

## CHAPTER 5

### SEWER CLEANING

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## INTRODUCTION

One of the most productive parts of a preventive maintenance program is the systematic cleaning of sewers. Another important part, inspection, was discussed in Chapter 4, while the topics of repair and rehabilitation will be discussed in Chapter 6. A cleaning program is necessary to ensure proper functioning of the collection system operation, and to minimize the chances for the development of more serious problems, such as sewer backups and overflows.

The frequency of sewer cleaning depends on many factors. A complete inspection of the system will help with making a decision as to how often any particular section of sewer line should be cleaned. Generally, smaller pipes should be cleaned more often than larger pipes. Also to be cleaned more often are pipes that have shown to be subject to root penetration or grease accumulation. The amount and type of suitable equipment, the availability of trained workers, and the amount of sewer to be cleaned are also factors to consider when developing a sewer cleaning program.

Typically, most communities try to schedule sewer cleaning of their entire sewer system every 1-5 years. An effective cleaning frequency must be determined by each agency for their specific system. Problem sections of pipe will need to be cleaned more often and sections scheduled for certain types of rehabilitation and inspection work will require cleaning prior to the start of work. It should be noted that following an extensive rehabilitation program to remove infiltration and inflow the collection system may require cleaning more frequently. Cleaning action may occur naturally in a sewer system prior to a rehabilitation program if wet weather flows provide sufficient velocities to flush accumulated debris from the sewer system. If the rehabilitation program is successful and wet weather flows are reduced, the cleaning effects previously provided by the wet weather flows may be decreased causing debris to accumulate in areas that were not considered problem areas prior to the rehabilitation program. Problem areas that did exist prior to rehabilitation should be inspected frequently and cleaned when necessary.

## LOCATING AND IDENTIFYING STOPPAGES

### Investigations

Stoppages or obstructions to wastewater flow can be located by the inspection processes described in Chapter 4. These include manhole inspections, sewer lamping and television inspection. Identification of dry manholes through surface inspections may indicate a blockage. This inspection technique, however, will not identify partial blockages nor will it identify the cause of the blockage.

Sewer lamping, which consists of shining light beams or reflecting sunlight through a sewer, can identify partial and total sewer stoppages under the right conditions. However, this technique may not be able to identify the cause of the stoppage.

Television inspection of the sewer line can identify a full or partial blockage and also the cause of the blockage. Television inspection is more costly than the other two investigative techniques and is therefore commonly used in conjunction with one of the other two techniques. Problem areas can be located by manhole inspections or sewer lamping and then specific sewer lines can be televised to confirm a blockage and identify what type of cleaning or repair method will be required.

### Causes of Stoppages

Once a stoppage is located, it is important to identify the cause or type of problem to simplify follow-up maintenance work. Stoppages are caused by obstructions such as roots, grease, debris, structural or joint failures. These obstructions require removal, repair, or replacement immediately to correct the problem.

Many stoppages are caused by vandals who place debris into lines and structure openings which were designed to vent the collection system. Vandals will sometimes remove manhole covers in isolated sewer easements, and these manhole openings may receive large amounts of surface debris which can cause a serious backup of wastewater.

Some stoppages in sewer easement areas also may be caused unintentionally. This is especially true when a large piece of construction equipment begins rough grading work and knocks off the top of a manhole, spilling dirt, rocks, and other material into the opening. In most cases, the equipment operator is not aware of the location of the manholes because they are buried or covered with overgrowth.

Other causes of physical stoppages are obstructions found in the barrel of the sewer. These obstructions are sometimes found to be created by plumbers, equipment, or by some force of nature. An obstruction made by a plumber can be caused by the placement of a building sewer tap connection that protrudes into the main sewer, a poorly repaired pipe section, backfill damage to pipe during backfilling and misuse of trench compacting equipment. Improper use of sewer cleaning equipment also contributes to physical stoppages.

Obstructions caused by natural forces include the penetration of roots into pipe joints, cracks or openings which cause pipes to break and/or restrict wastewater flow. Ground movement which shifts the pipe, freeze thaw conditions, soil conditions surrounding the pipe, and the deterioration of other utility pipes are other natural forces that could cause obstructions in the sewer system.

### Stoppages

Some of the most common types of debris found when removing a stoppage are a build-up of solidified grease, detergents, sticks, rags, plastic bags, broken pipe, brick, rocks, sand, eggshells and silt, to name a few. Larger items removed from lines and manhole openings, which have caused major problems in removal, include broken manhole and flushing inlet castings, concrete and asphalt rubble, steel rebars, large metal and plastic buckets, broken and lost plumber rods, snakes and plugs, wooden posts and timber material, barbed wire, tree limbs, stumps, and many other items.

In some cases, where the invert of a small diameter sewer is connected to the invert of a large diameter sewer, which is flowing at maximum flows, hydraulic conditions can cause serious stoppages to develop. This is caused by a sudden decrease in velocity of the flow when it enters the larger pipe. The velocity decrease may cause solids to settle and cause a blockage. Not only do stoppages develop in the sewer, but solids can build up in a

manhole and produce harmful and malodorous gases. Most instances of hydraulically-caused stoppage conditions are found in sewers that have been extended to new developments from existing mains which were not designed for the future potential growth of the community.

### Preventing Stoppages

Stoppages can be minimized by routine maintenance and proper design. An annual visual inspection of all manholes for debris and structural defects, such as missing or broken manhole covers, can help to prevent physical stoppages. Areas of the system which are susceptible to vandalism should be checked more frequently. Proper design of the sewer system, can help to prevent hydraulic stoppages. A frequent cleaning schedule is the best possible solution to all stoppages.

Once the cause of the problem has been identified, the methods for solving it can be analyzed.

## **METHODS FOR CLEANING SEWERS**

### General

Sewer cleaning methods depend on the characteristics of the wastewater being conveyed, fluctuations in wastewater flows, alignment or grade of the sewer, pipe material, size, and structural condition of the sewer. Stoppages can be cleared or prevented, and sewers cleaned by either hydraulic or mechanical methods. Traps should be placed in manholes downstream from the sewer cleaning operation to catch debris loosened during cleaning. Debris removed from the sewer should be observed for content. The type of debris removed will give a good indication of what types of defects may exist in the sewer and the severity of these defects. The debris removed should be disposed of in an approved location.

### Hydraulic Cleaning Methods

Hydraulic cleaning methods such as jet cleaners, jet rodders, and high velocity cleaners consist of cleaning a sewer with a high pressure water jet. This jet produces water velocities which are usually high enough to wash most grit, grease, and debris down the sewer and leave the pipe clean.

Balls, kites, bags, pigs, tires and scooters are all examples of hydraulic cleaning equipment. These devices fit into a sewer and partially block the flow. Water builds up behind the device and creates pressure. This pressure forces water at a high velocity around the outside edge of the cleaning device. This high water velocity cleans the walls of the sewer and pushes the material and debris downstream where it can be removed at a manhole.

Sewers can also be cleaned or kept clean by flushing. Flushing is most effective with a sudden rush of deep water down the sewer. It is important that depth and velocity are used together because the use of either depth or velocity alone will be ineffective. Devices are available that provide automatic and frequent flushing. Otherwise, hand flushing may be done at specified intervals. The devices commonly used in flushing operations include automatic flush tanks, flushing manholes, a fire hose, a connection to a water main with an air gap device, a temporary fixed dam, and a moving dam.

### Mechanical Cleaning Methods

Mechanical cleaning methods consist of using equipment that scrapes, cuts, pulls, or pushes debris out of the pipe. Mechanical cleaning equipment consists of bucket machines, power rodders, and hand rods. A bucket machine operation includes a special bucket-type device that is pulled through a sewer. This device removes debris as it is pulled through the pipe. Rodding can be done by power or hand. It entails pushing or pulling a steel rod or snake through a sewer with special tools attached to the end. These tools are used to cut roots or to chop up large chunks of debris. Mechanical devices are more effective in clearing blockages than in cleaning, and the sewers sometimes have to be flushed following a mechanical cleaning operation.

### Chemical Cleaning Methods

Chemicals can also be very helpful aids in sewer cleaning. The proper application of chemicals can be used to control roots, grease, odors, concrete corrosion, rodents, and insects. The use of chemicals is strictly to keep these problems under control they are not the solution to these problems. Be very cautious when using chemicals.

## **CONTROL OF ROOTS**

### General

Intrusion of roots into sewers is a problem that requires more discussion. Roots in the soil seek warmth and moisture, which are the conditions found in a sanitary sewer. Roots can penetrate sewer pipe through small hairline cracks, open joints or other structural defects. Once inside, the roots grow and expand in the warm, moist pipe. Root problems are more common in service connections because they are shallower and usually not as well constructed as sewer mains. The presence of roots in sewers causes increased structural damage and infiltration by expanding openings, increasing blockages, decreasing upstream velocities, and increasing solids deposition.

The ideal control method against root intrusion would be to have watertight sewers free from imperfections that will not crack, break, or deteriorate. This calls for thorough inspection of new sewer construction. However, when roots succeed in entering pipes there are techniques available to control or correct the problem.

### Mechanical

Cutting roots with a sewer rod and an auger tool solves the immediate blockage problem. Some types of mechanical equipment used for root cutting are rodding machines, bucket machines, winches equipped with root cutters, root saws, porcupines, and hydraulic jet machines equipped with hydraulically driven cutters. However, roots grow back thicker after they have been cut, so simply cutting roots can cause an increase in root regrowth. For this reason cutting of roots should be followed by chemical treatment or by flooding with scalding water to retard root regrowth.

### Chemical Removal

Chemical treatment of roots involves applying a herbicide, commonly dichlobenil, sodium methyldithiocarbamate, or 2,6, dichlorobenzonitrile by soaking, spraying, or foaming.

Soaking is accomplished by plugging the sewer at the downstream manhole. The pipe is then filled with a one percent solution of herbicide solution and is allowed to sit for an hour or more. This method requires that sewer service be interrupted. Spraying is not highly effective due to short contact time and is therefore not recommended. Foaming does not require isolating the sewer section, therefore interruption of sewer service is not required. Foam is applied with a hose which is pulled through the sewer to an upstream manhole. The foam generator is then started and the hose is retracted to the downstream manhole at a rate specified by the equipment manufacturer. The foam tends to cling to the the top section of the pipe and is not easily washed away. If used properly, foam will not kill trees, grass, or endanger residents or pets.

Another root control method consists of mechanically removing roots followed by grouting joints with a grout mixture which contains a herbicide. The grout mixture discourages root regrowth.

It is important to carefully evaluate the sewer system and all costs involved before making the decision to use herbicides as a root control technique. The decision to use herbicides should be based on the severity of the local root intrusion problem.

## **EQUIPMENT USED FOR SEWER CLEANING**

Deciding which type of equipment is best suited for removing stoppages and cleaning sewers can be done only after analyzing the cause of the problem. The following two sections describe the basic types of hydraulic and mechanical cleaning equipment used and advantages and limitations of each.

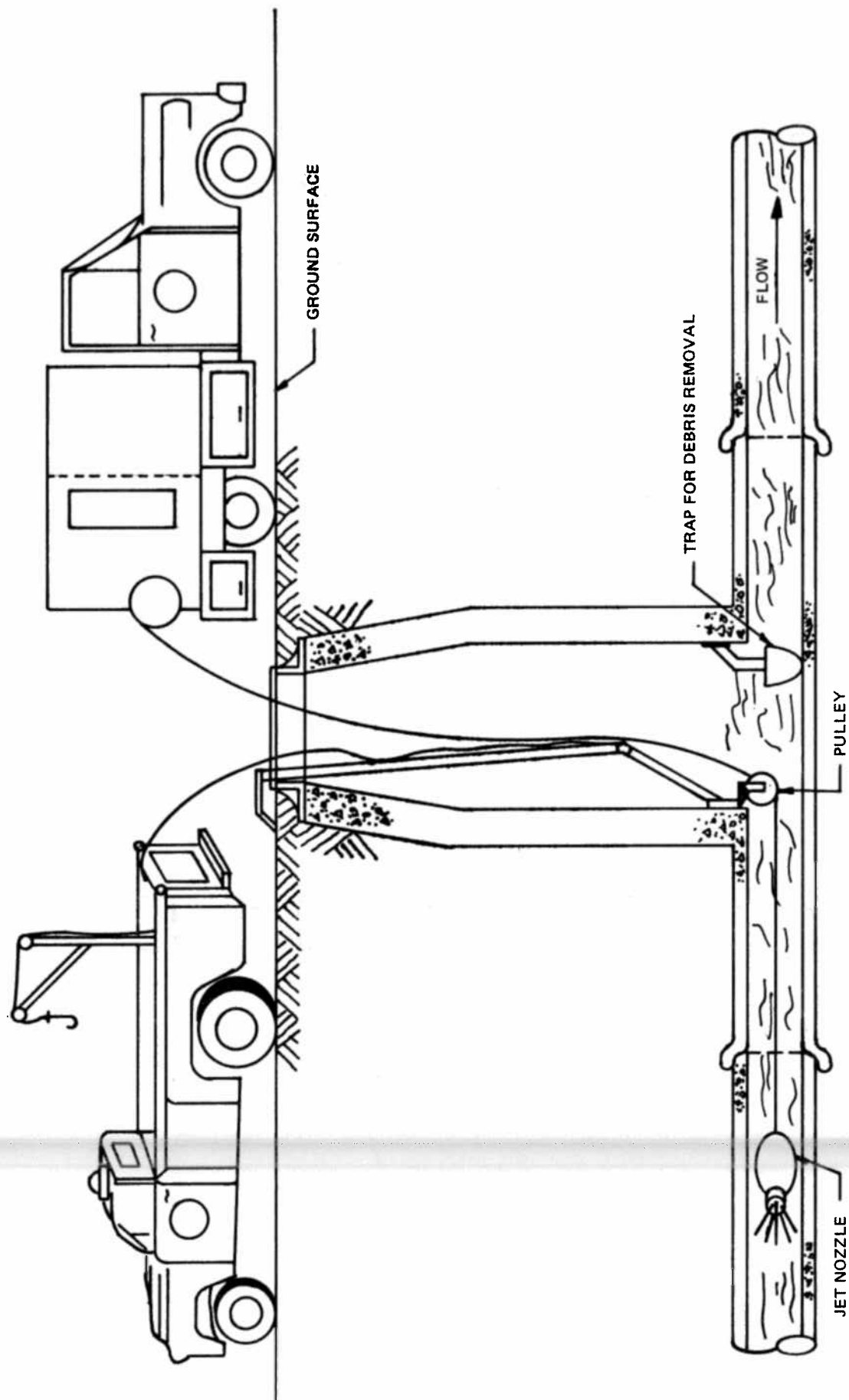
Note: Regardless of type of equipment used, it is highly desirable to have an eductor truck positioned at the downstream manhole to remove and collect the material rather than to successively chase it downstream.

## **HYDRAULIC CLEANING EQUIPMENT**

Sewer cleaning methods described as hydraulic rely on the cleansing action caused by high velocities of water in the line. High water velocities can effectively remove grease, sand, and other debris. Cleansing velocities can be obtained by allowing water pressure, or head, to build up in the line, or by using a pump to produce the water pressure. Hydraulic cleaning methods include high velocity cleaners, balling, flushing, sewer scooters, kites, tires, and poly pigs.

### **High Velocity Cleaning Machines**

The use of water pressure to clean sewers dates back to the early 1900's, however this method has been improved upon by the present day high velocity cleaning machines (Figure 5-1). The fundamental idea of using a self-propelling nozzle on the end of a hose is still used. Instead of using a fire hose hooked to a hydrant, a self-contained portable machine with hoses and nozzles is used, which not only does a better job, but is faster and cheaper. Although the design of the velocity cleaning machine will vary with different manufacturers, they are essentially all the same. Examples of high velocity cleaning equipment are balls, kites, bags, tires, pigs, and scooters.



REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-1. HIGH VELOCITY CLEANING OPERATION**



Manpower and Equipment. The high velocity cleaning machines consist of a water supply tank, usually with a capacity of 1,000 gallons or more; a high pressure water pump and an auxiliary engine for the operation of the pump. The units have a powered drum reel capable of holding at least 500 feet of hose, usually one inch in diameter. To the end of this hose, a nozzle is attached which will create water velocities to do the cleaning. Accessories are varied, and new tools continue to be developed, as well as techniques for their use.

Among the accessories for this cleaning method are a nozzle with rear jets only, a nozzle with rear jets and one forward jet, a dual nozzle, a hose roller or hose guide, and a wash-down gun or nozzle. In addition, sand or debris traps, manhole shovel, debris bucket and hand line, and a manhole cover hook are essential tools.

The machine is operated by one worker. This worker needs help in order to be notified when the cleaning nozzle has reached the upstream manhole, and when the grit and debris are removed from the working manhole. Safety regulations usually require two workers topside when a worker is in a manhole. Refer to Chapter 9 for safety precautions before entering a manhole.

Precautions and Safety. Although some of the precautions of operation have already been given, there are others which soon become obvious. One of these is cleaning from manhole to cleanout. Most often the cleaning nozzle will stop at the bottom of the cleanout. On short runs, however, it is possible to have enough speed and thrust that the nozzle will go up to the street surface, and even knock small cleanout covers out of place. When cleaning up to a cleanout, there is also the chance of getting the nozzle stuck. If this should occur, shut the machine off, pull the cleanout cover, and dislodge the nozzle with a long rod or pole.

While cleaning, so much material can build up below the nozzle that the nozzle cannot be pulled through under pressure. When this happens, stop the pressure and pull the nozzle back through the stoppage without water flowing out of the nozzle. If this fails, try to get the nozzle to the upstream manhole and take it off, thus allowing only the hose to be pulled back through the stoppage to the downstream manhole. Replace the nozzle and go back up the line after the stoppage.

Often a bend in the line will prevent pulling the nozzle back under full pressure. The more pressure at the nozzle, the stiffer the hose becomes. Reduce the pressure, or even turn it off, for a short time until past the bend.

In cold weather, particular precaution has to be taken to prevent the equipment from freezing. Special attention should be given to the high-pressure pump to make sure that it is properly drained. If the machine is equipped with a canopy over the engine and pump area, the areas can be separated by a curtain, and a small electric heater can be left inside the pump area overnight, or when not in use during freezing weather. Another approach to prevent freezing during cold weather is to install a piping system which allows water to circulate through the pump and hose. Be sure to include the hose because some water always remains in the hose, no matter how much time and care are taken to drain it.

An inexperienced worker should not operate the machine alone. Personal safety is not the biggest problem because of the design of the machine; however, costly problems can develop if care is not given to existing conditions in the collection system and those that the cleaning operation can create. Caution and experience are required to prevent "blowing toilets" with a high velocity cleaner.

Also, do not sacrifice clean lines for footage. This equipment is capable of doing a thorough cleaning job. When running low on water, there is the tendency to consider the line to be clean. Take the time to get more water, and make sure the line is properly cleaned before terminating the operation.

**Advantages:** Very effective in cleaning flat, slow flowing sewers. Efficient in removing grease, sand, gravel and debris in smaller diameter sewers. Effective in breaking up solids in manholes and washing structures. May be used to remove emergency stoppages.

**Limitations:** The efficiency is decreased as the size of the pipe increases. May cause backups into residences if not done properly.

### Balling

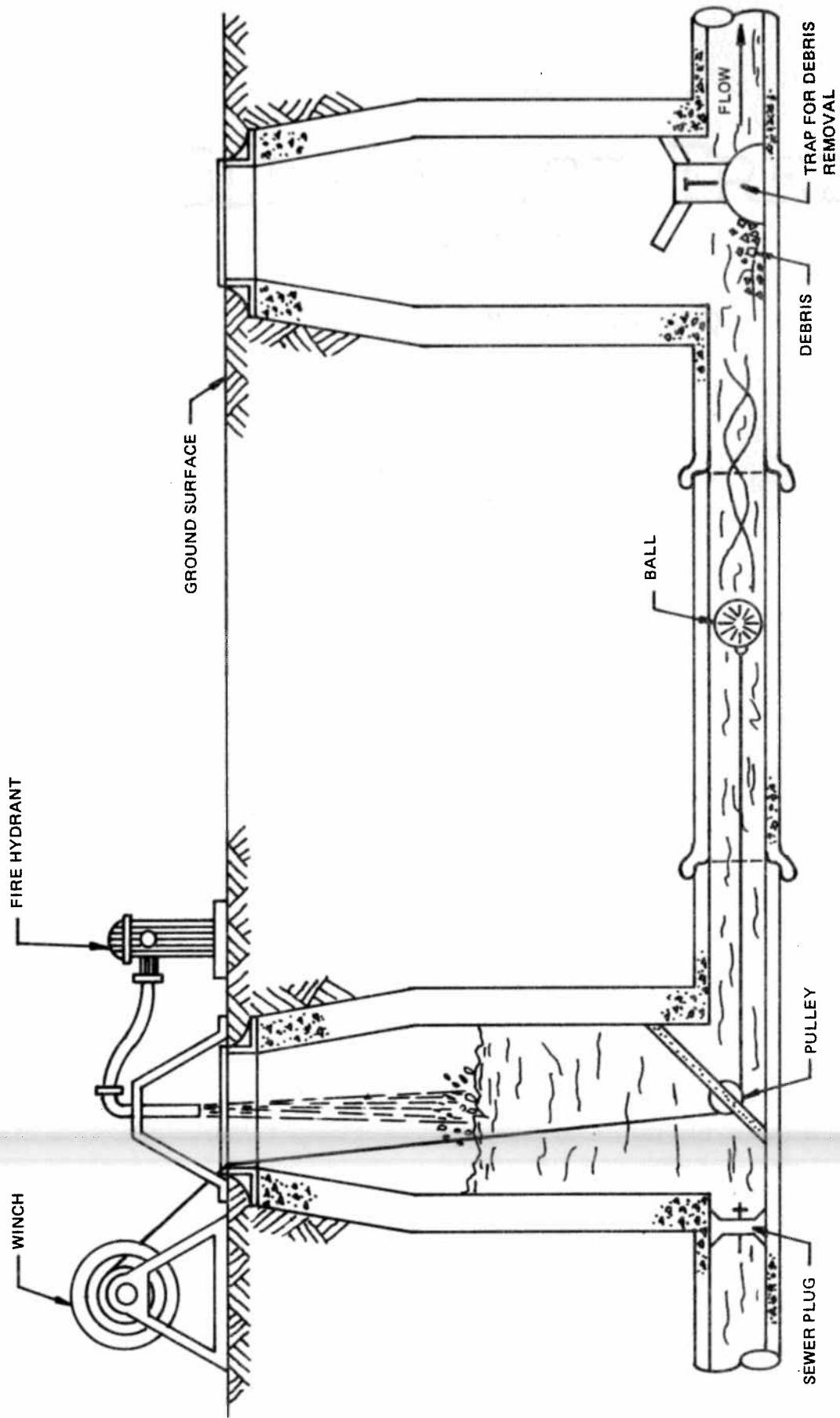
This cleaning procedure is one of the least expensive methods and is quite popular in some cities (Figure 5-2). Usually, balling is not the only cleaning method used by a sanitation agency, since the ball primarily removes deposits of inorganic (grit) material lying on the bottom of the line, and grease buildup inside the line. Balling can be used only in areas where the necessary water pressure behind and around the ball can be obtained without flooding basements or homes at low elevations. Flooding can occur when the elevation of the head of water on the upstream side of the ball is higher than a plumbing fixture in a home or basement. If many roots are in the line, a power rodding machine will probably be needed. Power rodding and other cleaning methods and procedures will be discussed fully in other sections.

Balling is most commonly used in preventive maintenance programs. Under these conditions, balling is very effective in reducing the possibility of stoppages developing. The main purposes of balling are to keep the sewer clear of debris, and to maintain flow velocities of two feet per second or more in the sewer. An effective balling program can also reduce the production of hydrogen sulfide in collection system, thus reducing corrosion and the release of rotten egg odors.

Some sewers require cleaning by balling more frequently than others. Required frequency may vary from six months in some sluggish lines, to three to five years in other lines. These are only typical frequencies. Some sewers may require monthly cleaning, while others may never need cleaning. Many communities try to ball their entire collection system every year. The frequency of cleaning the various sections of a collection system are based on the following:

1. The desire to reduce the number and types of stoppages and complaints by analyzing records and inspecting manholes for the presence and amount of debris.
2. The size of the area served by the collection system.
3. Types of waste carried by the collection system, such as residential, commercial, or industrial.

Manpower and Equipment. At least three workers are needed for cleaning lines up to ten to twelve inches. When cleaning lines located in easements or off the street, additional help may be required, depending on the difficulty of the job.



REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS:  
 A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
 AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-2. BALLING OPERATION**

Basic equipment requirements include:

1. Water truck holding 1,000 or 2,000 gallons.
2. Tag line and a suitable reel to store it on.
3. Manhole jack or roller.
4. Plugs.
5. Balls. These are available in sizes up to 48 inches for trunk lines.
6. Equipment truck.
7. Debris and grit trailer.
8. Ladder.
9. Manhole bars or hooks.
10. Buckets, rope, and manhole shovel.
11. Hip boots and gloves.
12. Waterless hand cleaner and hand towels.
13. Safety equipment.

In some instances, water will be obtained from a fire hydrant to provide the necessary head for a balling operation. In all cases, before using a fire hydrant, check the hydrant usage map and contact the agency water department. If fire hydrants are used, the following additional equipment will be needed:

1. Five to eight fifty foot lengths of 2.5 inch fire hose.
2. Hydrant wrench.
3. Water meter.
4. Control valve for regulating flow at manhole.
5. Traffic ramp to protect hose.
6. Air gap device.

Air gap devices are required to prevent any backflow of wastewater from a manhole into a drinking water supply. The purpose of an air gap device is to provide adequate space above the top of a manhole and the end of the hose from the fire hydrant so no wastewater will flow out of the manhole, reach the end of the hose, and be sucked back up the hose to the water supply from the fire hydrant. Suction conditions could develop if the water supply pipe near the fire hydrant should rupture and cause a washout, or any other rare condition develop that could cause a backflow through the hose.

The tag line material may vary from plain manilla rope to synthetic rope or steel cable required for the larger balls. Some synthetic ropes may be adversely affected by constituents in wastewater, and break in many locations with no previous evidence of deterioration. Cables are considered more reliable.

The reel on which the tag line is stored should hold at least 1,000 feet. The reel should be portable, and the rope easily uncoiled and recoiled. The reel, although used primarily to hold the rope, is also used to apply a brake, or drag, to control the travel of the ball down the sewer.

When cleaning large lines, 14 to 48 inches, a power driven reel is needed, and steel cable is used for the tag line. Usually the cable is one-quarter inch in diameter, and is available with standard balling machines. Power bucket machines can easily serve this dual purpose.

Power driven reels are either truck mounted or trailer mounted, with stabilizer legs to hold the machines firmly in place over the manhole while in operation. Because of the tremendous strain and pressure generated as water builds up behind the ball, a strong steel cable is needed. Truck mounted winches are preferred by some agencies because this method allows the truck to tow other trailer mounted equipment, such as exhaust blowers.

The smaller balls are designed with diagonal ridges and grooves on the outer surface. As water builds up in the sewer in back of the ball, water will flow through these grooves, and the ball will rotate. The outside design of the large balls differs slightly, usually having a heavy tread surface to encourage a scouring action to the interior of the sewer.

Sewer balls are resistant to punctures, and are inflatable by means of a valve core. A strong metal eye lug is molded into each side of the ball to which a clevis and swivel can be attached. The tag line is then attached to control the ball and to allow it to spin. The clevis and ball bearing swivel are very essential items, since they keep the line from twisting. The clevis is quickly and easily fastened to the tag line and ball.

The manhole guide jack or roller is essential to guide the tag line into the sewer without causing unnecessary wear, and to give proper rolling action as the tag line is pulled back and forth or the ball is restrained.

Plugs, either mechanical or inflatable, are needed to control water coming into the working manhole from upstream. If there is insufficient flow in a sewer for balling, this method of "plugging off" the upstream water provides a method of getting an adequate supply of water to begin the balling procedure. A two foot head of water on the ball usually provides sufficient water velocity around the ball to clean the sewer. Plugs are not needed if the flow in the sewer is sufficient to develop the necessary head behind the ball.

If the material removed from the line is to be hauled away by the balling crew, a truck is needed. This truck can be the same vehicle used to carry the balling equipment to and from the job site.

**Precautions and Safety.** Certain precautions have to be taken, or at least considered, before and during all cleaning operations.

1. Using water pressure in the cleaning of gravity flow sewers always requires care and judgement with respect to basement fixtures and low elevation homes. If there is any possibility of the water level behind the ball becoming higher than basement fixtures, inspect these residences or businesses for potential problems, or use another method of cleaning such as a high velocity cleaner.

2. If a stoppage occurs below the ball, it must be cleared as soon as possible to avoid flooding homes or streets. First try to break the stoppage by using the ball. If that doesn't work, use a hand rod, power rodder, or high velocity cleaner at the downstream manhole to clear the stoppage.
3. All street work requires safety measures sufficient for the particular conditions involved. It is important to place barricades or other warning measures a good distance from the working areas. Flagmen should be used where extensive traffic control is required.
4. If a sewer ball becomes stuck, try to work it loose without breaking the cable. A high velocity cleaner, inserted in the downstream manhole, may be able to knock the ball loose. Another approach is to use a power rodder and try to puncture the ball. When a ball becomes stuck, be sure upstream homes do not flood while working the ball loose.

Kites, bags, tires, and poly pigs describe equipment used to clean larger diameter sewers (Figure 5-3). For example, instead of using a sewer ball to clean a large diameter sewer, use a tire slightly smaller in diameter (two inches smaller) than the sewer. With a small head (two feet) on the sewer, the velocity of water flowing around the outside of the tire will create a cleansing velocity like the velocity around a sewer ball. Kites are sometimes called parachutes. Poly pigs are frequently used in force mains similar to balling, but a cable is not usually attached to the poly pig.

**Advantages:** The hydraulic action of spinning balls and high velocity water flowing around the ball dislodges debris from pipe walls and moves debris downstream. Very effective in removing large concentrations of sand, grit, rock, and grease from sewers.

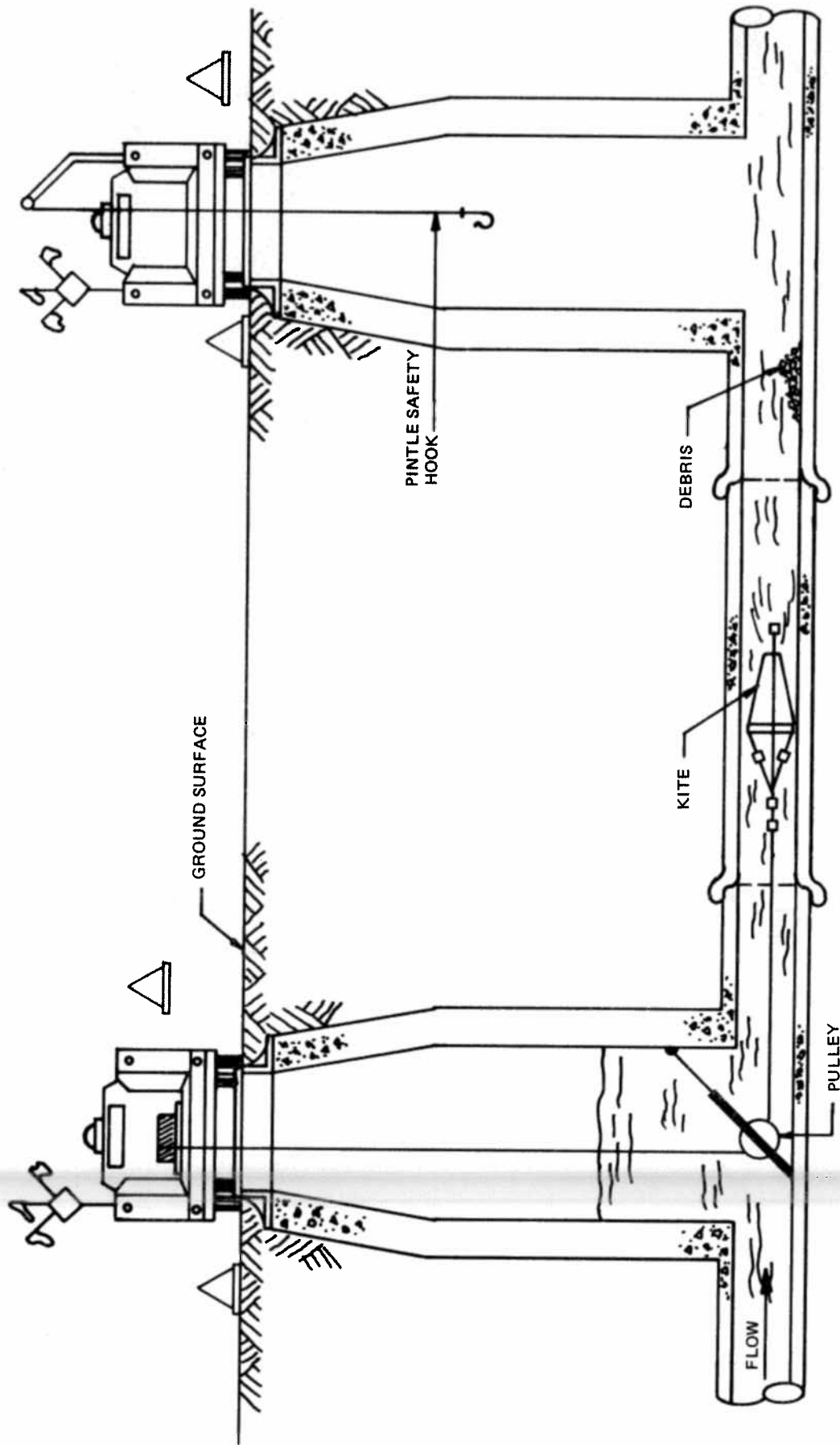
**Limitations:** Dangerous to use in locations with basement fixtures. Possibility of flooding dwellings. Cannot be used effectively when sewers have badly offset joints or protruding service connections because the ball can become distorted.

### Flushing

Flushing is another method of hydraulic cleaning (Figure 5-4). It is occasionally used at the beginning of the collection system where low or sluggish flows permit the deposition of solids. This procedure may be effective in removing floatable debris, but not grit and other heavy solids. Flushing is also used with mechanical cleaning operations such as power rodgers and bucket machines. High velocity cleaners and balling do a much better job of cleaning sewers than flushing.

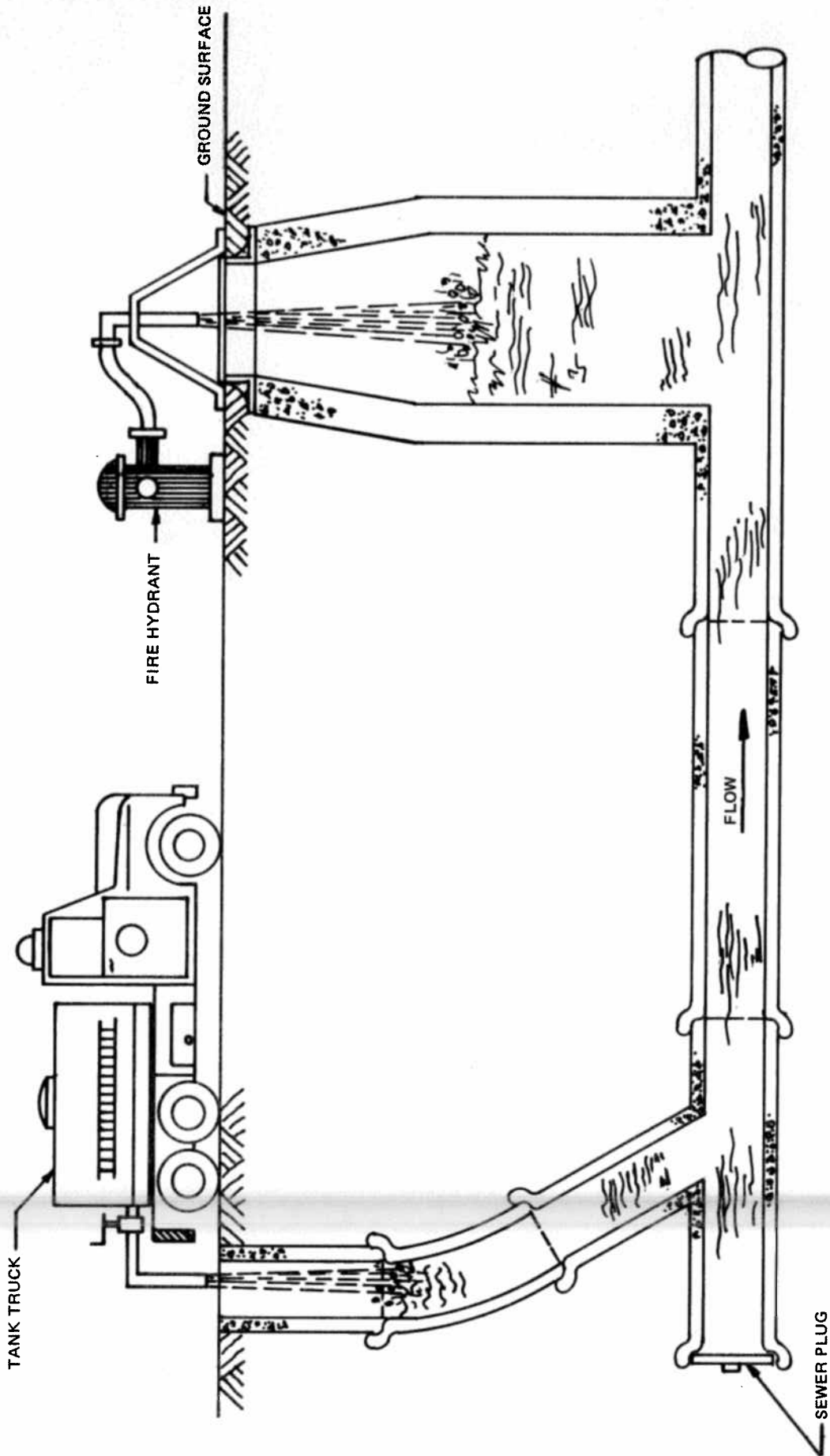
During the flushing operation, observe the flow characteristics in the sewer - is the flow through the manhole slow or sluggish. A partial stoppage may restrict the flow of the flushing water being discharged into the sewer. Observations of lower than expected flows at a downstream manhole indicate that the upstream segment of the line requires additional cleaning. As the water flows, a physical and visual check can be made of the material in the line such as sand, grease, and debris. This observation may also dictate that more extensive cleaning is needed.

Stoppages are often located during the flushing operation. Material often will have just built up to the point of causing a stoppage such that a sudden charge of water will be able to



REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-3. KITE CLEANING OPERATION**



REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-4. FLUSHING OPERATION**



break it loose, thus clearing the line. Having this large amount of water passing through all at once also provides control of rodents and insects.

Also, cleaning the manholes with water pressure eliminates manhole shelf build-up of street dirt and debris. Cleaning the manhole with water pressure, combined with the flushing action within the sewer, will minimize the build-up of hydrogen sulfide and slime in the line. This is one of the primary problems of line decay and replacement.

This method of cleaning in smaller collection systems usually must be repeated frequently to prevent the occurrence of many routine problems, but requires large volumes of water. The opening and closing of hydrants must be done with great care, because improper procedures could create water quality problems in the water distribution system.

Manpower and Equipment. Because of the small amount of equipment and small number of workers required for flushing, the cost appears attractive. However, the procedure may not be cost effective because of the limited cleansing action provided by flushing.

A tank truck with a capacity of 1,500 to 2,000 gallons is needed. The truck should be equipped with a reel for holding approximately 100 feet of one inch inner diameter hose and a pump to give sufficient pressure to do an effective job of manhole cleaning. The nozzle type may vary from an adjustable model to a plain piece of pipe reduced to give a good cutting action. A one-quarter inch pipe nipple, brazed onto a one inch female hose fitting, provides a good stream (if the pump provides 25 to 30 psi in the line) for hosing down the manhole barrels and shelf prior to flushing the line.

A two-and-one-half inch or larger gravity discharge from the bottom of the tank on the truck should be provided to permit a large flow of water. Location of the line must be convenient for the truck driver to position it over the manhole. If possible, the ideal location is just ahead of the left front wheel. This line should be equipped with a quick opening, full flowing valve. A short piece of old inner tube, fastened just above street level, will help direct the flow of water into the manhole if positioning is difficult.

The tank truck equipment should include a good filler hose, usually a short length of fire hose to reach from a fire hydrant to the top of the tank's filling hatch, hydrant wrench, water meter, air gap device and manhole cover lifter. Some communities require a two-and-one half inch water meter so they can pay for the water used in flushing operations.

A debris bucket, rope, and manhole shovel are other pieces of essential equipment, plus the usual safety equipment (see Ch. 9). The equipment and tools for this operation should be arranged on the tank truck in such a manner as to be handy and within the limits of space available.

If the flushing crew consists of only two workers, neither one should ever be allowed to enter a manhole. Flushing crews usually have to enter every third or fourth manhole to remove debris. Whenever a worker enters a manhole for any reason, two workers must be topside at all times. A third worker should be readily available when needed. Refer to Chapter 9 for safety procedures associated with entering a manhole.

Precautions and Safety. Safety measures need to be followed carefully at all times, from properly protecting the equipment and working area with safety cones, to checking manholes for hazardous atmospheres. When flushing, the turbulence may force accumulated gases, from dislodged debris or slime, downstream. Flushing presents problems very similar to those of balling. Care has to be taken not to put more water into

the collection system than it can handle. Caution must be taken against creating a stoppage which, in turn, may flood a residence or business. The amount of material and debris being flushed through should not be allowed to accumulate.

**Advantages:** Supplies a surge of water to move light, decaying organic matter in slow flowing sewers downstream.

**Limitations:** Causes a temporary movement of debris from one point to another in the collection system. Flushing does not remedy the cause of the problem, and does not move heavy debris and grit. Must use caution in locations with basement fixtures.

## MECHANICAL CLEANING EQUIPMENT

Wastewater collection line cleaning techniques described in this section rely on a mechanical action to clear the sewer. This cleaning action results from the material in the sewer being removed by the scraping, cutting, pulling, or pushing action caused by a mechanical device or machine. Cleaning techniques outlined here include bucket machines, power rodders, and hand rods.

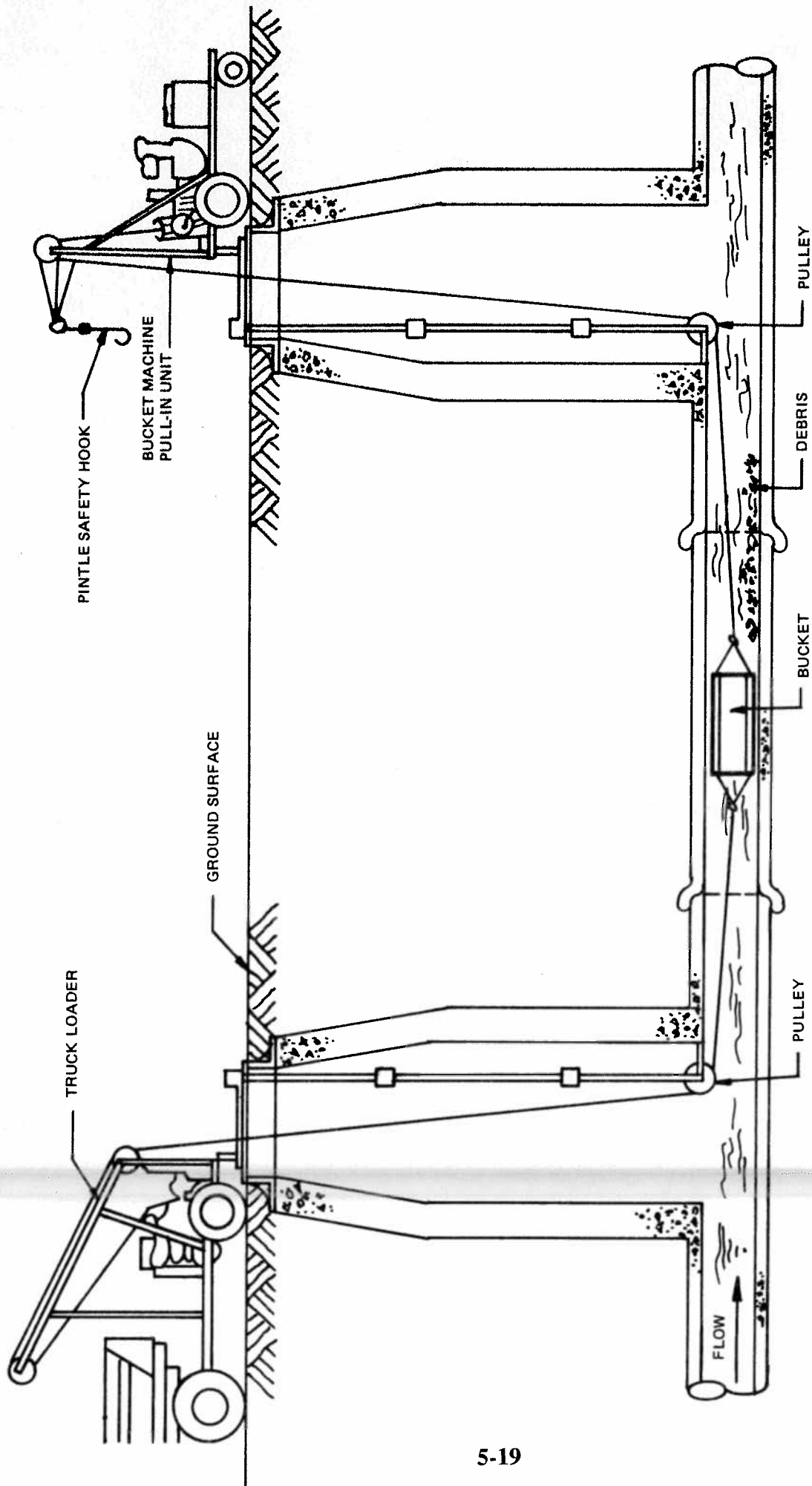
### Power Bucket Machines

Sewers are purposely designed to develop sufficient velocity to provide a self-cleaning action, and to convey solids through the system to the wastewater treatment plant. When deposition of solids occurs in a sewer, first consideration should be given to hydraulic cleaning methods to remove the solids from the sewer. Hydraulic cleaning techniques are used due to their simplicity, effectiveness and the costs of removing the deposited solids in comparison to other sewer cleaning techniques.

There are instances, however, when the hydraulic techniques are not the best method of removing deposited solids or roots because of the volume, size, weight, or type of the material found in the sewer. This material may be concentrated in one area or spread evenly along the line. Types of deposits include silts, sand, gravel, or some type of industrial solid waste. The entry of silt, sand and gravel, and rocks into the collection system is often traced to some damage done either to the sewer line or manholes, or a section where repairs were made to the system. Pipes or manholes may be broken by various construction projects, grade changes of streets, earthquakes, or excessive loads from vehicles and heavy equipment. When a pipe breaks, large quantities of debris can enter the collection system.

When there is an indication that a sewer is failing, and that sand or mud is entering the sewer, a high velocity cleaner should not be used. Nozzle action develops a negative pressure that can hasten the collapse of a failing section of pipe. A bucket machine (Figure 5-5) can be used to remove the sand or mud when proper care is exercised. If possible, a television inspection of the pipe should be performed as quickly as possible to determine the cause of the problem and the condition of the pipe before a cleaning method is chosen.

To clean a line after a pipe breaks, the power bucket machine can be used effectively, both before and after repair, to remove the heavy deposited material. Next, the sewer should be cleaned hydraulically to restore it to full capacity. A damaged line must be repaired to prevent the entry of more material.



NOTE: WORKING MACHINE IS AT THE UPSTREAM MANHOLE

REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-5. POWER BUCKET OPERATION**

The power bucket machine is one of the essential maintenance tools, but it should be used only when absolutely necessary. They are heavy, and the cleaning operation is a slow process. Power bucket machines are used mainly to remove debris caused by pipe failures, or other debris that cannot be removed by hydraulic cleaning techniques. They can also be used as scrapers with a root cutter or porcupine. They should not be used as a routine cleaning tool on a regular basis. Broken lines must be repaired and kept tight so the bucket machine will not have to remove debris from the same broken pipe location in the future.

Manpower and Equipment. Buckets range in size from six to thirty-six inches in diameter. Volumetric capacity of the buckets range from 0.13 cubic feet to 8.5 cubic feet. An 18 inch diameter bucket will pass through a standard 24 inch diameter manhole opening, and has a volume of approximately 1.6 cubic feet.

The bucket machine is usually trailer-mounted, but can be trucktrailer-mounted bucket machine units must have a pintle safety hook attached to the truck that tows the trailer to the job site. Also, a wire cable and shackle should be placed around the truck frame and to the frame on the bucket machine for added safety, in case the pintle hook fails.

The bucket machine units have a steel framework on which is mounted a gas engine and a drum winch. The drum is coupled to the engine through a controllable drive train, usually a chain and belt drive combination. The drum is capable of holding 1,000 feet of one-half inch steel cable, and is mounted on the framework in such a position that it can be centered over a manhole. The framework includes a vertical "A" frame of sufficient height to allow the cleaning bucket to be lifted above ground level.

Two machines are needed for this operation, and both are basically the same in design. At least one machine will also be equipped with an additional smaller drum capable of holding 1,000 feet of one-quarter inch cable. This drum can be operated separately from the one-half inch drum. The purpose is to thread the sewer-line from manhole to manhole, and the other is to have a suitable cable which can be left in the line overnight. The drum, therefore, is often referred to as an overnight drum.

An optional addition to one machine may be a chute with rollers and a shaker bar which allow the material removed to be deposited directly into a dump truck. Machines without this attachment have the "A" frame as previously mentioned. The machine which pulls the bucket out of the manhole will be referred to as the working machine. It will have a small swinging boom or arm attached to the "A" frame which is used for dumping the full buckets. Operation of this machine will be described later.

With each bucket machine, equipment will be needed in the manhole to guide the cable into the sewer line without rubbing or cutting into the pipe. At the working machine, use a v-shaped roller of sufficient size to accommodate the size bucket being used. This roller will be held in place by means of a steel pad which, in turn, is firmly secured flush with the street surface by two adjustable stabilizer legs on the machine. The companion machine may use the same method, or alternately, a slant jack can be used in the bottom of the manhole for the cable to travel over. This would dispense with the use of the pad and roller.

A variety of tools are available for use with these machines, and more are being developed, making the power bucket machines usable for purposes other than bucketing of debris. Root cutters and insertion pullers can be used with bucket machine power winches.

Clamshell buckets and porcupine tools are available in sizes from six to 36 inches in diameter, but sizes under twelve inches are rarely used. The bucket is of such design that

when being pulled into the sewer line, the jaws are in an open position. The jaws dig into the deposits of material. When the working machine pulls the bucket out, the jaws are forced closed by means of a slide action. Any material in or in front of the bucket is scooped up.

The porcupine tool is a steel cylinder having solid ends, with eyes cast in them to which a cable can be attached. Many short pieces of cable protrude from this cylinder like a round brush. This tool is quite effective for final cleanup, since the bristles produce a scrubbing action.

Equipment needed other than that furnished with the bucket machines includes: sandtraps, manhole shovel, debris bucket and hand line, manhole cover lifter, pipe wrenches and hand tools such as crescent wrenches and pliers.

Safety equipment includes flags, cones, barricades, traffic signs, sewer gas detection equipment, safety harness, rope, and other safety devices as the job setup may require.

Experience has shown that many unexpected repairs occur during the clearing operation. Extra cable swivels, clevises, cable clamps, and other essential accessories should be readily available to make such repairs.

The number of workers needed to effectively conduct the clearing operation will vary, but at least three are required, and four workers are recommended. If traffic control dictates, flagmen will also be needed.

Precautions and Safety. Because a rather large tool is being used in the sewer, any problems encountered which would keep the bucket, porcupines, or other such clearing devices from moving can cause water to build up behind it. Prevention of stoppage during clearings should be foremost in the mind of the operator. If there is any questions of the clearing tool getting through, try a smaller size, and determine if a larger tool would pass through the sewer. As mentioned previously, it is important to know the location of the clearing tool at all times. Footage counters are recommended, but if they are not available, keep track of the wrap of cable. In the event the clearing tool has to be dug up, it helps to know where it is stuck.

Regularly inspect cable clamps, clevis and swivels, bucket condition, cable condition, and condition of accessories. If a cable should come loose from the bucket on the wrong end for any reason, you may not be able to pull the bucket through the debris to the manhole at the other end.

If a bucket becomes lodged, do not try to force it through. If pulling the bucket upstream, have the downstream machine pull it back a few feet and try again. Pulling it back will open the jaws, and will likely let the bucket come into the problem area at a different angle. If repeated attempts fail, have the bucket pulled back a few feet, enough to open the jaws, and then hold the brake tightly on the upstream machine while working the machine pulls. This tends to hold the jaws open, and also gives a lifting effect to the bucket.

Be careful when lowering the bucket into the working manhole. Do not allow the cable to tangle or come off the lower roller, by keeping the slack out of the cable. Prevent the bucket bowl from folding back on the bucket when it is pulled into the sewer, because there is no way of flipping back over when the bucket is being pulled.

Personal safety must be stressed when using cable operated equipment. Be especially careful when guiding cable onto the drums. Hands should be kept clear of the drum. Use

a manhole hook to guide the cable. In an instant, hands and fingers can become entangled, and the operator cannot stop the machine fast enough to avoid injury.

New or inexperienced workers should not operate this equipment without proper training and supervision. Some of the safe practices used are techniques acquired through repeated operations and observations of problems encountered during rewinding.

**Advantages:** Removes large amounts of sand and debris from larger diameter sewers.

**Limitations:** May leave as much debris as it removes. Should be followed by other methods. Can damage sewers. Equipment setup is time consuming.

### Power Rodding

Power rodding machines use a steel rod to push or pull various clearing tools through sewers. These machines, illustrated in Figures 5-6, 5-7 and 5-8, vary in design; but are equipped to store either continuous or sectional rods in a reel type cage in lengths up to approximately 1,000 feet. This reel can be rotated to give turning action at the same time the rod is pushed out or in.

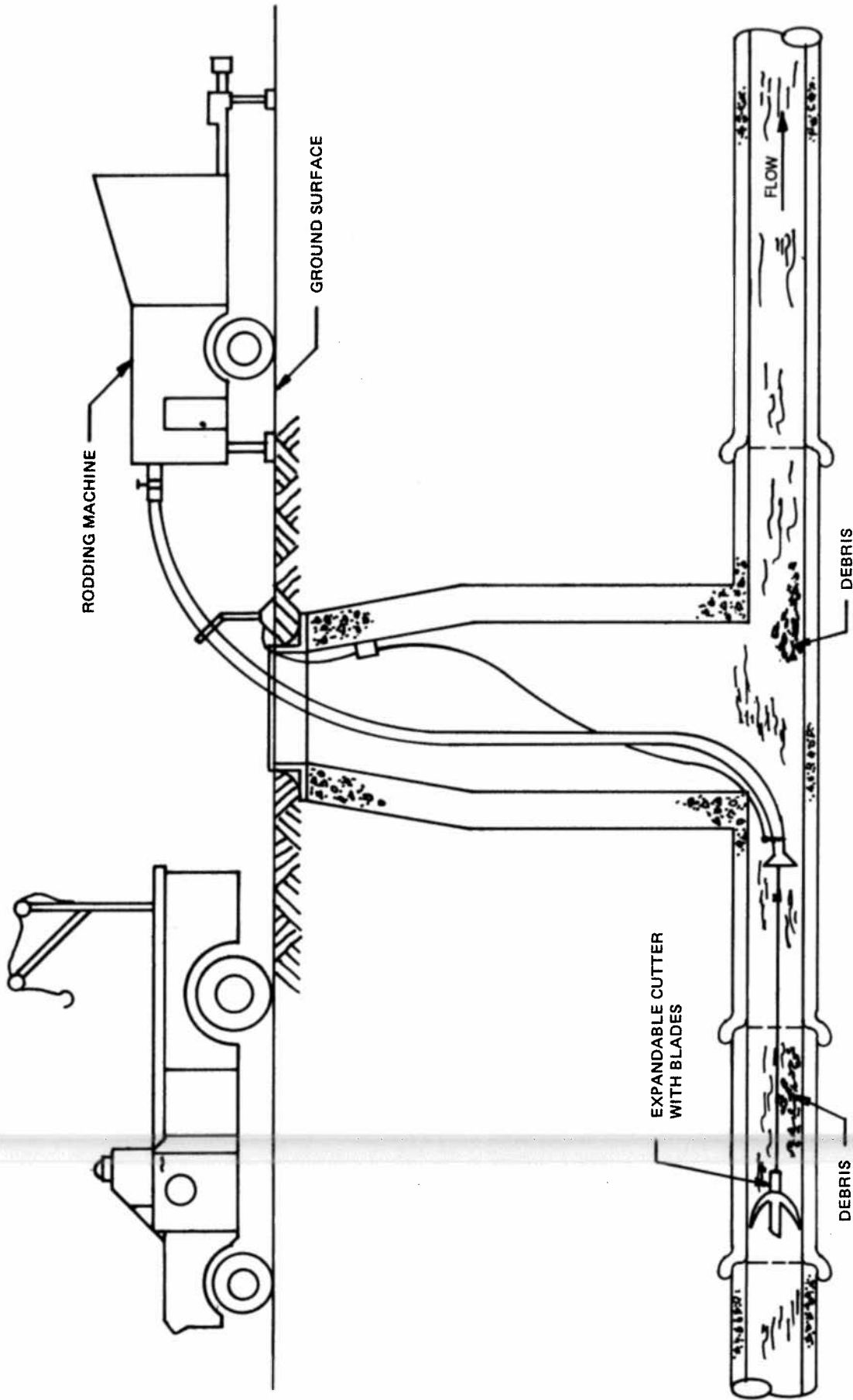
Power rodders can be used for the following purposes:

1. Routine preventive maintenance.
2. Scheduled clearing of roots, grease deposits, and debris accumulations.
3. Threading cable for balling equipment, TV inspections, and bucket machines.
4. Emergency use for clearing stoppages.

Power rodders are one of the most widely used methods for clearing a wastewater collection system. Since the machine were introduced for commercial use in the early 1950's, many improvements have been made in design, operation, and clearing tools.

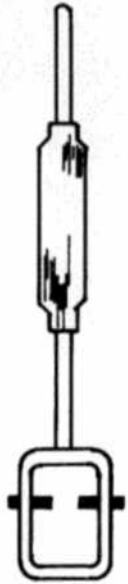
Although other clearing methods play an important role in maintaining the collection system, the power rodder can handle stubborn stoppages of roots, grease, and debris. The power rodder is called for when emergency crews cannot clear a stoppage with hand rods. This could be due to the type or size of stoppages, or if the stoppage is at a distance too great for hand rods to be effective. The power rodder is a handy tool as support equipment to thread cables in lines for other cleaning and maintenance methods. After a sewer has been cleared with a power rodder, it should be cleaned hydraulically to restore the line to full capacity.

**Classification:** The power rodder can be classified according to several different characteristics. Basically, consideration is given for either sectional or continuous type machines. There are, however, machines which employ coiled rod, and are called coil rodders. The electric unit is usually equipped with one oiled rod, and is capable of clearing pipe sized to eight inches in diameter and to distances of as much as 250 feet. The gas powered coil rodder is capable of clearing line sizes of ten inches and distances of as much as 500 feet. A one inch coiled rod is used on gas powered units. The coil rod for both gas and electric powered units is available in 25 and 50 foot sections with a thread and nut coupling.

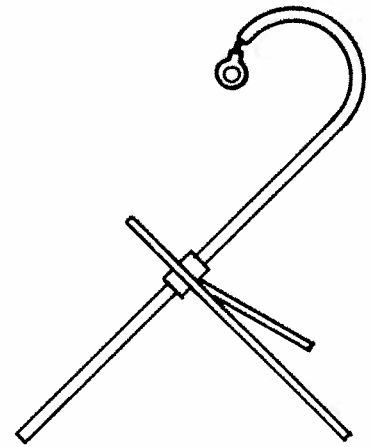


REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

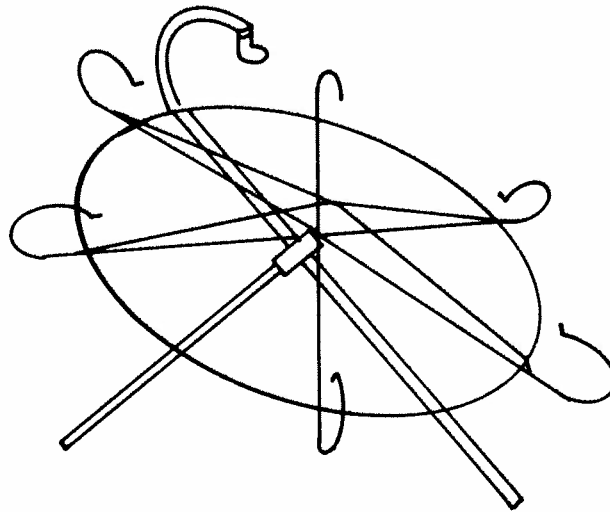
**FIGURE 5-6. POWER RODDER OPERATION**



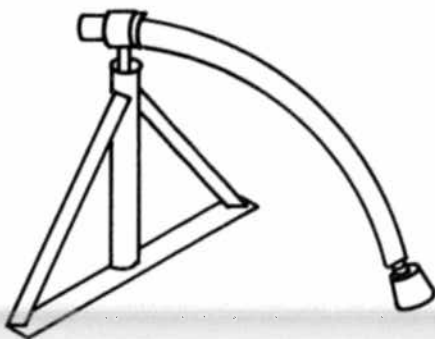
ROD GUIDE HOLDER



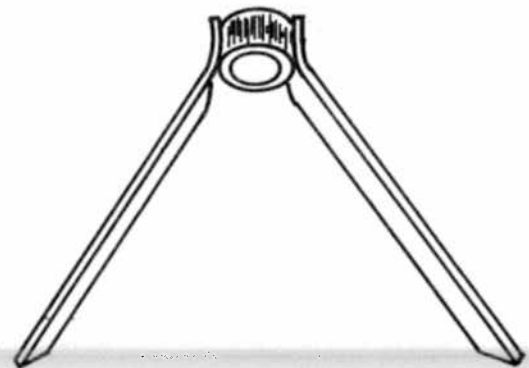
ROD SAFETY STAND



ROD REEL SAFETY STAND



ROD LINE PULLER  
GUIDE PIPE STAND

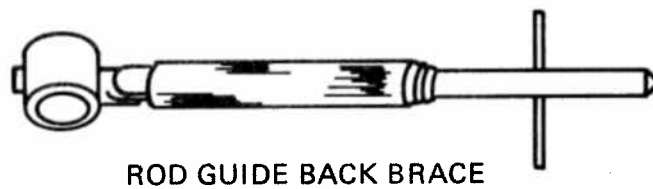
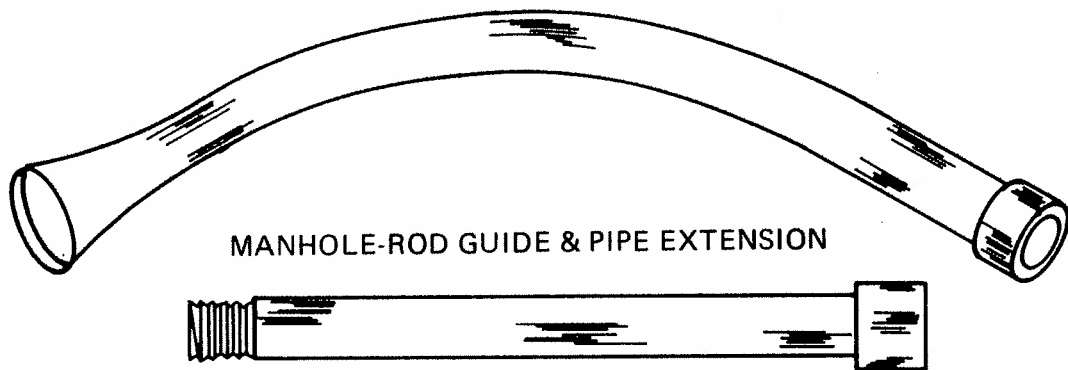
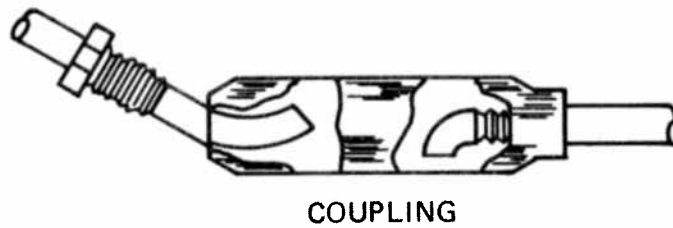
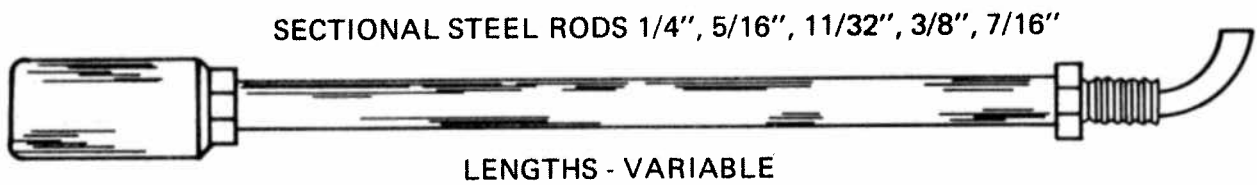


ROD GUIDE FOOT BRACE

REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS:  
A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

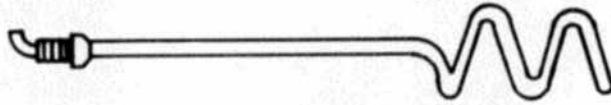
**FIGURE 5-7. POWER DRIVE AND HAND RODDING ACCESSORIES**





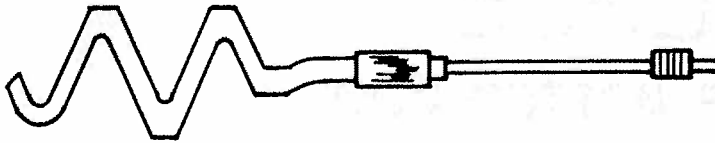
REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-7. (Cont.). POWER DRIVE AND HAND RODDING ACCESSORIES**



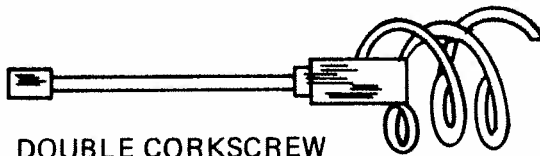
### ROUND STOCK CORKSCREW

FOR RODDING THROUGH SEWERS WHERE CONDITIONS ARE UNKNOWN.



### SQUARE STOCK CORKSCREW

FOR REMOVING HEAVY ROOT GROWTH, SHARPENED CUTTING EDGE WILL TEAR LOOSE ROOTS AND REMOVE OTHER RIGID OBSTRUCTIONS WHEN PULLED BACKWARDS.



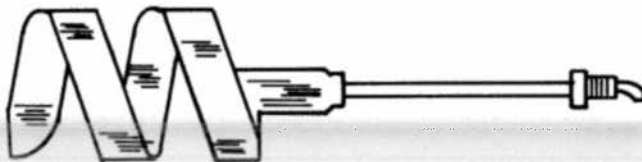
### DOUBLE CORKSCREW

A DOUBLE-PRONGED TOOL TO REMOVE MISCELLANEOUS OBSTRUCTIONS.



### DOUBLE SAND CORKSCREW

THE BORING ACTION OF THE CORKSCREW HELPS TO PULL ROD THROUGH LINES IMPACTED WITH SAND, GRAVEL AND SIMILAR BUILD-UPS. THIS TOOL MUST BE KEPT MOVING SINCE IT MAY SETTLE INTO BUILD-UP MATERIAL AND BECOME STUCK.

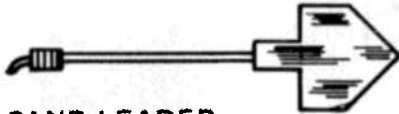


### AUGER

THIS TOOL IS USEFUL IN THE CUTTING OF LONG STRINGY ROOTS AND THE LOOSENING OF SEDIMENTARY DEPOSITS IN SEWER PIPE.

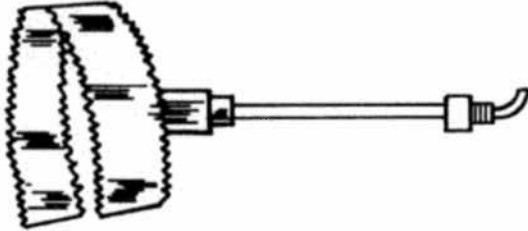
REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-8. SEWER RODDING TOOLS AND USES**



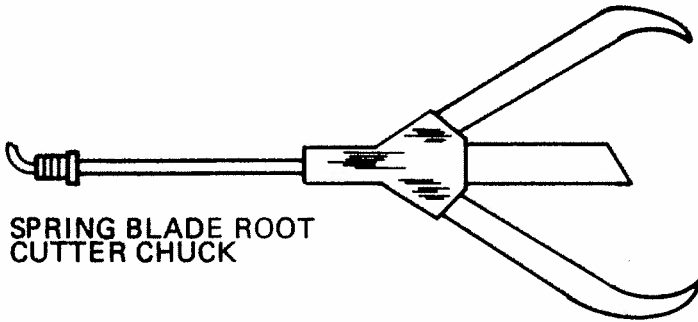
**SAND LEADER**

USED TO GUIDE RODS ACROSS THE TOP OF BUILT-UP MATERIALS IN THE LINE BY THE FLIPPING ACTION OF BLADES



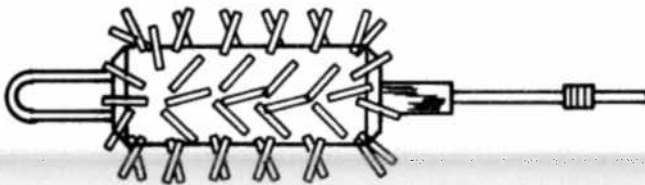
**ROOT SAW**

USED FOR POWER SAWING OF STUBBORN ROOT MASSES IN THE SEWER PIPE



**SPRING BLADE ROOT CUTTER CHUCK**

THIS CUTTER WITH THE PROPER SIZE BLADES IS USED IN PREVENTIVE MAINTENANCE SEWER WORK. SHOULD BE ROTATED AT HIGH SPEED (POWER RODDER MACHINE) AND PULLED SLOWLY THROUGH THE LINE WHILE ROTATING TO EFFECT A THOROUGH SCOURING OF THE PIPE. NOTE: THIS TOOL IS NOT DESIGNED TO BE PUSHED INTO A SEWER LINE.

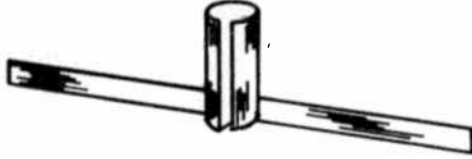


**PORCUPINES**

THE USE OF TURN-TYPE PORCUPINES IS USED IN LINES UP TO 21 INCHES IN DIAMETER AND ITS FUNCTION IS TO SCOUR LINES OF LIGHT BUILD-UPS IN CONJUNCTION WITH WATER FLUSHING OF SEWER LINES.

REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-8 (Cont.). SEWER RODDING TOOLS AND USES**



#### PULLOUT TOOL

USED TO ENCIRCLE ROD COUPLER TO PUSH RODS INTO OR PULL RODS OUT OF LINE.



#### ASSEMBLY TURNING HANDLE

USED FOR ASSEMBLING NUTS AND COUPLERS FOR TURNING RODS, SPRING LOADER PIN ENGAGES HOLE IN COUPLER.



#### BAR TURNING HANDLE

USED TO SECURE INTO HOLE IN COUPLER FOR TURNING, PUSHING AND PULLING RODS.

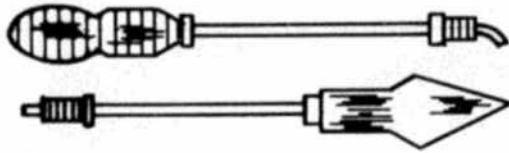


#### ROD END SWIVEL

USED FOR PULLING CABLES AND WIRES THROUGH A PIPE AND IS DESIGNED TO BE FREE TURNING UNDER LOAD AT THE ROD END COUPLING.

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REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.



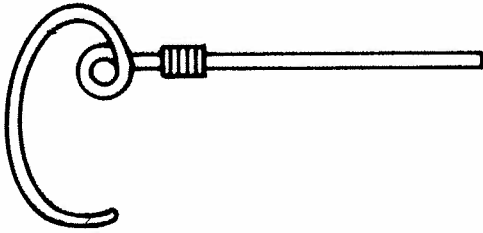
### SPEARHEAD BLADES

USED IN SMALL PIPES TO REMOVE HARD DEPOSITS AND BREAK UP HARD OBSTRUCTIONS SUCH AS GLASS, BOTTLES, CANS AND PLASTER.



### BULLET NOSE

DESIGNED TO BE SCREWED INTO END OF COUPLER FOR LEAST RESISTANCE WHEN RODDING THROUGH HEAVY ROOTS, ETC.



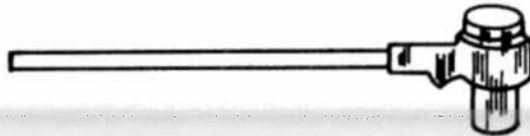
### PICK-UP TOOL

USED TO SNARE BROKEN SECTIONAL SEWER RODS.



### ASSEMBLY WRENCH

USED FOR HOLDING AND TURNING NUTS AND COUPLERS IN ASSEMBLY RODS AND TOOLS.



### RATCHET TURNING HANDLE

USED WITH LOCKING PIN THROUGH PULLOUT TOOL AND COUPLER TO TURN RODS.

REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-8 (Cont.). SEWER RODDING TOOLS AND USES**

Both machines are usually trailer mounted with the trailer equipped with storage boxes for tools and other equipment. The clearing tools used on the coil rodders, though basically designed the same as those used on the large rod machines, have a different type of connection for attaching to the coil rod.

The sectional power rodder is designed to use rods put together in sections. Rod size is 5/16 inch diameter, and is available in lengths of 36, 39, and 48 inches. They are connected with a double nut coupling. The sectional machines will be equipped with a chain drive "head" for one of these lengths, and only that length rod can be used.

The sectional machine, usually 9 to 12 horsepower, is capable of clearing lines effectively of diameters to 12 inches and distances up to approximately 750 feet. In smaller diameter lines it may be possible to extend this to 1,000 feet if the machine's rated capacity will allow. These distances are too long for effective clearing if the sewer contains sand or grit.

The continuous rodder is capable of holding approximately 1,000 feet of one piece continuous rod. Effectiveness decreases with the large line sizes, and consideration must be given to the capabilities of the rodding machine and equipment. Most machines are powered by a 20 horsepower engine, and use a rod with a diameter of 3/8 inch. Other models are available which can use rod diameters up to one-half inch, and lengths of 2,000 feet.

These larger machines are not commonly used for clearing sewers, except for special applications. Generally, a .375 inch diameter rod is used.

Power rodding machines can be operated by a mechanical or hydraulic drive mechanism, or a combination of both. Both styles, sectional or continuous, are basic in their design, and are available either as truck or trailer mounted. There are some small differences in styles, but most of these differences are relative to the individual machine's operation. The following is a comparison between sectional and continuous rods:

1. Continuous rodding machines are quickly and easily loaded, while a sectional rodding machine requires several hours to couple the sections together and tighten them.
2. Sectional rods are pushed through the drive head by a positive drive, not by rollers which can slip and cause wear; however, the "drive dogs" push against the individual coupling, and cause wear to the "drive dogs" and coupling. Couplings on sectional rods cause more wear on the guide liner than continuous rods do.
3. Continuous rodders can rod greater distances than sectional rodders can, and are less apt to break at great distances.
4. Couplings and nuts on sectional rods tend to work loose, and require constant inspection.
5. Continuous rodders are easier to clean than are sectional rodders. Constant care must be given to cleaning both types of rods when they are being retrieved to prevent grit from going up the roller system.
6. When a sectional rod is broken, repair can be quickly done in the field by replacing the broken section or recoupling the rod and adding a new rod when more footage is needed. When a continuous rod breaks, repair is difficult. One

style of rod requires flat spots to be ground on the rod tip for seating set screws. Filing is not recommended because of the hardness of the rod. Another style requires a short, sharp bend at the tip to fit the coupling. Often the rod will break off before a usable bend is attained.

7. A broken continuous rod in a sewer is more difficult to retrieve, since the pick-up tool does not have couplings to grab. The broken end of the continuous rod cannot be reused, and possibly the remaining portion of the rod on the machine is also unusable if remaining footage is too short.

Manpower and Equipment. Two workers are needed to properly operate the power rodder, but three are recommended. One worker performs the actual operation, and an assistant is needed for close observation of the action of the rod and guide hose at the working manhole. The third worker is needed to notify the operator when the cleaning tool has reached its destination, when it is to be removed, or when it is changed to a different tool. If a two-worker crew has to enter a manhole, a foreman or someone else must be called to the job site so two workers will be topside when the third worker enters the manhole.

The operator should be well trained in the use and operation of the power rodder, and will be responsible as well for supervision of the proper setup, safety measures, and selection of clearing tools to be used. The effective use of the selected tool will depend, to a great extent, upon the operator - how well the operator analyzes the problem at hand, and how conscientious the operator may be in getting the sewer as clear as possible.

Tools and accessories are varied, but basic in design. Many have been developed on the basis of field reports, and the industry continues to produce more effective new tools and techniques. The same basic tools are used for either the continuous or sectional power rodder. These tools include root saws, square bar augers, spring blade cutters, round or square bar corkscrews, pick-up tools, and assembly wrenches.

Precautions and Safety. An emphasis must be placed on the speed of rod travel and rotation. These two items combined tend to break or twist most rods. Most machines will be capable of holding close to 1,000 feet of rod. With the weight of the rod on a spinning reel, considerable twisting power is developed, but it also takes a few moments to get it stopped. An operator can get through some difficult stoppages or root problems with skill and patience.

It is not advisable to rod distances greater than from one manhole to the next unless absolutely necessary. Trying to avoid extra set up time in this manner can only compound the hazards associated with power rodding.

With constant use, rods do suffer from fatigue; and when a rod breaks, it is likely to be in the sewer. Avoid turning the rod without rod travel in the sewer. Heat builds up very quickly at any bend when the rod is turning. Therefore, it is important to keep it moving at all times, if possible.

Porcupine cleaning tools are available for attachment to the power rodder. Their use presents several safety hazards. If a porcupine must be used, a winch and tag line must be used to guard against these hazards. Other tools can do a similar job in a safer manner and should be used when possible or practical.

**Maintenance of Rods and Equipment:** Sectional rods should have the rod couplings kept tight at all times. These will work loose during a rodding operation, and a visual inspection by the operator, even while working the machine, can detect a coupling that is loose.

A practice should be made of running the rod out on top of the ground on occasion, to inspect the rod for bent pieces and loose couplings. When they are allowed to stay loose, the rod will wear and become weak at that point. Couplings can be reused, so they should not be thrown away.

Continuous rods are driven by rollers pressing on the rod. A clearing tool in the form of a clamp is furnished with the machine and has a very important function. A coarse piece of cloth or similar material is kept in the clamp tool; and when the rod is ready to be pulled back into the machine, the tool is clamped around the rod at the head of the machine and wipes the rod clean as it is returned to the reel. If grease and grit are allowed to continue passing on into the pressure rollers, they will build up and cause wear on the rod.

Even with a clean rod, the pressure of its being rolled back and forth results in some wear. Therefore, the torque on the drive rollers has to be periodically checked and reset. Specifications for the particular machine are furnished by the manufacturer.

Always avoid sharp bends in the guide hose, regardless of the type of machine. The metal liner can become bent and distorted. Inspect the guide hose frequently and carefully for wear, mounting, and mechanical damage such as crimping. Inadequate maintenance before rodding a sewer can result in considerable lost time while attempting to recover a broken rod. The following necessary maintenance items can easily be done on the job:

For sectional rodder:

1. Inspect for loose rod couplings.
2. Keep drive head chain tight.
3. Inspect for worn drive dogs and improperly adjusted belts.
4. Look for "stacking" of the rod on the reel when bringing the rod back into the reel cage.

For continuous rodder:

1. Maintain proper torque on the drive rollers.
2. Examine for wear on the rod guide bushings.
3. Inspect for sharp teeth on drive gears. This indicates wear or needed adjustment.
4. Look for leaky hoses and fittings on hydraulic units. Maintain proper oil level in the hydraulic oil tank. Keep the hydraulic oil filter clean.
5. Fluctuating oil pressure may be due to hot hydraulic oil. This may or may not be from continuous use. Be sure to check for other problems.

Always keep the rodder, tool, and accessories as clean as possible. The engine should receive the maintenance and care as recommended by the shop foreman or the manufacturer's instructions. With proper maintenance and care, the rodding machine will



do a good job of clearing a sewer. Like any other machine, it has its limitations, and as experience is gained in its operation, so will knowledge of what it can and cannot do.

**Advantages:** May be used to clear stubborn blockages of roots, grease and debris. A wide variety of tools can be attached to the rods.

**Limitations:** Rods can break off inside the sewer line. Excavation may be required to remove the broken rods. Hydraulic cleaning is generally required following power rodding. Some of the power rodding tools can damage the sewer pipes.

### Hand Rodding

Despite all of the modern equipment available, it is still necessary to have hand rods available. (Figure 5-9). One of the main reasons is that hand rods can be used when and where the modern methods cannot be used effectively. Hand rods are a quick and simple solution for many stoppage problems. Hand rods are often used on "service request" trucks and for "off-hours" stoppage calls. They are used extensively for emergencies at night or during weekends. After the stoppage is cleared, thorough cleaning can be done at a later date.

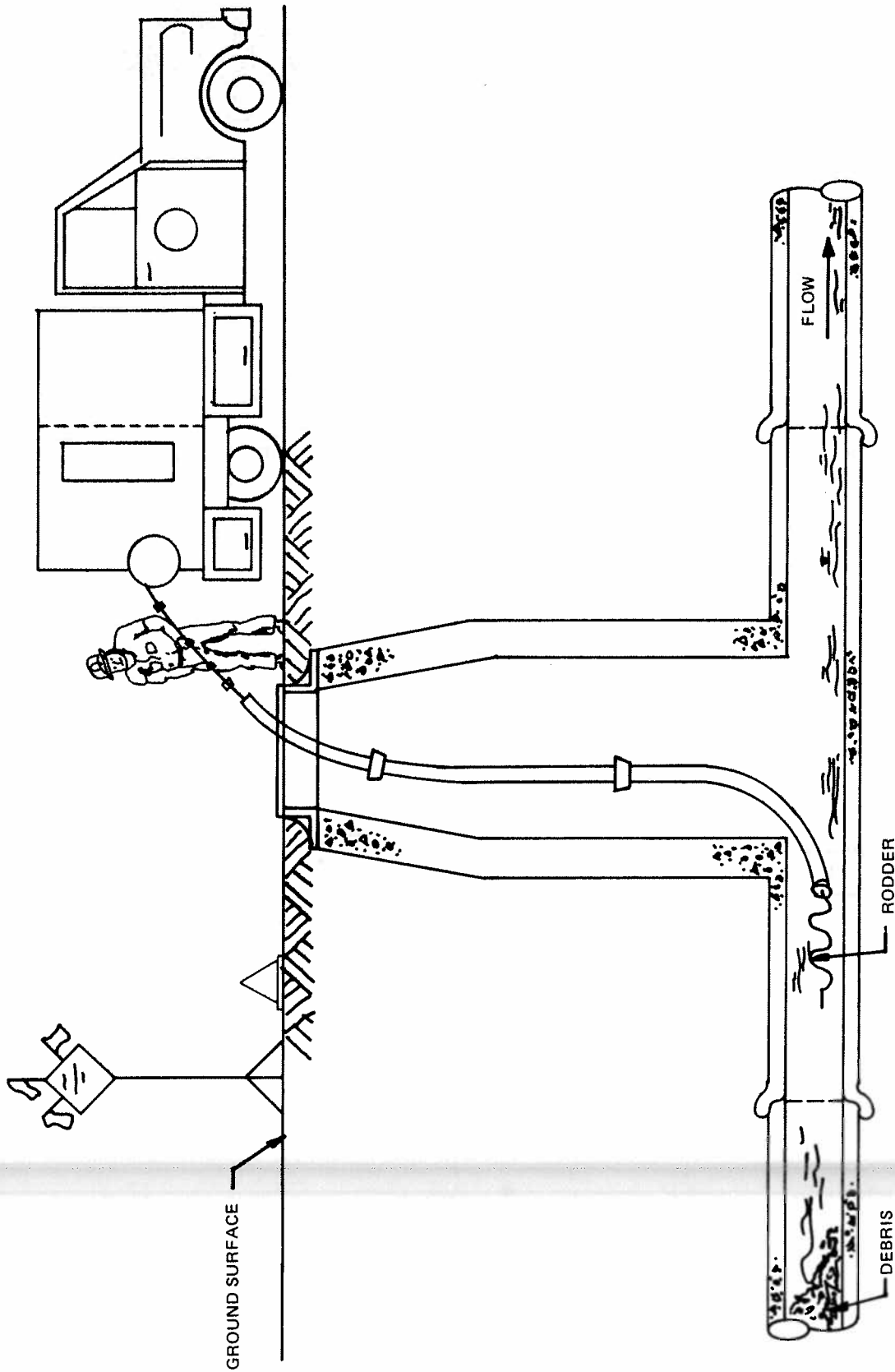
Often, maintenance crews will carry a reel of hand rod on the work truck, to be used in conjunction with the power rodder. If, when clearing a particular area, the power rodder cannot be put to use (such as in an easement), the hand rod can be used. This will ensure that the section will be cleared and not forgotten. Also, a hand rod can be used from the opposite manhole to free a stuck or broken power rod.

Other maintenance crews may do only hand rodding. This is not uncommon in sanitary districts with hilly areas, also in very small districts where the total length of sewer in the system does not warrant machine clearing with other types of equipment. Other factors may be involved, but the main point is that the hand rod is still a very useable cleaning method and will remain to be so, at least for the foreseeable future.

Manpower and Equipment. The particular job will often dictate how many workers will be needed. However, if a crew is essentially doing only hand rodding, at least two workers are recommended. A three-worker crew is required if one worker has to enter a manhole. Usually rod crews or "service request" crews consist of two workers, and they never enter a manhole. See Chapter 9 for safety precautions before entering a manhole.

The hand rods are regular sectional rods as used on power rodders. Usually the rod length is 36 inches. The length is easy to control and makes it simple to keep track of footage or number of sections used. The rod is stored in a shallow reel, approximately four feet in diameter, and so constructed as to keep the rod contained on the reel. It is equipped with a removable tripod which allows the reel to be set up quickly near the work site, at an angle convenient for operation. When the reel is properly set up on the tripod, the rod can be pulled off or onto the reel, allowing the reel to turn freely. Many work trucks are equipped with this reel fastened to the truck. When rodding is needed when the truck cannot be taken, such as at an easement, sections of the rod are simply removed from the reel and pulled to the working area by hand.

Hand rod trailers are available, as well, that are compact, and have the reel mounted at an angle convenient for use. These trailers also have a box for tools, and a rack for a three-wheel, gas powered unit to turn the rod. This power drive is essential, especially when other rodding equipment is not available or useable. The power drive has a lightweight



REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**FIGURE 5-9. HAND RODDING OPERATION**

engine with a gear reduction control which allows the end of the rod to be attached for turning. With a hand control, rotation of the rod can be accomplished to cut roots or to make penetrations into stoppages very similar to the operation of large power rodders. However, the distance of penetration is not as great.

Other than these basic items - reel, rod, power drive, and perhaps a trailer unit - tools would include root saws, augers, cutter blades, pick-up tool, assembly wrench, turning handle, rod guide tube and extension pipe, guide tube jack, sand traps, manhole shovel, debris bucket and hand line, and a manhole pick or hook.

Precautions and Safety. One particular problem occurs all too often when hand rodding. That is, having too much loose rod unattended or used in an unsafe manner. Because it is time consuming to be continually fastening short sections of rod together, the tendency is to use a long section. If proper care and attention are given to this loose rod, a certain amount of looseness is acceptable. However, someone can be seriously injured, and considerable property damage done, should a car run over and catch hold of a loose piece of rod.

Another problem arises when using the power drive unit. If too much distance is allowed between the power drive and the manhole rod guide tube, a loop can easily and suddenly be thrown in the rod, and someone may be injured.

Never use rubber gloves while handling or guiding a rod that is turning. Even if the rod is wet, it will seize the palm of the rubber glove, and if not stopped in time, either twist the glove from the worker's hand or cause injury. Use a manhole hook or other devices to guide a turning rod.

On steep grades where a root mass has been broken loose, it is not uncommon for the water pressure to literally force the rod back out of the guide tube so powerfully that it cannot be held. In that instance, all that can be done is to control the loose rod as much as possible.

**Advantages:** May be used to cut roots, scrape, dislodge and remove certain types of materials found in sewers. This equipment is very effective in removing emergency stoppages.

**Limitations:** Ineffective for removing sand and grit accumulations, but may loosen material so it can be flushed out of the sewer. Rods have a tendency to coil and bend when used in large diameter sewers.

## **SEWER CLEANING RECORDS**

A record of all cleaning operations should be made and filed for future reference. These records should include the date, street name or number, line size, distance, and manhole identification numbers. It is also important to note the type and amount of material removed. For example, if pieces of broken sewer are removed, this may indicate a TV inspection is needed and a repair made on the broken sections of pipe. The amount of auxiliary water used should also be recorded. If particular problems were encountered, these should also be noted.

## **CLEANING VEHICLES**

High velocity water jets, rodders, and bucket machines can be purchased mounted on trailers or trucks. The water jet equipment can be used alone or with hydraulic cleaning equipment such as balls, kites, bags, and pigs. Miniature, portable water jets can be purchased which are either gasoline or electrically powered. These portable water jets cannot produce as much water pressure as trailer or truck mounted water jets and are therefore limited to small diameter pipe cleaning. Common uses for these machines include cleaning of materials, floor drains, sink drains, window wells, etc. Some water jet trucks are also equipped with vacuum loaders which are capable of cleaning debris out of sewer manholes, catchbasins, lift station wet wells, etc.

## **SUMMARY OF CLEANING METHODS AND SOLUTIONS**

Table 5-1 shows the relative effectiveness of the possible cleaning methods when applied to different problems. The larger the size of the box in the square, the more effective the solution is for a particular problem. One problem may have several effective solutions, while another problem may have only one possible solution. Table 5-2 is a summary to provide an indication of the general effectiveness of solutions. Evaluate every problem and select the best solution using available equipment.

**TABLE 5-1. EFFECTIVENESS OF SOLUTIONS**

SOLUTION TO PROBLEM	TYPE OF PROBLEM				
	EMERGENCY STOPPAGES	GREASE	ROOTS	SAND, GRIT, DEBRIS	ODORS
BALLING <sup>1</sup>					
HIGH-VELOCITY CLEANING					
FLUSHING					
SEWER SCOOTERS					
BUCKET MACHINES, SCRAPERS					
POWER RODDERS					
HAND RODS	<sup>3</sup>				
CHEMICALS <sup>2</sup>					
BACTERIA <sup>4</sup>					

**NOTES:**

1. KITES, TIRES, BAGS, PARACHUTES, AND CONES ARE COMMONLY USED INSTEAD OF BALLS IN LARGER SEWERS (GREATER THAN 24 INCHES IN DIAMETER) WITH SIMILAR RESULTS.
2. EFFECTIVENESS DEPENDS ON TYPE OF CHEMICAL AND ITS INTENDED USE.
3. POWER RODDERS AND HIGH-VELOCITY CLEANERS MAY BE FASTER (IF AVAILABLE) UNDER CERTAIN CONDITIONS.
4. EFFECTIVENESS DEPENDS ON FORMULATION OF CULTURES.
5. THE LARGER THE SIZE OF THE BOX IN THE SQUARE, THE MORE EFFECTIVE THE SOLUTION IS FOR A PARTICULAR PROBLEM.

REFERENCE: FROM OPERATION AND MAINTENANCE OF WASTEWATER COLLECTION SYSTEMS: A FIELD STUDY TRAINING PROGRAM. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND OFFICE OF WATER PROGRAM OPERATIONS. CALIFORNIA STATE UNIVERSITY, SACRAMENTO.

**TABLE 5-2. CLEANING AND MAINTENANCE PROBLEMS AND SOLUTIONS**

Identification of Problem	Source or Cause	Solution Method	Comments
<p>1. Stoppages - emergency condition such as overflowing manholes and/or flooding of residences or businesses.</p>	a. Grease	Hand rods and high velocity cleaner	Hand rods will usually unplug most grease stoppages. Rod from downstream manhole with 4" auger into stoppage. When clear, run 6" auger through restricted area. Write work request to high velocity clean line as soon as possible. If cannot open with hand rods, try high velocity cleaner. A high velocity cleaner will open most grease stoppages.
	b. Roots	Hand rods	Rod from downstream manhole with 4" auger or saw. Be cautious in opening stoppage if there is a high head on the upstream manhole. Remove as much of the root mass as possible. Request TV inspection for root concentration; schedule power rodding to open line and chemical treatment to control future root growth. Hand rods are effective 90% of the time. If cannot clear roots with hand rods, try high velocity cleaner.
		High velocity cleaner	High velocity cleaner will usually open stoppage and restore service. Schedule TV check and treatment. If unable to clear roots with high velocity cleaner, try power rodder.
		Power rodder	Power rod line to clear stoppage. Schedule TV check, cleaning, and chemical treatment.
	c. Debris stoppage such as rocks, lumber	High velocity cleaner	Caused by broken lines, open manholes, vandalism.
		Power rodder	Clean line with high velocity cleaner. Use caution. May jam tool in line requiring a dig-up to clear line and remove broken rod and tool.

**TABLE 5-2 (Cont.). CLEANING AND MAINTENANCE PROBLEMS AND SOLUTIONS**

Identification of Problem	Source or Cause	Solution Method	Comments
2. Grease  Stoppage causes grease build up	a. Restaurant on blocked segment of sewer	High velocity cleaner	High velocity cleaner is an effective tool in removing grease build-ups in line sizes up to 15 inches. High velocity cleaner becomes ineffective in larger diameter pipes.
TV report on routine inspection	b. Low velocity allowing grease build-up from home disposal unit. Problems often develop where high velocities are suddenly slowed down.	Balling	Balling will remove grease deposits from pipe walls, but will not clean walls as effectively as high velocity cleaner.
Observe build-up on side walls of sewer		Kite	More effective in greater than 18-inch diameter lines than high velocity cleaner.
Past records		Power rodder	Extensively used, but not as effective in grease removal as high velocity cleaner and balling - usually ineffective in lines above 10 inches.
		Chemicals	Be sure to insist on a performance contract. Do not pay until the chemical or material performs as claimed.
Grease trap		Clean trap regularly	A regular maintenance program must be established and continued.
3. Roots	a. Trees and shrubs	Chemicals	For long-term control, chemical treatment provides the best solution with up to three years between applications.
TV report			
Poor joints or damaged pipe allow root entry		Power rodder	May be used to clear an opening so that flow may pass. Cutting roots stimulates root growth. Therefore, if power rodding is only control used, it must be repeated frequently.
Past records		Repairs	If TV report shows only one section of broken line or a few bad joints, dig up and repair. If a great number of defects are observed, consider pressure sealing or relining the pipe.

**TABLE 5-2 (Cont.). CLEANING AND MAINTENANCE PROBLEMS AND SOLUTIONS**

Identification of Problem	Source or Cause	Solution Method	Comments
4. Sand, grit, debris  TV report	a. Eggshells, coffee grounds, bones from residential disposal units	High velocity cleaner	For light concentration of grit in small lines, not effective in lines above 15 inches.
Grit settles during low flows		Balling	The work horse for cleaning. Large volumes can be removed at a reasonable cost. Requires careful control in shallow lines. Not manageable in sewers larger than 24 inches.
Grit sticks to grease or slime	b. Broken china, bones, and glass from restaurant disposal units	Kites	More effective in larger lines. Removes some dangers of flooding in shallow lines that balling may create if not properly controlled.
Routine inspection	c. Sand, silt from poor joints and broken lines	Bucket machines	Used where extreme concentrations of grit and sand have loaded the line to extent that the above methods are ineffective due to cost and handling of materials to be removed.
Past records	d. Lines with low flows or velocities permitting deposition of solids		
5. H <sub>2</sub> S and odor control	a. Force mains	High velocity cleaner	Fast cleaning of slimes in lines up to 15 inches.
Odor complaints	b. Low flows and velocity	Balling	Best for sewers with bellies and offset joints in lines up to 24 inches, but expensive operation for odor control only.
Manhole inspection reveals line deterioration	c. Bellies in line	Flushing	Small lines. Usually not effective for more than one week.
	d. Drop man-holes	Plug lifting and vent holes in manhole cover	Roofing cement makes a satisfactory hole sealer.
	e. Manhole where trucks dump septic tank contents	Control program	Develop program using combination of solutions.