May 17, 1960 E. T. NORD ET AL 2,936,959

SPRAY GUN

Filed April 19, 1956 2 Sheets-Sheet 1

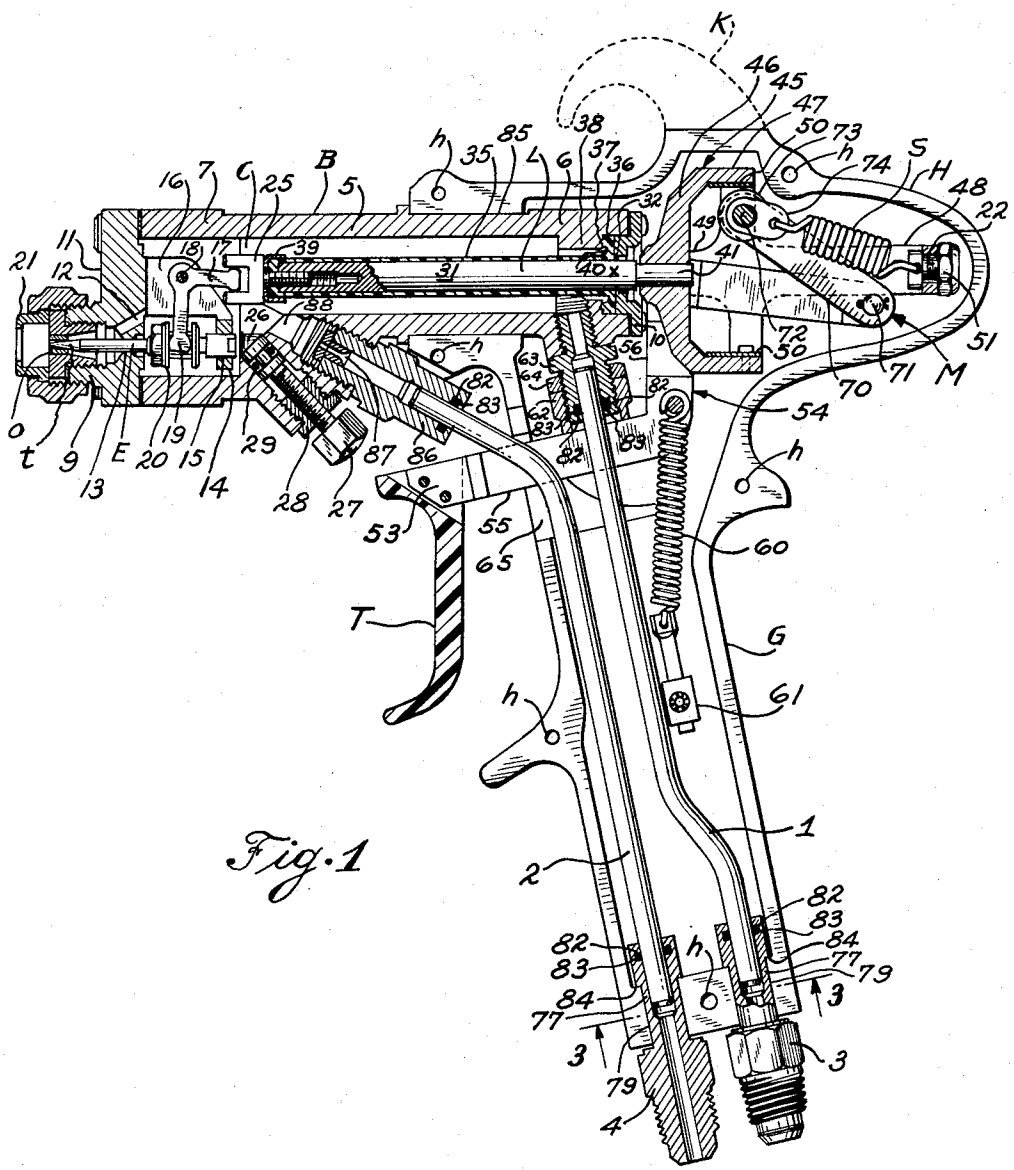


Fig. 1

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SPRAY GUN

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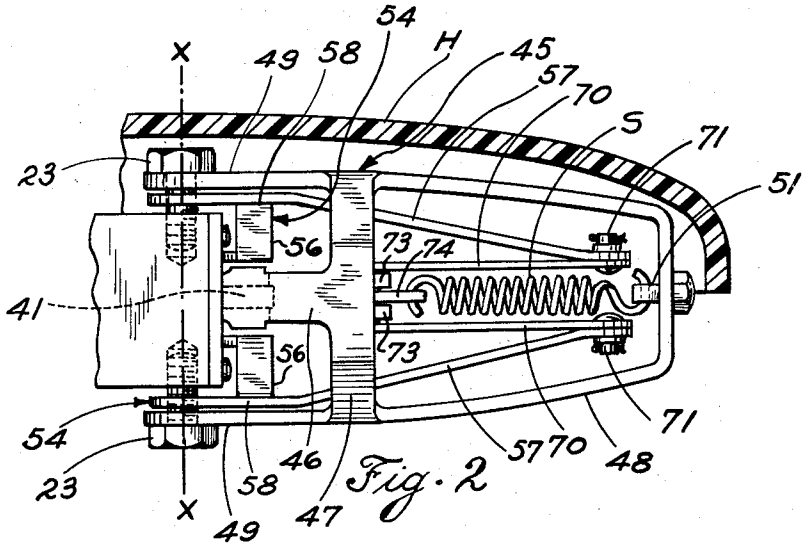


Fig. 2

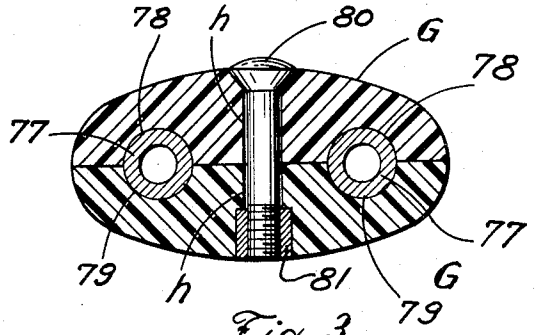


Fig. 3

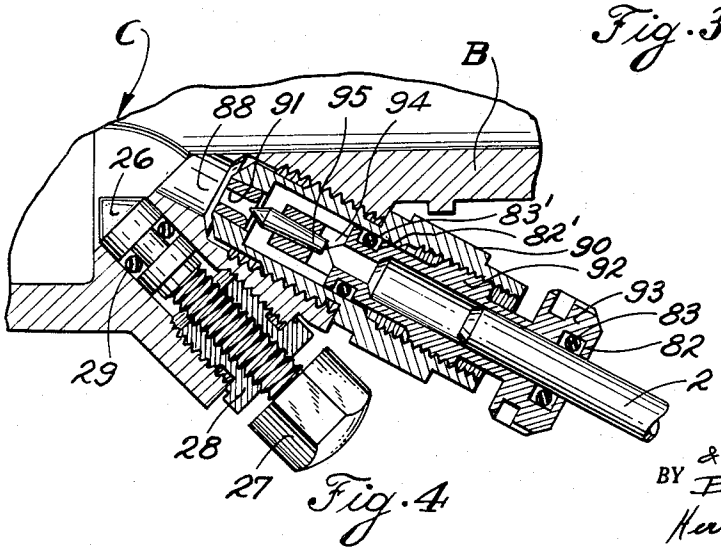


Fig. 4

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2,936,959

SPRAY GUN

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Application April 19, 1956, Serial No. 579,253

28 Claims. (Cl. 239—127)

This invention relates to spray guns and more particularly to spray guns of the so-called airless type for spraying hot "paint" at high pressure.

It is among the objects of our invention to provide an easily operated, leakproof airless spray gun for spraying hot paint at high fluid pressure with positive "on" and "off" action, low or modest trigger effort, freedom from "spit" and drip, giving a symmetrical spray pattern, having a rapid positive opening and closing action, using fluid pressure to advantage, being easy to handle, aim and point in different directions, being of light weight, free of frictional packing resistance and having assurance of desired temperature maintenance during the "off" intervals.

Other objects of our invention are to provide a high pressure fluid gun with a low pressure fluid return line for internal circulation and temperature maintenance and with a flow control for the return line; to provide swiveling connections between the fluid lines and the gun to ease the handling and aiming thereof; to provide a balancing of forces between the trigger retractor spring and the snap action spring to ease the operator's effort and return "snap" action of the discharge valve of the gun; to provide an advantageous impact force and action to the valve closure to add to the certainty and effectiveness of seating the valve closure member in the "off" or closed position and concomitantly to decrease, pro tanto, the need for spring pressure to effect positive closing of the discharge orifice; to provide accessible means for limiting the travel of the valve closure and the resulting net opening of the discharge orifice; to provide a self-centering tendency and disposition of the discharge valve in respect to the discharge orifice whereby to avoid giving an asymmetrical discharge or spray pattern to the outflowing stream or spray, and withal to provide a gun capable of carrying out the avowed objects of our invention that is economical of manufacture, dependable and efficient in operation, easily used, adjusted and repaired and given to a long and satisfactory life.

Other objects and advantages will appear from the following description of a preferred form and embodiment of our invention, reference being had to the accompanying drawings in which:

Figure 1 is a partial longitudinal section and partial side elevation of the gun embodying our invention with the near half of the outer longitudinally split casing removed to expose the parts otherwise contained therein.

Figure 2 is a partial top plan view showing the rearward end of the gun and snap action mechanism with the casing half shown in horizontal section at about the level of the longitudinal axis of the gun barrel.

Figure 3 is a transverse section taken near the lower end of the hand grip of the gun along the line 3—3 of Figure 1.

Figure 4 is a fragmentary longitudinal section showing a modified and adjustable control of the circulating fluid outlet passage.

In this preferred form of our invention, the gun comprises a barrel B having an internal chamber C for the high pressure fluid to be discharged therefrom through the main discharge orifice O at the forward, leftward as viewed, end of the gun, a needle valve closure element E, movable to and from "on" and "off" positions by, inter alia, the longitudinally extending lever L, snap action mechanism M at the rear of the gun and trigger T. The rearward end of the barrel B and action M is enclosed in a housing H, only the "far" longitudinally split half of which is shown; the lower depending portion of which comprises the pistol grip G of the gun appropriately related to the trigger T and enclosing, inter alia, the fluid tubes 1 and 2 and supporting the swivel fittings 3 and 4 through which the gun is detachably connected to fluid conducting means, not shown. Advisedly the housing and grip portion thereof is made of heat insulating material such as molded thermosetting plastic to preserve comfort in handling when the paint to be sprayed is hot.

When our gun is employed for spraying hot paint under high pressure, for example, and a desirable elevated temperature is desired to be maintained in the paint in the chamber C, paint under the desired pressure and temperature is admitted to the chamber C through the tube 1 from an appropriate pump and heater, not shown, and is continually bled off from the chamber at a restricted rate through the tube 2 for recirculation through the pump and/or heater so that circulation and substantially constant temperature of fluid is maintained in the chamber C and adjacent the discharge orifice O at all times, and especially during the "off" condition of the gun when the paint to be sprayed would otherwise tend to cool.

For illustration of the utility and operation of our gun, and without limitation, we use the words paint and hot paint and airless spraying to comprehend, among other things, the senses in which those terms are employed in the presently allowed application of James A. Bede, Serial No. 337,042, filed February 16, 1953, for Method of Spray Painting, now Patent Number 2,754,228. Incidentally, our gun has utility in connection with the process described in said application. Briefly, paint for our purposes comprising paint as such as well as varnishes, lacquers, enamels, finishes and coating compositions with pigments, solvents, driers and the like, included therein. Hot paint as presently sprayed with our gun variously has a temperature range from about 135° F. to about 250° F. And by airless spraying we refer to the art of spraying without an air blast or stream to convey the paint from the gun to the surface to be coated, the fluid pressure in the gun providing the prime force to move the paint, atomize it and transport it. The pressure maintained in the chamber C of the gun will depend on factors known to those skilled in the art, including, inter alia, the viscosity of the paint at the desired temperature and for illustrative purposes may be taken to range from about 200 to 700 pounds per square inch.

The barrel B of the gun comprises a hollow elongated central portion 5 of hollow cylindrical interior comprising the middle part of the chamber C with a rearward part 6 of reduced internal diameter and an enlarged forward end part 7 affording a forward, not necessarily round enlargement of the chamber C. The rearward end of the barrel is closed by an apertured closure plate 10 through which the lever L extends with freedom of movement. The enlarged forward end of the barrel is closed by the forward closure member 11 which has a forwardly extending external boss 9 carrying the orifice O to which fluid may flow from the chamber C through the passage 12. The member 11 also has an aperture 13

axially aligned with the orifice O in which the needle valve closure member E is slidably movable, and the member 11 has a rearwardly projecting and rearwardly depending boss 14 having an aperture 15 axially aligned with the orifice O and the aperture 13 in which the rearward part of the member E is slidably supported. The boss 14 also comprises laterally spaced portions 16 between which the bell crank 17 is pivotally supported on the transverse pin and axis 18; the lower end of the crank having a yoke 19 coacting with the collar 20 carried by the needle valve E wherewith to induce forward and rearward motions of the needle valve responsive to clockwise and counterclockwise movements respectively of the bell crank.

The orifice O comprises at its rearward end the seat for the needle valve closure member E and is ordinarily not the ultimate discharge orifice for the gun: a so-called nozzle tip, not shown, commonly being provided immediately adjacent the forward end of the orifice O and secured thereagainst by the cap 21; the tip having the duty and property of giving ultimate form to the spray of the fluid passing through the orifice O. The orifice O and the cap 21 are located and secured in and by the hollow internal and external nuts having threaded engagement with the internal and external threads of the boss 9.

The lever L in its operative entirety engages the bell crank 17 at its forward end and is engaged at its rearward end as at 22 and given swinging motion by the spring S of the snap-over mechanism M whereby to be swung about the axis X, see Figure 2, where it is pivotally supported on trunnions 23 externally of the barrel B; the axis X being noted approximately at X in Figure 1.

The forward end of the lever L carries a yoke 25 with a threaded shank screwed into the lever; the yoke engaging the rearward end of the bell crank and imparting rotation to the bell crank responsive to upward and downward motion of the forward end of the lever and yoke 25. Such motion, in turn, is imparted to the needle valve member E, forward motion of which is limited by orifice closing engagement with the seat in the orifice as shown in Figure 1, and rearward motion of the valve member being adjustably limited by the disposition of the conically tapered end 26 of the adjusting screw 27 which has fine-threaded engagement with the bushing 28 for fine adjustment; the screw 27 also having the O ring or other packing 29 to prevent leakage of fluid from the chamber C.

As will more fully appear, our invention provides very rapid opening and closing movement and acceleration of the member E to and from the open and closed positions relative to the orifice O, fluid pressure in the chamber C opposing the initial opening and aiding the closing movements. Freedom of axial motion of the member E is afforded by freedom of fit in the aligned guiding and bearing apertures 13 and 15, and the freedom of this sliding fit affords advantage in permitting the tapered forward end of the member E to have limited lateral play in the open position relative to the seat in the orifice wherewith it tends to be self-centering in respect to the hydraulic axis of the orifice as induced by the rapidly moving high pressure stream flowing to and through the orifice. By this freedom, the member E tends to exert no deleterious influence on the form of the spray pattern emanating from the gun. Similarly, the lateral freedom of the member E facilitates firm, tight, freely aligned seating of the tapered end of the member in the seat of the orifice unimpeded and "unbound" by the guiding apertures. In effect the member E is tended to be given relatively free axial motion in space substantially, but not necessarily literally, in the axis of the orifice during the instants of its rapid opening and closing movements. The effective discharge opening through the orifice in the open condition is controlled by the extent of rearward motion permitted the member E by the adjusting screw 27. Thus for any given paint, temperature and pressure or other condition, the screw 27 may select and adjustably control the rate of fluid discharge from the gun.

The middle and forward portion of the lever L takes the form of an elongated cylindrical pin 31 having an outside diameter but slightly smaller than the least diameter of the forward part of the aperture 32 in the rear closure plate 10 through which the pin passes with little more than sufficient clearance to permit full swinging motion of the pin about the transverse axis X, the aperture 32 having its minimum diameter closely proximate the vertical plane of the axis X and tapering or expanding rearwardly and away therefrom. To seal the chamber C in respect to the pin 31 and aperture 32, and permit the desired substantially free motion of the pin relative to the aperture, the pin is encased in a boot 35 having an integral, radially outwardly disposed, thickened annular flange 36 near the rearward end of the pin 31 lying in the plane of the axis X normal to the longitudinal axis of the pin. The flange 36 is squeezed and gripped fluid tight between the inner forward face of the plate 10 and a rearwardly facing, preferably grooved or serrated face 37 of the internal annular shoulder 38 of the rearward end 6 of the barrel B; the shoulder 38 having an internal diameter freely greater than the external diameter of the boot adjacent the flange and shoulder, permitting free swinging of the pin about the axis X. The inner forward face of the plate 10 engages substantially the full rearward face of the flange 36 down to the aperture 32 to support the flange and boot against blow-out pressure from the chamber C. Preferably the rearmost end of the barrel B is counterbored, as shown in Figure 1, to closely fit the peripheral margin of the flange 36 and closely receive the forwardly stepped shoulder of the plate 10 to aid in gripping and sealing the flange in respect to the barrel.

The physical and chemical qualities of the boot 35 for the service preferably required in our gun when the same is used for spraying hot paint under high pressure are exemplified in the plastic resin, polytetrafluoroethylene, sold under Du Pont's trademark Teflon. We have found this resin satisfactorily resistant to chemical action and having the elasticity, flexibility and mechanical strength desirable for our purposes in the form and structure described above coacting with the other parts of the gun in the way we have provided. One of the known properties of this resin is its deleterious reaction with alkali metals, wherefor the same are avoided; the plate 10 and pin 31 conveniently being made of steel and the barrel B advantageously being made of cast and machined aluminum. It is also advantageous to make the front cover plate 11 of aluminum or other high conductive material to aid in keeping the paint hot in the passage 12 and in the space behind and adjacent the orifice O, particularly during "off" times when these spaces are not in the direct path of recirculation of paint through the chamber C.

The boot 35 has a snug fit with the pin 31 covering the forward end thereof and squeezed in tight contact with the forward end of the pin within the collar 39 by the threaded connection between the pin and the yoke 25. The boot 35 fits the pin with increasing tightness as the pressure in the chamber C increases and prevents leakage between the boot and the pin. The flange 36 is held leakproof in relation to the barrel and plate 10, and since the flange 36 is approximately in the vertical plane of the axis X, flexing of the flange for all necessary motion of the pin 31 and lever L is minute and well within the limits of flexibility and elasticity of the resin consistent with long-lived employment in our gun. The flange 36 may have a radially intermediate portion of reduced thickness as at 40 to minimize the working of flexure.

The pin 31 has a rearward shouldered extension 41 tightly fitting the cage 45, see also Figure 2, which acts

operatively as the integral rearward end of the lever L; the snap-over spring S engaging the extreme rear end of the lever L through the rearmost end of the cage **45** at **22**. The cage **45** comprises a forwardly disposed vertically extending C-shaped portion **46** tightly receiving the extension **41**. The portion **46** integrally joins at its upper and lower rearward ends the central ring portion **47** of the cage which in turn is integrally formed at its sides and joined with the horizontally disposed rearwardly extending U-shaped portion **48** and also the forwardly extending arms **49**, the forward ends of which carry the trunnions **23** through which the whole of the lever L is pivotally supported on the axis X. Hard metal wear and impact pads **50** are secured interiorly of the ring **47**; it being convenient to cast the cage of aluminum to, inter alia, reduce the inertia thereof. A threaded and eyed fitting **51** detachably connects the extreme rearward end of the cage to the spring S at the point **22** as mentioned above. Thus, the cage and lever L are bodily swingable about the axis X as induced by the spring S, and with the lever L and bell crank **17** proportioned about as shown in the drawings, a small angular displacement of the lever is translated into a large axial motion of the needle valve E. For example, given the lever L about six inches long and pivoted in the middle, a one eighth inch travel of the valve E represents a swing of the lever of only about an eighth inch up and down, as viewed in Figure 1, at both its ends, i.e. through about 2.5° of arc. Such angular movement involves very small motion between the pin and the aperture **32**, and taking the pin at ¼ inch O.D. and the boot **35** about 1/32 inch thick, the flexing of the flange **36** at the radius of the point or circle **40**, of not more than ¼ inch, is only about 1/100 inch.

Our invention proceeds to induce vigorous snap action, "on" and "off" swings of the lever L responsive to squeezing and releasing the trigger T with modest trigger effort from the finger of the operator, thus: Prudently the trigger T is made of non-conducting, heat insulating material attached as at **53** to a laterally spaced pair of jointly acting levers, called trigger arms, for convenience, **54**, which are pivotally supported on the trunnions **23**, see Figure 2. Particularly the trigger arms have a generally T-shaped form, the lower part **55** of the leg portions of the T being bent abruptly forwardly and traversing the grip G and engaging the trigger externally of the grip, the upper portions **56** of the legs of the T being bowed outwardly from the longitudinal plane of the axis of the gun, i.e. the section of Figure 1, as the legs rise adjacent the forward C-shaped part **46** of the cage **45**, see Figure 2. The leg portions of the trigger arms join the head portions **57** thereof at the points **58**, see Figure 2, and the head portions lie generally horizontal and move through parallelism with the U-part **48** and arms **49** of the cage in the course of stressing the spring S for snap-over action of the lever L. A retractor spring **60** stressed between an adjustable anchorage **61** in the grip G and the legs of the trigger arms resiliently urges the trigger arms clockwise, as viewed in Figure 1, against the adjustable stop **62** carried on the fitting **63** for the high pressure tube **1**; a lock nut **64** securing the stop **62** and the spaced trigger arms spanning the tubes **1** and **2**. An opening **65** in the grip G near the trigger admits counterclockwise movement of the trigger arms away from the stop and against the retractor spring when the trigger is squeezed.

The rearmost ends of the trigger arms are pivotally connected to the rearward ends respectively of a pair of laterally spaced links **70** through pins **71**; the forward ends of the links reaching into the ring **47** of the cage and being connected together by the pin **72** which also carries a pair of spaced rollers **73**, between which a link **74** carried by the pin connects the spring S (stressed in the position shown in Figure 1) to the pin **72** and the forward ends of the links **70**. The links **70** clear the springs S on opposite sides thereof, Figure 2. In the position of the parts shown in Figure 1, the rollers **73** are in stressed contact with the upper pad **50** within the ring **47** and the spring is exerting an upward force on the right, as viewed, end of the lever L holding the needle valve E in the closed "off" position as shown.

To operate the gun in the sense of opening the orifice O to project paint spray therefrom in the "on" condition, squeezing the trigger T from the position shown in Figure 1 swings the trigger arms counterclockwise, as viewed, about the trunnions **23**, raising the pin **71** and the rearward ends of the links **70**, increasing the stress in the spring S, moving the rollers forwardly on the upper plate **50**, whilst, however, the trigger arms gain mechanical advantage over the spring S as the links **70** approach alignment with the spring S and approach the snap-over point of the whole mechanism M. Even though the spring **60** is increasingly stressed as the snap-over state is approached, the trigger effort tends to stay about constant and practicably light as the arms gain mechanical advantage over the spring S.

Continued counterclockwise movement of the trigger and trigger arms forces the pin **71** further upwardly and carries the links **70** beyond alignment with the spring S inducing a sharp downward movement of the forward end of the links **70**, rollers **73** and pin **72**, sharply reversing the direction of force exerted by the spring on the lever L at the point **22** from upward to downward, and simultaneously slamming the rollers **73** against the lower plate **50** in the ring **47** of the cage and adding violent impact to the lever L driving the rightward end downwardly in conjunction with the downwardly exerted force of the "snapped-over" spring S. The hammering impact of the rollers against the plate adds to the total downward force exerted on the lever and reduces the demand on the spring S, and correspondingly reduces the trigger effort required to swing the lever L and move the needle E sharply rightwardly out of the seat of the orifice O to the "on" position; the rearward end of the needle E striking the end **26** of the screw **27** and being forcibly held thereagainst by the tension of the spring S exerted through the lever L and bell crank **17**. The fluid pressure in the chamber C necessarily opposes the initial opening movement of the needle valve E, acting on the net effective area thereof while the orifice O is closed, but this opposition drops off sharply in the first minute increments of time and motion of the valve member away from its seat. The impact of the rollers **73** with the inertia of the parts moving therewith contributes particularly and advantageously to the initial force to overcome the maximum initial resistance to valve opening movement.

In the "on" position of the gun and the parts thereof, the trigger T is held by the operator more nearly adjacent the grip than shown in Figure 1, the rightward end of the lever L and cage **45** is lowered, as viewed, and the leftward end of the lever and yoke **25** raised relative to the position shown in Figure 1, the bell crank moved counterclockwise, the spring S and links **70** inclined downwardly from rear to front, the pin **70** lying above the spring, substantially obversely related to the position shown in Figure 1, the rollers **73** engaging the bottom plate **50**, and the spring **60** stressed and extended more fully than shown in Figure 1. In fact, the spring **60** in the "on" position is stressed sufficiently to provide the energy and power to actuate the snap-over mechanism and action to bring the gun to the "off" position from the "on" position as the trigger is permitted to move leftwardly, as viewed, when the operator releases his squeeze thereupon.

Release of the trigger T permits the spring **60** to move the trigger arms clockwise, moving the pin **71** and the rearward ends of the links **70** downwardly toward and to aligned parallelism with the spring S, whereafter the snap-over action above described is repeated in opposite

direction and with opposite results; the rollers 72 slamming against the upper pad 50 and with the links 70 and the spring S violently returning to the position shown in Figure 1, all giving sharp acceleration and continuing acceleration and velocity of valve closing movement, which is augmented as the tapered end of the valve member nears and reaches forcible and/or violent contact with the seat in the orifice, by the continuing stress in the spring S, the whip of the lever L, the inertia of all the parts moving toward the "off" position, the outward movement of fluid through the orifice and, increasingly in the last minute increments of time and motion of the needle valve, by the fluid pressure in the chamber C. All the forces and effects collaborate to cause a sharp, positive, forcible closing of the orifice and seating of the needle E on the seat thereof; a thing much to be desired with hot paint, for example, wherein true and effective closure of the orifice seems to require or be enhanced by a squashing out or obliterating of pigments, "solids" or the like, on, at or from the seat of the orifice and the mating portion or tapered tip *t* of the needle valve E. Ruggedness and hardness of the orifice, its seat, and the tapered tip *t* of the needle valve closure element E enhances the life and efficacy thereof and of the satisfaction of the gun and users thereof. Preferably the orifice O and the tip *t* are made of tungsten carbide or other material of similar properties; the orifice being separately formed and secured in the hollow male nut of more freely machinable material and the tip *t* being separately formed and secured to the forward end of the needle valve E, the balance of which is made of more freely machinable though adequately strong material.

As suggested above, the fluid, hot paint, for example, to be sprayed or projected from our gun is supplied at the desired temperature and pressure from a pump and heater via a flexible high pressure conduit, not shown, to the input tube 1 through the fitting 3 to which the conduit is tightly threadably secured at the base of the grip G. The facility of our gun is measurably enhanced by connecting the input conduit, as well as the circulating outlet conduit, not shown, (*a*) at the base or heel of the grip, and (*b*) in freely swiveling relation thereto. The outlet fitting 4 is preferably the same as the fitting 3 and preferably similarly related to the tube 2 and the heel of the grip G.

As shown also in Figure 3, the fittings 3 and 4 have reduced cylindrical necked portions 77 in the shanks thereof of slightly smaller O.D. than the inside diameters of the pair of semi-cylindrical bearing pads 78 and 79 formed or molded in the complementary halves of the grip G; the upper or "near" half of the grip being supplied in Figure 3, and the halves of the grip being secured together by a screw 80 extending through the holes *h* and threadably entering a nut 81 preferably molded into the body of the grip. Similar holes *h* with similar nuts molded in one of the halves of the housing and grip afford means for securing the halves together in the final assembly of the whole gun. The shanks of the fittings 3 and 4 are enlarged and shouldered, as shown in Figure 1, above and below the bearing pads to restrict longitudinal motion of the fittings relative to the grip while permitting free rotation and swiveling of the fittings in the bearing pad so that angular movement of the gun around and about the axis of the fittings relative to the conduits secured thereto is facilitated; the high pressure conduit especially tending to resist twisting when the gun is rotated or waved about the axis of the grip. Each of the fittings 3 and 4 has a longitudinal bore for the passage of fluid and is counterbored in the upper portion of the shank to freely and closely receive the ends of the tubes 1 and 2; the counterbored portions being grooved as at 82 to receive, preferably O-ring, packings 83 which are fluid tight while permitting freedom of motion between the tubes and the fittings.

The tube 1 is similarly received and sealed at its upper end in the fitting 63 through which fluid passes to the chamber C. The ends of the tube 1, as shown in Figure 1 (and the same is true in principle of the tube 2 though shown less conspicuously), are spaced away from the adjacent ends of the counterbores to prevent binding or buckling as the tubes expand and contract when heated by the hot paint; the packings 83 admitting free longitudinal motion of the tube ends in the counterbores of the fittings. With high pressure in the tube 1 the fitting 3 is strongly urged to blow off the end of the tube but this is resisted by the shouldered engagement between the shanks of the fittings and the bearing pads of the grip as at 84, Figure 1. Conversely, the housing H and grip portion G thereof are stressed in tension between the barrel B and the fitting 3 corresponding to the area of the tube 1 and the pressure therein; the housing H having a firm, snug grip on the external cylindrical surface 85 of the barrel between semi-cylindrical pads in the halves of the housing clamped thereupon as suggested but not specifically shown in the section of Figure 1.

To maintain desirable temperature of the fluid in the chamber C a continuous restricted outflow of fluid therefrom and circulation therein (and preferably also through the external heater and/or pump and heater) is provided through the tube 2, the fitting 86, restricted orifice 87 and opening 88 through the lower wall of the barrel B communicating with the forward end of the chamber C; the fitting having a bore, counterbore, packing groove and packing corresponding to these aspects of the fittings 3 and 4 and similarly receiving and sealing the upper end of the tube 2. The orifice 87 is shown as sleeved into the end of the bore of the fitting, preferably removably, wherewith to be selectively adapted to restrict circulating outflow from the chamber C with respect to the temperature, pressure and viscosity of the fluid to be sprayed therefrom through the orifice O, and maintain the desired high pressure in the chamber C while the orifice O is open, and still permit enough circulation when the orifice O is closed to maintain the desired temperature of fluid in the chamber C when the orifice O is closed for significant periods of time.

Alternatively we suggest in Figure 4 an externally adjustable outlet for recirculating the fluid from the chamber C wherein the fitting 90 is substituted for the fitting 86 connecting the tube 2 with the barrel B and the chamber C through the opening 88. In this form the fitting 90 carries an orifice 91 at the inner end of the bore, and the fitting is deeply counter-bored to proximity with the orifice and tapped remotely therefrom to receive threadably and slidably a valve carrying member 92 having an internal fluid passage therethrough, the rearward portion of which slidably and rotatably receives the end of the tube 2 fluid tight and movable in packing 82—83. The member 92 has a nut-like externally accessible rear end 93 by engagement of which the member 92 may be screwed into and outwardly of the fitting 90 by coaction between the external threads of the member and internal threads of the fitting as shown. Forwardly of the threaded portions of the member and fitting, the member has a smooth external cylindrical surface slidably fitting the smooth surface of the counterbore of the fitting and grooved at 82' to receive an O-ring packing 83'. A cross-drilled passage 94 affords communication between the bore of the member and the orifice 91 around the forward end of reduced diameter of the member 92, said forward end having an axially aligned tapered hole receptive of the valve closure member 95 aligned with and coactable with the proximate seating portion of the orifice 91. Positioning the closure 95 relative to the orifice 91 by manual adjustment of "nut" 93 throttles the flow from the chamber C through the tube 2 and brings the rate of recirculation within the continuous and convenient control of the operator of the gun.

As suggested in broken lines at the top of Figure 1, there may be molded with the housing H a hooked ex-

tension K from which the gun may be suspended during idle intervals or for storage. Those skilled in the art will understand without extended exposition that appropriate gaskets may be provided as between the fittings and the barrel and between the closure **11** and the barrel, and that appropriate means such as cap screws entering tapped holes in the barrel may be provided to secure the plates **10** and **11** thereto.

While we have illustrated and described a preferred form of our invention, suggesting, inter alia, our preference for certain materials by way of illustrating the offices and functions of the parts and their coaction in the functioning, mode of operation and results of our invention, modifications, changes and improvement will suggest themselves to those skilled in the art who come to understand the principles of our invention and the teachings of this specification, wherefore we do not wish to be limited in the scope of our patent to the specific or illustrative form or forms of our invention herein particularly illustrated and described nor in any manner inconsistent with the progress by which the art has been promoted by our invention.

We claim:

1. A gun suitable for airless spraying of hot paint under high pressure having in combination means defining a chamber for fluid under pressure and having a fluid discharge orifice, an axis and a valve seat therein, a valve member in said chamber and generally aligned with said axis and coacting with said seat for opening and closing said orifice, bearing means aligned with said axis for supporting said valve for free axial motion in the direction of said axis, said bearing means supporting said valve member with a loose sliding fit therewith admitting lateral play between said valve and said means, means moving said valve member operatively connected therewith inside said chamber and extending outside said chamber through an opening provided in said chamber defining means spaced from said valve which means has a shoulder around the opening, said valve moving means comprising a lever pivotally supported exteriorly of said chamber for swinging motion within and without said chamber about a second axis disposed in said opening parallel with said shoulder and transversely of the axis of said opening, and a frictionless flexible fluid seal for closing said opening and admitting substantially free limited swinging motion of said lever about said second axis in said opening, said seal comprising a sleeve part surrounding said lever and having fluid-tight engagement with said lever and being supported against collapse under fluid pressure by said lever within said chamber and being smaller than said opening, and said seal comprising a flange part normal to said sleeve part and integrally joined and flexibly related thereto, said flange having fluid tight engagement with said shoulder, said flange lying closely adjacent the plane of said second axis which is substantially normal to said lever, and a closure plate apertured for said lever adjacent said plane and forcibly holding said flange against said shoulder and securing said seal against blow out adjacent said lever; the juncture of said sleeve and said flange being closely proximate said second axis whereby small flexings of said seal correspond to relatively great motions of the lever remote therefrom, said seal being symmetrically disposed in said opening and unbiased by fluid pressure in said chamber, said valve moving means including actuating means for moving said valve member rapidly from open to closed position.

2. The gun of claim 1 in which said valve member has a part remote from said valve seat, and an adjusting device movably mounted in said chamber defining means and having one end accessible from outside said chamber and its other end disposed to be engageable with said part of said valve member within said chamber at adjustably different distances from said valve seat whereby to limit the movement of said member from said valve seat to selectively different open positions.

3. The combination of claim 1 in which said valve member has a hard tapered tip engaging said valve seat, and said valve seat is also hardened whereby the lateral play between said valve member and said bearing means may accommodate eccentricity of said seat from said axis.

4. The combination of claim 1 in which said seal is made of polytetrafluoroethylene.

5. The combination of claim 4 in which said lever within said seal comprises an elongated cylindrical pin snugly fitted in the sleeve part of said seal, and the said closure plate adjacent said seal lies in the said plane of said second axis closely adjacent said pin and supports said seal closely adjacent said second axis.

6. The combination of claim 5 in which the said flange part of said seal takes annular form and includes a weakened portion comprising a flexible annulus near the juncture of the said sleeve and flange parts of the seal.

7. The combination of claim 1 in which said lever within said seal comprises an elongated cylindrical pin snugly fitted in the sleeve part of said seal, and the said closure plate adjacent said seal lies in the said plane of said second axis closely adjacent said pin and supports said seal closely adjacent said second axis.

8. The combination of claim 1 in which the said flange part of said seal takes annular form and includes a weakened portion comprising a flexible annulus near the juncture of the said sleeve and flange parts of the seal.

9. The combination of claim 1 in which said seal comprises polytetrafluoroethylene and includes a weakened portion comprising a flexible annulus encircling said sleeve part.

10. The combination of claim 9 with means for limiting the angular motion of said lever about said second axis to about 2.5° of arc between open and closed positions of said valve.

11. The gun of claim 27 in which said barrel and said tubing are made of heat conducting material and said housing is made of material that is resistant to heat conductivity.

12. The combination of claim 1 in which said actuating means comprises snap action mechanism connected to said lever whereby to enhance the acceleration of said valve member.

13. The combination of claim 12 with means for limiting the travel of said valve member from closed to open position.

14. The combination of claim 1 with fluid under pressure of from about 200 to 700 pounds per square inch in said chamber tending to force said valve member into said valve seat; said valve moving means requiring to be stressed against the force of said pressure on said member preliminary to moving said valve out of engagement with said seat.

15. In a fluid gun having a discharge orifice, means for opening and closing said orifice including a lever having a longitudinal axis and pivotally mounted for swinging motion about a transverse axis, snap action mechanism for swinging said lever abruptly for opening and closing said orifice and for holding said lever in the open or closed position of said orifice, a spring having one end connected to an end of said lever remote from said transverse axis, pads carried by said lever on opposite sides of said longitudinal axis and oppositely spaced from and approximately parallel with the plane of said axes and located longitudinally between the end of said lever and said transverse axis, an actuating arm pivoted on an axis parallel with said transverse axis remote from said end of said lever and adjacent said longitudinal axis, one end of said arm adapted to lie near the said end of said lever and be movable relative thereto, a link having one end pivotally connected to said one end of said arm and extending toward one of said pads and engageable at its other end alternatively with one or the other of pads and

connected at its said other end with said spring, said one end of said arm and said one end of said link lying in the closed or open positions of said orifice on one side of said longitudinal axis and stressing said spring to exert a holding force on the end of said lever and, through said link, against one of said pads both tending to rotate said lever about said transverse axis in one direction, movement of said one end of said arm in said one direction increasing the said force until said link crosses parallelism with said spring whereupon said link and said spring are swung in an opposite direction about the ends of said arm and lever respectively moving said other end of said link into abrupt contact with the opposite of said pads and reversing the direction of forces exerted by said spring on said lever and swinging said lever oppositely of said one direction and disposing said one end of said arm on the opposite side of said axis, opposite movement of said one end of said arm repeating the motions of the parts in opposite directions.

16. The gun of claim 15 in which said arm has a trigger at its other end beyond the axis supporting said arm, and a retractor spring yieldably resisting motion of said arm in one direction.

17. The gun of claim 15 with rollers carried by said other end of said link engageable with said pads.

18. The gun of claim 15 in which the said transverse axes coincide and said arm and lever are pivotally mounted externally of said gun.

19. A gun having a chamber for fluid under pressure, and having a discharge orifice, a closure member movable in said chamber to open and close said orifice, means for moving said closure member connected with said member inside said chamber and extending externally thereof, a trigger located externally of said chamber to induce movement of said means, snap action mechanism actuated by said trigger and actuating said means, and a frictionless fluid seal associated with said means where it enters said chamber, said means comprising a lever pivotally mounted on an axis passing through said seal, said trigger having a pivotal mounting in the same axis, said snap action mechanism including a spring connected with said lever movable to quickly change its direction of strain on said lever and a part actuated by said spring forcibly engageable with said lever at oppositely spaced points with impact supplementing the strain of said spring to move said lever.

20. A gun having a chamber for fluid under pressure and having a discharge orifice, a closure member axially movable in said chamber to open and close said orifice, means for moving said member connected with said member inside said chamber and extending externally thereof, a trigger located externally of said chamber to induce movement of said means, snap action mechanism actuated by said trigger and actuating said means, a frictionless fluid seal associated with said means where it enters said chamber, said means comprising a lever pivotally mounted on said gun for pivotal motion about an axis passing through said seal, said trigger having a pivotal mounting for motion about the same axis, said snap action mechanism including a spring connected with said lever movable to quickly change its direction of strain on said lever, a part actuated by said spring forcibly engageable with said lever at oppositely spaced points with impact supplementing the strain of said spring to move said lever, said closure member being supported in said chamber remotely from said seal for axial motion in the direction of a second axis aligned with said orifice said lever being laterally spaced from and generally parallel with said member and having oscillatory movement in the plane of said second axis about said first axis, and a bell crank swingably supported on a third axis parallel to said first axis and adjacent and connected to said closure member and connected to said lever remote from said first axis whereby to translate oscillatory motion of said lever in said plane to longitudinal motion of said member in said first named axis.

21. In a fluid gun having a discharge orifice, means for opening and closing said orifice including a lever having a longitudinal axis and pivotally mounted for swinging motion about a transverse axis, snap action mechanism for swinging said lever abruptly for opening and closing said orifice, a spring having one end connected to an end of said lever remote from said transverse axis, pads carried by said lever on opposite sides of said longitudinal axis and oppositely spaced from and approximately parallel with the plane of said axes and located longitudinally between the end of said lever and said transverse axis, an actuating arm having one end adapted to lie near the said end of said lever and be movable relative thereto, a link having one end pivotally connected to said one end of said arm and extending toward one of said pads and engageable at its other end alternatively with one or the other of said pads and connected at its said other end with said spring, said one end of said arm and said one end of said link lying in the closed or open positions of said orifice on one side of said longitudinal axis and stressing said spring to exert a holding force on the end of said lever and, through said link, against one of said pads both tending to rotate said lever about said transverse axis in one direction.

22. The gun of claim 21 with anti-friction means between said other end of said link and the pad engaged thereby.

23. A gun having a chamber for fluid under pressure and having a discharge orifice, a closure member axially movable in said chamber to open and close said orifice, means for moving said member connected with said member inside said chamber and extending externally thereof, a trigger located externally of said chamber to induce movement of said means, snap action mechanism actuated by said trigger and actuating said means, a frictionless fluid seal associated with said means where it enters said chamber, said means comprising a lever pivotally mounted on said gun for pivotal motion about a first axis passing through said seal, said trigger having a pivotal mounting for motion about the same axis, said snap action mechanism including a spring connected with said lever movable to quickly change its direction of strain on said lever, a part actuated by said spring forcibly engageable with said lever at oppositely spaced points with impact supplementing the strain of said spring to move said lever, said closure member being supported in said chamber remotely from said first axis for axial motion along a second axis aligned with said orifice, said lever being disposed in a laterally spaced generally parallel relation to said member and having oscillatory movement in the plane of said second axis about said first axis, a bell crank swingably supported on a third axis parallel to said first axis and adjacent and connected to said closure member and connected to said lever remote from said first axis whereby to translate oscillatory motion of said lever in said plane to longitudinal motion of said member in the direction of said second axis, and bearing means for supporting said valve closure member for axial motion in substantially said second axis, said second axis coinciding with the axis of said orifice, said bearing means and said member having different diameters and a loose sliding fit admitting lateral play between said member and the said axis of said orifice.

24. A gun having a chamber for fluid under pressure and having a discharge orifice, a closure member movable in said chamber to open and close said orifice, means for moving said member connected with said member inside said chamber and extending externally thereof, a trigger located externally of said chamber to induce movement of said means, a frictionless fluid seal associated with said means where it enters said chamber, said means comprising a lever pivotally mounted on said gun for motion about an axis passing through said seal, said closure

member being supported in said chamber remotely from said first axis for axial motion along a second axis aligned with said orifice, said lever being disposed in a laterally spaced generally parallel relation with said member and for oscillatory movement about said first named axis, a bell crank swingably supported on a third axis parallel to said first axis and adjacent and connected to said closure member and connected to said lever whereby to translate oscillatory motion of said lever in said plane to longitudinal motion of said member in the direction of said second axis, and bearing means for supporting said valve closure member for axial motion in substantially said second axis, said bearing means and said member having different diameters and a loose sliding fit admitting lateral play between said member and the said axis of said orifice.

25. A gun having a chamber for fluid under pressure and having a discharge orifice, a closure member axially movable in said chamber to open and close said orifice, means for moving said member connected with said member inside said chamber and extending externally thereof, a trigger located externally of said chamber to induce movement of said means, a frictionless fluid seal associated with said means where it enters said chamber, said means comprising a lever pivotally mounted on an axis transverse thereto passing through said seal, said closure member being supported in said chamber for axial motion along a second axis aligned with said orifice, said lever being disposed in a laterally spaced generally parallel relation to said member for oscillatory movement in the plane of said second axis normal to said first named axis, and a bell crank swingably supported on a third axis parallel to said first axis and adjacent and connected to said member at the adjacent end of said lever whereby to translate oscillatory motion of said lever in said plane to longitudinal motion of said member along said second axis.

26. A gun having a chamber for fluid under pressure and having a discharge orifice with an axis, a closure member movable substantially in the axis of said orifice in said chamber to open and close said orifice, means for moving said member connected with said member inside said chamber and extending externally thereof, a trigger located externally of said chamber to induce movement of said means, snap action mechanism actuated by said trigger and actuating said means, a fluid seal associated with said means where it enters said chamber, said means comprising a lever pivotally mounted on an axis passing through said seal, said snap action mechanism including a spring connected with said lever movable to quickly change its direction of strain on said lever, a part actuated by said spring forcibly engageable with said lever at oppositely spaced points with impact supplementing the strain of said spring to move said lever, and bearing means for supporting said closure member for said axial motion in the axis of said orifice, said bearing means and said member having different diameters and a loose sliding fit admitting lateral play between said member and the said axis of said orifice.

27. A fluid gun having a barrel with a high pressure chamber and having a discharge orifice at the front end of said chamber, orifice opening and closing means partly contained within said chamber and extending outwardly externally of said barrel, actuating mechanism for actuating said means connected with said means and said barrel outside said barrel, high pressure non-flexible tubing communicating with said chamber and extending downwardly from said barrel, a hollow attachable housing removably encompassing and secured to said barrel and removably enclosing said actuating means and having a pistol grip portion with a heel remote from said barrel removably enclosing said tubing, and connector means in the heel of said grip portion for removably attaching said tubing to external fluid conducting means at the said heel of said grip portion of said housing, said connector means being supported for rotatable motion without axial motion in the heel of said grip portion of the housing, and said connector means having a fluid tight engagement with said tubing with freedom for rotation as well as axial motion therebetween.

28. A gun adapted to spray hot paint under high pressure comprising a barrel having a paint chamber and having a downwardly extending tubular fluid conduit communicating with said chamber, a hollow detachable housing comprising longitudinally split halves embracing said barrel and freely encompassing said conduit and comprising a hand grip disposed below said barrel with a lower heel portion, the halves of said housing at said heel portion having mutual engagement on flat surfaces for a limited longitudinal extent and having semi-cylindrical mating grooves with a common axis common to said conduit and forming together a cylindrical hole leading from the interior to the exterior of said housing, a connector having an externally cylindrical journal part rotatably supported in said hole, means for limiting longitudinal motion of said connector in said hole, said connector having a bore, said conduit entering the upper end of said bore and fitting therein with freedom for rotary and longitudinal motion, a fluid seal between said conduit and said bore admitting said motion therebetween, and means on said connector outside said housing for rigid attachment to external fluid conducting means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,055,538	Johnson	Mar. 11, 1913
1,291,869	Heeley	Jan. 21, 1919
1,300,396	Holley et al.	Apr. 15, 1919
1,596,968	Hansen et al.	Aug. 24, 1926
1,829,661	Krautzberger	Oct. 27, 1931
2,057,434	Jaden et al.	Oct. 13, 1936
2,059,760	Teahen	Nov. 3, 1936
2,068,161	Bramsen et al.	Jan. 19, 1937
2,271,715	Saffell et al.	Feb. 3, 1942
2,417,546	De Giers	Mar. 18, 1947
2,457,320	Rosenberger	Dec. 28, 1948
2,555,238	McNulty et al.	May 29, 1951
2,610,410	Abee-Lund	Sept. 16, 1952
2,705,663	Gilbreath	Apr. 5, 1955
2,716,014	Dinkelkamp	Aug. 23, 1955
2,754,228	Bede	July 10, 1956
2,757,688	Klingler	Aug. 4, 1956
2,767,956	Rubin	Oct. 23, 1956