

## CHAPTER 5

### SEWAGE PUMPS AND LIFT STATIONS

#### Section I. TYPES AND CHARACTERISTICS

##### 5-1. General

Pumps for lifting sanitary sewage, storm water, and plant-unit effluents are usually high-capacity, low-head types with large openings and low velocities to allow passage of large particles of solid material. The types in most common use are the centrifugal, axial-flow propeller, turbine, and ejector. A detailed description of pumps and their operation is given in TM 5-660.

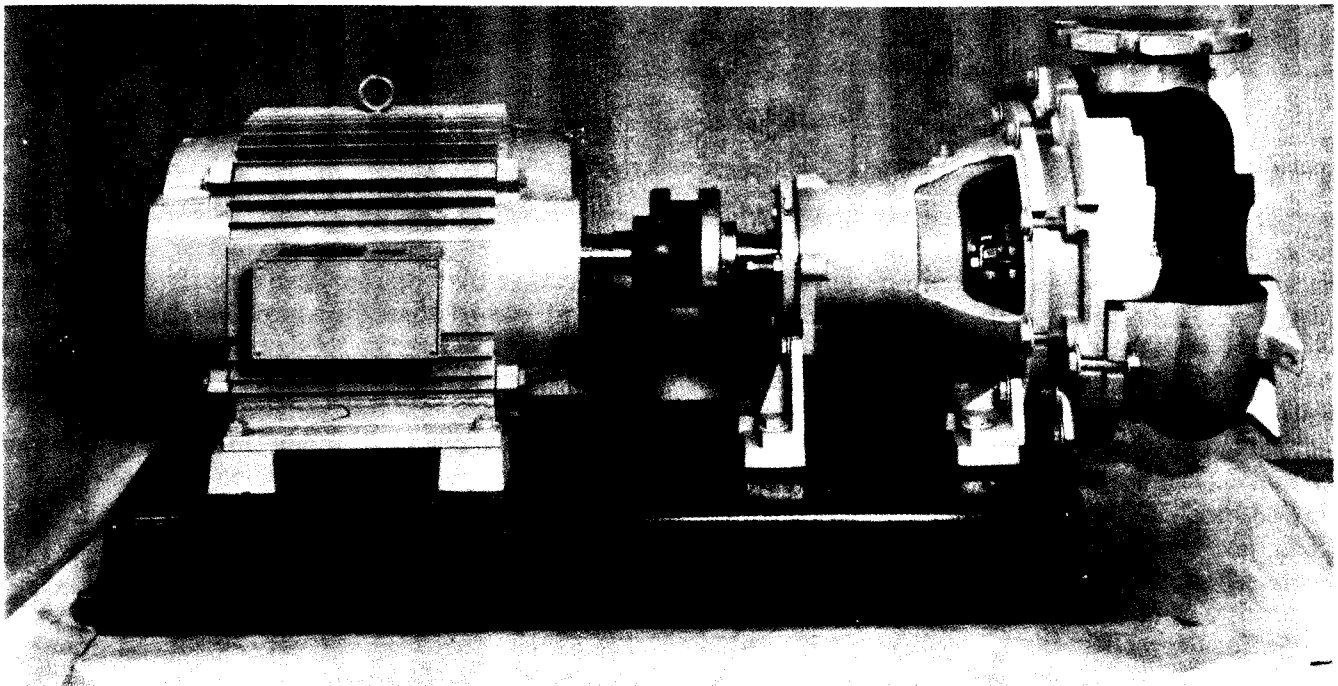
a. Desirable characteristics in sewage pumps are freedom from clogging and resistance to wear. Most installations provide for pump protection by adequate screens or grinders which either remove the larger solids or cut them to a size which can easily pass the pump openings. Because rags and strings, which cause stoppage, are most troublesome, provision is usually made in the pump casing for their ready removal.

b. Sewage pumps may be powered either by electric motors or internal-combustion engines. Gas from sewage digesters is sometimes used as a fuel.

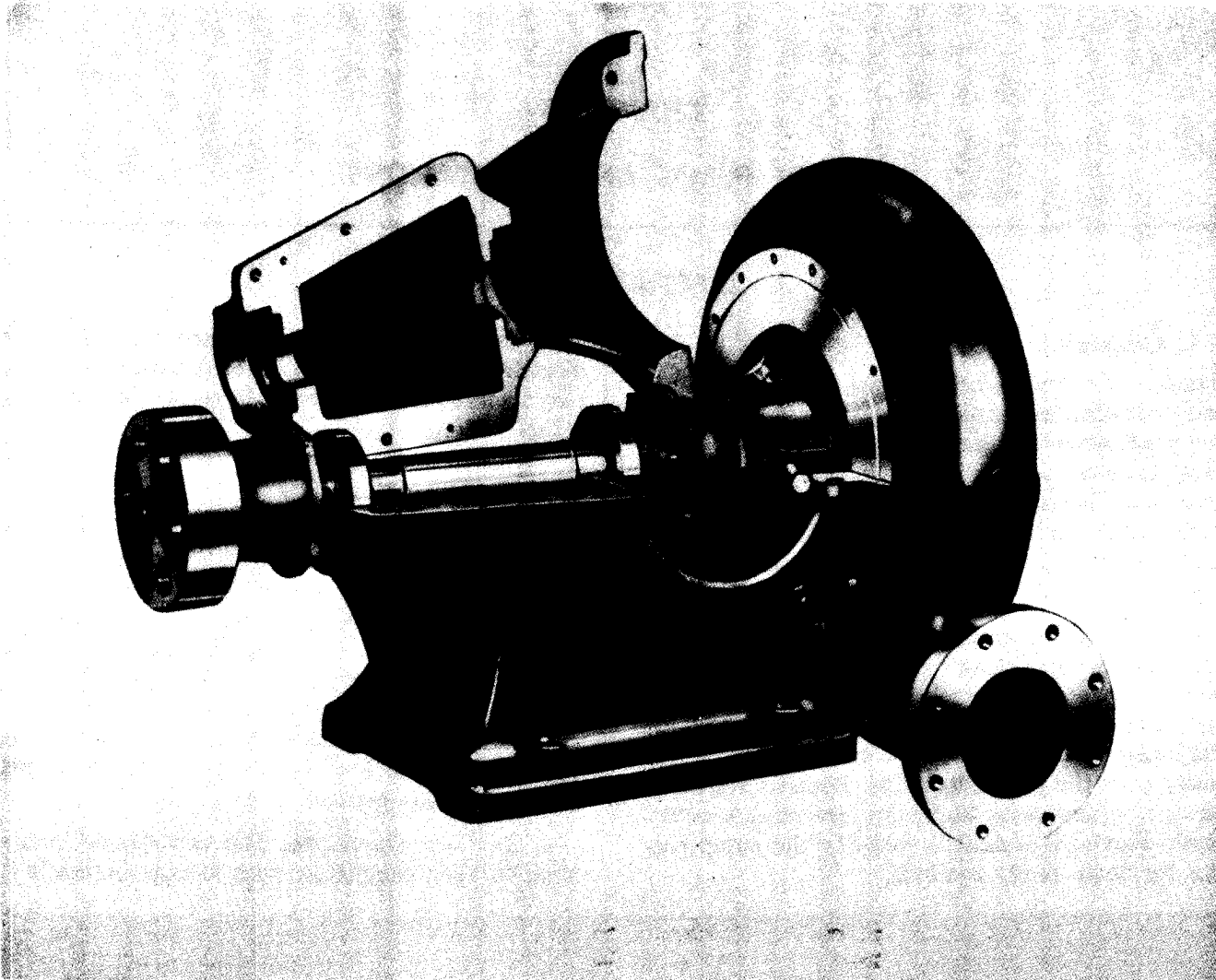
##### 5-2. Centrifugal Pumps

Centrifugal pumps are used to pump sanitary sewage because of their comparative simplicity, ease and efficiency of operation, and small dimensions. The type used for sewage is single-stage slow-speed (about 1,150 rpm), mounted either horizontally or vertically. Figure 5-1 shows a typical single-stage horizontal type pump and figure 5-2 a close-up of the centrifugal sewage pump. Figures 5-2 and 5-4 show a vertical submerged type with float control.

a. *Starting Operation.* The centrifugal pump must be filled completely with sewage before it is



*Figure 5-1. Horizontal type centrifugal pump for sewage.*



*Figure 5-2. Closeup of horizontal type centrifugal pump.*

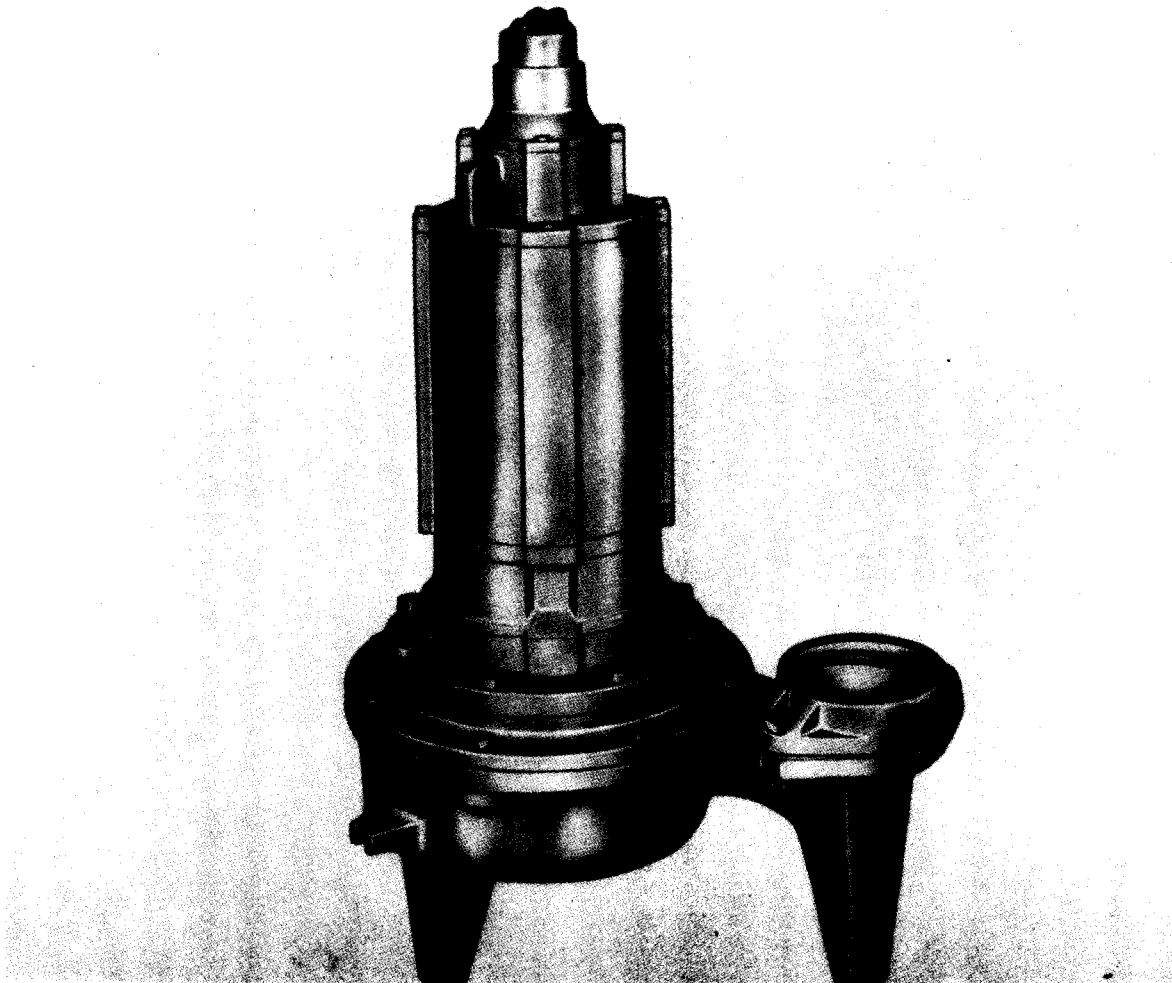
started to remove air from the casing and provide water for lubrication. If the pump is set above water level, priming devices are required. The pumps are usually set either in the well from which the sewage is pumped or in a dry well outside and below the sewage elevation of the wet well. The suction lift must not be excessive, 15 feet being considered maximum; all piping on the suction side of the pump must be airtight to avoid air binding. If the pump characteristics differ from the requirements, the motor may overload and overheat. The manufacturer may be contacted concerning pump characteristics and recommendations for alterations.

*b. Flush-Kleen Type.* Flush-kleen centrifugal pumps are widely used for sewage pumping to

avoid some of the difficulties with clogging (fig 5-5). Sewage enters the discharge line of this type rather than discharging directly into the wet well; it passes through a strainer just ahead of the impeller where the solids are removed; sewage flows through the pump to the well. The pump lifts sewage from the well through the screen, forcing the retained solids into the discharge main. These pumps are installed in duplicate.

### 5-3. Axial-Flow Pumps

Axial-flow propeller type pumps are described in TM 5-660. This high-capacity, low-head pump is used largely for recirculating treatment-unit effluents and for pumping storm water.



*Figure 5-3. Vertical submerged type centrifugal pump for sewage.*

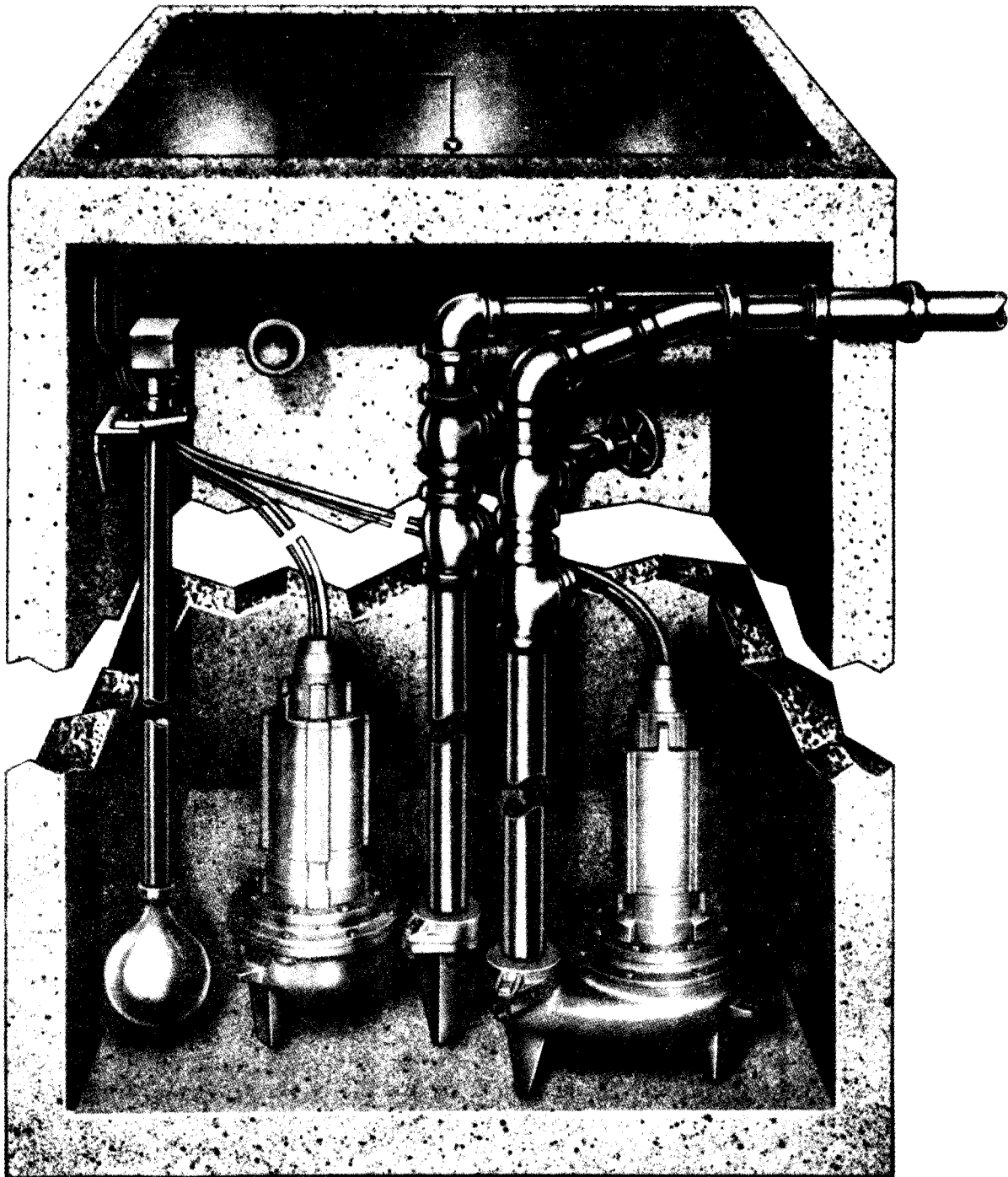
#### **5-4. Turbine Pumps**

Turbine type pumps, described in TM 5-660, are used to pump large volumes of storm water.

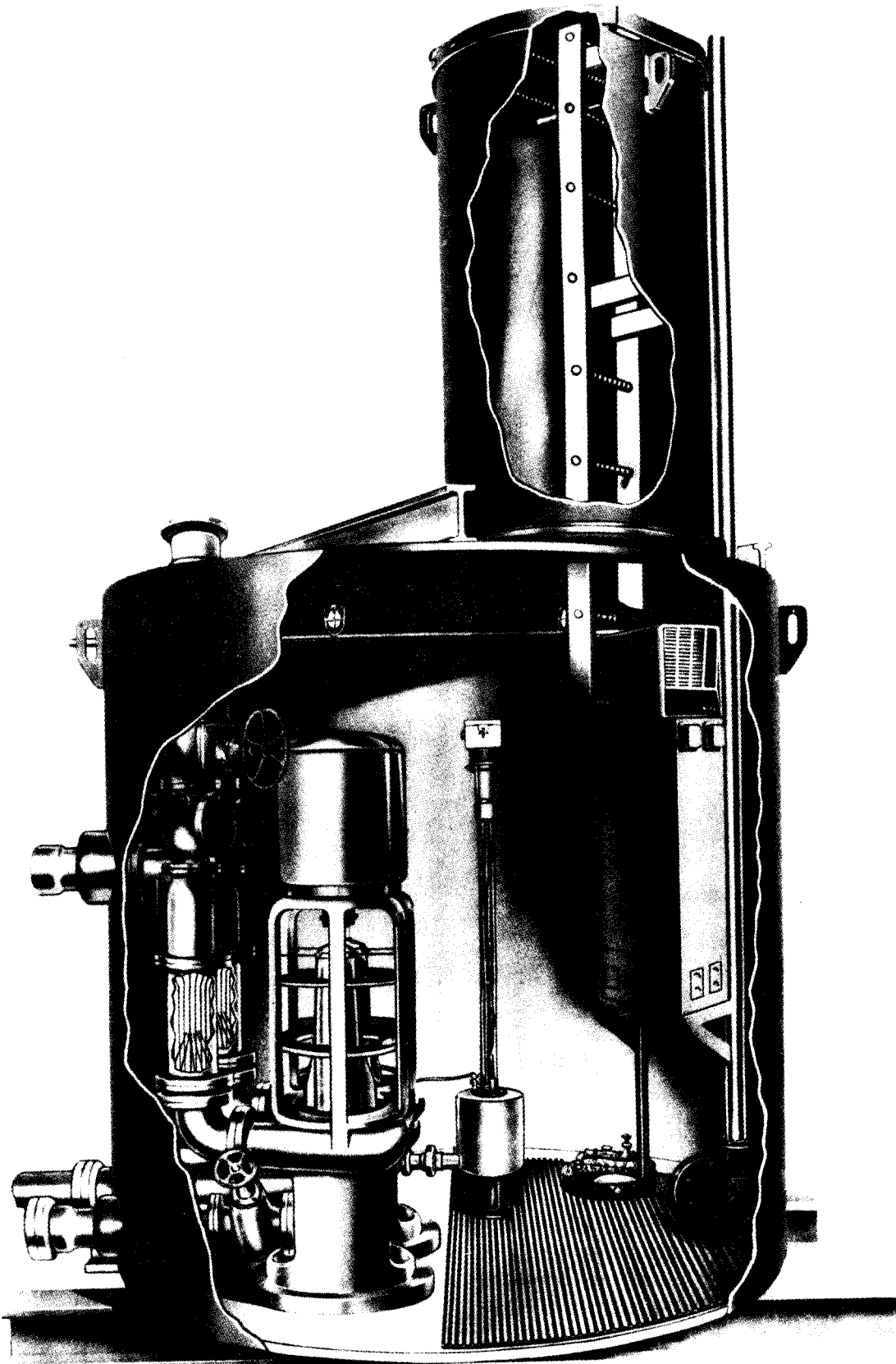
#### **5-5. Sewage Ejectors**

The sewage ejector is used to avoid the trouble of cleaning screens and clearing material from pumps. The sewage flows into a metal chamber; when the chamber is full, an automatic control admits compressed air which forces the sewage

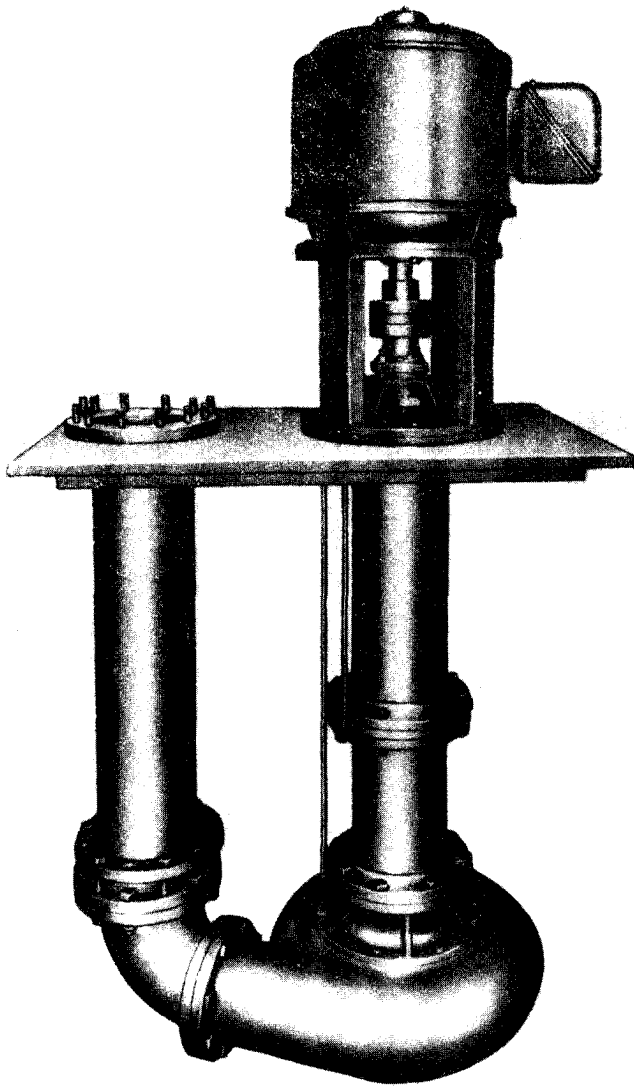
out through the discharge line. This installation requires air compressors, air tanks, and other items which make the system expensive. The efficiency is low, seldom attaining 15 percent. Sewage ejectors are better than centrifugal pumps for lifting sewage from basements of buildings into the main sewer because the relatively small flow requires a pump so small that it clogs easily. Figure 5-6 shows a typical installation lifting sewage from a manhole on a sewage line to a higher sewer. Figure 5-7 is a cross section of an ejector.



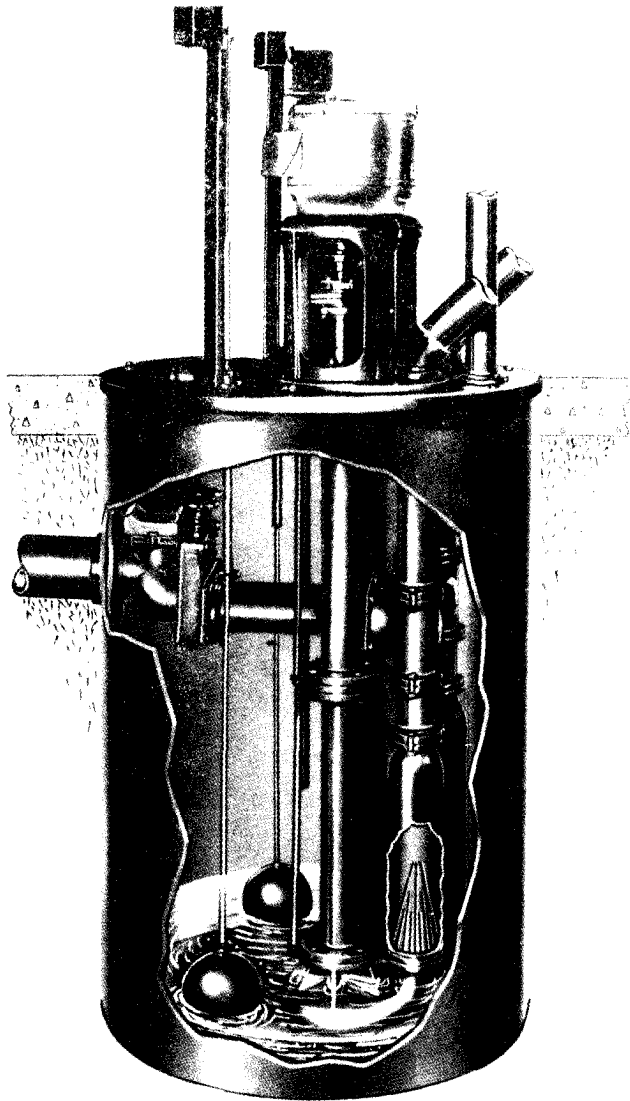
*Figure 5-4. Typical vertical submerged type centrifugal pump installation.*



*Figure 5-5. Flush-kleen centrifugal pumps.*



*Figure 5-6. Typical installation of sewage ejector.*



*Figure 5-7. Cross section of a sewage ejector.*

## Section II. CONTROLS AND OPERATION OF PUMP STATIONS

### 5-6. Controls

Pumping cycles controlled by float and sequence switches are adjusted, if possible, to avoid large fluctuations of flow to the treatment plant. Where pumps of different capacity are installed, the smaller pump is set to cut out when the larger pump starts, both pumps operating only at peak periods. Where two pumps of identical capacity are provided, their use is alternated frequently to provide equal wear. Standby pumps are operated manually once a week to maintain proper operating condition. Since sewage pumps usually have automatic operation, the float control requires frequent attention. The float may be connected to the electric switch either by a push rod or a chain

running over pulleys with a counterweight to balance the float. Floats hanging unprotected are likely to be moved sideways by the sewage, causing the rod to bend; some guiding device must be provided to prevent such damage. Proper protection must be provided to eliminate building up ice on the rods exposed to the weather.

### 5-7. Operation of Pump Stations

Because pumping costs are often a major operating expense in a sewage treatment plant and sewage system, maintaining normal efficiency of all pumping units is extremely important. Partly clogged pumps, worn impellers, and other inefficient conditions may greatly increase the power

consumption and cost of repairs. In addition, breakdowns may cause health hazards by backing up sewage in buildings or flooding low areas. Pumping stations are often located in housing areas where odors caused by lack of cleanliness are especially objectionable. Proper maintenance and frequent inspection can insure continuous and efficient operation of pumping stations.

a. Although most sewage pumping stations are equipped to operate automatically, daily attention is required. Accumulation of solids in the wet well must be prevented.

b. The sewage level is drawn to minimum elevation daily; walls and bottom are thoroughly flushed with a heavy stream of water. This operation may require manual operation of pumps. Any air trapped in the pump can be bled by hand, following this operation, if an automatic air-relief valve is not provided. If the potable water system is used for flushing, the hose must be physically disconnected from the well to prevent contaminating the water supply.

c. Grit accumulations are removed periodically by bucket and shovel if flushing is not effective.

d. Slopes in the bottom of the wet well may be increased by laying concrete in the corners of the well sloping to the pump suction. Slopes of 1:2 or 1:1 are desired to prevent accumulations.

e. Grease accumulation in float tubes is removed by daily flushing and scrapping with a homemade hoe-shaped tool, when necessary. Replacement of float tubes with open guides of vertical-steel angle iron eliminates grease clogging.

f. Bar screens and basket screens installed at pumping stations must be cleaned daily, or more

often if necessary, to prevent obstruction to flow or overflow of basket.

g. Water accumulations in the dry well are removed daily by the sump suction valve of a sewage pump. If a separate sump pump is available, this operation is done automatically by a float switch. The dry-well floor should slope toward the sump.

h. Structures housing pumping equipment require careful maintenance to prevent rapid deterioration.

i. Pumping-station floors, walls, and windows must be kept clean to avoid odor nuisance and unsightliness.

j. Acid-laden condensation from sewage which severely corrodes concrete and masonry structures, steelwork, window sashes, and settings, may be relieved by adequate ventilation. Forced ventilation is necessary in underground installations without surface structures. Where required, paints specially manufactured to protect masonry are applied. All metal must be protected with paint.

k. Sewage gas and explosive vapors are likely to accumulate in the wet well. Daily flushing and removal of solids reduces the production of gas.

l. In some cases, particularly where the lift is high and discharge pipes are long, check-valve slam occurs, which may fracture the pipe or loosen the joints. Remedial measures must be taken by installing the following:

(1) Slow-closing check valves.

(2) Large air chambers with small compressors to replenish air in the chamber.

(3) Hydraulic shock eliminators.

m. Maintenance of pumps and auxiliary equipment is covered in TM 5-666.