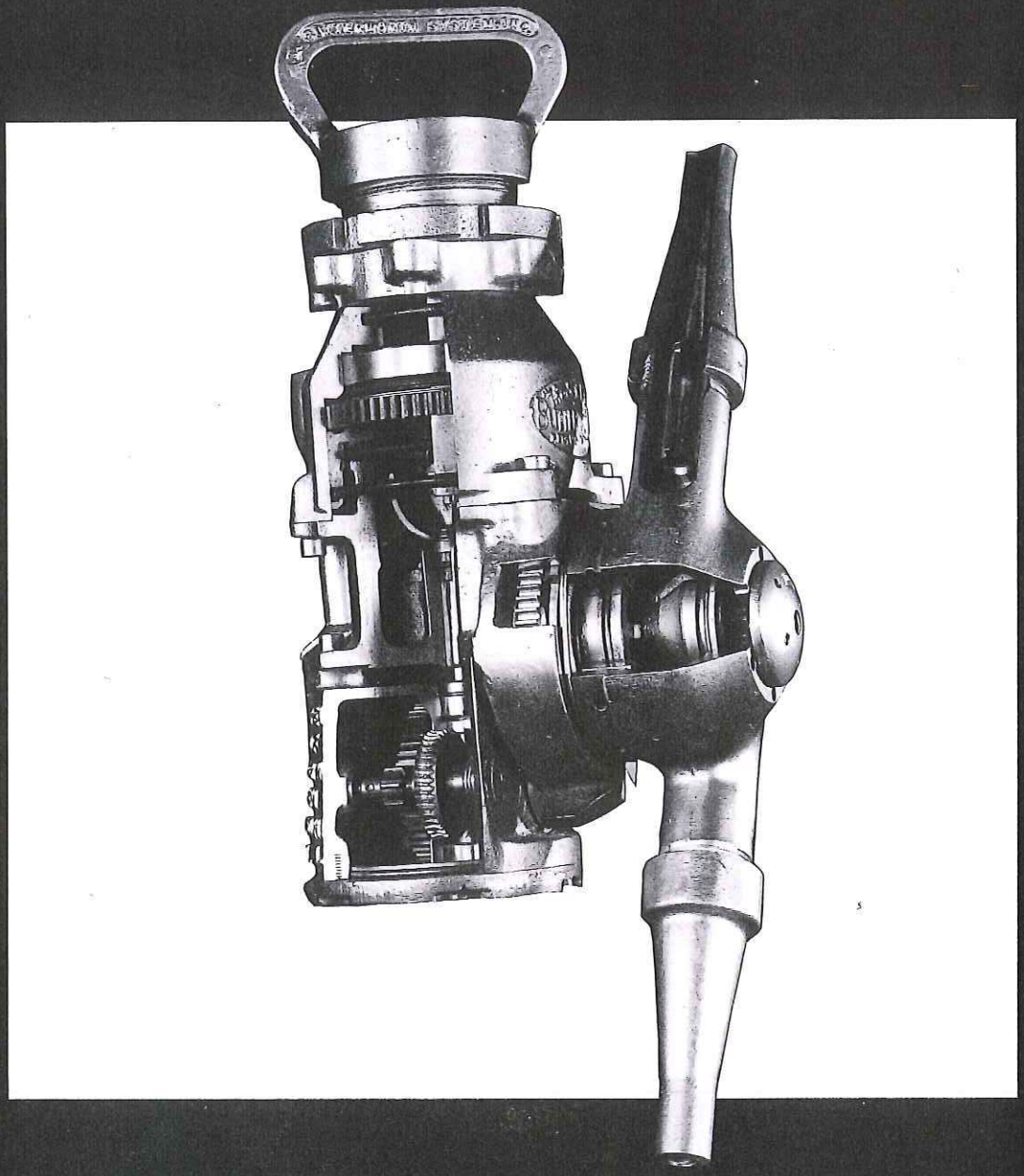
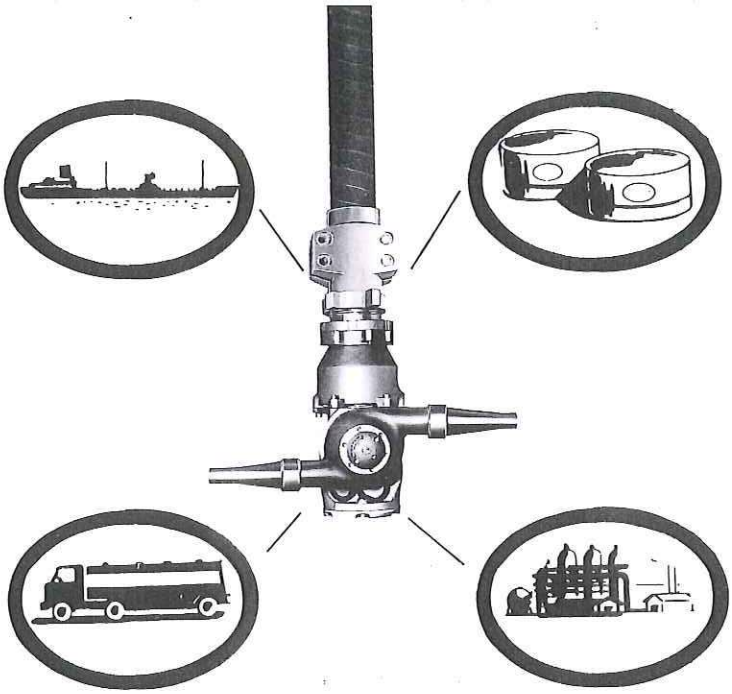


CARE & MAINTENANCE OF THE BUTTERWORTH® TYPE K/SK TANK CLEANING MACHINES



BUTTERWORTH® Types K and SK tank cleaning machines will have an exceptionally long, trouble-free service life if you observe a few simple rules for their proper care and operation.

As the gear mechanism and bearings are totally enclosed, fully lubricated, and completely sealed from the hot salt water, wear and tear of moving parts is practically eliminated. No special adjustments of the machine are required, nor is it necessary to lubricate the sealed portions after each use. The machine is ruggedly designed to withstand normal shipboard handling, and the internal parts are protected from shock by unique overriding clutches. Rugged as it is, however, the machine is not designed to be thrown on the deck or otherwise abused.

GENERAL PRECAUTIONS

1. Before connecting any tank-cleaning machines, flush all water supply lines for several minutes. Open the last valve in the line, then open and flush out each of the other valves. This will prevent the clogging of the machines by rust and scale.

2. Never hammer the hose nuts or the machine collar when connecting the machine to the hose or when coupling hoses together. Always use BUTTERWORTH spanners to make connections, thus preventing leaky joints and damage to the machine or couplings.

If chemicals are used and the cleaning solution recirculated, a strainer should be used to remove solids entrained from previous washings.

3. Test tank-cleaning hose for electrical continuity between couplings before each use. This is easily and quickly done with a Megger or, preferably, an ohmmeter. As electrical instruments must be used to make the test, carry it out in a place free from petroleum vapors. Be sure that the connections to the couplings are clean and tight before using the instrument.

4. Make sure machines hang clear of the ship's structure or obstructions in the tanks. Allow for their swinging from the motion of the ship.

5. After each use, flush the machine with fresh water; then place a few drops of light lubricating oil on the impeller shaft bearing. (This bearing can be seen by looking down into the inlet.) Next rotate the shaft several times with a screwdriver to allow the oil to penetrate this bearing and prevent salt deposits from forming. After flushing and lubricating the machine, store it in a safe, dry place. The Type K/SK machines should not be stored in oil.

6. Never tie a rope to the inlet of the machine during cleaning, as the rope may foul the machine and stop nozzle rotation. If a rope is required to position the machine or to haul it out of the tank, fasten the rope at the hose coupling just above the machine.

CHECKING AN INOPERATIVE MACHINE

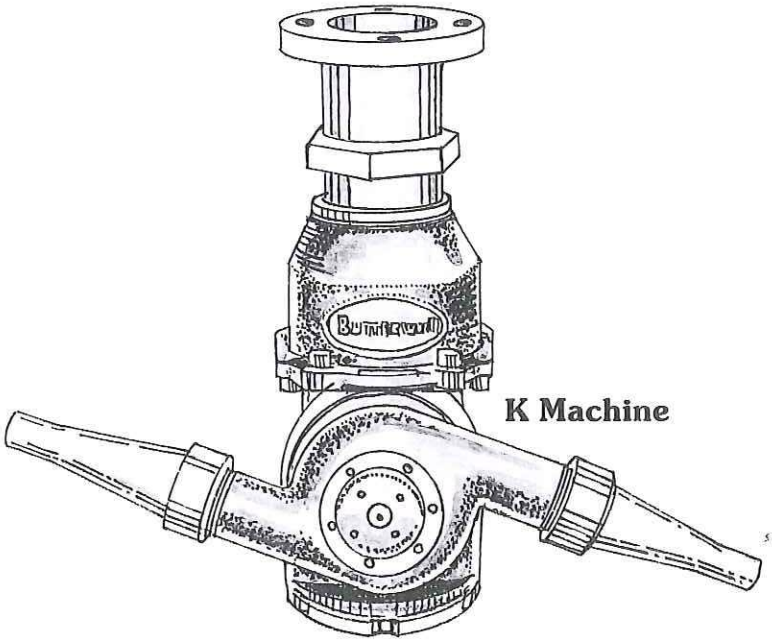
Only the following maintenance procedures should be carried out on leased machines. For any other work, a replacement machine should be requested from Butterworth Systems Inc., or one of its authorized Supply Centers.

If a machine will not operate, determine by hand turning whether or not the nozzle and the inlet will rotate freely in a 360-degree arc. If either the nozzle or the inlet will not rotate, the machine should be replaced as it has probably been severely damaged by dropping or by an unusually hard blow.

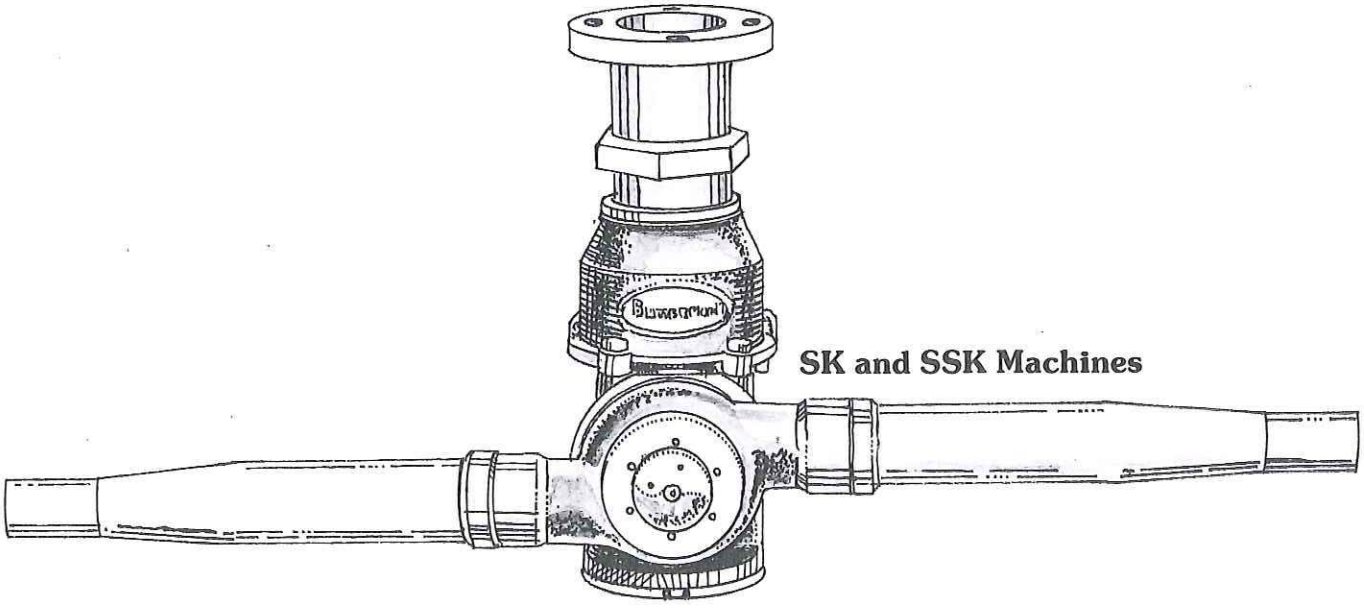
Inspect water passages at inlet and nozzle tips to be sure that foreign matter is not obstructing the water flow.* To inspect nozzle tips, unthread them from the nozzle and remove the tubular insert, which has four equally spaced vanes. (If you cannot remove the insert by hand, use a stiff wire with a small hook at one end to draw it out.) Check the inlet by simply looking down into it to see if any foreign matter is present. Next check the impeller shaft by placing a screwdriver through the inlet and rotating the shaft. If the impeller shaft turns but appears somewhat tight, it may have a salt deposit in the bearing. Placing a few drops of oil and rotating the bearing as previously described will probably free it. If the impeller shaft does not rotate, it is possible that foreign matter is caught in the impeller vanes. To find out, it will be necessary to partially disassemble the machine as follows:

*Refer to diagram on next page.

BUTTERWORTH®
K Series
Tank Cleaning Machines



K Machine



SK and SSK Machines

K Series Portable and Fixed-in-place Tank Cleaning Machines

GENERAL

Proven performers for over 20 years, the K series machines feature rotating twin nozzles and a wash head revolving in planes 90° apart. The "full-sphere" washing pattern traced by the jets on tank surfaces has been compared to the windings of a "ball-of-twine"... with successive traces crisscrossing and falling between previous traces. The result is a highly efficient programed cleaning.

Simple, rugged, and with a proven record for long trouble-free service, the K series machines have long been used portably for water washing. They are also being used increasingly for fixed-in-place crude oil washing of small and medium size tanks and for cleaning hard-to-reach surfaces in larger tanks. They can operate in any position.

K MACHINE.

Small, low-cost and weighing less than 28 kilograms (62 pounds), the K machine has a cleaning range of 10 meters (33 feet) and fluid capacity up to 32 cubic meters (377 cubic feet) per hour. Wash cycle times range from 50 to 23 minutes for inlet pressures of 3.5 to 12 kilograms per square centimeter (50 to 175 psi).

SK AND SSK MACHINES.

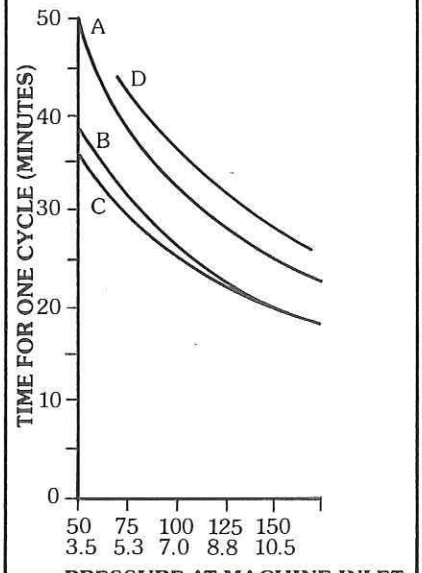
The SK and SSK machines both weigh 30 kilograms (66 pounds) and are identical except for the SSK's larger nozzles and greater capacity. The SSK (only used for fixed-in place installations) has a maximum capacity of 75 cubic meters per hour and a cleaning range of 25 meters (82 feet). The SK has a maximum capacity of 53 cubic meters per hour and a cleaning range of 21 meters (69 feet). The wash cycle times for both units run from 17 to 32 minutes with inlet pressures of 5.25 to 12 kilograms per square centimeter (75 to 175 psi).

SPECIFICATIONS

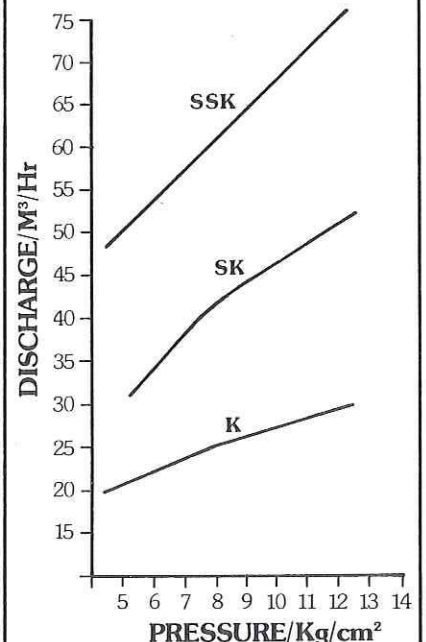
Type: Integral turbine drive.
Activation: Power derived from full flow of washing fluid.
Washing Pattern: "Full-sphere" with 360° coverage.
Inlet Pipe (fixed installation): K and SK–50 mm (2") to 65mm (2.5"). SSK–75mm (3").
Thread Connection (for hose): American National, 2" x 7½ TPI male.

BUTTERWORTH®
TYPE K, SK & SSK
TANK CLEANING MACHINES

A: TYPE "K", NOZZLE TIPS 11mm (7/16")
B: TYPE "K", NOZZLE TIPS 9.5mm (3/8")
C: TYPE "SK", NOZZLE TIPS 14.2mm (9/16")
D: TYPE "SSK", NOZZLE TIPS 22mm (7/8")

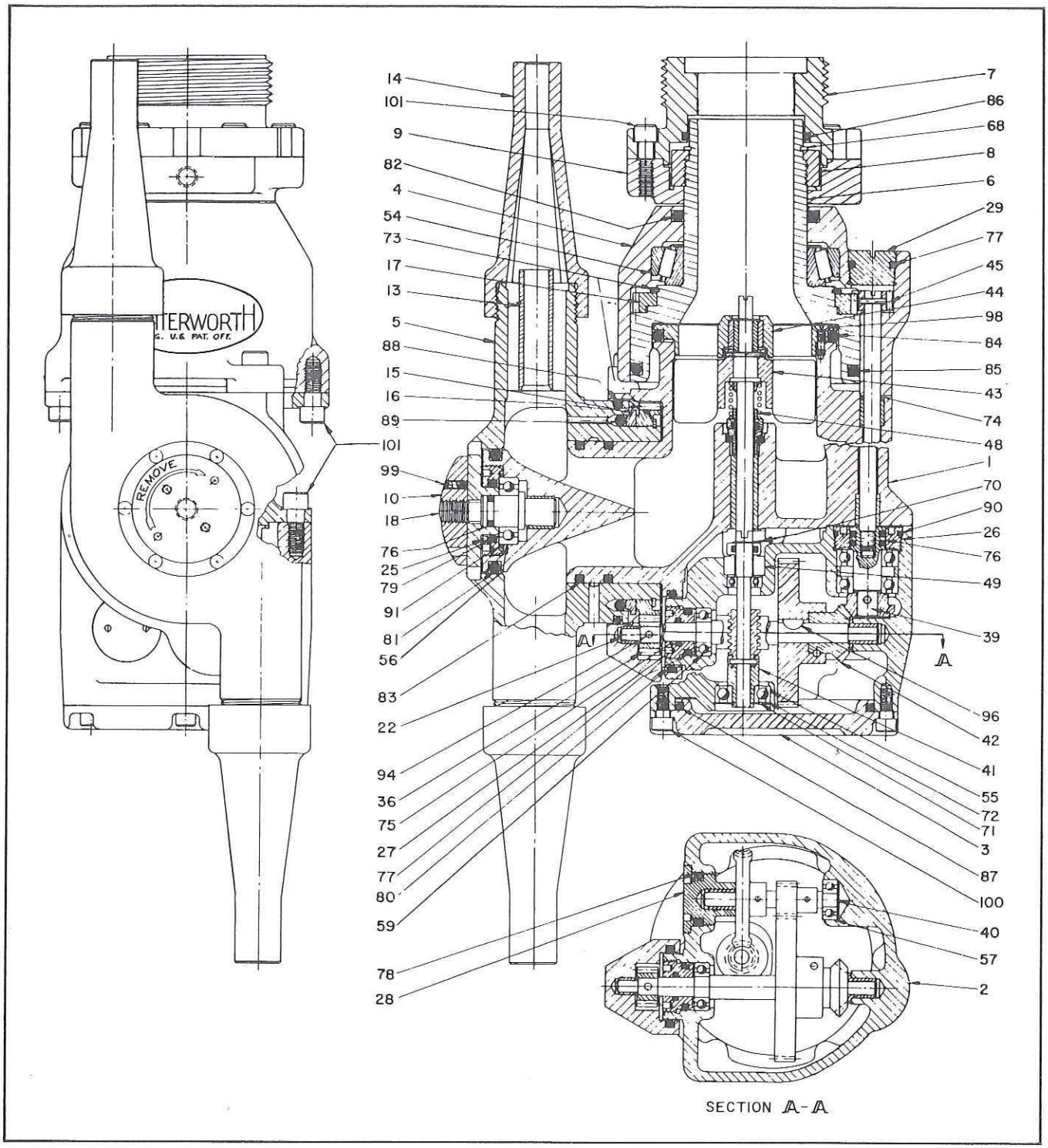


Typical Discharge Rate of K Series Machines



TYPE K PART LIST

PART NO.	DESCRIPTION
K 1	L-HEAD
K 2	GEAR HOUSING
K 3	COVER
K 4	BEARING HOUSING
K 5	NOZZLE
K 6	BEARING SLEEVE
K 7	INLET
K 8	BEARING SLEEVE NUT
K 9	INLET COLLAR
K 10	NOZZLE NUT
K 11	GUIDE VANE
K 12	IMPELLER
K 13	NOZZLE TUBE INSERT
K 14	NOZZLE TIP
K 15	NOZZLE GEAR
K 16	DRIVE RING
K 17	BEARING SLEEVE GEAR
K 18	NOZZLE BEARING SHAFT
K 19	MITER GEAR SHAFT
K 20	IMPELLER SHAFT
K 21	L-HEAD DRIVE SHAFT
K 22	NOZZLE DRIVE SHAFT
K 23	WORM SHAFT
K 24	WORM GEAR SHAFT
K 25	NOZZLE BEARING LOCKNUT
K 26	MITER GEAR BEARING LOCKNUT
K 27	NOZZLE DRIVE BEARING LOCKNUT
K 28	WORM GEAR SHAFT CAP
K 29	L-HEAD DRIVE SHAFT CAP
K 30	MITER GEAR BEARING SPACER
K 31	WORM SHAFT SPACER (If Used)
K 32	WORM GEAR
K 33	IMPELLER SHAFT BUSHING,LOWER
K 34	SPUR GEAR
K 35	MITER GEAR
K 36	DRIVE PINION
K 37	IMPELLER SHAFT BUSHING, UPPER
K 38	GUIDE VANE BUSHING
K 39	MITER GEAR SHAFT
K 40	WORM GEAR & PINION
K 41	WORM SHAFT
K 42	SPUR & MITER GEAR
K 43	IMPELLER & SHAFT
K 44	GUIDE VANE & BUSHING
K 45	L-HEAD DRIVE SHA. . & PINION
K 48	IMPELLER SHAFT SEAL
K 49	WORM SHAFT SEAL
K 50	WORM
K 52	PINION GEAR
K 53	MITER GEAR
K 54	ROLLER BEARING (see below)
K 55	BALL BEARING
K 56	BALL BEARING
K 57	BALL BEARING
K 58	BALL BEARING
K 59	BALL BEARING
K 60	BALL BEARING
K 62	BUSHING
K 63	BUSHING
K 64	BUSHING
K 66	BUSHING
K 67	BUSHING
K 68	RETAINING RING
K 69	RETAINING RING
K 70	RETAINING RING



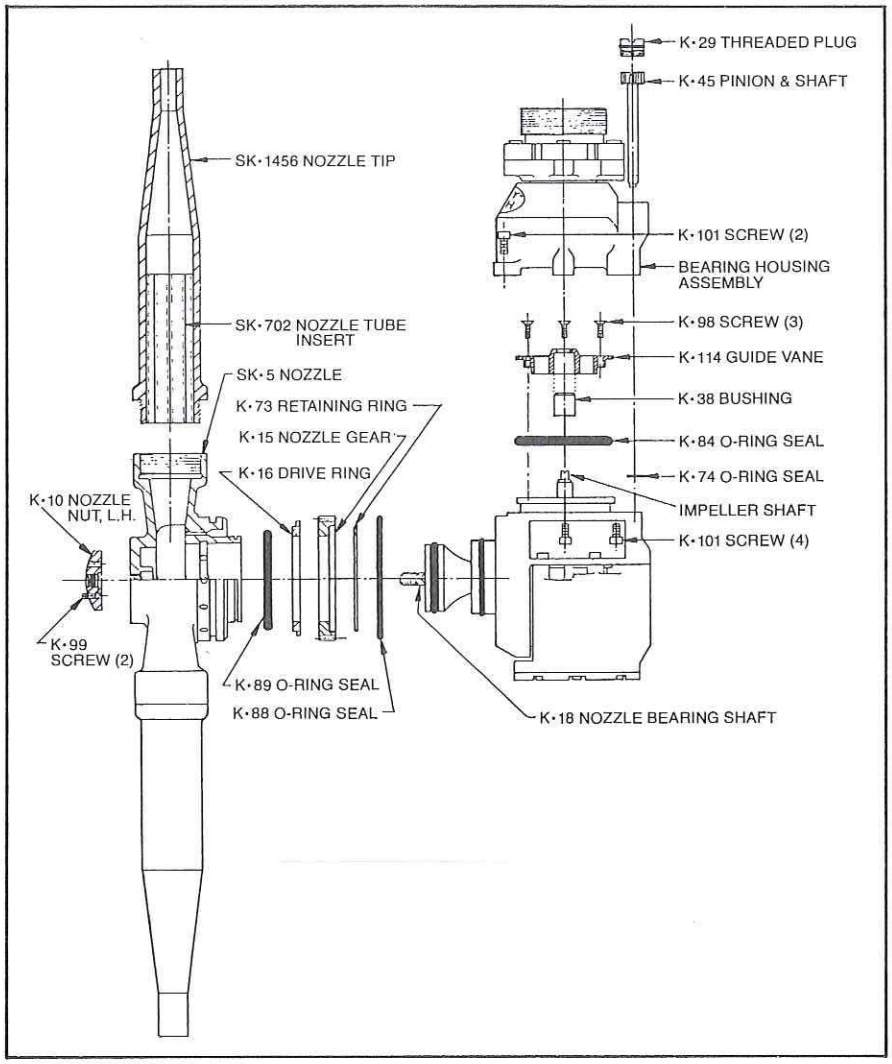
PART NO.	DESCRIPTION
K 71	RETAINING RING
K 72	RETAINING RING
K 73	RETAINING RING
K 74	L-HEAD DRIVE SHAFT 'O' RINGS
K 75	NOZZLE DRIVE SHAFT "
K 76	MITER GEAR & NOZZLE BRG. SHAFT
K 77	CAP & LOCKNUT "
K 78	WORM GEAR SHAFT CAP "
K 79	NOZZLE BEARING LOCKNUT
K 80	L-HEAD "
K 81	L-HEAD, OUTER "

PART NO.	DESCRIPTION
K 82	BEARING HOUSING 'O' RINGS
K 83	L-HEAD, INNER "
K 84	GUIDE VANE "
K 85	BEARING SLEEVE "
K 86	INLET "
K 87	COVER "
K 88	NOZZLE "
K 89	NOZZLE CLUTCH "
K 90	MITER GEAR BEARING LOCKNUT
K 91	NOZZLE BEARING "
K 92	PIN "

PART NO.	DESCRIPTION
K 93	PIN
K 94	PIN
K 95	PIN
K 96	KEY
K 97	PIN
K 98	FLAT HEAD SCREW
K 99	SOCKET SET SCREW
K 100	SOCKET HEAD CAP SCREW
K 101	SOCKET HEAD CAP SCREW
K 102	PIN
S 408	CARRYING CAP

SPECIAL SK and SSK PARTS

PART NO. FOR TYPE K MACHINE (SEE PAGE 1)	EQUIVALENT FOR TYPE SUPER K MACHINE	EQUIVALENT FOR TYPE SSK MACHINE
K 5	SK 5	SK 5
K 11	SK 11	E 5336
K 13	SK 702	SK 702
K 14	SK 1456	E 5337

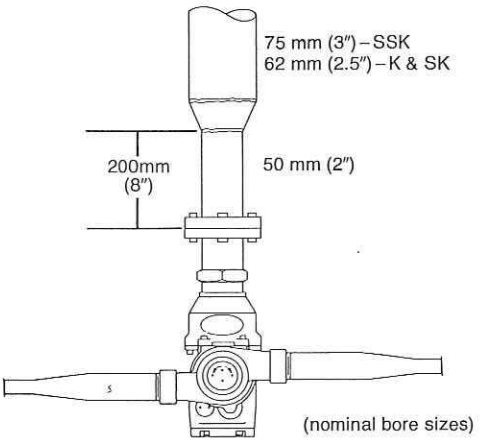


INSTALLATION

For portable applications, BUTTERWORTH K Machines are fitted with American National threaded connections. They may be connected directly to appropriate female hose couplings. Adaptors for other type connectors are available.

For fixed-in-place installations, flanged Series K machines should be specified. To prevent interference with nozzle rotation, the outside diameter of the mating flange should not exceed 140 mm (5.5 inches). When using a supply pipe greater than 50 mm (2″) for the SK and SSK, a pipe reducer is required between the supply pipe and the inlet flange.

Prior to operation all input lines should be checked and flushed out to make sure that they are free of debris.



SAFETY

When used in tanks that may be used for carrying static-accumulation oils, the danger of electrical discharge to probes must be considered. In these instances, either machine should be mounted from the bottom up on transverse frames rather than suspended from the top of tanks, or appropriate operational precautions observed.

BUTTERWORTH

BUTTERWORTH

16737 W. Hardy Rd.
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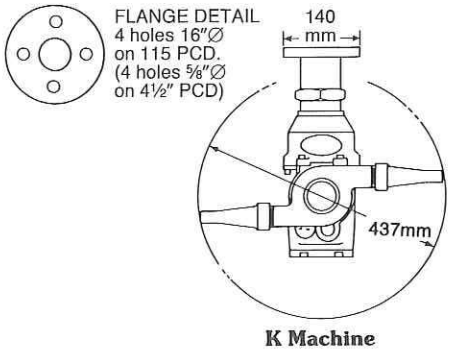
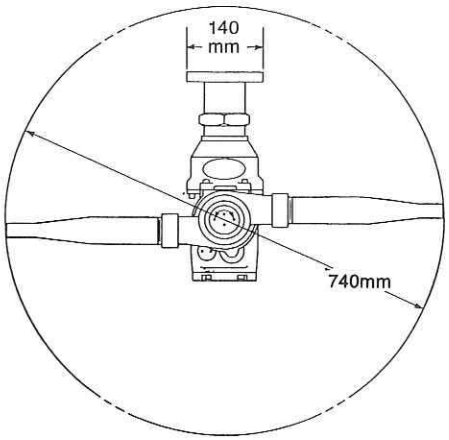


K Machine



SK and SSK Machines

1. Locate a threaded plug *A* at the rear of the machine, opposite the BUTTERWORTH trademark and just below the inlet. Remove the plug with a large screwdriver. Within the opening, a pinion gear mounted on the upper end of the shaft *B* is visible. Its top side is slotted. The lower end of the shaft is threaded and must be unscrewed. It requires nine complete revolutions in a counterclockwise direction to unthread this shaft.

2. Remove six socket-head cap screws *C* which fasten the housing containing the BUTTERWORTH trademark *D* to the lower portion of the machine. Lift the entire housing with inlet assembly off the machine. The pinion and shaft *B* will come away also. If it does not, then the shaft has not been unscrewed as described in (1.) possibly as a result of damage at the lower end of the shaft. The machine should be reassembled and returned. (Be sure not to lose the small *O* ring seal *E* during disassembly.) Inspect the guide vane to see if there is any obstruction between it and the impeller. Remove any foreign matter. Should the impeller shaft still not rotate, the machine has probably suffered damage and should be replaced.

To reassemble, take the following steps in order shown:

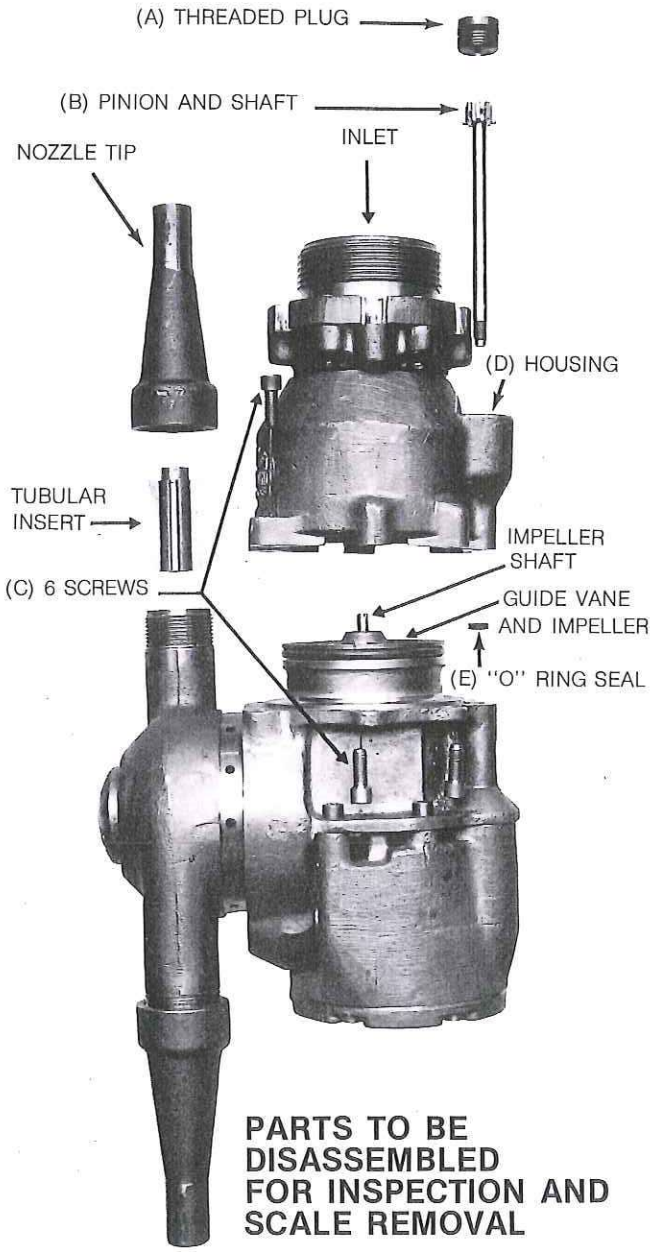
1. Place assembly *B* in housing *D*.
2. Slide *O* ring *E* over protruding end of shaft.
3. Line up housing *D* on lower part of machine.
4. Push assembly *B* down. With large screwdriver, screw end of shaft into mating part in machine. This step must be completed before step 5.
5. Replace assembly screws *C* and plug *A*.

The gear housing is lubricated at the factory and should not require attention for many hundreds of hours of operation. However, it should be inspected once or twice a year to make sure there is no contamination or leakage which might cause a breakdown.

To inspect the gear housing, invert the machine and remove the bottom cover plate. The oil level should be at the level of the horizontal shafts or just covering them. There should be no appreciable amount of water present. (A few drops resulting from condensation will cause no harm.) If there is an appreciable quantity of water, or if the oil has leaked out, a seal is probably failing. In this event the machine should be replaced at the first opportunity.

The oil used for lubrication in the gear housing is Teresstic 68. If for any reason it becomes necessary to change or replace this lubricating oil, use Teresstic 68 or its equivalent. Any lubricating oil used in the gear housing should conform to the following specifications and should contain effective antifoam, antirust, and antioxidation agents:

Specific gravity, °API	30.9
Specific gravity, 60/60 °F.	0.871
Viscosity, SSU at 100 °F	311
Viscosity, SSU at 210 °F	59.3
Pour point, °F.	+ 10
Flash point, °F.	440
Viscosity index	107



PARTS TO BE DISASSEMBLED FOR INSPECTION AND SCALE REMOVAL

CAUTION: Never fill the gear housing more than to the level of the horizontal shafts as this will result in damage to the seals from expansion. Untrained personnel should never attempt any further disassembly than that described. The cost of repairing or replacing any parts necessary for reasons other than reasonable wear and tear is at the user's expense.