United States Patent

[11] 3,604,610

[72] Inventor **William S. Fortune**
14250 Dearborn St., Panorama City, Calif. 91402

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[54] **DESOLDERING IMPLEMENT**
11 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **228/20,** 15/344, 219/234
[51] **Int. Cl.** **B23 1/00,** B23 5/22
[50] **Field of Search** 228/19, 20; 15/344; 219/234

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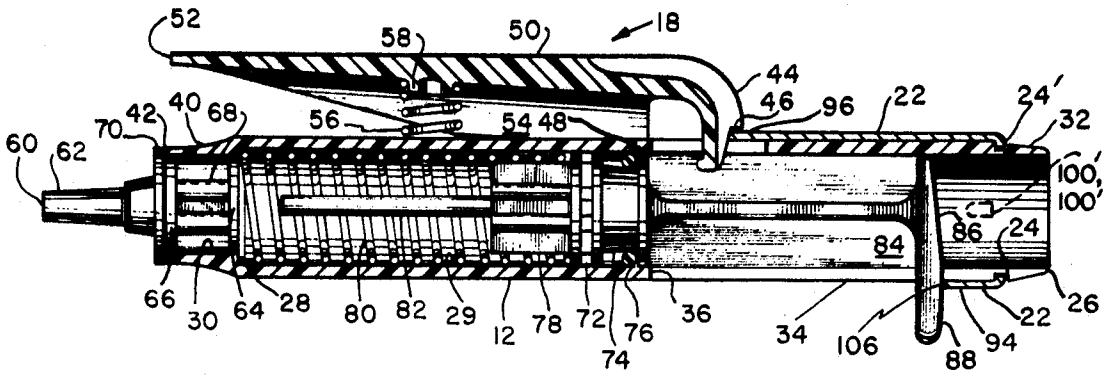
Primary Examiner—John F. Campbell
Assistant Examiner—R. J. Craig
Attorney—Daniel T. Anderson

ABSTRACT: A small, hand-held desoldering tool having a spring-loaded piston carried within a cylindrical body member having a removable nozzle element at one end and being substantially open at the other. The piston has a finger-engaging cocking portion which extends radially outwardly through an elongate slot in the cylindrical body member and which permits axial motion of the piston for cocking and flyback. When in the cocked position, a trigger lever carried externally of the body member holds the piston in its forward position. Moving the trigger lever in one direction releases the piston for its flyback stroke and moving it in the opposite sense forces the piston further forward to eject the nozzle element from the body for cleaning or replacement. A rod member carried by the piston extends forwardly through the nozzle element to clean its bore with each cocking cycle. A reading of the complete specification is recommended for a full understanding of the principles and features of the disclosed tool.



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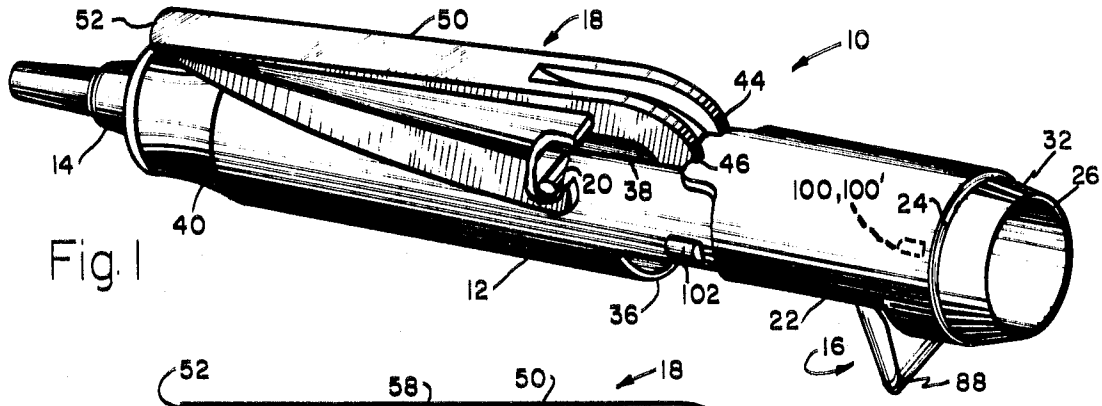

Fig. 1

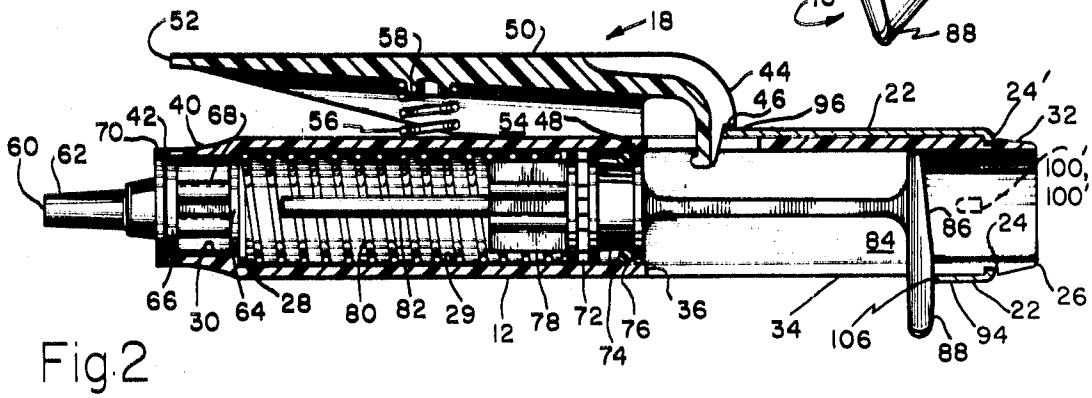

Fig. 2

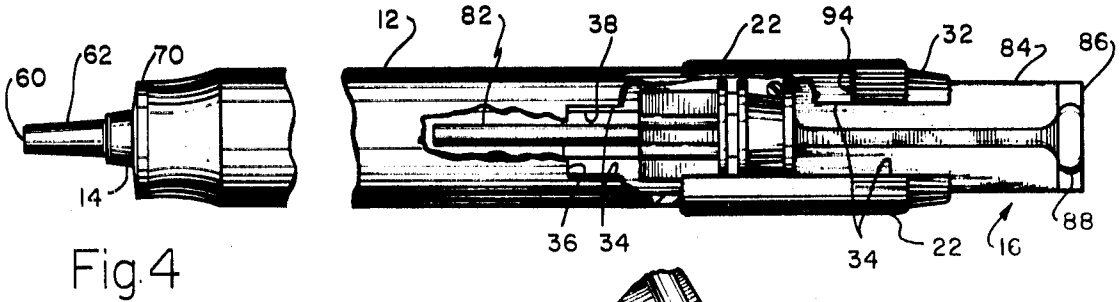

Fig. 4

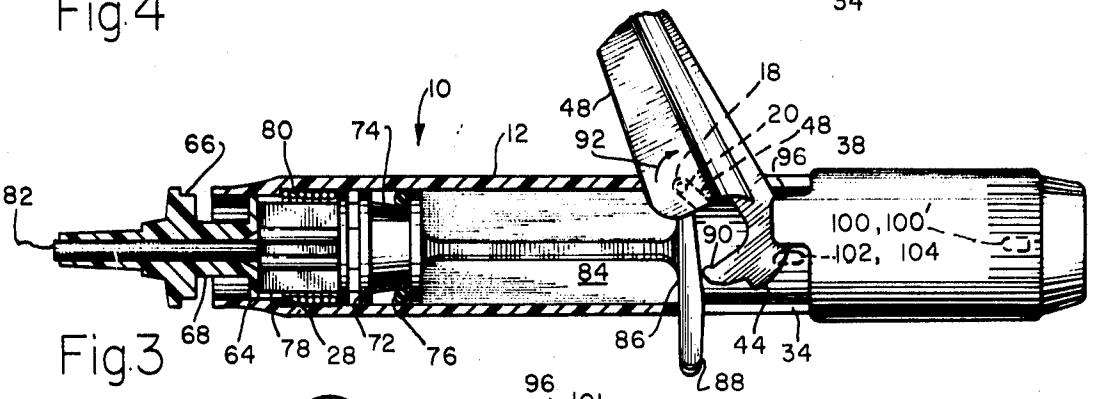

Fig. 3

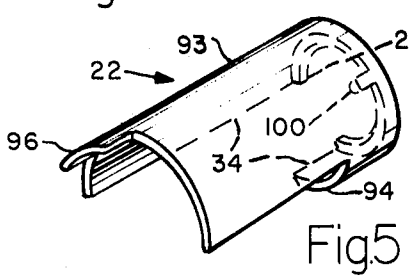

Fig. 5

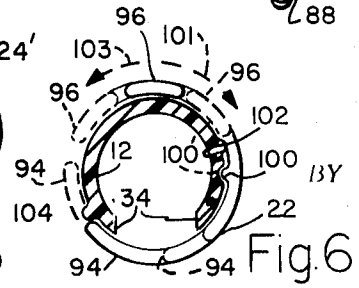

Fig. 6

William S. Fortune

INVENTOR.

BY Daniel T. Anderson

ATTORNEY

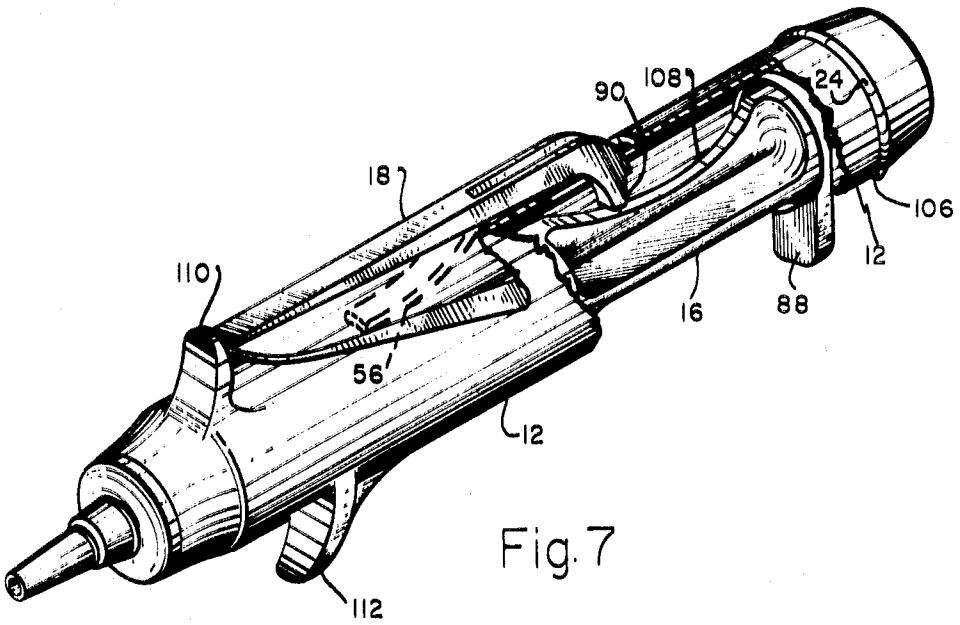

Fig. 7

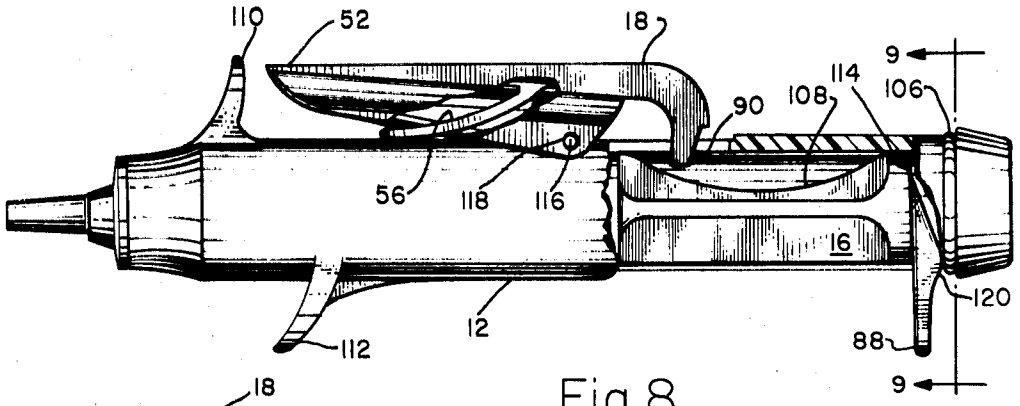

Fig. 8

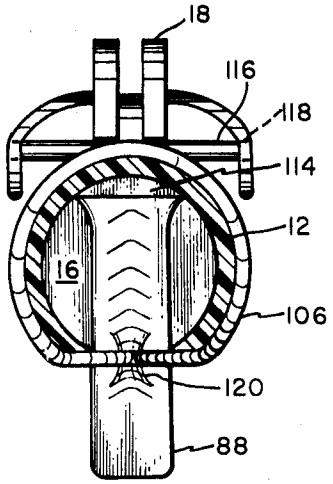

Fig. 9

William S. Fortune
INVENTOR

BY Daniel T. Anderson

ATTORNEY

DESOLDERING IMPLEMENT

FIELD OF THE INVENTION

This invention relates generally to the removal or lifting of small quantities of mobile substances such as particulate, liquid, or molten matter and especially to improvements in apparatus for removing molten solder from electrical connections. Although the present invention finds particularly useful application in the field of soldering, desoldering, and "rewiring" in an electronic laboratory, maintenance shop, factory or hobbyist bench; and although in the cause of brevity and clarity, much of the following discussion and description of examples of the invention are directed theretoward, it is expressly to be understood that the advantages of the invention are equally well manifest in other fields, as indicated above, where such substances are to be removed from a limited or particular portion of an object.

BACKGROUND Of THE INVENTION

In the electrical arts as mentioned, it is often desired to desolder an electrical connection such as, for example, a wire-wrapped terminal, a wire to circuit-board eyelet, or the like. The removal from the connection, of the molten solder without dropping or spattering it onto the other portions of the equipment is generally essential. Blowing or shaking the molten metal away, is therefore not an acceptable practice; and, in combination with its high-mass density, the high-surface tension associated with the solder makes its removal particularly difficult. Furthermore, the problem is aggravated by the requirement that the solder be removed quickly and without application of cooling means before the mechanical connection such as a wire-wrapped terminal may be taken apart.

Various nonportable central vacuum systems and highly portable and efficient hand-held vacuum-stroke tools have advanced the state of the art and have solved certain aspects of the desoldering problems outlined; however, the former suffer from disadvantages of cost, complexity, lack of versatility, and nonportability while the latter suffer from some disadvantages, to a lesser extent, of cost and complexity, and, in some applications, undesirable recoil due to the flyback action of the piston-cocking shaft-knob assembly during the vacuum stroke. Typically, in these prior art devices the cocking shaft which functions as a connecting rod between the piston and the cocking knob must be relatively massive to be strong enough to cock the piston against a relatively strong loading spring. Also the cocking knob is typically large and soft, and therefore massive, for comfortable repeated cocking cycles by the hand of the operator. These criteria cause the flyback mass to be relatively large compared to the thin-walled cylindrical-housing body; consequently, the outer housing suffers a recoil causing a deflection of the solder inlet tip away from the location of the molten solder.

Another disadvantage of the abrupt flyback of the shaft and knob is that the eye of the operator during the vacuum stroke is typically disposed near thereto in a position causing risk of eye injury.

It is, accordingly, an object of the present invention to provide improved desoldering apparatus which is not subject to these and other disadvantages and limitations of the prior art.

It is another object to provide such apparatus which, while providing consistently a high amplitude of impulse airflow, has substantially no exposed flyback portion and a very low inertia associated with the flyback portions thereof causing a negligible deflection of the tool during its vacuum stroke.

It is another object to provide such apparatus which is low in cost and simple, rugged, and reliable in its structure and performance.

It is another object to provide such apparatus in which the operator's hand may be disposed to hold the implement closely to its tip end in pencil-holding fashion, for improved precision use thereof.

It is another object to provide such apparatus which is automatically self-cleaning with each cocking cycle.

SUMMARY OF INVENTION

Briefly, these objects are achieved in accordance with the structural aspects of an example of the invention in which a hand-held, finger-operated desoldering implement includes a body-barrel member having a forward, nozzle end and a major central portion having, as a function of displacement along its length, s substantially constant and smooth internal surface configuration. A tip element, of the character to be carried ejectably by its frictional engagement with the forward end of the barrel member is provided and is formed to include a forwardly extending nozzle member and a central duct therethrough for drawing mobile substance into the interiors of the barrel chamber. A piston member is carried within the barrel member in a sliding, air seal relation with its smooth internal surface; and the piston member includes a central, forwardly extending nozzle-cleaning rod for clearing the duct of foreign matter when the piston member travels fully forwardly in the barrel member. The piston member further includes a rearwardly extending, finger- engageable cocking portion.

A trigger-lever member is carried pivotally by the body-barrel member at a pivot fulcrum disposed rearwardly from its nozzle end and includes a body portion extending forwardly to a tip portion thereof which is contiguous to the nozzle end and is normally disposed radially apart from but displaceable toward the barrel member. The trigger-lever member further includes a piston engaging arm portion which is extendable into the barrel member for holding the piston means in a forward, cocked disposition and is removable laterally from within the barrel member for releasing or triggering the piston member for its flyback, vacuum-stroke action when the tip portion of the trigger-lever member is displaced radially inwardly toward the nozzle portion of the barrel member.

The piston and trigger-lever members and said piston are further adapted to force the piston member further forwardly into a tip-ejecting contact with the tip when the tip portion of the trigger lever member is forcefully displaced laterally away from the nozzle portion of the barrel member.

Further details of these and other novel features and their operation and cooperation as well as additional objects and advantages of the invention will become apparent and be best understood from a consideration of the following description taken in connection with the accompanying drawing which is provided by way of illustrative example only.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is perspective of an example of a desoldering tool constructed in accordance with the principles of the present invention in an uncocked, or unloaded, configuration;

FIG. 2 is a longitudinal sectional view thereof;

FIG. 3 is a longitudinal sectional view thereof in a nozzle removal configuration;

FIG. 4 is a bottom, partially cutaway, view thereof in a piston released configuration;

FIG. 5 is a perspective view of the rear, capping element portion thereof;

FIG. 6 is an essentially cross-sectional view illustrating certain operational aspects of the implement; and

FIGS. 7, 8 and 9 are views thereof illustrating alternative structural features of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

With specific reference now to the FIGS. in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and structural concepts of the invention. In this regard, no attempt is made to show structural details of the apparatus in more detail

than in necessary for a fundamental understanding of the invention. The description taken with the drawing will make it apparent to those skilled in the mechanical arts how the several forms of the invention may be embodied in practice. Specifically, the detailed showing is not to be taken as a limitation upon the scope of the invention which is defined by the appended claims forming, along with the drawing, a part of this specification.

In FIG. 1 the example of the vacuum-stroke desoldering tool **10** illustrated includes a substantially cylindrical barrel or body **12**; a forward tip element **14** and piston element **16** both carried removably substantially therewithin; a trigger-lever element **18** pivotally carried externally thereon by engagement with a pair of mounting pins **20**; and a stop member **22** rotatably carried thereon by engagement with a right circumferential retaining groove **24** formed near the rearward end thereof.

Referring to FIG. 2, the barrel **12** may be seen to consist, in this example, of a unitary molded plastic body having a constant internal diameter for the greater part of its length from its open rearward end **26** to a spring retaining shoulder **28** near its forward end, the shoulder **28** being formed by the transition from the larger diameter major portion **29** to a reduced diameter, nozzle-retaining portion **30**. Additional structural aspects of the barrel **12** include: The retaining groove **24** and a radially inwardly tapered end cap receiving portion **32** extending from the retaining channel **24** rearwardly to the end **26** of the barrel; a piston-cocking access slot **34** extending from its forward end **36** to and through the extreme rearward end **26** of the barrel **12**; a trigger-lever-receiving slot **38**; and a finger-grip contoured reduced diameter portion **40** formed contiguously to the forward end 42 of the barrel **12**.

The trigger-lever element **18** is also, in this example, a unitary, molded plastic article and comprises a piston-engaging arm portion **44** having a stop-cap-abutting shoulder **46** formed therein and extending generally rearwardly and inwardly from fulcrum determining, mounting-pin-engaging slots, indicated at **48** and shown in a subsequent figure. The main body portion **50** of the trigger-lever element extends forwardly, and substantially parallel to the barrel **12**, so that its forward, tip portion **52** is axially disposed contiguously and in fingertip grippable cooperative relation with the reduced outer-diameter-contoured portion **40** of the barrel **12**. Symmetrically disposed to either side of the main body portion **50** are a pair of shroud portions **54** which add rigidity to the lightweight molded element and which are formed to contain, at their rearward, barrel-straddling ends, the mounting slots **48** for engaging retentively the mounting pins **20** of the barrel **12**.

A small trigger spring **56** is compressively retained about an inwardly directed mounting post **58** molded with the under surface of the trigger-lever body **50**. The spring **56** serves 1) to maintain, elastically, a disposition of the piston engagement arm **44** whereby cocking of the piston is permitted and, once cocked, the piston is held in its forward, loaded position; and 2) to permit a vacuum-stroke-producing flyback of the piston when the forward tip portion **52** is pressed inwardly by the operator's fingertip toward the shaped portion **40** of the barrel **12**. This triggering action compressed, slightly, the trigger spring **56** between the underside of the body portion **50** of the trigger-lever **18** and the barrel **12**.

The forward-tip element **14** similarly may be of molded plastic fabrication with a central bore **60** extending axially through a forwardly projecting, small diameter nozzle portion **62** thereof. The tip element includes rearward and forward, barrel-engaging cylindrical surfaces **64**, **66** which are axially separated by a reduced diameter midportion **68**. A forward-retaining shoulder is formed where the surface **66** joins an enlarged diameter forward potion **70** which mates with and terminates the contoured portion **40** of the barrel **12**.

In FIG. 3 it may be seen clearly that when the tip element is forced a short distance forwardly to clear the barrel-engaging surface **66**, the reduced-diameter portion **68** permits the operator to remove it the remainder of the way by laterally oscillating it as he pulls it forwardly by his fingertips.

To complete the discussion of FIG. 2, the piston element **16**, also one-piece plastic-molded, is seen to include a cylindrical body portion **72** having a piston-ring-retaining groove **74** therein which is formed with a tapered, rearwardly converging surface whereby a captive O-ring **76** is substantially free during forward or cocking motion of the piston but in tight-sliding seal relation with the barrel **12** when traversing rearwardly during the flyback vacuum stroke. Formed forwardly of the piston body portion **72** is a reduced cross section portion **78** about which is disposed, in the annular space between it and the inner cylindrical surface of the portion **29** of the barrel **12**, the rear end portion of the main spring **80**, the latter being axially compressively retained between the larger diameter body portion **72** of the piston element **16** and the spring-retaining shoulder **28** at the forward end of the barrel **12**. In practice the reduced cross section portion **78** has been molded in an essentially cruciform cross section configuration thereby significantly reducing the flyback recoil suffered by the barrel during a vacuum-stroke operation of the assembly. A nozzle-bore-cleaning rod **82** extends forwardly centrally from the reduced cross section portion **78** and automatically clears the nozzle bore **60** of foreign matter with each cocking stroke of the piston element **16**.

A cocking-plunger portion **84** of the piston element **16** extends rearwardly of its body portion **72** and is terminated by an end element **86** which includes a laterally extending, finger-engageable cocking tab **88**. Again the axially extending midportion of the plunger **84** may be molded in a skeletal, cruciform configuration for rigidity with minimum mass.

Referring to FIG. 3, the implement **10** is illustrated in tip-element-removing arrangement. By pivoting the trigger-lever element **18** away from the barrel **12**, the bearing end **90** of the arm **44** engages the end **86** of the piston element **16** and forces it forwardly as shown. The forward end of the reduced cross section portion **78** of the piston element in turn abuts the rear face of the tip element **14** and displaces it sufficiently forward whereby its forward, barrel-engaging surface **66** is removed from the barrel **12**. It may then be grasped externally by the operator's finger tips and further removed for replacement by a new or differently shaped nozzle or for cleaning or lubricating the interior of the barrel cylinder.

In the lever action, just described, of the trigger-lever **18**, the pivotal engagement of the slots **48** (of the shroud portions **54**) with the mounting pins **20** (of the barrel **12**) is apparent and is indicated by the motion arrow **92**. It may be noted that when the lever **18** is thusly lifted away from the barrel **12**, the trigger spring **56** (FIG. 2) is retained on the post **58** and is carried therewith away from its normal contact with the outer surface of the barrel. In this example, the small spring is never in tension; and, in some embodiments, is a simple leaf element molded integrally with the body of the trigger-lever.

Referring to FIG. 4, an arrangement of the elements is illustrated wherein the piston element **16** is shown being drawn axially rearwardly from its containment within the barrel **12** by moving the cocking tab **88** of the piston end element **86** rearwardly along the length of the cocking access slot **34** and beyond the rearward end **26** of the barrel. Such removal is achieved when desired for the servicing of the mainspring **80**, thorough cleaning of the cylinder, or replacement or cleaning of the O-ring **76**.

In FIG. 5, the stop member **22** which controls the mode of action of the trigger-lever **18** and the removal or assembly of the piston element **16** is illustrated apart from the remainder of the implement assembly. The stop member is in a form as though cut from essentially a thin-walled hollow cylinder body **93** with a slot **34'** removed from its full length and a second major portion removed to form a retaining or piston stop shoulder **94**. In addition, a forwardly extending, trigger-lever stop tab **96** is formed by removing trigger-lever clearance portions from either side thereof. Formed about its rear periphery is an inwardly directed retaining flange portion **24'** which is of

the character to engage rotatably retentively the annular channel **24** of the body **12**. Similarly, a detent-engaging protrusion **100** is formed in the rear portion of the stop member **22** for indexing with a detent **100'** formed in the barrel **12**.

The stop member **22** may be fabricated of metal, however, in practice, it has been molded of plastic. During assembly of the implement **10**, the stop member **22** may be applied at any time by pushing it on from the rear and forcing the retaining flange **24'** over the tapered end portion **32** of the barrel until it snaps into the retaining channel **24**. It may then be rotated to a position to permit the insertion of the piston element **16** through the slot **34'**. Once the piston element is emplaced, the stop member **22** may be rotated to a position such that the rear of the slot **34** in the barrel blocked by the piston stop shoulder **94**.

With reference now to FIG. **6** in particular: During normal operation of the tool, the detent pair **100**, **100'** are engaged thereby holding the stop member **22** in the rotational disposition indicated in FIGS. **1**, **2**. When it is desired to force the piston element forward with the trigger lever **18** as for ejecting the tip element **14**, the stop member **22** is rotated in accordance with the motion to remove the engagement of the detent pair **100**, **100'** and until the trigger-lever stop tab **96** is disposed against the stop **102** on the side of the barrel **12** (FIG. **3**). This configuration causes the piston stop shoulder **94** to remain as a stop across the piston access slot **34**. When it is desired to unblock the slot **34** (FIG. **4**) the stop member **22** is rotated in the opposite sense in accordance with the motion arrow **103** until the trigger-lever stop tab **96** is in contact with the stop **104** formed on the opposite side of the barrel **12**.

In normal working operation, the detent pair **100**, **100'** are engaged, the piston is cocked and the nozzle bore cleaned by pressing the cocking tab **88** fully forwardly past the trigger arm portion **44** which is, by the forward motion of the end **86**, pushed outwardly against the force of the trigger spring **56**, until the end **86** is past the trigger arm **44** whereupon the trigger spring **56** causes the arm **44** to return inwardly behind the end **86** and retain the piston element forwardly against the compressed mainspring in a cocked configuration. The nozzle tip may than be placed contiguously to the material, e.g., molten solder, to be removed and the tip **52** of the trigger-lever pressed inwardly to cause the piston flyback and the desired vacuum stroke. To cushion the termination of the rearward flyback of the piston element, a shock-absorbing rubber cushion **106** may be disposed between the otherwise contacting portions of the cocking tab **88** and the piston, stop shoulder **94**.

Referring to FIGS. **7** and **8**, it may be seen that, when desired, the rubber cushion may be in the form of an O-ring **106** compressively retained in the circumferential retaining groove **24**. In this latter configuration, the entire stop member **22**, of the earlier figures, is omitted from the assembly. It may also be noted that in such arrangement, the O-ring **106** may serve to add a desired amount of circumferential support to the otherwise divided end portions of the barrel **12**.

Also illustrated in FIGS. **7** and **8** is a structural cutaway at **108** from the body portion of the piston member **16**. The cutaway provides clearance radially for the bearing, tip end portion **90** of the trigger-lever **18**. When the tool is stored for extended periods of time and when the trigger-lever spring **56'** is in the form of a leaf molded integrally with the body thereof, the relief precludes any nonelastic deformation of the leaf spring due to the long term effect of bending stress upon the plastic material.

A further modification, presently preferred, illustrated in FIGS. **7** and **8** is a pair of integrally molded finger grip tabs **110**, **112** provided at the forward end of the barrel **12** to aid the operator in compressing the mainspring **80** with the rear, movable cocking tab **88**.

Also illustrated in FIG. **8** is a small, flat trigger arm-resting portion **114** formed on the otherwise sloped rear end portion of the piston element **16**. This provides a discrete dwell area for the tip **90** of the trigger-lever **18** when the implement is in its cocked disposition and urges the trigger lever into an enabling position so that the front end **52** thereof is at least reasonably close to the barrel body and therefore most convenient and ready for use. The sloped portion also provides a greater axial displacement of the piston forwardly by the trigger-lever when it is desired to eject the forward-tip element **14** out of the barrel **12**.

In FIG. **9**, the trigger-lever-supporting fulcrum pins **116** are shown in engagement with the skirt portion **54** of the trigger-lever **18**. The pins **116**, in this example, are integrally molded with the barrel **12**; and, in assembly, the skirt portion **54**, with appropriate pin-receiving bores **118** provided therein is emplaced onto the barrel **12** by elastically spreading the skirt portions over the ends of the pins **116**.

One further point of structure to be noted in this example is that a small protuberance **120** may be added to the rear, O-ring-engaging portion of the cocking tab **88** to soften, effectively, the piston-stopping action of the O-ring **106**.

There have thus been disclosed and described an example of a desoldering tool which achieves the objects and exhibits the advantages set forth hereinabove.

I claim:

1. Hand-held, finger-operated desoldering implement comprising:

body-barrel member having a forward, nozzle end and a major central portion having, as a function of displacement along its length, a substantially constant and smooth internal surface configuration;

tip element of the character to be carried ejectably by frictional engagement by said forward end of said barrel member, said element being formed to include a forwardly extending nozzle member and a central duct therethrough and communicating to the interior of said barrel member for the travel of mobile substance therethrough;

piston means carried within said barrel member in sliding, air seal relation with said smooth internal surface thereof, said piston means including central, forwardly extending, nozzle bore-cleaning rod means for clearing said duct of foreign matter when said piston means travels fully forwardly in said barrel member, said piston means further including rearwardly extending, finger-engageable cocking means;

trigger-lever means carried pivotally by said body barrel member at a pivot fulcrum disposed rearwardly from said nozzle end thereof, said trigger-lever means including a body portion extending forwardly to a point contiguous to said nozzle end and having a tip portion normally disposed radially apart from but displaceable toward, in piston-release-triggering operation relation, said barrel member, said trigger-lever means further including a piston-engaging arm portion which is extendable laterally into said barrel member for holding said piston means in a forward disposition and which is removable laterally from within said barrel member for releasing said piston means for its flyback, vacuum stroke action when said tip portion of said trigger-lever means is displaced radially inwardly toward said nozzle portion of said barrel member,

said piston and trigger-lever means being further of the character to force said piston means further forwardly into tip-ejecting contact with said tip element when said tip portion of said trigger-lever means is forcefully displaced laterally away from said nozzle portion of said barrel member.

2. The invention according to claim **1** in which said forward, nozzle end of said barrel member includes spring-retaining shoulder means disposed internally thereof contiguously forwardly of said substantially constant and smooth internal surface, and which further includes axially compressible main spring means disposed between said piston means and said spring-retaining means for causing vacuum-stroke-producing flyback action upon rearward release of said piston means.

3. The invention according to claim 2 which further includes trigger-spring means disposed between said trigger-lever means and said barrel member for biasing said tip portion of said trigger-level means away from said barrel member and said piston-engaging arm portion inwardly.

4. The invention according to claim 1 in which said piston means further includes a piston body portion from which forwardly extends said bore-cleaning rod means, and a rearwardly extending piston control end means affixed to the rear of said piston body portion and which is engageable by said piston-engaging arm portion of said trigger-lever means for selectively holding said piston means in a forwardly, cocked disposition and urging said piston means against said tip element for said ejecting thereof.

5. The invention according to claim 4 in which said piston control end means further includes a finger-engageable surface portion for urging said piston means into its forwardly, cocked position, and in which the rear portion of said barrel member is formed to define an axially elongated cocking slot for cooperative operation with said finger-engageable surface portion of said piston means.

6. The invention according to claim 5 in which said finger-engageable surface portion comprises a laterally extending tab element disposed radially outwardly through said cocking slot.

7. The invention according to claim 6 in which said barrel member is open-ended at its rearward extremity with said cocking slot and said substantially constant and smooth internal surface extending therethrough and further defining a window slot through said barrel member for communication therethrough of said piston-engaging arm portion with said piston control end means of said piston means.

8. The invention according to claim 7 in which said barrel member is substantially cylindrical and is further of the character to include a retaining channel extending circumferentially about at least substantially a major portion of the outer surface of said barrel member contiguously to said rear extremity thereof.

9. The invention according to claim 8 which further includes a stop ring member of the character to be disposed about said barrel member contiguously to said rear extremity thereof, said stop ring member having inwardly protruding, retaining channel-engaging means for axially securing said stop ring member thereto with rotatable freedom circumferentially about said retaining channel, said stop ring member being peripherally noncontinuous by an opening at least as long as approximately the width of said cocking slot whereby when said stop ring opening is circumferentially in register therewith, said piston means is withdrawable from said barrel member.

10. The invention according to claim 9 in which said stop ring member includes a forward extending trigger-lever-engaging portion which is disposable, by predetermined rotational disposition of said stop ring member, over a portion of said window slot of said barrel member and in which said piston-engaging arm portion of said trigger-lever means includes interference shoulder means which engages said trigger-lever-engaging portion of said stop ring member to limit the intrusion of said arm portion inwardly through said window slot, said stop ring member further including stop ring means for normally effectively closing the rear of said cocking slot for retaining said piston means within said barrel member.

11. The invention according to claim 10 which further includes rotation-locking detent and detent engagement pair means carried by said stop ring member and said barrel member for removably locking said stop ring member against rotation in a disposition whereby said trigger-lever arm portion is limited in its travel into said window slot and said piston means is retained within said barrel member, and which further includes rotation stop means for, in a first case, limiting the rotation of said stop ring member in a disposition to permit the removal of said tip member by said arm portion of said trigger-lever means, and, in a second case, permitting the circumferential registering of said cocking slot with said opening in said stop ring member whereby said piston means may be removed rearwardly from said barrel member.