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Kramer

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[54] **OIL-FIRED FLAME CULTIVATOR**

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[52] **U.S. Cl.**.....**47/1.44**, 126/271.2

[51] **Int. Cl.**.....**A01m 15/00**

[58] **Field of Search**.....47/1.44; 126/271.2 A, 271.2 C, 271.2; 239/291

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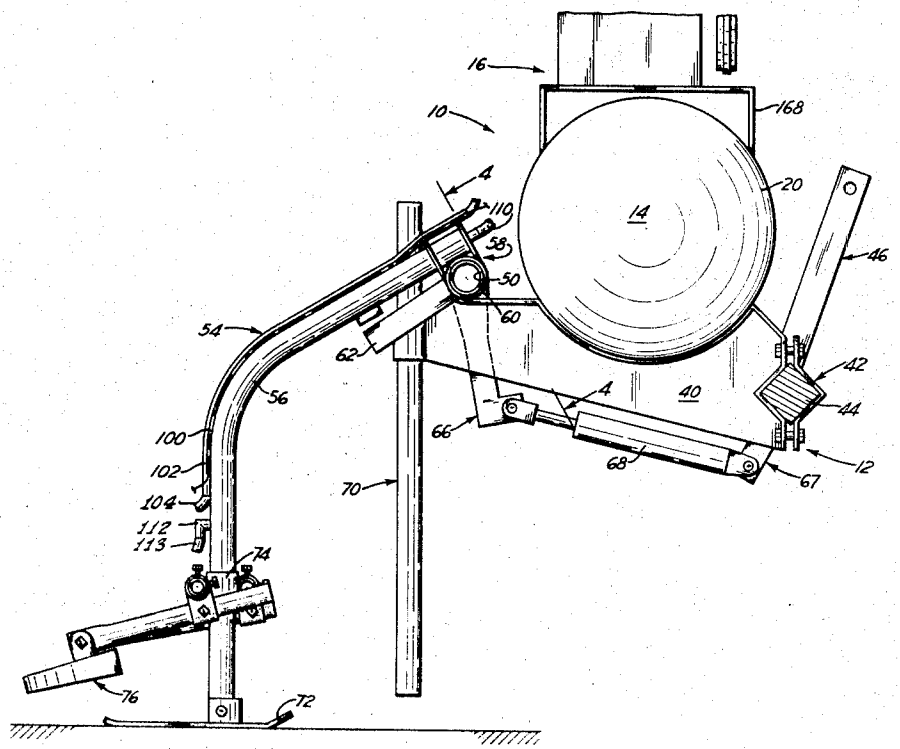
Primary Examiner—Robert E. Bagwill

Attorney—Meyer Neishloss, Deane E. Keith and William Kovensky

[57] **ABSTRACT**

A flame cultivator for row crops as opposed to field crops. The improvements of the invention comprise modification of commercial flame weeding equipment so as to render the structural burner supporting legs into air sumps, to thereby eliminate the need for surge tanks, large manifolds, and the like. A second improvement is a modified burner housing to facilitate the drawing in of secondary air and to protect the nozzles and electrodes from stones, tall weeds and the like which may be encountered during operation.

7 Claims, 8 Drawing Figures



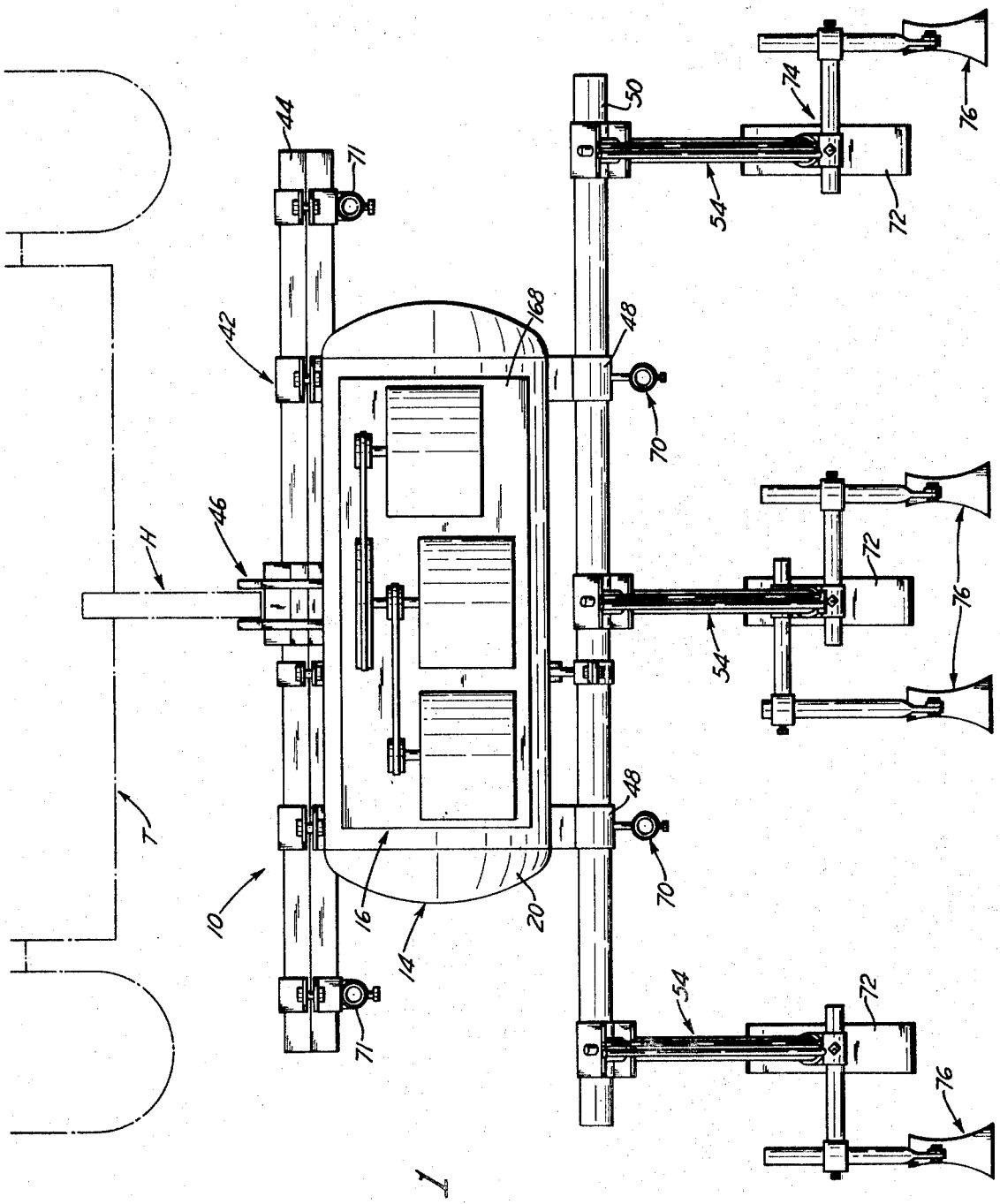


Fig. 1

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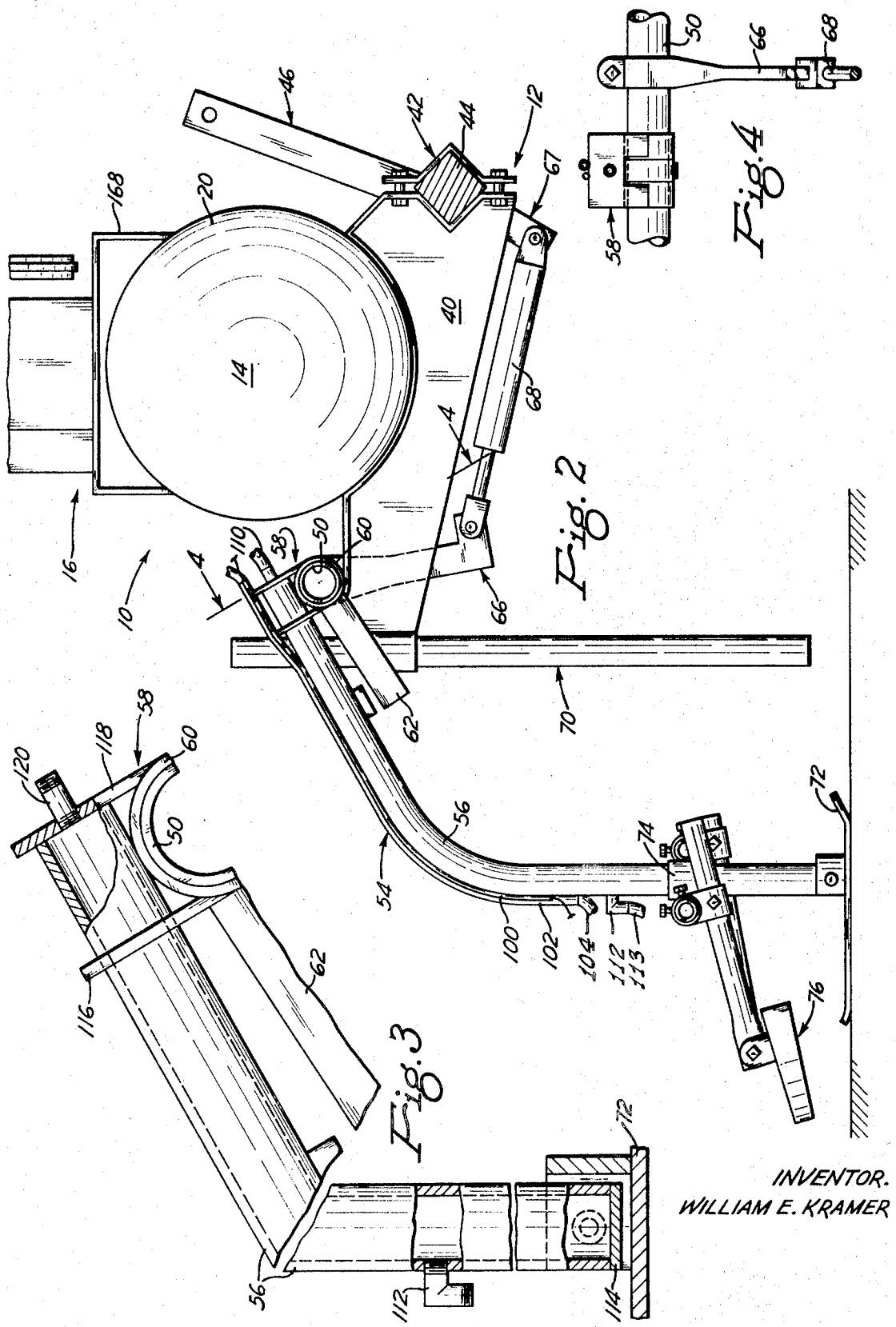


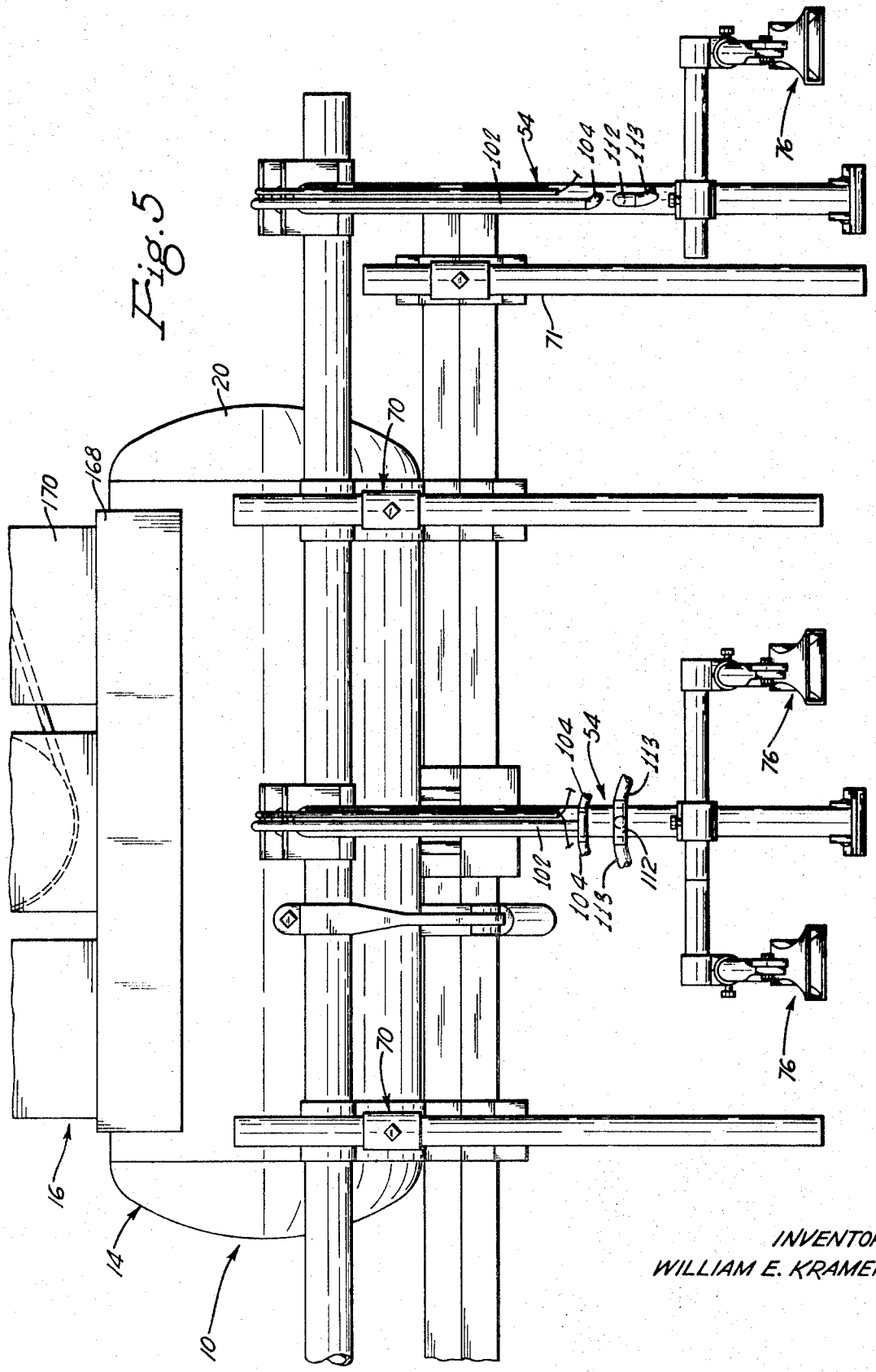
Fig. 2

Fig. 3

Fig. 4

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Fig. 5



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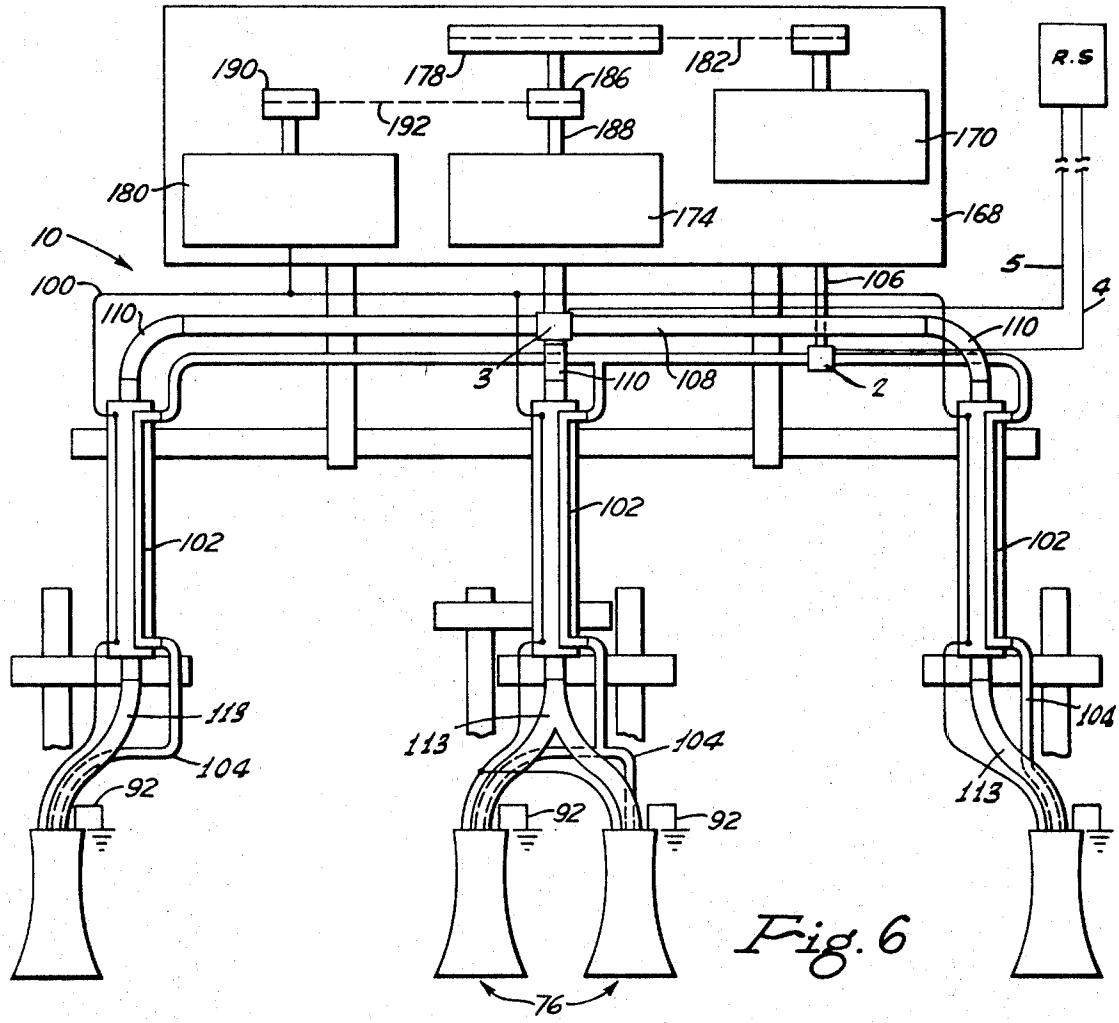


Fig. 6

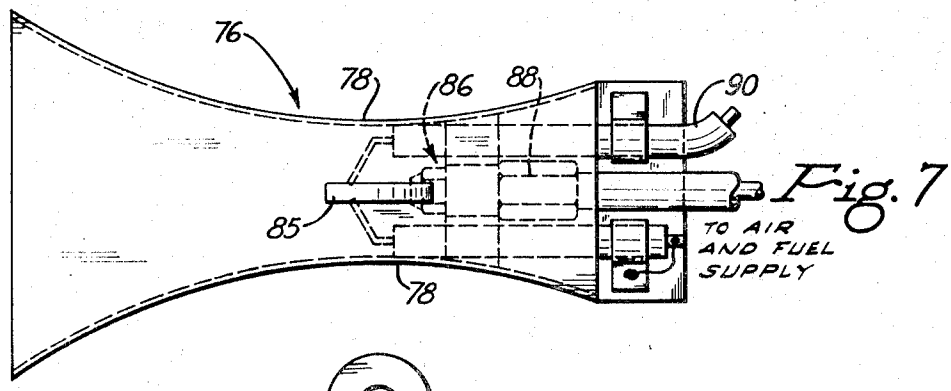


Fig. 7

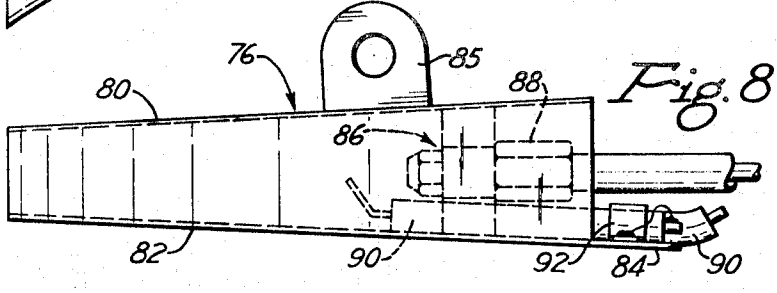


Fig. 8

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OIL-FIRED FLAME CULTIVATOR

This invention pertains to flame cultivation of certain kinds of commercial crops. More in particular, the invention concerns a flame weeder for use with row type crops, as opposed to crops which grow randomly in fields such as alfalfa. The invention may be used, for example, in flame cultivating soybeans, corn, cotton, grain sorghum, potatoes, sugar beets, onions, and strawberries.

The invention is essentially a modification of commercially available flame weeding equipment so as to permit said equipment to burn fuel oil rather than any other fuel, and to improve the primary air handling capability of the equipment. Many farmers prefer to burn fuel oil rather than other fuels because oil is more easily available, simple to handle, presents very minimal safety hazards, is less expensive than certain other fuels, and has a higher heat content on a volume basis than certain other fuels.

The invention provides improved means to supply pressurized air to the oil burner nozzles, and further provides a modification of the commercial equipment which simply and easily creates a primary air sump, or a plurality of such sumps, in such equipment. Such sumps are desirable to dampen out fluctuations which may otherwise appear in the primary air supply which, if not countered, would have undesirable effects on the flames. Additionally, the invention provides the sumps in such a manner that they are protected against damage or disruption by stones or other hazards farm equipment might encounter. The provision of such sumps in the manner taught by the invention also eliminates the need for a relatively large primary air conduit which would otherwise be needed, thus reducing the cost of fabricating oil fired flame cultivation equipment in accordance with the invention, and thus eliminating possible damage to said external primary air conduit. Another advantage of this portion of the invention is that uniform primary air characteristics are obtained. The apparatus includes a dual purpose tank, and when the tank is fairly full of fuel, there is little air space left to act as a sump.

The invention also provides two other improved portions. Within each burner housing, wherein the fuel nozzle is located, the invention provides structure and arrangement of parts to reduce the possibility of interference with normal operation by tall weeds, flying debris, and the like. The second improvement is the provision of solenoid valves in the fuel and air lines, operable from the drivers position on the tractor, to shut off the nozzle or reduce it from a full flame to a pilot flame at the convenience of the driver. Because of the intense hot flames produced by the oil burners used, it is desirable to be able to conveniently shut off the nozzle or reduce it to a pilot flame at various times such as when the tractor makes a turn at the end of a row, or when the driver may stop the apparatus in the field for various reasons. Absent such remote control, the driver would have to leave his seat on the tractor to shut off the flames so as to prevent damage to the crops, fences, and the like at times other than during normal operation.

Flame cultivation of row crops is generally old, and the advantages thereof as well as a good deal of the equipment used, both the equipment of the invention and other more conventional equipment, are known, and will not be pointed out herein in any more detail than is required to understand the invention.

The present invention is related to another pending application in the sense that some apparatus is common to both inventions. That prior application is entitled Oil Fired Weevil Control Burner," application Ser. No. 774,859, filed Nov. 12, 1968, by Orvis A. Davis, Sr. and the present inventor, assigned to the same assignee as the present invention, and now issued as U. S. Pat. No. 3,534,725. The reader should refer to that patent for a more detailed explanation of certain parts of the equipment described herein.

Another advantage of the invention's use of oil as fuel is that oil burners emit an "easy-to-see" yellow-white flame, whereas LP-gas burners emit a "hard-to-see" transparent blue flame often causing farmers to be accidentally burned. A further advantage is that the greater amount of radiant heat emanating from an oil flame, combined with the higher heat content of fuel oil per unit volume, results in less volume of fuel used per acre of crop; thus effecting an overall saving on fuel costs. Another advantage of the invention is that the oil burner flame can be adjusted from about 6 inches to about 3 feet in length by changing fluid pressures. To do the same with LP-gas units requires two or three different types of burners which would increase the farmer's investment in capital and time to make changes.

The above and other advantages of the invention will be pointed out or will become evident in the following detailed description and claims, and in the accompanying drawing also forming a part of the disclosure, in which:

FIG. **1** is a top plan view of apparatus embodying the invention;

FIG. **2** is a side view taken from the right side of FIG. **1**;

FIG. **3** is an enlarged view of the air sump of the invention with some portions broken away and in cross-section;

FIG. **4** is a cross-sectional view taken on line **4—4** of FIG. **2**;

FIG. **5** is a front view;

FIG. **6** is a view similar to FIG. **1** but showing certain systems schematically; and

FIGS. **7** and **8** are top and side views respectively of a single burner assembly.

Referring now in detail to the drawing, "T" indicates a tractor or the like which may be used to pull the apparatus **10** of the invention through a field of row crops to flame cultivate the same.

The invention includes a structural portion **12** which comprises a tank assembly **14**. Mounted on tank assembly **14** is a power group **16**. These three large portions **12**, **14** and **16**, and especially tank assembly **14**, are very similar to the corresponding portions in the aforementioned prior patent. Reference should be had to said patent since many of the detailed parts described therein are not shown and/or not described herein because they are not needed for an understanding of the present invention. In regard to the structure which is common or similar between said prior patent and this specification, an effort has been made, to the extent practical, to use the same reference numerals, for the convenience of the reader. Accordingly, por-

tions of the disclosure of said prior patent are incorporated herein by reference as if set forth herein in full.

The apparatus **10** of the invention is connected to the rear of tractor T by means of a conventional farm hitch indicated generally at H on FIG. **1**.

The pressure vessel **20** of tank assembly **14** is mounted on a pair of cradle members **40** forming part of structural portion **12**. At their rear ends, each cradle member **40** carries a bar holder assembly **42**, in which is removably and adjustably mounted a square cross-section bar **44**. Removably and adjustably mounted on bar **44** is a hitch member **46**, which provides the upper connection point of the standard three-point farm hitch H. The other two hitch members, not shown, are connected to bar **44**, whereby the apparatus **10** of the invention is adapted to be attached to a farm tractor with the weight of the apparatus of the invention supported by the tractor via the three hitch members on bar **44**, in the conventional manner.

At its front end, each cradle member **40** carries a bearing **48**, which bearings rotatably mount a leg mounting shaft **50**. The shaft **50** carries a plurality of leg assemblies **54**. Each assembly **54** comprises a leg member **56** whose upper end is mounted in a bracket **58**, and which bracket is carried by a sleeve **60** rotatably mounted on shaft **50**. Fixedly mounted on shaft **50** is a leg lifting arm **62** adapted to lift all the leg assemblies **54** when shaft **50** is turned about its axis in the bearings **48** carried by the cradles **40**. To turn shaft **50** and lift the legs, a bell crank assembly **66** and a cylinder **68** pivotally mounted as at **67** to the square bar **44** is provided. The cylinder **68** may be operated from the utility pneumatic connection on the tractor T. The cradles **40** also carry a pair of utility leg assemblies **70** adapted to be dropped and secured in position when it is desired not to support the weight of the assembly on the legs **54**. Another pair of utility legs **71** are carried on bar **44** to support the apparatus when it is not attached to a tractor.

At their lower ends, each leg assembly **54** comprises a pivotally mounted skid foot **72**. Above foot **72** each leg **54** carries at least one articulated burner holder arm assembly **74**.

As thus far described, the flame cultivating apparatus **40** to **74** is a commercially available piece of equipment, one source being the AFCO Flame Cultivator Company of Little Rock, Arkansas. In the successfully constructed apparatus their Universal three-Point Hitch Model, Two Row Flame Cultivator was used.

At the end of each articulated arm assembly **74** the invention provides a burner nozzle and housing assembly **76** pivotally mounted to the end of the arm assembly. Referring to FIGS. **7** and **8**, the assembly **76** is shown in detail. It comprises a pair of side walls **78** of arcuate configuration which connect a top wall **80** and a bottom wall **82**. The bottom wall **82** is provided with an extension **84** extending out rearwardly beyond the plane in which the side walls **78** and the top wall **80** terminate.

The side walls **78** define a venturi throat at the place where they come closest together to facilitate the drawing in of secondary air from the open rear end of the assembly **76**. The top and bottom walls **80** and **82** converge towards each other in the direction of flame exit from the burner to spread the flame laterally with respect to the row crops being cultivated. A flange **85** is provided on top wall **80** for attaching assembly **76** to arm assembly **74**. A spider assembly **86** is provided within the walls **78**, **80** and **82**, and this spider carries a nozzle **88** and a pair of ignition electrodes **90**.

The improvement in this portion of the invention is the provision of the extension **84** together with the location of the electrodes **90** below the nozzle **88**. These two elements in concert provide the advantage of protecting the electrodes and the nozzle from tall weeds, debris and the like which might otherwise be drawn into the rear end of the burner assembly, while at the same time facilitating the drawing in of secondary air for combustion through said open rear end. Another improvement is that one of the electrodes is grounded as at **92** directly to the extension **84**, thereby eliminating the need for a ground cable to be run to other parts of the apparatus.

Nozzle **88** is preferably of the type disclosed and claimed in U. S. Pat. No. 3,373,941, to Orvis A. Davis, Sr., and assigned to the same assignee as the present invention. The nozzle of that patent produces a flat spray which is advantageously utilized in the apparatus of the present invention, because, among other obvious reasons in flame cultivation, it can operate with a wide variety of different fuels thus lending further versatility to the apparatus of the invention.

The power group **16** is similar to the same group in the above first mentioned prior patent. The secondary air blower, the hover, and their associated parts in that patent are not used in this invention.

The power group **16** is mounted on a stand **168** of inverted "U" cross-section, with the legs welded to the top of the pressure vessel **20**. Referring to FIG. **6**, the power group consists of an internal combustion engine **170**, a compressor **174**, a fly wheel **178**, and electrical means **280** described further below. The output shaft of engine **170** is connected by suitable transmission means **182**, such as a plurality of "V" belts, to fly wheel **178**. For safety purposes, transmission means **182** may be provided with a protective cover. Compressor **174**, fly wheel **178**, and an intermediate pulley or sheave **186** are on a common shaft **188**. The drive pulley **190** of electrical means **180** is joined to pulley **186** by suitable transmission means **192**.

An advantage of this power train of the power group **16** as shown in the upper portion of FIG. **6** is that the apparatus of the invention may be easily modified for use with a different prime mover. For example, an electric motor and speed reducer set or hydraulic motor could be substituted for internal combustion engine **170**, the only modification being, possibly, changing the lengths of the belts or other power transmission means.

In the successfully constructed embodiment of the invention electrical means **180** comprises an automotive type of ignition system including an eight-point distributor, a 15,000 volt high tension coil, and a small battery. The advantages of an automotive type ignition include low cost, and a reliable constant intermittent spark in the burners. The arrangement of a distributor belt driven by a pulley on the air compressor shaft requires less power to operate than a magneto of comparable output. As shown in the drawing, the invention includes four burner assemblies **76** and is set up to cul-

tivate two rows of crops. Assemblies **76** are shown in parallel alignment for the sake of clarity only. In an actual flame-weeding operation the articulated burner holder arm assemblies **74** would be rotated and adjusted to cross-flame two rows of crop. Each pair (right and left) would be staggered fore and aft along each row. If desired, more leg assemblies **54** could be put on the leg mounting shaft **50** to cultivate more rows, the spacing being adjusted in the conventional manner.

Means are provided to supply fuel under pressure, primary air under pressure, and high voltage electricity to each burner assembly **76**. The dual purpose tank **20** is the same as described in said prior patent, and that description is hereby incorporated by reference. To this end, lines are strung from tank assembly **14** and power group **16** along the legs **56**. A line **100**, carrying one or two cables depending on how many burners are on the leg, is provided to run from the electrical means **180** to the burners. A line **102** delivers fuel to each of the nozzles **88**, and is provided, at its lower end, with either a single or double connection to flexible hoses **104** connecting the conduit or line **102** with the nozzle. Similarly, at its upper end, line **102** connects to a main hose or line **106** running to a solenoid and filter at the main fuel outlet of the tank **20** all not shown. The flexibility provided by the hoses **104** and **106** is needed to permit the legs to move as required during normal usage or when they are all lifted together by the cylinder **68**.

Another improvement of the invention concerns the means to supply the primary air from tank **20** to nozzles **88**. Tank **20** serves as both a fuel and primary air reservoir, and the details of how this is accomplished is set forth in the aforementioned patent, as mentioned above. A primary air manifold pipe **108** extends from tank **20** and hoses **110** branch off of said manifold and terminate at the upper ends of the legs **56**. Near their lower ends, each leg is provided with a pneumatic fitting **112** from which at least one hose **113** extends to the nozzle in burner assembly **76**, see FIGS. **2**, **5** and **6**.

In modifying the commercial purchased apparatus in accordance with the invention both the upper and lower ends of the hollow tubular leg member **56** were sealed as by plugging and welding, thus rendering the entire leg member into an air sump. Surges of air pressure which might otherwise be produced by the compressor **174** are thus damped out. Absent this modification it would be necessary to run a pipe or conduit having a dimension on the order of one-half to three-quarters of an inch or more inside diameter along each leg **56** to the nozzle. Thus, the need for this additional pipe is eliminated, while at the same time utilizing the strength of the tubular steel leg **56** to provide a strong primary air conduit at a very minor additional cost. To produce the sump, each leg **56** is modified at its lower end by removing the skid **72** and sealing the lower end of the leg by means of a plate **114** which- is preferably welded in place. As shown in FIG. **3**, the bracket **58** is used for this purpose at the upper end. Bracket **58** comprises a lower flange **116** which is provided with an opening to snugly receive tubular leg **56**, and with an upper flange **118** which fits over the top open end of the leg and is sealed thereto as by welding or the like. A pneumatic fitting **120** is provided in upper flange **118**, and connection to the sump thus provided inside of leg **56** is made by connection of hose **110** to fitting **120**. Thus, the advantages are achieved in a straight-forward and relatively simple manner.

Means shown diagrammatically in FIG. **6** are provided to shut off the flow of oil and of air to the nozzles from the driver's seat on tractor T. To this end, commercially available 6 or 12 volt, as required, solenoid valves, with the controls convenient to the driver's seat of the tractor, are provided in the oil and air supply systems, preferably a solenoid value **2** to fuel control in the main oil outlet line **106** of tank **20**. By push button, rotary switch, or similar simple means the operator can shut off the burners. The electrical system is caused to operate continuously, thus assuring re-ignition when fuel flow is resumed and at any other time for safety purposes. In the actual embodiment of the invention successfully built, a rotary switch RS was used to sequentially reduce the flow of air and then reduce the flow of fuel, using solenoid valve **2** for fuel, and a solenoid valve **3** in the primary air manifold pipe **108** for air control to provide a pilot flame, in the well known manner. The rotary switch RS also has a position to shut down the fuel flow completely when needed, and is connected to the solenoid valves **2** and **3** by a pair of lines **4** and **5**, respectively.

While the invention has been described in detail above, it is to be understood that this detailed description is by way of example only, and the protection granted is to be limited only within the spirit of the invention and the scope of the following claims.

I claim:

1. Flame cultivation apparatus comprising a structural assembly having means for attaching said assembly to a vehicle, a tank assembly mounted on said structural assembly, a power group mounted on said tank assembly, at least one burner leg assembly having its upper end mounted on said structural assembly, burner means mounted on the lower end of said leg assembly, said leg assembly including a hollow leg member, conduit means on the outside of said leg member and in fluid communication with said tank assembly to supply fuel under pressure from said tank assembly to said burner means, electrical conductor means on the outside of said leg member and connected to said power group to supply electrical energy from said power group to said burner means, the improvement comprising means sealing said hollow leg member to form a closed space within substantially all of said leg member, conduit means extending from said tank assembly to said leg member to supply air under pressure from said tank assembly to the inside of said leg member in the region of the upper end thereof, and means extending from said leg member to said burner means to tap the air under pressure inside said leg member in the region of the lower end thereof and to supply the air so tapped to said burner means, whereby said leg member functions as a sump for the pressurized air supplied from said tank assembly to said burner means.

2. The combination of claim **1**, said burner means comprising a burner housing open at its front and rear ends, a flat spray nozzle mounted in said burner housing, wherein said means to supply said tapped air to said burner means supplies said air to said nozzle, wherein said means to supply fuel to said burner means

supplies said fuel to said nozzle, electrical ignition means mounted in said burner housing, wherein said means to supply electrical energy to said burner means supplies said electrical energy to said ignition means, said burner housing comprising top and bottom walls sloping towards each other in the direction of flame propagation and a pair of side walls interconnecting said top and bottom walls, said side walls being of arcuate configuration to define a venturi throat therebetween, whereby said venturi throat facilitates the drawing in of secondary air for combustion through said open rear end of said burner housing.

3. The combination of claim 2, an extension on said bottom wall extending out rearwardly beyond the plane of said open rear end of said housing.

4. The combination of claim 3, a pair of ignition electrodes in said burner housing positioned below the nozzle therein, and means to ground one of said electrodes to said bottom wall extension.

5. The combination of claim 1, and remotely operable rotary switch means operatively cooperable with said air and fuel conduit means to sequentially control the flow of air in said air conduit means and the flow of fuel in said fuel conduit means to bring air and fuel to said burner means.

6. The combination of claim 1, said tank assembly comprising a pressure vessel having a volume of fuel therein less than the volume of said pressure vessel, said power group comprising an air compressor in fluid communication with said pressure vessel supply pressurized air to the space in said pressure vessel above the level of said fuel therein.

7. The combination of claim 1, said power group including an automotive type ignition system for supplying continuous intermittent electrical energy to said burner means.

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