage intermittent current to the spark plug 14.

When the system is shut down, by opening of either the space thermostat switch 54 or the heater head thermostat switch 56, the switches 58 and 59 are opened, cutting off normal operating current to the blower motor and de-energizing the spark coil and fuel pump actuator. Thereupon current still flows through the resistance 57*a* to supply the blower motor for operation at very low or scavenging speed. Such low speed operation is insufficient to cause withdrawal of fuel from the nozzle jet 9, but it is sufficient to sweep any residue of combustible gases out of the burner head and flame tube, insuring that, upon recycling of the apparatus there will be no explosion. Meanwhile the residual heat in the heat exchange portions of the unit is delivered slowly to the space served.

The variation in construction illustrated by Fig. 4 is adapted to water heating or boiler use as previously indicated. Such frequently requires that the flame tube 1*a* be placed vertically, being surrounded by a water jacket or reservoir as indicated at 70. In such case the spark terminal may be positioned as at 71 adjacent the defining wall of a central orifice 72 in the screen or partition wall 11*a*. In that case, a film of fuel is maintained by condensation and drainage around said defining wall to insure ignition, and, due to the concentration or relatively high volume of flow through such relatively large central orifice, there is little likelihood of blow-back of flame into the burner cone 10. In this installation the sight tube 40*a* is preferably placed in the top wall of the flame tube either vertically or (as shown) directed generally toward the spark point. In both illustrated installations the insulation portions of the spark plug are amply protected against destructive heating, and ignition and proper combustion are effectually assured.

We claim:

1. In a heating apparatus of the type described, means forming a mixing chamber for air and liquid fuel, means to conduct fuel and air to the chamber, means forming a combustion chamber, a metal mixture delivery tube of gradually expanding transverse area connecting the two chambers and in sealed relation thereto adjacent respective chambers, a mixture distributor plate across the larger end of the tube and having a multiplicity of openings therethrough including one relatively large opening, electrical ground surface means adjacent said larger opening adapted and arranged to retain a film of condensed liquid fuel thereon, and a spark plug insulatingly and removably mounted on a wall of the tube and having a terminal projecting adjacent said larger opening and in sparking rela-

tion with said ground surface means, said larger opening providing clearance for the spark terminal.

2. In a heater apparatus of the liquid-hydrocarbon-burner, electrical-spark-ignition type, a mixer device and means to conduct fuel and air thereto, a burner head and associated means forming a combustion chamber, said head including a conical metal tube connecting the mixer device and chamber and with its large end in sealed relation to the chamber, a spark plug insulatingly carried by the tube, an apertured distributor plate between the tube and combustion chamber, a fuel-film-collector plate inside the burner chamber and electrically grounded to the plate and tube, said spark plug having a spark terminal projecting through one of the apertures of the distributor plate and into sparking relation with the film collector plate.

3. In an air operated spark ignited, liquid-fuel-burner, means forming a mixing chamber and a combustion chamber spaced apart horizontally, means to conduct fuel and air to the mixing chamber, a conical metal tube extending between the two chambers, sealingly connected at its small end with the mixing chamber and at its large end with the combustion chamber, an apertured metal screen plate bridging said large end, an electrically grounded flash pan inside the combustion chamber and positioned with an upwardly exposed fuel-film-supporting surface in receiving relation to liquid fuel that may drain through apertures of the plate from the tube wall, and an electrical spark plug insulatingly carried by the tube wall and projecting through an aperture of the plate, out of contact therewith, into sparking relation to said surface of the flash pan.

4. The apparatus according to claim 3, wherein the lowermost inclined surface of the tube wall is contiguous to an adjacent margin of the flash pan and at least one of the apertures of the screen plate is adjacent said lowermost surface so as to afford direct fuel communication from the tube to the flash pan.

5. In a burner apparatus of the class described, a metal mixer device having a through orifice to receive air and having an injector nozzle opening into the orifice, means to conduct air and fuel to said orifice and nozzle, means forming a combustion chamber, a metal distributor tube for conveying atomized fuel from the orifice to the chamber, means to ignite the atomized fuel for propagation of flame thereof in the combustion chamber, and a sealing connection between the tube and the mixer device comprising a flange on one of said metal elements, a sleeve nut on the other, and a pair of non-metallic heat barrier washers on opposite sides of the flange and arranged to be compressed thereagainst by tightening of the sleeve nut.

6. In a burner apparatus of the class described, a tubular metal mixer device adapted to have air passed therethrough, an injector nozzle opening into the path of such air, means forming a combustion chamber at the outlet end of the mixer device, a tubular metal distributor device for conveying atomized fuel to the chamber, means to ignite the fuel and air mixture in the combustion chamber, the distributor device being metallically connected to the chamber forming means, a clamping collar adjustably connected with one of said devices and having an annular shoulder around the other device, and non-metallic heat barrier washers one of which lies between the two devices and the other of which lies between said annular shoulder and said other device for establishment of a low-heat-conductive seal between said devices by adjustment of the clamping collar.

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