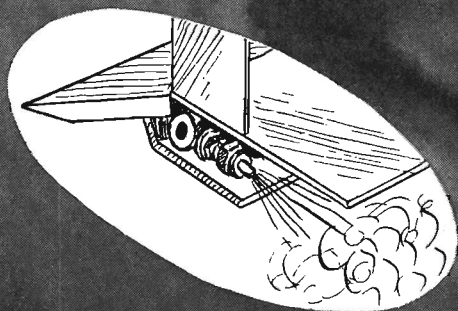


# Soil Fumigation Equipment

## *for Nematode Control*

Glen Page

Harold Jensen



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Application methods depend on size of the infested area .....	4
Application equipment may be hand-operated, or power-drawn of chisel or plow-sole type .....	4-8
Construction and operation of OSC experimental blade applicator .....	8-10
Rate of application and operation procedure .....	11
Materials required for OSC blade applicator .....	12
Engineering plans for OSC blade applicator .....	13-19

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SOIL fumigation with chemicals is a common method of controlling nematodes, symphyliids, and certain insects which feed on crop roots. Chemicals to kill nematodes are called "nematocides," and are usually marketed and applied in liquid form. Shortly after such liquids are injected into the soil they volatilize into gases which disperse throughout the spaces between the soil particles.

Carefully read manufacturer's recommendations regarding the use of specific materials. Be familiar with the instructions regarding:

- ▶ Health hazards to the operator,
- ▶ Soil preparation,
- ▶ Best soil temperature and moisture conditions for treatment,
- ▶ Compaction of the soil with a drag or roller after treatment to help hold gas temporarily,
- ▶ Proper time interval between treatment and planting to avoid plant injury,
- ▶ Proper cleaning of application equipment.

Influencing the efficiency of soil fumigation for nematode control are soil composition, structure, temperature, and moisture. How they influence fumigation efficiency is only partly understood. Best results are being achieved in sandy-type soils, and poor

or erratic results are frequently obtained in peat or heavy clay soils. Unfortunately, many serious nematode pests occur in the latter soil types. Manufacturers claim their materials are effective within a wide range of soil temperatures (40° F. to 85° F.) at application depth, but most materials are more effective at the higher temperatures. Great importance is being placed upon moisture content of the soil. Most present recommendations, however, call for a soil moisture content slightly below field capacity. Soil to be treated should be in seedbed condition, relatively free from clods and unrotted crop refuse. Other items influencing the efficiency of soil fumigation control are: timing treatment with development of the pest, correct dosage, and the efficiency of application equipment.

In spite of the many problems involved, soil fumigation has become popular, and each year thousands of acres are being treated to control various nematode pests. Infested areas may involve a home garden or a field of several acres. The entire area may be given a general blanket treatment, or the application may be confined to potential rows of the subsequent crop. Recently a row or side-dressing treatment with a small amount of material along the rows of established plantings has been developed for some crops.

## Applying Fumigants

Treatment of small localized areas by home gardeners, florists, and nurserymen may be made by:

- ▶ Sprinkling the material into a shallow trench and covering immediately with soil.
- ▶ Pouring a certain amount or placing capsules of material into holes punched into the soil.
- ▶ Applying material with a hand-operated dispenser.

If the infested area is greater than a half acre, power-drawn applicators are used, usually of a chisel or plow-sole type. The nematocide is applied by a pressure system or by a simple gravity feed device. Another type uses a blade applicator, applying the material with a pressure system or gear-driven pump.

## Application Equipment

### Hand-Operated Applicators

A popular applicator for treating home garden, lath, or greenhouse, and sites for ornamental plantings, is a hand-operated dispenser that looks like a giant hypodermic needle (figure 1). The applicator usually consists of a discharge handle, a reservoir tank, injection pump, depth guide, delivery tube, and a device to regulate the amount of material applied for each injection. Application is made by pressing the dispenser into the soil and by pushing down on the handle, forcing the nematocide into the soil.

Soil prepared for treatment is marked off in a grid to aid in injecting the material at proper intervals. The operator closes the hole made by the delivery tube, and compresses the soil by stepping on the previous injection site. A "water seal" may be applied by soaking the upper inch of treated soil with a garden hose. Nematocides are injected to a 6-inch depth. Most applicators of this type are provided with additional delivery tubes or an adjustable depth guide in case the operator desires to make an application at different depths.

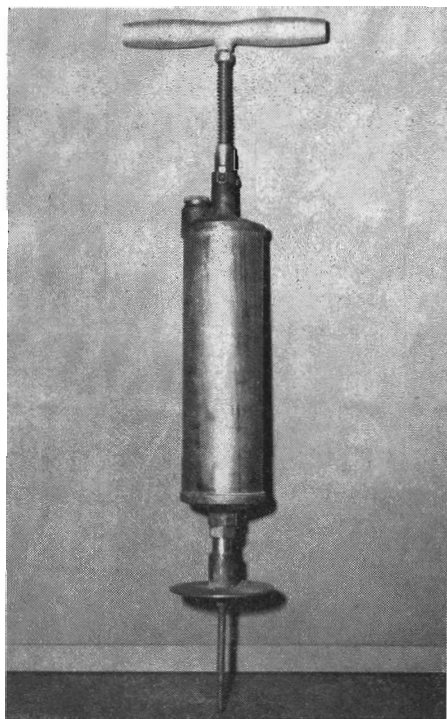


FIGURE 1. Hand-operated injector.

Table 1 gives dosage rates per injection and application rates in pounds per acre for DD or EDB (Dowfume W-85), two common soil fumigants,

**Table 1. Dosage Rates, DD and EDB, CC per Injection Equivalent to Pounds per Acre**

Application rate in cc.	6- by 6-inch spacing		9- by 9-inch spacing		12- by 12-inch spacing	
	DD	EDB	DD	EDB	DD	EDB
	<i>lbs./acre</i>	<i>lbs./acre</i>	<i>lbs./acre</i>	<i>lbs./acre</i>	<i>lbs./acre</i>	<i>lbs./acre</i>
1.....	46.0	66.5	20.5	29.6	11.5	16.6
2.....	92.1	133.1	41.0	59.2	23.0	33.3
3.....	138.1	199.6	61.4	88.8	34.5	49.9
4.....	184.1	266.2	81.9	118.5	46.0	66.5
5.....	230.1	332.7	102.4	148.1	57.5	83.2
6.....	276.2	399.3	122.9	177.7	69.0	99.8
7.....	322.2	465.8	143.4	207.3	80.6	116.5
8.....	368.2	532.4	164.9	236.9	92.1	133.1
9.....	414.3	598.9	184.3	266.5	103.6	149.7
10.....	460.3	665.5	204.8	296.1	115.1	166.4
11.....	506.3	732.0	225.3	325.8	126.6	183.0
12.....	552.4	798.6	245.8	355.4	138.1	199.6
13.....	598.4	865.1	266.3	385.0	149.6	216.3
14.....	644.4	931.7	286.8	414.6	161.1	232.9
15.....	690.4	998.2	307.2	444.2	172.6	249.6
16.....	736.5	1064.8	327.7	437.8	184.1	266.2
17.....	782.5	1131.3	348.2	503.4	195.6	282.8
18.....	828.5	1197.9	368.7	533.0	207.1	299.5
19.....	874.5	1264.4	389.2	562.7	218.6	316.1
20.....	920.6	1331.0	409.6	592.3	230.1	332.7
21.....	966.6	1397.5	430.1	621.9	241.7	349.4
22.....	1012.6	1464.1	450.6	651.5	253.2	366.0
23.....	1058.7	1530.6	471.1	681.1	264.7	382.7
24.....	1104.7	1597.2	491.6	710.7	276.2	399.3
25.....	1150.7	1663.7	512.1	740.3	287.7	415.9
26.....	1196.8	1730.2	532.6	770.0	299.2	432.6
27.....	1242.8	1796.8	553.0	799.6	310.7	449.2
28.....	1288.8	1863.3	573.5	829.2	322.2	465.8
29.....	1334.8	1929.9	594.0	858.8	333.7	482.5
30.....	1380.9	1996.4	614.5	888.4	345.2	499.1
31.....	1426.9	2063.0	635.0	918.0	356.7	515.7
32.....	1472.9	2129.5	655.5	947.6	368.2	532.4
33.....	1519.0	2196.1	675.9	977.3	379.7	549.0
34.....	1565.0	2262.6	696.4	1006.9	391.2	565.7
35.....	1611.0	2329.2	716.9	1036.5	402.8	582.3
36.....	1657.1	2395.7	737.4	1066.1	414.3	598.9
37.....	1703.1	2462.3	757.9	1095.7	425.8	615.6
38.....	1749.1	2528.8	778.4	1125.3	437.3	632.2
39.....	1795.1	2595.4	798.8	1154.9	448.8	648.8
40.....	1841.2	2661.9	819.3	1184.6	460.3	665.4
41.....	1887.2	2728.5	839.8	1214.2	471.8	682.1
42.....	1933.2	2795.0	860.3	1243.8	483.3	698.8
43.....	1979.3	2861.6	880.8	1273.4	494.8	715.4
44.....	2025.3	2928.1	901.2	1303.0	506.3	732.0
45.....	2071.3	2994.7	921.7	1332.6	517.8	748.7
46.....	2117.3	3061.2	942.2	1362.2	529.3	765.3
47.....	2163.4	3127.8	962.7	1391.9	540.8	781.9
48.....	2209.4	3194.3	983.2	1421.4	552.3	798.6
49.....	2255.4	3260.9	1003.7	1451.1	563.9	815.2
50.....	2301.5	3327.4	1024.1	1480.7	575.4	831.8

**Table 1. Dosage Rates DD and EDB, CC per Injection Equivalent to Pounds per Acre—(Continued)**

Application rate in cc.	6- by 6-inch spacing		9- by 9-inch spacing		12- by 12-inch spacing	
	DD	EDB	DD	EDB	DD	EDB
	<i>lbs./acre</i>	<i>lbs./acre</i>	<i>lbs./acre</i>	<i>lbs./acre</i>	<i>lbs./acre</i>	<i>lbs./acre</i>
5.1.....	2347.5	3393.9	1044.6	1510.3	586.9	848.5
5.2.....	2393.5	3460.5	1065.1	1539.9	598.4	865.1
5.3.....	2439.5	3527.0	1085.6	1569.5	609.9	881.8
5.4.....	2485.6	3593.6	1106.1	1599.1	621.4	898.4
5.5.....	2531.6	3660.1	1126.6	1628.8	632.9	915.0
5.6.....	2577.6	3726.7	1147.0	1658.4	644.4	931.7
5.7.....	2623.7	3793.2	1167.5	1688.0	655.9	948.3
5.8.....	2669.7	3859.8	1188.0	1717.6	667.4	964.9
5.9.....	2715.7	3926.3	1208.5	1747.2	678.9	981.6
6.0.....	2761.8	3992.9	1229.0	1776.8	690.4	998.2

using injection spacings of 6 by 6 inches, 9 by 9 inches, and 12 by 12 inches. Application rate in gallons per acre can be obtained by dividing the rate for DD by 10 or EDB by 14.4. Manufacturers usually state dosages on a per acre basis.

### Power-Drawn Applicators

Nearly all large-scale treatments are applied with power-drawn equipment, and consist of some type of plow-sole or chisel applicator. The chisel applicator is probably most popular. Effectiveness of this type of equipment depends on (a) a continuous flow of materials through the applicator tubes into the chisel furrows, (b) the subsequent lateral diffusion through the soil between the chisel paths, (c) and vertical diffusion of the nematocide in the upper foot of soil.

Frequently, applicator tubes become plugged, leaving untreated areas in the field. Clods or excessive unrotted organic material may interfere with the lateral diffusion between chisel furrows leaving areas in the field untreated. Better control of nematode pests is frequently obtained by plow-sole application in friable soils. Plow-sole applica-

tion is less effective in heavy soils which are apt to be cloddy and interfere with the dispersion of the nematocide.

To offset the problem of lateral diffusion a blade type applicator, discussed in detail on pages 8 to 10, has been designed and built at Oregon State College.

Chisel or tooth application equipment has been used for several years for most large-scale fumigation. Fumigants are injected behind chisels or cultivating teeth spaced 9 to 12 inches apart, and operated at an injection depth of 6 or 8 inches. This equipment is very similar to that used for the



**FIGURE 2. Chisel applicator.**

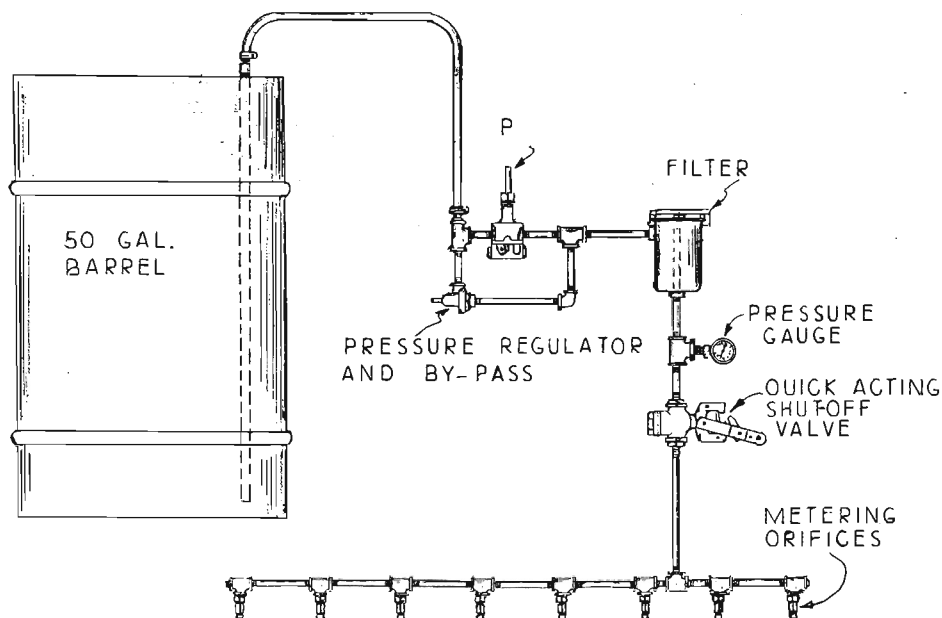


FIGURE 3. Fluid system for chisel or blade applicator.

application of aqua or anhydrous ammonia and other liquid fertilizers. The fumigant is pumped from the supply tank with a gear type power takeoff pump, equipped with a built-in pressure regulator and a bypass, to the manifold of metering orifices. (An orifice is a small opening through which a passing liquid is metered. See figures 3, 4, and 5.) Liquid pressures used at the orifices are 10 to 60 pounds per square inch. Rate of application is controlled by tractor speed, spacing between chisels, size of orifice, pressure at the orifice, or addition of a diluent. The fluid flows from the orifice to the base of the shank by gravity through tubes or pipes. Screens or filters are provided to keep metering orifices from plugging. Since most fumigants are highly corrosive to iron, all plumbing should be made from copper, brass, or stainless steel. Gal-

vanized pipe may be used. Current nematocides are very destructive to natural rubber and most synthetic rubber hoses. Use polyethylene tubing where possible in the place of rubber hose.

The plow-sole applicator puts the liquid fumigant in the bottom of the furrow just ahead of the plow, then it is immediately covered with soil. The machine is simple in design with no movable parts likely to give trouble from corrosion or clogging. It can be constructed by a careful workman.

The applicator consists of a constant-flow supply tank, a fixed orifice flow regulator for each liquid line, a quick shut-off valve, piping, and plastic tubing. Since most of the current soil fumigants are corrosive, metal parts in contact with the fumigant should be resistant to corrosion, with the tank

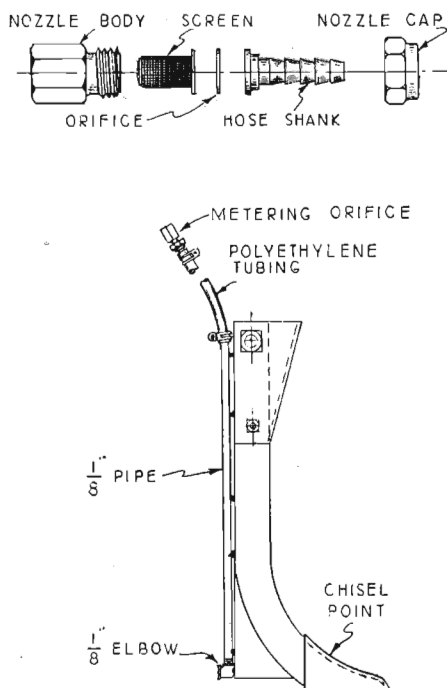


FIGURE 4. Layout of metering orifice for chisel or plow-sole applicator.

made either of copper or galvanized iron. The quick shut-off valve should have a brass body, and the piping should be copper, brass, or galvanized pipe.

The constant flow tank must be airtight, except for the air vent which introduces the air within 1 inch of the bottom of the tank. The purpose of this location is to regulate the air pressure in the supply tank to compensate for the gradual decrease in head of fumigant in the tank. All fittings to the tank must be airtight so the only air entering the tank goes through the air vent. Use of an interchangeable air vent assembly (figures 5 and 6) permits use of the fumigant container as a constant flow tank.

The flow regulator consists of a  $\frac{1}{4}$ -inch nozzle body, fitted with a stain-

less steel orifice disk. Once fitted with the proper orifice adjusted to proper height no further attention is needed for the same fumigant and the same rate of application. For a two-way plow, two quick shut-off valves are needed, but only one quick shut-off valve is required for a one-way plow. A flow regulator and delivery tube must be provided for each plow bottom. A polyethylene tube carries the fumigant from the regulator to the bottom of the furrow.

The hose is clamped to the plow beam or some other part of the plow to hold it in correct position. If the plow furrow is wider than recommended spacing for the fumigant, some additional means of spreading the fumigant should be provided.

**OSC experimental blade applicator.** This applicator was designed to insure a more effective injection pattern than is obtained by the plow-sole or chisel applicators. The nematocide is applied in the soil as a continuous sheet at the injection point, eliminating most of the difficulties encountered in obtaining efficient lateral diffusion. The injection boom, mounted in a protected recess beneath the blade, sprays the

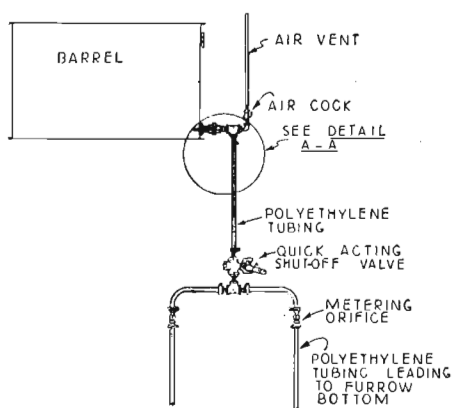
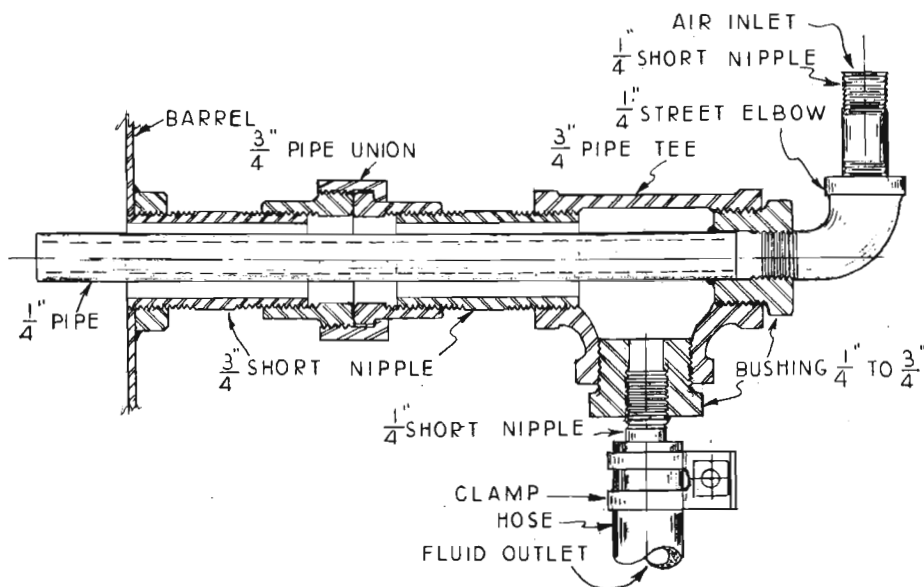


FIGURE 5. Fluid system of plow-sole applicator.





DETAIL A-A

FIGURE 6. Air inlet and fluid outlet connection.

nematocide into the soil as it breaks over the rear edge of the blade. The spray shield protects the boom from the soil particles and provides a void behind the cutting edge of the blade. This allows spray from the fan-type weed nozzles to treat the entire width of the soil as it falls from the after-edge of the spray shield. Several nozzles are used to insure complete coverage for the entire area corresponding to width of the blade.

The soil fumigation blade can be constructed in most welding or machine shops of standard materials obtained from steel supply houses and farm spray equipment dealers. It will take about 15 to 20 man-hours to build the frame and 8 to 10 man-hours to build and install the fluid system. The Noble blade, or other similar cultivation blade mounted on its own carriage, could be fitted for soil fumiga-

tion by the addition of a suitable spray shield and fluid system.

Figure 7 shows the complete blade ready for field use. Plans are shown in drawings on pages 13-19. The frame and blade are made by cutting, bending, and welding standard mild steel shapes. The  $\frac{1}{2}$ - by  $5\frac{1}{2}$ -inch mild steel blade has the top surface of the cutting edge protected with hard surfacing rod. The normal wear of the unhardened lower surface will tend to keep the blade sharp. The hard surfacing should be applied to the bar before relieving underside of the blade. The leading edge of the blade supports should be rounded to aid in clearing trash. Sharp edges tend to break plant stems, causing them to cling to blade supports.

The liquid fumigant system should be made of corrosion-resistant materials. All pipe should be of copper,

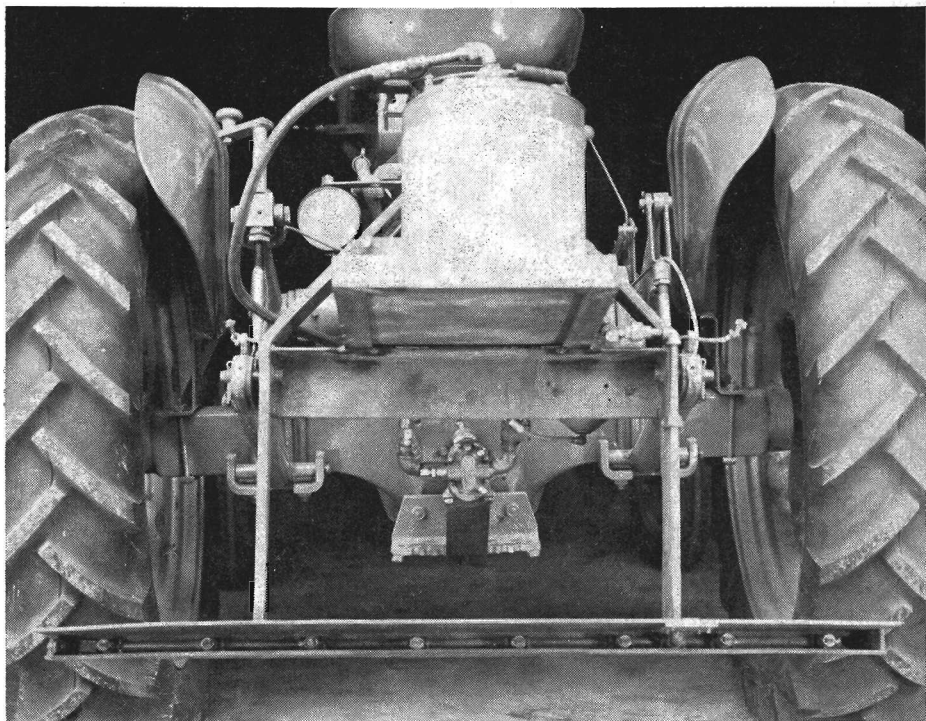


FIGURE 7. Rear view of blade applicator.

brass, or stainless steel, and polyethylene tubing should be used instead of neoprene hose where possible. Tee-Jet spray nozzles,  $\frac{1}{4}$  PT eyelet or  $\frac{1}{4}$  TT standard nozzles, should be used with Tips 730039 and 800067 for EDB and DD respectively. These tiny orifices clog easily; the use of type S-6 AC oil filter with a cartridge has proved very effective in avoiding nozzle clogging. The metering orifice within the filter should be enlarged to  $\frac{3}{8}$ -inch diameter to keep pressure drop through the filter to a minimum. The container in which the fumigant is purchased may be used as the tank. A power takeoff driven pump (equipped with pressure regulator) pumps fumigant from tank through filter to the spray boom and nozzles in the blade,

as in figure 3. A compressed air fluid system could replace the system described above if desired.

After soil has been plowed and worked into a seedbed condition, the surface should be firmed with a roller or float. This is essential to give good traction and to aid in movement of soil over the blade. The blade was constructed to mount on tractors equipped with hydraulic controls and a three-point hitch. The hydraulic control should be set on constant depth rather than constant draft to reduce blade fluctuation at the application level. During application the speed used for calibration must be maintained. Soil should be rolled or floated immediately after application to temporarily seal in the fumigant.

## Rate of Application

Prior to calibrating equipment, determine speed at which an applicator can be drawn through your soil. Do this for the plow applicator while opening the field for fumigation. For either the blade or chisel applicator, make a few trials through the field. The tractor speed can be determined with a tractor-tachometer or a spray-speedometer.

Width of coverage for each nozzle or orifice can be determined by measuring the distance between chisels for the chisel applicator; dividing the width of cut of the plow by the number of metering orifices for the plow-sole applicator; and by measuring the distance between nozzles on the blade applicator.

By use of the following formula, the equipment can be calibrated by finding the number of seconds required for the fumigant from one nozzle or metering orifice to fill a pint measure.

$$T = \frac{C}{SRD}$$

Where T = time to fill a pint measure (seconds)

S = speed (miles per hour)

R = application rate (gallons per acre)

D = distance between nozzles (inches)

C = equation constant 44,550

### Example

Using the formula above, find the time in seconds for the fumigant from one nozzle to fill a pint jar when nozzles are spaced  $6\frac{1}{2}$  inches apart, tractor speed 2 miles per hour, and rate of application 30 gallons per acre.

$$T = \frac{44,550}{(2)(30)(6.25)} = 119 \text{ seconds or } 1 \text{ min., } 59 \text{ sec.}$$

By proper adjustment of pressure and right choice of nozzle tip, the desired flow may be obtained in the proper time.

## Operation Procedure

The following check list is included to assist those who may not be familiar with soil fumigation procedures.

### Before treatment, be sure that—

- Soil is in a good seedbed condition relatively free of large clods and excess unrotted plant residues.
- Soil temperature at the application depth is within limits of the manufacturer's recommendations.
- Applicator is properly assembled and calibrated.
- You are familiar with the manufacturer's instructions.

### During treatment, be sure that—

- Applicator is functioning properly at all times.
- Application depth and tractor speed are uniform.

• Applicator - treatment width is maintained so all areas are treated.

• Tractor is never in reverse when applicator is in the ground.

### After treatment, be sure that—

- Soil surface is firmed with a culti-packer or similar implement.
- Soil is left undisturbed for the time specified by the manufacturer.
- Applicator is thoroughly cleaned, leaving an oil film over all surfaces as a protection against rust and corrosion.
- Soil is aerated at end of the specified period with a disk or harrow to aid final escape of the fumigant.
- Planting is delayed in accordance with recommendations of the manufacturer.

## Materials List

Item	Amt.	Description
1	1	Blade with slot plate.....Details on pages 14-15
2	1	Adjusting link & screw.....Details on pages 16-17
3	1	Link pin .....Details on page 17
4	1	Pump bracket.....Details on pages 16-17
5	1	Strainer stand .....Details on page 19
6	1	Spray pipe clamp # 1.....Details on page 18
7	1	Spray pipe clamp # 2.....Details on page 18
8	1	Pipe line clamp.....Details on page 19
9	1	Pump, bronze, $\frac{1}{2}$ " with $\frac{5}{8}$ " shaft & Zerk. Grease fittings, Oberdorfer std. series #50 zx
10	1	Flexible coupling for 1— $\frac{1}{8}$ " to $\frac{5}{8}$ " shafts
11	1	Quick opening valve, bronze $\frac{1}{2}$ "
12	1	A. C. oil filter, $\frac{1}{8}$ " type S-6
13	1	Can strainer, $\frac{3}{4}$ " Q (spraying systems)
14	1	Pressure gauge, 0-100 pounds, $\frac{1}{4}$ " thd.
15	8	Tee-Jet spray nozzle, $\frac{1}{4}$ " TT 800067 or $\frac{1}{4}$ " TT 730039
16	8 ft.	Spray hose, $\frac{1}{2}$ " oil resistant with 8 hose clamps approx. 8'-0" (total), cut as reqd. Pipe fittings required for spray pipe assem., strainer & line pipe.
17	20	Nipple, $\frac{1}{4}$ " std. pipe x 1" lg. brass
18	1	" $\frac{1}{4}$ " " " x 1 $\frac{1}{4}$ " lg., brass for item #9
19	1	" $\frac{1}{4}$ " " " x 2 $\frac{3}{4}$ " lg., brass
20	1	" $\frac{1}{4}$ " " " x 5" lg., brass
21	5	" $\frac{1}{4}$ " " " x 5 $\frac{1}{2}$ " lg., brass
22	1	" $\frac{1}{4}$ " " " x 3" lg., brass for item #9
23	1	Pipe, std. $\frac{3}{4}$ " x 1'-0" lg., thd. both ends, brass
24	5	Bushing, reducing $\frac{1}{2}$ " to $\frac{1}{4}$ "; brass, for items 9 & 11
25	1	Coupling, $\frac{1}{2}$ " std. pipe, brass, for item #29
26	10	Tee, $\frac{1}{4}$ " std. pipe, brass
27	1	Pipe, $\frac{1}{4}$ " std. pipe, brass
28	1	Elbow, $\frac{1}{4}$ " std. pipe, 90°, brass
29	1	Elbow, street reducing, $\frac{3}{4}$ " to $\frac{1}{2}$ "—90°, brass
30	2	Plug, $\frac{1}{4}$ " std. pipe, brass
31	1	Elbow, $\frac{1}{4}$ " std. pipe, 45°, brass
32	1	Hydraulic hose connector, $\frac{1}{4}$ ", male thd.
33	4	Cap screws, $\frac{1}{4}$ "—20 thd. flat hd. x $\frac{5}{8}$ " lg.
34	2	Mach. bolts, $\frac{3}{8}$ " x 1" lg., with lock washers
35	1	" " $\frac{1}{4}$ " x 1 $\frac{1}{2}$ " lg., with lock washers.
36	2	" " $\frac{1}{4}$ " x 1" lg., with lock washers.
37	3	Cotter pin, $\frac{1}{4}$ " x 2" lg.

PRESSURE GAUGE 0 - 100\*

A.C. OIL FILTER TYPE S-6

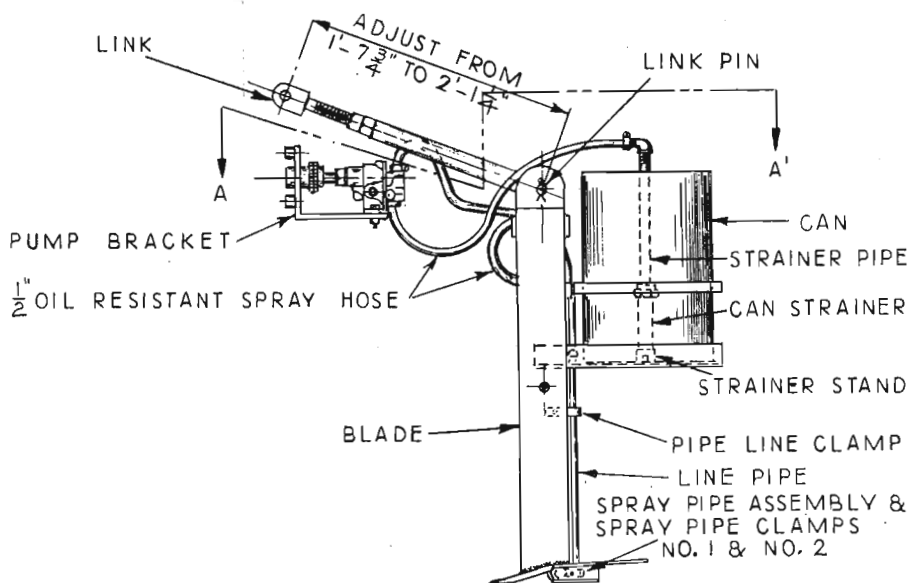
QUICK OPENING VALVE

FLEXIBLE COUPLING  
FOR  $1\frac{1}{8}$  -  $\frac{5}{8}$ " SHAFTS

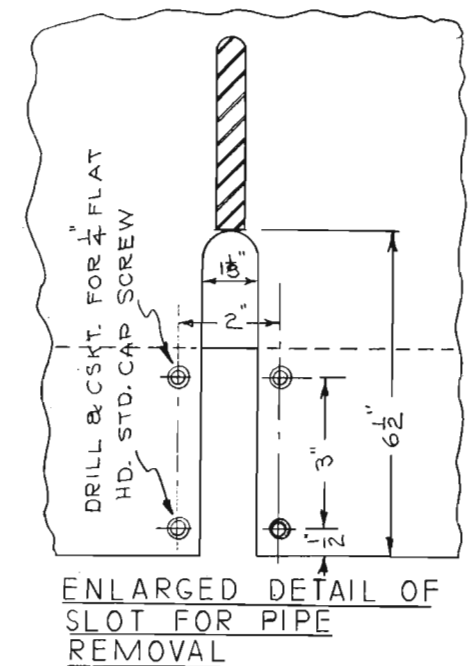
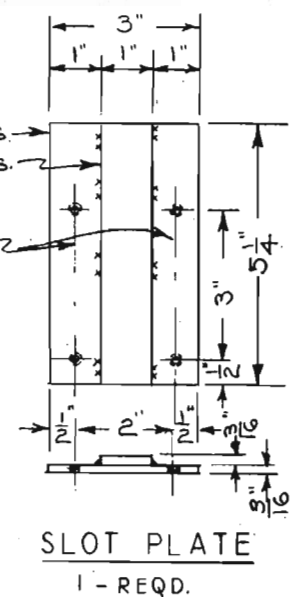
OBERDORFER STD. SERIES  
NO. 50 ZK  $\frac{1}{2}$ " BRONZE PUMP,  
WITH  $\frac{5}{8}$ " SHAFT & ZERK  
GREASE FITTINGS

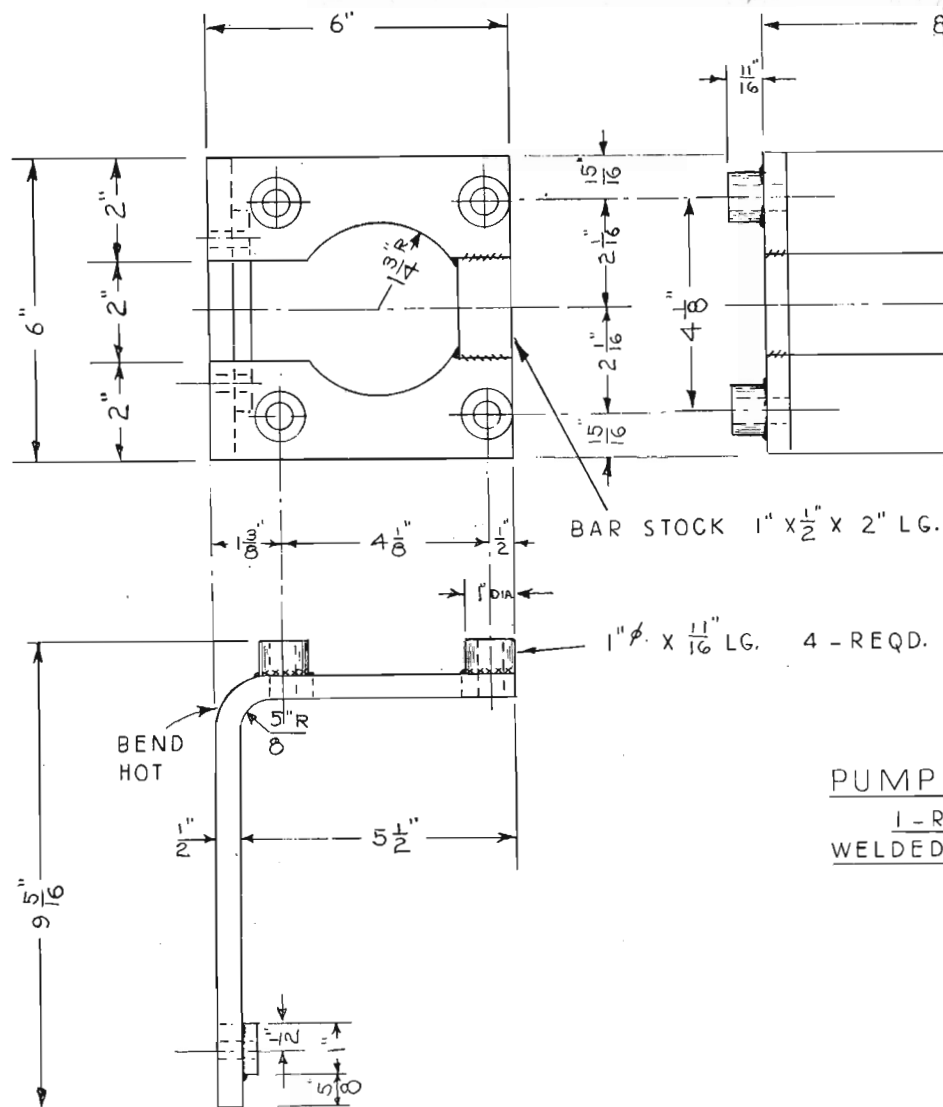
CAN  
SUPPORT

PLAN AT SECTION A-A'

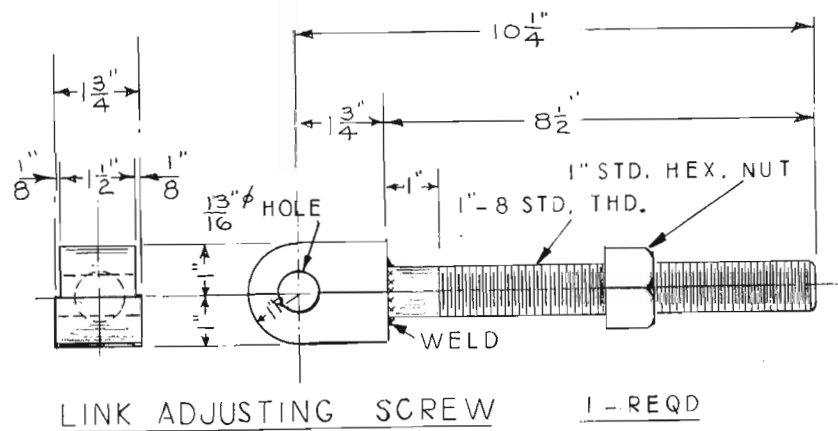


SIDE ELEVATION OF SOIL FUMIGATION BLADE

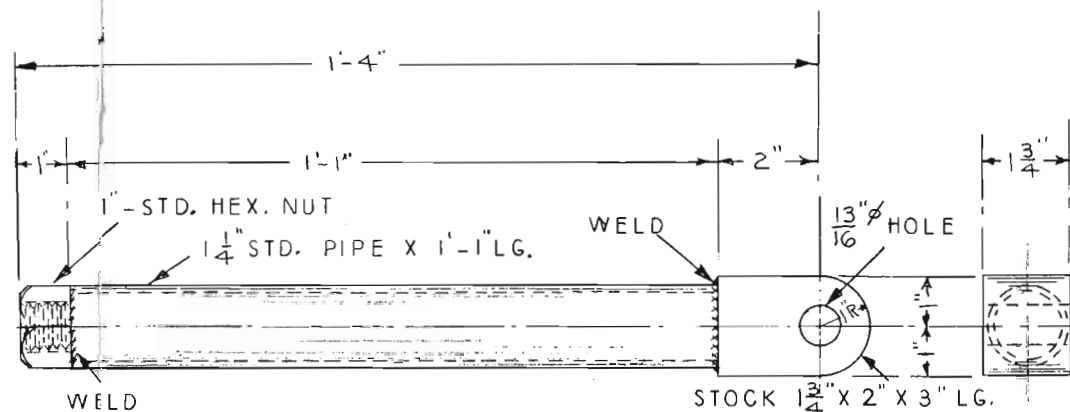




PUMP BRACKET  
1 - REQD  
WELDED CONSTRUCTION

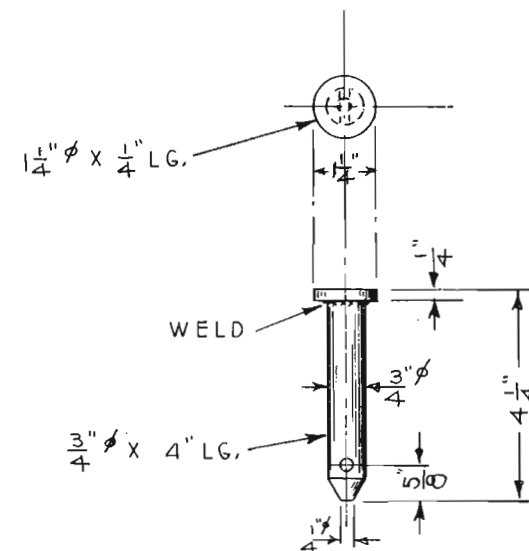


LINK ADJUSTING SCREW 1 - REQD

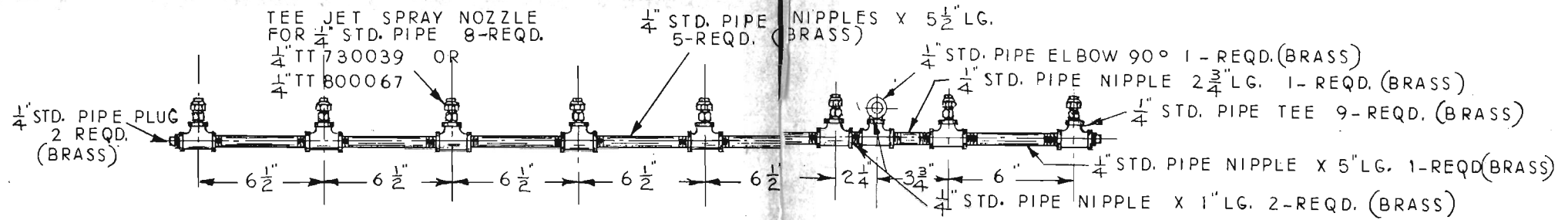


LINK 1 - REQD.

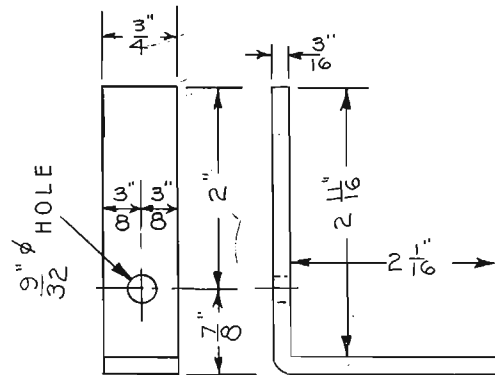
BAR STOCK 2 X 1/2" X 1'-2" LG. 2 - REQD.  
STOCK 1" X 3/8" X 4" LG.  
BAR STOCK 1 5/8" X 1/2" X 2" LG.



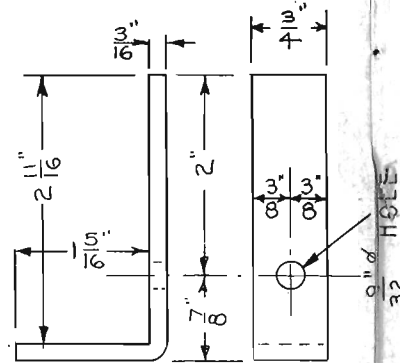
LINK PIN  
1 - REQD.



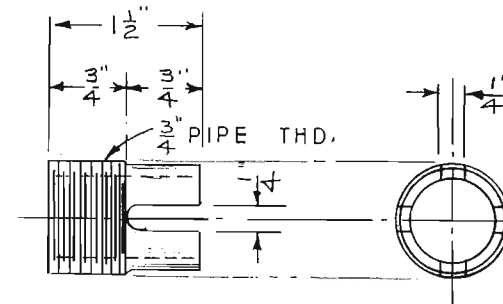
SPRAY PIPE ASSEMBLY 1-REQD.



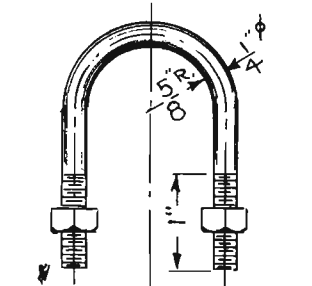
SPRAY PIPE CLAMP NO. 1  
 BAR STOCK  $\frac{3}{4}$ " X  $\frac{3}{16}$ " X  $4\frac{13}{16}$ " LG.  
 1-REQD.



SPRAY PIPE CLAMP NO. 2  
 BAR STOCK  $\frac{3}{4}$ " X  $\frac{3}{16}$ " X  $4\frac{1}{16}$ " LG.  
 1-REQD.

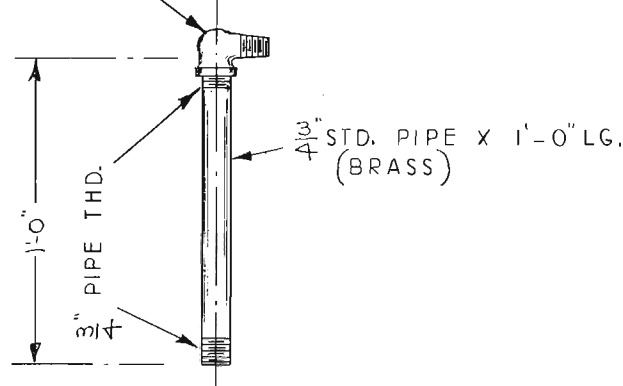


STRAINER STAND 1-REQD.  
 STOCK  $\frac{3}{4}$ " STD. PIPE X  $1\frac{1}{2}$ " LG. (BRASS)



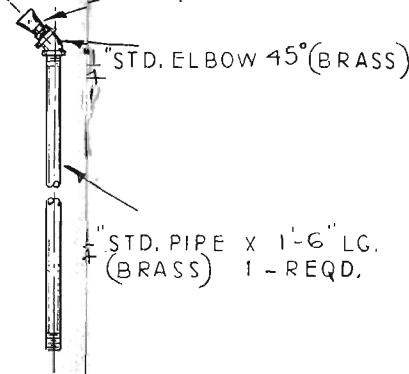
U-BOLT 2-REQD.  
 STOCK  $\frac{1}{4}$ " X  $5\frac{1}{2}$ " LG.

STD. 90° STREET REDUCING ELBOW  $\frac{3}{4}$ " TO  $\frac{1}{2}$ " 1-REQD. (BRASS)

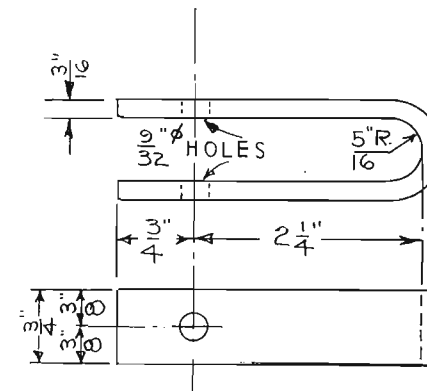


STRAINER PIPE 1-REQD.  
 NOTE TO BE INCREASED IN LENGTH IF LARGE TANK IS USED

HYDRAULIC HOSE CONNECTION WITH MALE THD.  $\frac{1}{4}$ "



LINE PIPE 1-REQD.



PIPE LINE CLAMP 1-REQD.  
 BAR STOCK  $\frac{3}{4}$ " X  $\frac{3}{16}$ " X  $6\frac{11}{16}$ " LG.