The following four papers were presented at a conference on high-temperature pasteurization, held at the University of Connecticut, Storrs, on June 16, 1944.

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Short-Time High-Temperature Pasteurization*

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SHORT TIME PASTEURIZER CONTROL SYSTEM

AUTOMATIC Temperature Control equipment is a very important part of a Short Time Pasteurizing system, and as such, deserves careful and regular maintenance. The usual installation, aside from indicating thermometers employs:

A—A steam pressure controller, for maintaining a constant supply of steam to the diaphragm valve of the water temperature control under conditions of forward flow.

B—A temperature controller for maintaining the circulating water at the correct value.

C—A Safety Thermal Limit Recorder which serves three functions:

(a) Provides record of temperature of milk leaving the holder tube;

(b) Electro-pneumatically actuates Flow Diversion Valve; and

(c) Records whether Flow Diversion Valve is in forward flow or diverted flow position, depending on whether bulb of Safety Thermal Limit Recorder is above or below desired cut-out temperature.

DESCRIPTION OF A TYPICAL SHORT TIME PASTEURIZER CONTROL SYSTEM AS SHOWN IN FIG. 1

The milk temperature is controlled indirectly by maintaining the water inlet temperature at a given value by controller B with its bulb located in the outlet from the water circulating pump. Controller B actuates diaphragm valve D, thus regulating the quantity of steam necessary for maintaining a constant water temperature.

When starting up and during periods of flow diversion, solenoid valve 9 shuts off air to Flow Diversion Valve M. Pressure controller C receives its air supply from 9. Therefore, during these periods valve C_1, which is a direct acting, air-to-close type, is wide open.

This allows full boiler steam pressure to be applied ahead of valve D to accelerate heating while milk is diverted to the float tank. As soon as the pasteurization temperature is reached and forward flow takes place, air supply is admitted to C which then controls the steam pressure at the optimum predetermined value.

Safety Thermal Limit Recorder A with its bulb in the milk outlet from the holder tube records the temperature of the milk leaving the holder. If the milk temperature falls below the predetermined minimum, it actuates solenoid valve 9, bleeding the air from the top of Flow Diversion Valve M, the disc of which moves upward to divert the milk. It also provides a record on the outer edge of the chart of the frequency and duration of the flow diversion. This is accomplished by a solenoid-operated pen inside the case, which is actuated by the micro switch on the Flow Diversion Valve.

* Summary of a talk to Milk Inspectors and Processors given at the University of Connecticut Conference on June 16, 1944.

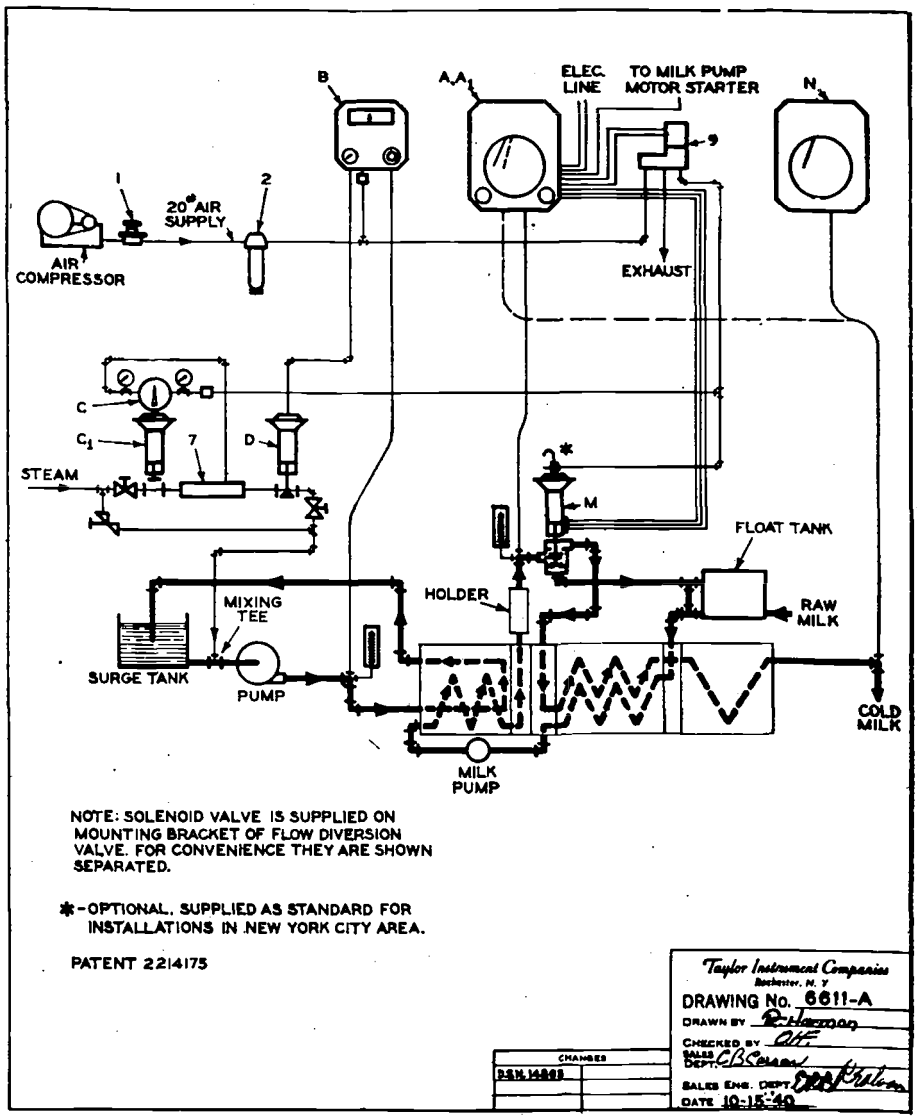

FIGURE 1
Layout of Air-operated Control System for Short Time Pasteurizer

A_1 is an alternate instrument which may be used instead of A, and which besides performing the duties of A also records the cold milk temperature.

The Flow Diversion Valve stem clip must be in place, and the stem connected; otherwise, the milk pump will not run.

Recording Thermometer N records the cold milk tempertaure.

DESCRIPTION OF FLOW DIVERSION VALVE

Fig. 2 is representative of a Flow Diversion Valve such as used with most Short Time Pasteurizing systems

and many 30-minute holders. The sectional view on the right shows the disc in a diverted position. The construction of the valve is such that if improperly assembled, forward flow of milk cannot be obtained unless two conditions are satisfied; i.e., the temperature of milk at the bulb of the Safety Thermal Limit which operates it must be above the output point, such as 161° F., and key 18 must be correctly inserted. Key 18 connects push-rod 5

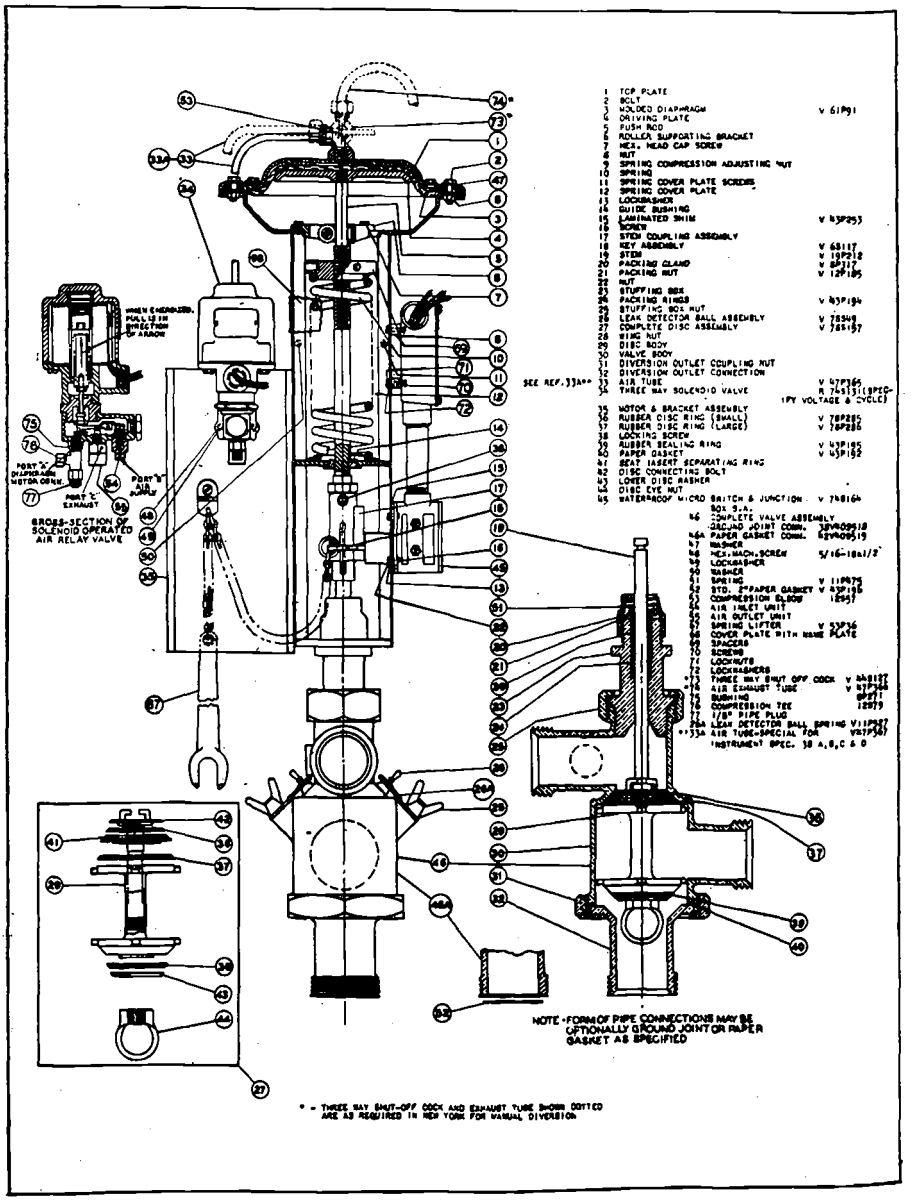

FIGURE 2
Flow Diversion Valve

which when pushed downward by air pressure applied to the top of rubber diaphragm 5 causes the valve to assume the forward flow position. When air pressure is relieved from above the diaphragm through solenoid valve 34, spring 10 moves the stem upward, closing the forward flow port, thereby causing diversion. Unless key 18 is correctly in place micro switch 45 fails to operate which in turn prevents the milk pump from starting, when the temperature is below the set point of the Safety Thermal Limit Recorder.

If the valve has been correctly assembled and the milk pump fails to start, the micro switch should be examined to make certain that its rounded end actuating plunger extends far enough toward key 18 to be moved at least 1/16" by the beveled edge of the latter when the valve stem moves downward. If this condition does not exist, the micro switch may be moved closer to kep by removing one of the laminated shims (15).

DESCRIPTION OF SAFETY THERMAL LIMIT RECORDER

Fig. 3 shows a typical instrument of this type with chart plate removed. This instrument operates the flow diversion valve by opening and closing an electrical circuit to the solenoid valve mounted on the Flow Diversion Valve itself. This solenoid valve in turn admits compressed air at 20 to 25 lbs. pressure to cause the Flow Diversion Valve to assume a forward flow position. When de-energized it releases air causing diversion.

The Safety Thermal Limit Recorder requires no maintenance other than that necessary for recording thermometers. Quoting from the U.S.P.H.S. Code: "The cut-out and cut-in milk temperatures shown by the indicating thermometer shall be determined daily by the plant operator and at least monthly by the health officer, and entered upon the recording thermometer chart. This test may be made at any time during the day's run by reducing the steam supply to the heater so as to slowly reduce the milk temperature (not over 1° F. per each 30 seconds). If the flow stop (Safety Thermal Limit Recorder) operates of its own accord at any time during the day's run the above test may be omitted for that day, since the recording thermometer will automatically record the cut-out and cut-in response." Thus it will be seen that an accuracy check of the instrument is regularly obtained. The speed of response or the thermometric lag of the instrument must meet definite requirements as set forth in the U.S.P.H.S. Code. Instruments that are initially built to conform to this specification usually do not change unless pen friction becomes excessive due to the pen bearing too hard against the chart. Periodic checking for thermometric lag is recommended in conformity with directions given in the U.S.P.H.S. Code.

COLD STERILIZATION

In some localities, cold sterilization of the forward flow lines and the regeneration section of the heater is permitted. In order to have the Flow Diversion Valve in the forward flow position while the temperature is below the setting point of the Safety Thermal Limit Recorder, a micro-switch in the water temperature controller is used to energize the Safety Thermal Limit Recorder relay which in turn applies air to the Flow Diversion Valve diaphragm motor through the solenoid air valve. The water temperature controller set point is lowered to 110° F. or below, which action actuates the micro-switch. As soon as the set point is raised to the temperature necessary for pasteurization, the micro-switch circuit is opened, and the Flow Diversion Valve is under complete control of the Safety Thermal Limit Recorder. This arrangement is permissible in some communities on the basis that an operator would not attempt pasteurization at 110° F. or lower. If this practice is not allowable, the alternative is to remove the Safety Thermal Limit

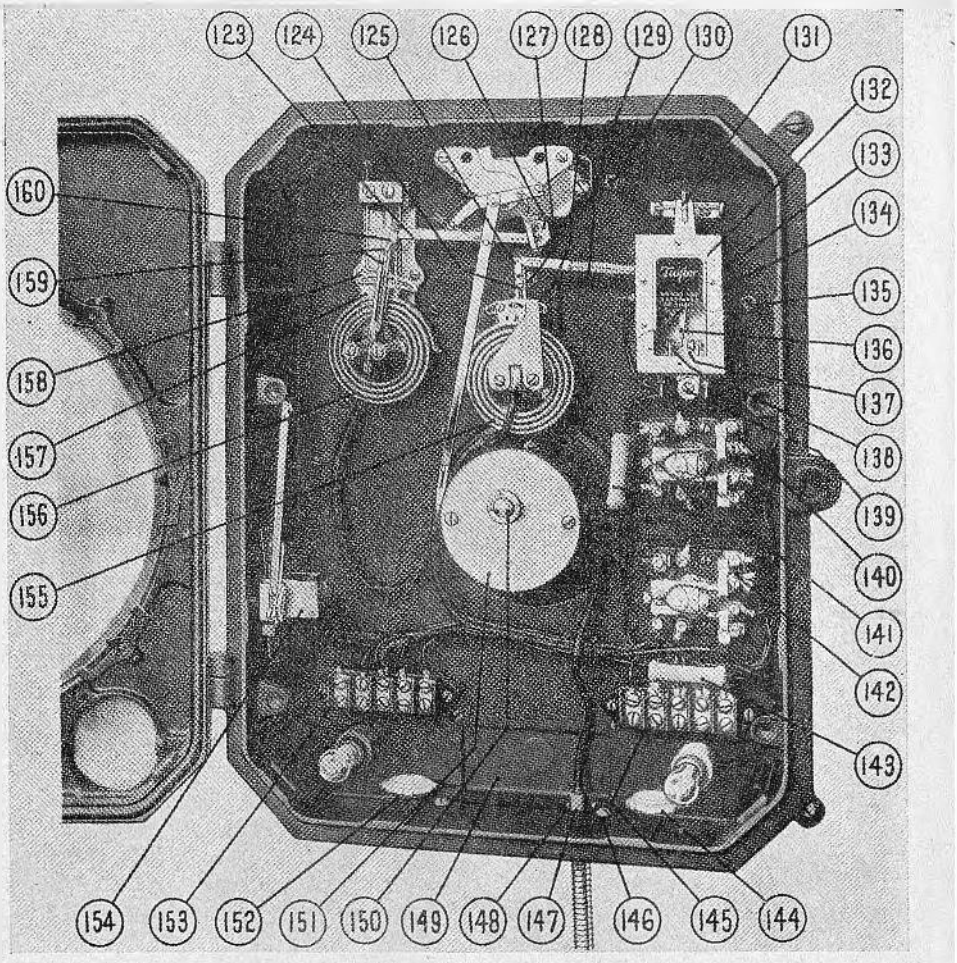

FIGURE 3

List of Parts

Ref. No.	*Description*	*Part No.*
135	Sealing Plate Post	9P885
136	Contact Arm	
137	High Contact	
138	Low Contact	
139	Pivot Screw	#8-32x⅜"rd.hd.br.screw,B.N.
140	Relay	220V., 60 cycle – 74S152
		110V., 60 cycle – 74S151
141	Resistor	220V.–4000 ohms,10watt,IRC Type AB wire wound resistor
		110V.–500 ohms, 10 watt,IRC Type AB wire wound resistor
142	Relay	220V., 60 cycle – 74S152
		110V., 60 cycle – 74S151
143	Resistor–220V. only.	4000 ohm, 10 watt, IRC Type AB wire wound resistor
144	BX Ell, ¼"	
145	Terminal Block	
146	Screw (4)	#10–32 rd.hd.steel screw, cadmium plate, two ⅜" long and two ¼" long
147	Case Fitting	
148	Case Fitting Screws (4)	#6–32x¼"rd.hd.br.screw,B.N.
149	Tube System Mounting Plate	6S121A–white; 6S121B–black
150	Clock Hub	
151	Clock (12 hour)	Same for 110V. and 220V., 60 cycle – 83S96–2A
152	BX Ell, ¼"	
153	Terminal Block	
154	Frequency Pen Solenoid	220V., 60 cycle – 66S117C
		110V., 60 cycle – 66S117A
155	Bourdon Spring – Contact Arm	
156	Bourdon Spring – Pen Arm	
157	Sub-base	
158	Sub-base Screw (2)	#8–32x½"Fil.Hd.Iron Screw (Cadmium plate)
159	Pivot Screws (2)	9P232
160	Pivot	

bulb and immerse it in water above 160° F. to obtain forward flow.

ROUTINE MAINTENANCE OF SHORT TIME PASTEURIZER TEMPERATURE CONTROL SYSTEMS

It is well to establish a routine for periodically checking over vital points in a short time control system. Even though unsatisfactory performance of any kind has not been experienced, there are definite benefits to be derived from what might be termed "precautionary service."

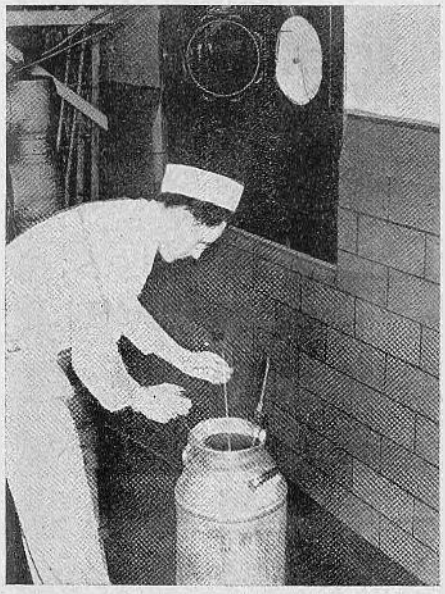

FIGURE 4

The following procedure is recommended:

A—Clean air valve in pressure controller.

B—Blow out all air filters (recommended as a daily operation).

C—Clean air valve in temperature controller B.

D—Check accuracy of Safety Thermal Limit Recorder pen. A regular 40 quart milk can makes an ideal test bath for this purpose. Place can at same elevation at which bulb is located in service. A steam hose is useful to bring the water up to temperature. See Fig. 4. Fully immerse the bulb along with a test thermometer of known accuracy. Vigorously agitate the water with a wooden paddle or similar stirring device, and after a period of at least 2 minutes, or until the recorder pen comes to rest, compare the pen indication with that of the thermometer. Quickly reset the pen position to agree with the temperature indicated by the standard thermometer by means of the micrometer screw provided on most makes. For best results this operation should be carried out by two persons, one reading the test thermometer and stirring while the other adjusts the recorder. An etched stem thermometer made according to specifications of the U. S. Public Health Service is made especially for this purpose. It is calibrated for 4″ immersion with a range of 138° to 165° F. graduated in 1/5° divisions. For testing at temperature above and below this range, use a general test thermometer with a range of 30° to 220° F. in 1° divisions.

E—Check condition of rubber disc rings in Flow Diversion Valve and replace if wear is evident. Leakage through forward flow port will be indicated by milk running down the body from leak detector balls when valve is in diverted position.

F—Examine all air piping connections for leaks.

UNSATISFACTORY PERFORMANCE TRACEABLE TO CONDITIONS AND INSTRUMENTS

(See specimen chart, Fig. 5.)

Lag in Reaching Final Milk Temperature

A—If milk temperature becomes slower in reaching that required to cause the Flow Diversion Valve to assume a forward flow position, it is probably due to insufficient steam pressure. Particularly is this true if, after reaching the forward flow point, the milk temperature suddenly drops causing diversion, and then again repeats this performance.

Wandering of Final Milk Temperature

B—"Wandering" of milk outlet temperature can sometimes be accounted for in several ways. The milk flow should be checked to see that it is steady. A change in head of the raw milk supply, if too great, will cause variations in the milk flow rate which will be reflected in the final milk temperature, as shown on the Safety Thermal Limit Recorder chart. Another possible contributing factor may lie in the air supply to the controllers. This should be constant, within 1 lb., and if it varies more than this, the operation of the temperature controller may be adversely affected. Sudden changes in milk inlet temperature may also cause a disturbance in final milk temperature.

Continuous Fluctuations of Final Milk Temperature

C—"Hunting" or rapid fluctuation of the final milk temperature may be due to too high a steam pressure, or may be accounted for by erratic action of the pressure controller itself. For best operation, the steam pressure should be *steady* and should not be more than about 5 lbs. above that required when the unit is operating with regeneration. A cleaning of the air

(Continued on page 309)

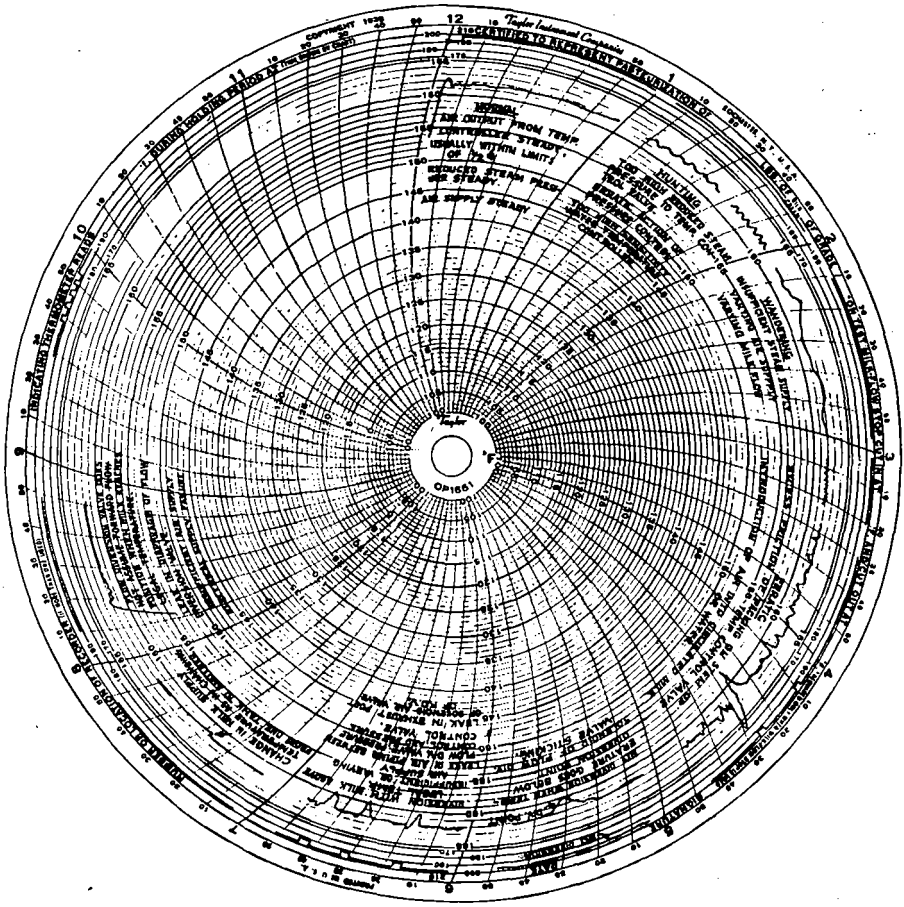

FIGURE 5

Illustrative Chart—Various effects in connection with short-time pasteurization of milk.

SHORT-TIME HIGH-TEMPERATURE PASTEURIZATION

(Continued from page 282)

valve in the pressure controller is usually all that is necessary to correct faulty pressure controller action although if the installation is 5 years or more old, the rubber diaphragm in the pressure controller valve should be examined. Also, the valve itself should be examined, for excessive stuffing box friction. "Hunting" can also be caused by improper temperature controller operation due to a dirty air supply. Its air valve should be cleaned. If this does not produce the desired results, the sensitivity adjustment in the controller should be changed. Regardless of make, an air-operated controller of the type used on H-T-S-T Pasteurizers is usually equipped with a means for changing its sensitivity. Lowering the sensitivity provides a means for reducing the amount of diaphragm valve movement obtained for a given temperature. When this is done usually the hunting action diminishes, providing all the equipment is in good mechanical order and that the steam pressure is not excessive. The criterion of performance is the indication of the air gage showing diaphragm valve pressure. This should be steady between 8 to 10 pounds per square inch. On an installation that has been operating satisfactorily, it is emphasized that such a change in its sensitivity adjustment should be made only as a last resort. See also previously suggested procedure for servicing air-operated pressure controllers and make certain that diaphragm valve stem moves freely. Repack valve if in doubt.

Failure of Flow Diversion Valve to Operate When Milk Is at Correct Temperature

D—If the Flow Diversion Valve is inoperative and remains in its diverted position, the electrical and air supplies should be checked. (The valve will assume a diverted position if either the electrical power or air supply fails). If the movement of the Flow Diversion Valve is too slow, examination should be made of the air inlet valve mechanism within the solenoid valve.

Failure of Flow Diversion Valve to Remain in Forward Flow Position

E—Failure of milk in reaching the temperature necessary to permit forward flow or in not remaining substantially constant, thereby causing repeated diversions, may also be traced to air binding of the water circulating system. This in turn can be attributed to there being not enough water in the surge tank to prevent air from entering the suction port of the circulating pump. The remedy is to see that the surge tank is filled, particularly when starting up. Erratic performance can also be traced to air entering the milk stream through improper gasketing of connection in the milk pump suction. This can also lead to a discrepancy occurring between indications of the mercurial thermometer and the pen of the Safety Thermal Limit Recorder under certain conditions particularly where the end of the holder tube terminates vertically.

Failure of Milk Pump to Start

F—Failure of milk pump motor to start may be attributed to a blown fuse in the Safety Thermal Limit Recorder. Before replacing fuse, the wiring should be checked for defects with assistance of wiring diagram furnished by the manufacturer. (Never attempt making any adjustment other than the one provided for changing the cut-in and cut-out points in this instrument without first making certain the electrical supply is cut off.) Milk pump motor may also be prevented from starting by foreign matter such as a gasket lodging between seat and disc of forward flow port, thereby preventing operation of micro switch 45.