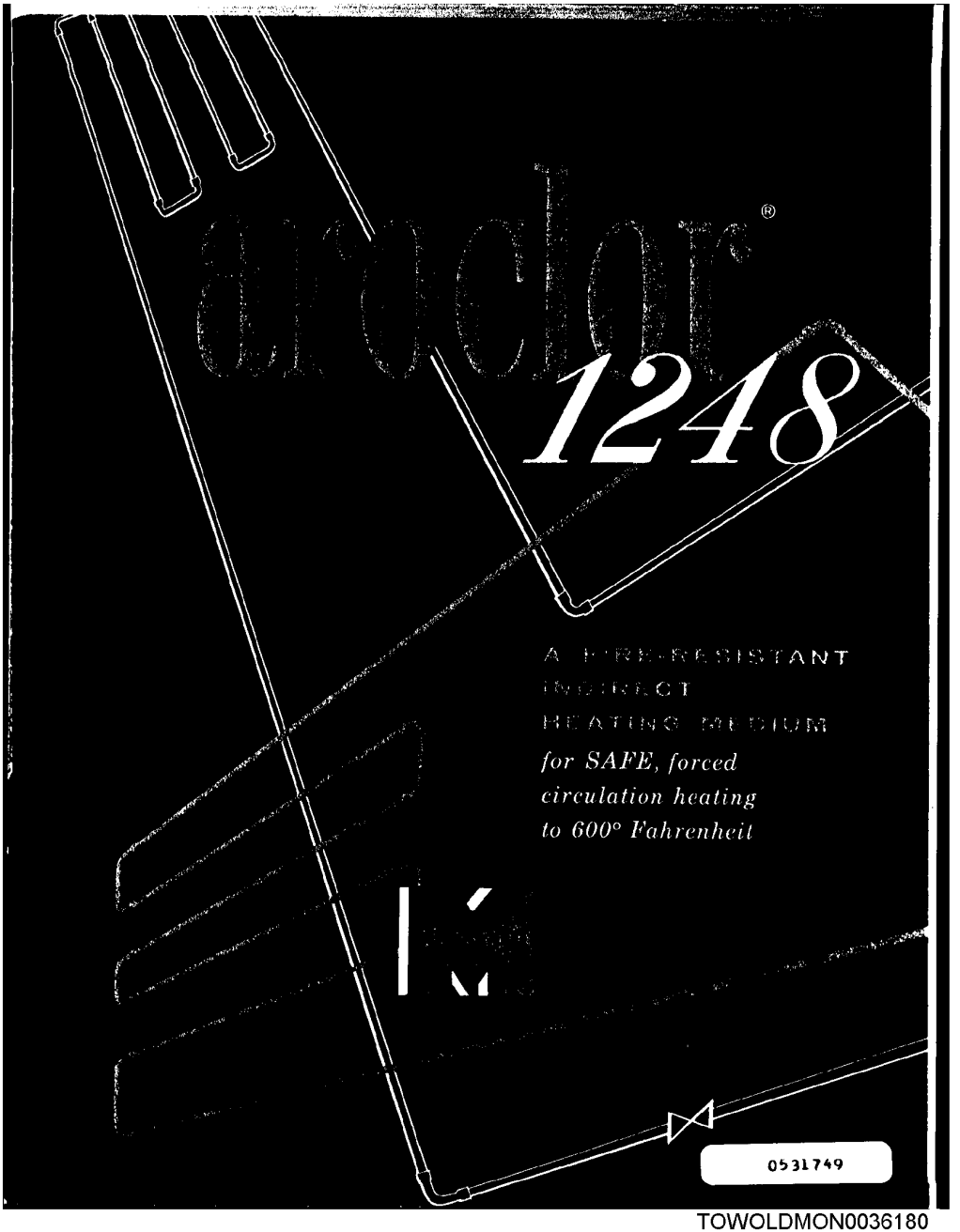

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aroclor®

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*Registered Trade Mark for Monsanto's family of chlorinated polyphenyl compounds. Aroclor 1248 is the one most suited for indirect heating applications.

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FIRE-RESISTANT INDIRECT HEATING

Aroclor® 1248 is fire-resistant. It does not support combustion up to its boiling range, 652°-725° F., and has a high flash point 380° F.

Thus indirect heating with Aroclor greatly reduces plant fire hazard, thereby increasing worker safety and possibly preventing costly fire damage to plant and equipment.

Aroclor is used in the liquid phase at atmospheric pressure or at low pressures, and does not require costly high pressure equipment. Explosion hazard is eliminated.

Forced circulation indirect heating with Aroclor is efficient and uniform. It gives accurate control of heat put into the process. This often leads to increased production, lower costs, and better quality of the finished product.

The general purpose of this booklet is to assist you in evaluating the benefits of using Aroclor for indirect heating in your plant or processes.

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HISTORY OF INDIRECT HEATING WITH aroclor® 1248

In 1941, certain new manufacturing processes of the Monsanto Chemical Company required using a noncombustible heat transfer medium at pressures of 30 pounds per square inch or less and temperatures in the range of 500 to 600° F.

Monsanto's Aroclor 1248 was the only commercial and economical material which met these requirements.

Complete success in operating these early heaters using Aroclor created more general interest in the benefits of a high temperature, fire-resistant, heat transfer agent for a variety of industrial applications.

Also about this time, heating design engineers had begun to advocate in this country the benefits of liquid phase high temperature heating.

Subsequently, leading manufacturers of heating equipment began to build heaters constructed specifically to accomplish maximum efficiency and maximum operating temperature using Aroclor liquid.

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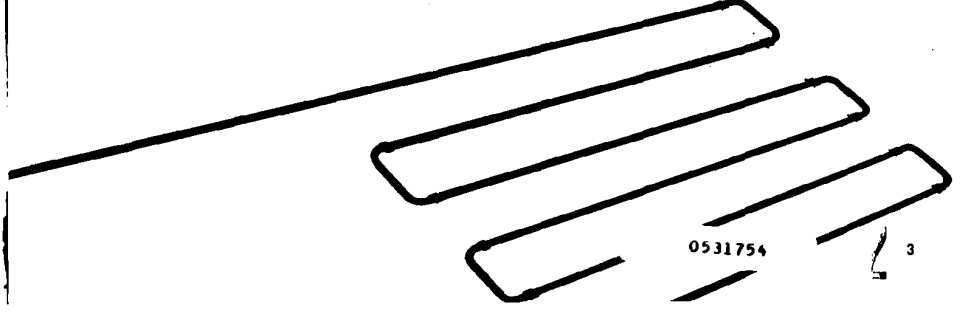
A PARTIAL LIST OF PRESENT COMMERCIAL AROCLOR HEATING APPLICATIONS INCLUDES:

1. Heating chemical process equipment, especially where flammable materials are handled.
2. Processing varnishes and resins.
3. Molding plastics and rubber materials.
4. Heating bituminous materials.
5. Heating vegetable oils for deep-frying potato chips and other food processing operations.
6. Processing titanium and other metals.
7. Indirect heating in the manufacture of dyestuffs.
8. Heating corrugating rolls.
9. Indirect heating of distillation equipment.
10. Heating panels for continuous vacuum belt drivers.

To assist industry with installation of indirect heating systems using Aroclor, a handbook entitled, "Aroclor 1248 Heat Transfer Data", giving engineering data is available from Monsanto.

In addition, the names of leading heating design engineers and manufacturers who build heaters for Aroclor will be supplied when desired.

Monsanto does not manufacture or supply equipment for heating with Aroclor.



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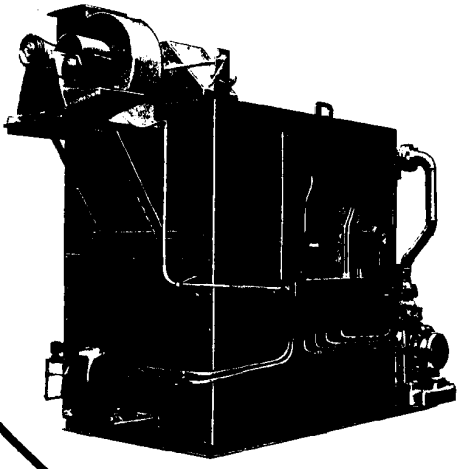

ADVANTAGES OF HEATING WITH

aroclor® 1248

SAFETY
It is fire-resistant and operates at low pressures, not over 30 psi gauge.

ECONOMY
Expensive pressurized heating equipment is not required.

EFFICIENCY
Aroclor 1248 has good heat transfer properties and is efficient up to maximum temperature of 600° F.

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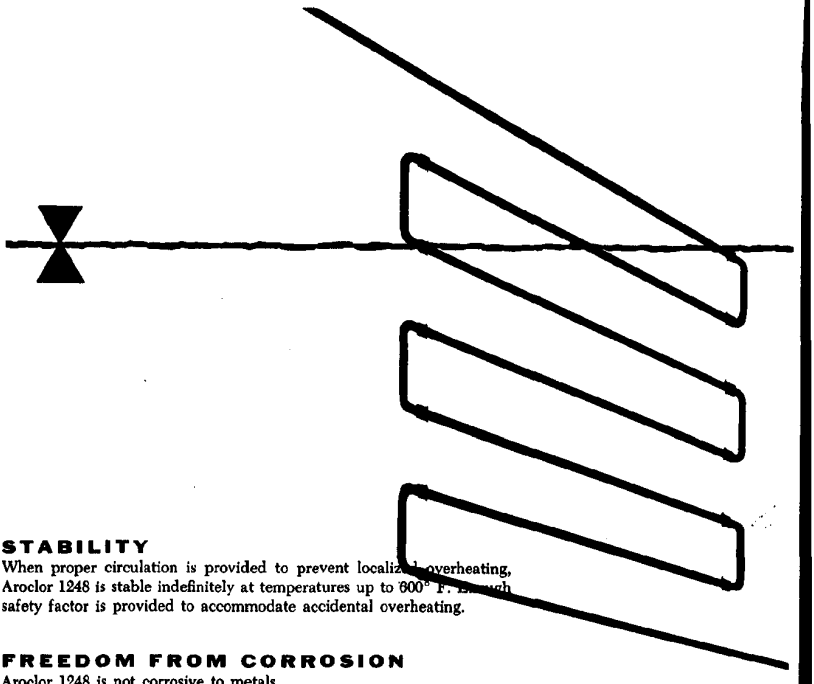

STABILITY

When proper circulation is provided to prevent localized overheating, Aroclor 1248 is stable indefinitely at temperatures up to 600° F. Enough safety factor is provided to accommodate accidental overheating.

FREEDOM FROM CORROSION

Aroclor 1248 is not corrosive to metals.

SIMPLICITY

The heaters are characterized by simplicity of construction and operation. There is no vapor formation and consequently no traps, feed pumps, etc. to maintain. An open vented tank permits free expansion of the fluid and avoids all problems of feed regulation, vacuum systems, or condensers.

ACCURACY OF CONTROL

Accurate temperature control for heating and cooling is provided.

CONVENIENCE

Aroclor heating units are compact, space saving and may be fired with gas or oil or heated electrically. Convenient controls for safety and temperature regulation are provided. The viscosity of the fluid permits pumping at room temperatures.

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DESCRIPTION OF aroclor 1248

Aroclor 1248 is a practically colorless [illegible] at room temperature. It is essentially tetrachlorob[illegible] very small amounts of both lower and more highly [illegible] biphenyls.

PHYSICAL PROPERTIES OF AROCLOR 1248

Appearance	Practically colorless mobile liquid		
Absolute density, g./ml.	1.44 1.41 1.37 1.27 1.17	[illegible] [illegible] [illegible] [illegible] [illegible]	86 140 212 398 [illegible]
Absolute viscosity, centipoises	[illegible] [illegible] [illegible] [illegible]	[illegible]	[illegible] 140 [illegible] [illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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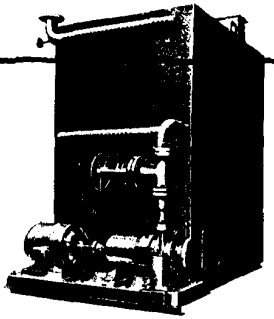
PERFORMANCE QUALITIES OF

aroclor 1248



LIQUID PHASE LOW PRESSURE 600° F. MAXIMUM

Aroclor 1248 is used in the liquid phase at atmospheric pressure or not over 20 to 30 PSI gauge and up to a maximum continuous operating temperature of 600° F.

HIGH BOILING FLUID

The maximum operating temperature is sufficiently below the 652°-725° F. boiling range of Aroclor 1248 to assure a liquid condition at all times.

EXCELLENT HEAT STABILITY

Although Aroclor is very stable to heat, adequate forced circulation, (about 20 to 80 gpm depending on the size of the system) should be provided to protect the liquid against localized overheating. Fluid velocity should be about 5 to 8 feet per second.

FORCED CIRCULATION AVOIDS LOCALIZED OVERHEATING

Brief overheating may not be harmful but extended heat injury above 600° F. will result in an increase of viscosity and measurable dehydrohalogenation.

TIGHTLY CLOSED SYSTEM ELIMINATES VAPOR LEAKS AND ODOR

With the exception of an open vented expansion tank, the system must be completely closed and sealed tightly to prevent vapors and odor from entering workroom areas.

DRY AND FULL SYSTEM ELIMINATES POSSIBLE CORROSION

The system should be kept dry and free from moisture. It is desirable to keep the heater and piping full of Aroclor liquid at all points. This eliminates spaces where moist air might collect during shutdown periods. By following these simple precautions, possible corrosion is minimized or eliminated.

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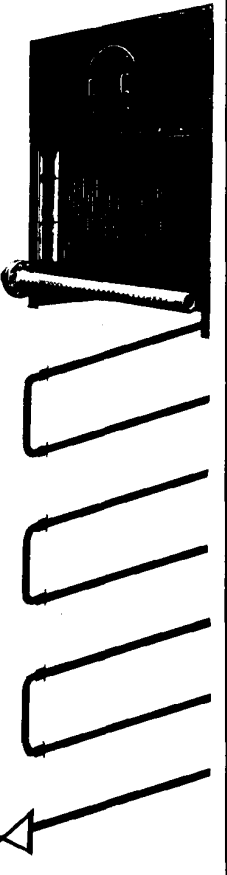
CHARACTERISTICS OF A TYPICAL HEATER



TAILORED TO FIT THE JOB

Heating equipment using Aroclor is selected or designed to meet the requirements of the process, whether it is large or small. The heating equipment ranges in size from small portable units which are usually electrically heated to large gas or oil fired units with capacities ranging from 250,000 to more than 10,000,000 B.t.u.'s per hour

ADVANTAGES OF FORCED RECIRCULATION HEATERS

Especially in the case of large size heaters where the maximum operating temperature of 600° F. is required, the forced recirculation heater is superior to any heater dependent on natural circulation heaters. The forced circulation system is engineered to give a positive, uniform fluid flow through all tubes fed from a header, whereas natural circulation units have no special design to equalize the flow in the heater tubes. Where natural circulation units are operated with thermal liquids, it is impossible to distribute the flow equally through all tubes. The thermal liquid seeks the shortest route to the discharge outlet.

Consequently, the longer tubes, because of their greater resistance to flow, are subject to overheating. This becomes an important consideration when such units are operated at the high temperature range prescribed for a given fluid and may result in decomposition of fractions of the thermal liquid.

Also, since the discharge temperature from the circuit through a natural circulation unit is the average temperature of the short-circuited fluid and the overheated fluid from the longer tubes, this causes variable temperatures which are produced at the heater outlet.

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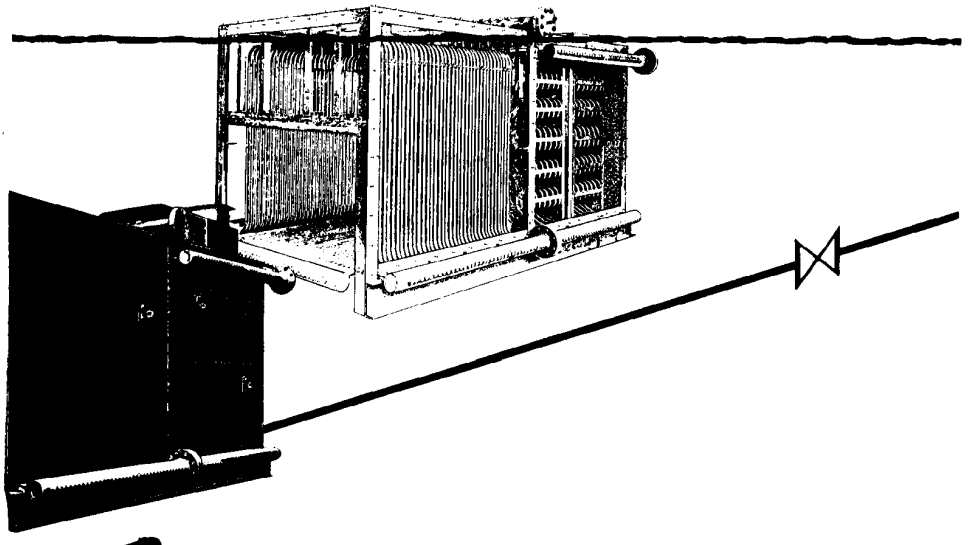

UNIFORM TEMPERATURE

Forced recirculation thermal liquid heaters, which consist of groups of small diameter tubes of equal length and orificed for uniform flow, provide even temperature distribution through all tubes in the circuit. Small diameter tubes, which are not practical in natural circulation heaters because they limit capacity, have a distinct advantage in forced recirculation units. In the smaller tubes the volume of fluid from the surface film to the center of the tubes is less and therefore heating is more uniform than in larger diameter tubes.

The forced recirculation heater is designed to move the fluid at velocities of 5 to 8 feet per second. This high velocity and resulting turbulence, coupled with the small fluid content of the tubes assures high rates of heat transfer and extremely close control of the outlet temperature. Tolerances of plus or minus 2° F. or closer are possible.

ELIMINATES SLUGGISH FLOW

Forced circulation eliminates dead spots or sluggish flow areas where localized overheating of the Aroclor may occur.

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HEATER SYSTEM COMPONENTS

The next four pages describe the main features of the typical piping diagram shown on pages 14 and 15. A summation of primary advantages of heating with Aroclor 1248 then follows.

THE HEATER FLOW CIRCUIT

The flow circuit consists of a thermal liquid heater and a recirculation pump which discharges the fluid returned from the system into the upper header of the heater as shown in Figure 1.

THE PUMP

All Aroclor heaters are designed to avoid direct flame impingement on the tubes. The recirculation pump may be any one of a number of standard centrifugal units designed for hot liquid service. The pump should be made of cast steel and have a water-cooled stuffing box and water-cooled bearings. The stuffing box should have room for at least eight rings of packing and a lantern ring. Durametalic No. D-110 or Garlock No. 234 may be used for packing the pump. Mechanical seals have also proved to be successful at elevated temperatures. An open non-over-loading impeller is desirable, as it will handle the cool, more viscous liquid on starting the system better than a positive displacement type pump.

THE BURNERS

Gas and light oil burners are usually used. Heavy oil burners using bunker "C" oil usually require furnishing steam to preheat the oil.

INDUCED DRAFT FAN

As an economy feature to eliminate the expense of building and maintaining a high chimney, the heater is usually fitted with an induced draft fan. The products of combustion are discharged from the fan into an exhaust vent higher than surrounding buildings.

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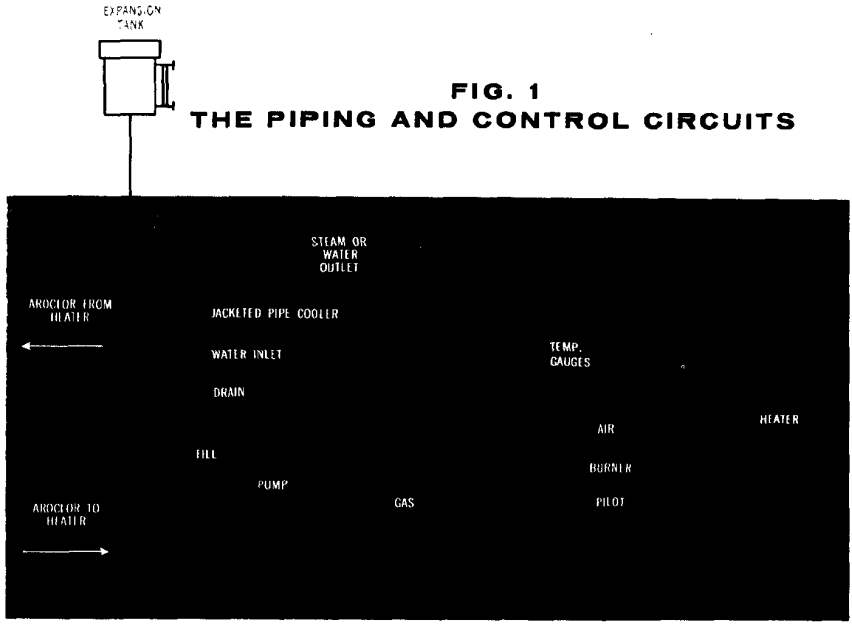

FIG. 1
THE PIPING AND CONTROL CIRCUITS

PIPING

A typical heater piping and control circuit is shown in Figure 1. All piping larger than ¾-inch is flanged or welded; experience has shown that hot Aroclor penetrates screwed joints of larger sizes. Steel and cast steel are used throughout. Spiral wound stainless steel and asbestos gaskets are recommended for all connections. For operation in areas where the Aroclor temperature may drop so low as to make the fluid unusually viscous, it may be desirable to steam-jacket the Aroclor circulating lines to facilitate rapid start-up in cold weather (or "when needed"). Suitable safety provisions such as safety pop-off valves, must be installed in the steam jacket system to prevent pressure ruptures which would develop if any condensate remained in a closed system during subsequent high temperature operation.

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DIFFERENTIAL PRESSURE CONTROL

SAFETY AND TEMPERATURE CONTROLS

Connected to the suction and discharge sides of the pump, this device shuts off the burner in case of pump failure or a broken pipe line. Any factor causing a decrease from the desired operating pressure will activate this device to shut down the burner.

TEMPERATURE CONTROL

This unit modulates the burner in response to temperature variation of the liquid.

FLAME FAILURE CONTROL

An electronic flame control apparatus pilots the flame and stops the burner in case of unsatisfactory combustion.

TEMPERATURE LIMIT CONTROL

This contains thermocouples attached to discharge ends of the tubes at critical points. Excessive temperature rise induces the control to shut down the burner.

PUMP MOTOR STARTER

The motor starter should be furnished with an auxiliary switch. The auxiliary switch is on the burner circuit so that any motor failure or short-circuit will stop the burner.

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LIQUID LEVEL CONTROL

This should be located at the highest point in the system, usually in the expansion tank. Its purpose is to shut off the burner in case of a liquid level drop in the system such as would result from a pipe break or excessive leakage at the pump.

AIR SAFETY SWITCH

This control is applied to the suction side of the induced draft fan. Its purpose is to stop the burner in case of fan motor burn-out or overheated bearings.

VENT TANK

The vent tank or expansion vessel is located at the highest point in the system and "floats" on the line. It is best connected to the intake side of the pump as this tends to give a positive head on the pump.

The Aroclor in the vent tank should be relatively cool. It acts as a seal. However, the tank should be closed and fitted with a vent pipe and elbow with a moisture trap to keep out moist air.

The capacity of this tank is normally 25% of the volume of Aroclor in the system.

COOLER

A very useful adjunct to the system is a double pipe cooler on the outlet of the heater. By circulating water through the jacket, the Aroclor may be cooled and the temperature of the system lowered. This is helpful when it is necessary to cool a batch before removing it or when an exothermic reaction requires control.

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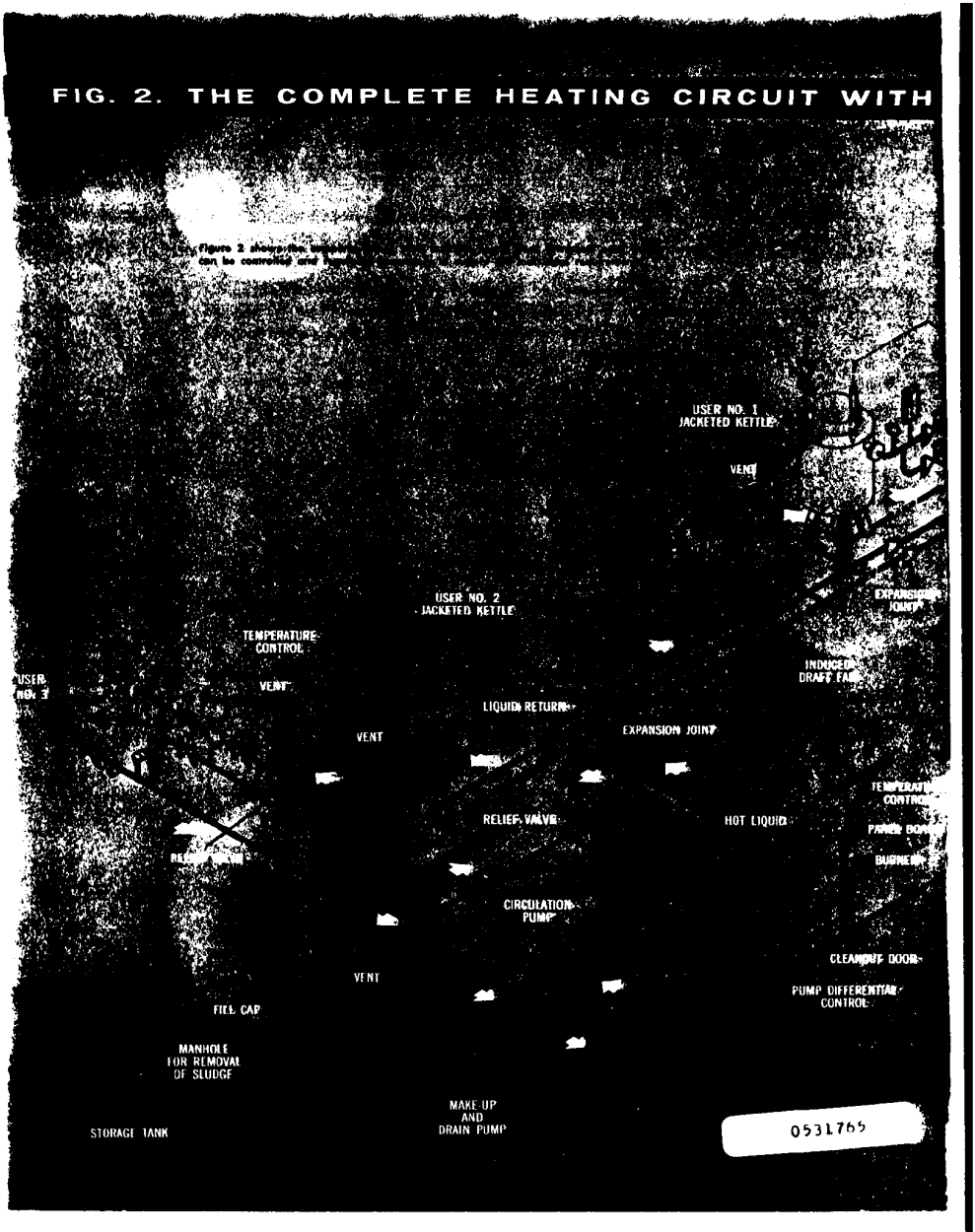
FIG. 2. THE COMPLETE HEATING CIRCUIT WITH



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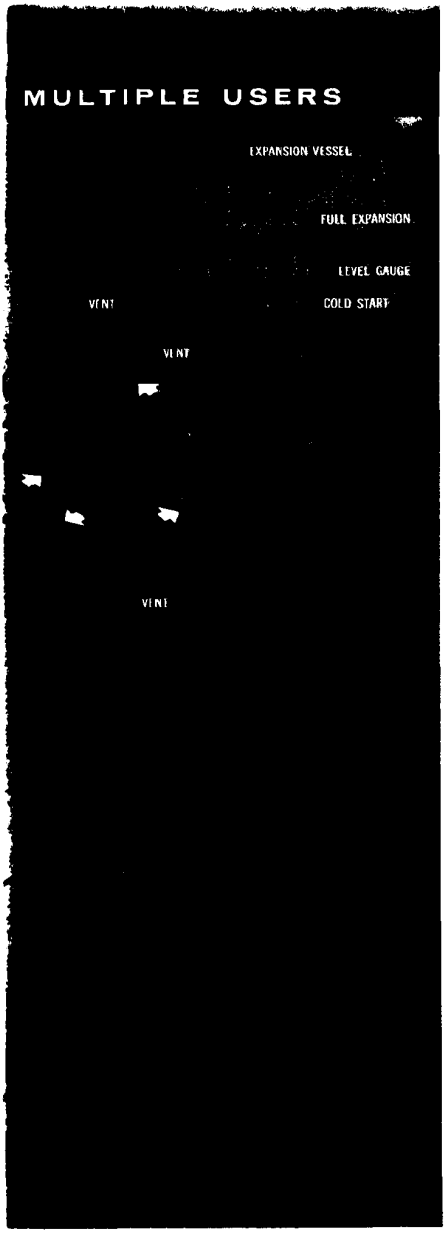

WHAT INDIRECT HEATING WITH aroclor DOES

New developments and increased production requirements in the chemical and process industries demand higher temperature heating with safety, accuracy and economy. Temperatures required are no longer practical with steam due to the extreme pressures required, costly equipment, and extra controls needed.

To meet indirect heating requirements up to 600° F., Aroclor 1248 used in properly designed equipment will do the job accurately, efficiently, economically and without the hazards of fire or explosion. The heaters are of simple construction, easy to operate and maintain, and their compactness saves space.

Indirect heating with Aroclor gives highly accurate temperature control. It simplifies process operations, increases production rates and lowers costs.

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SUMMARY OF BENEFITS FROM

INDIRECT HEATING WITH

aroclor® 1248

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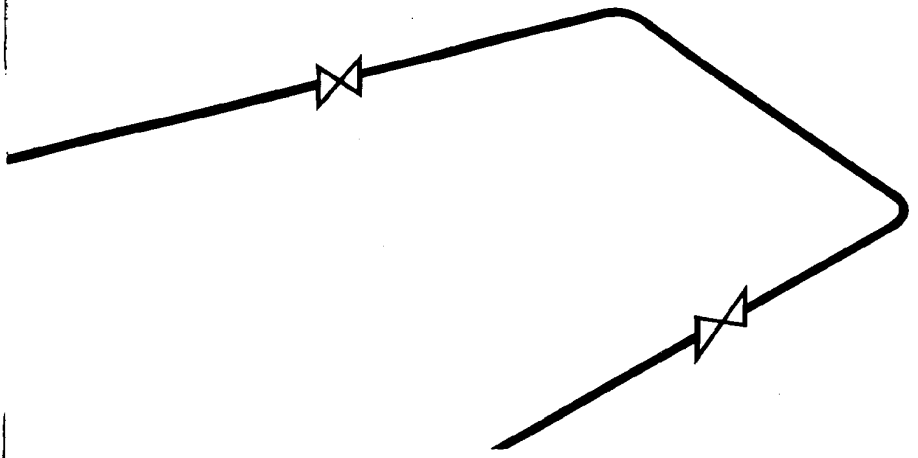

1. Safety from fire and explosion.
2. Operating temperatures up to 600° F. in properly designed recirculation heaters.
3. Accurate and uniform temperature control.
4. Economy of heating, low cost non-pressurized equipment, low maintenance, space savings, low fluid make-up.
5. Increased production. In some processes, production rates were increased as much as 50%.
6. Product uniformity results from more accurate temperature control.
7. Reduced product cost results from better control of quality.
8. Heating and cooling in the same equipment.
9. Different individually controlled temperatures at various user stations in the circuit gives flexibility.
10. Simplicity of installation and operation.

For engineering data or further information on the use of Aroclor 1248 for heat transfer, contact Monsanto Chemical Company, Organic Chemicals Division, Post Office Box 478, St. Louis, Missouri.

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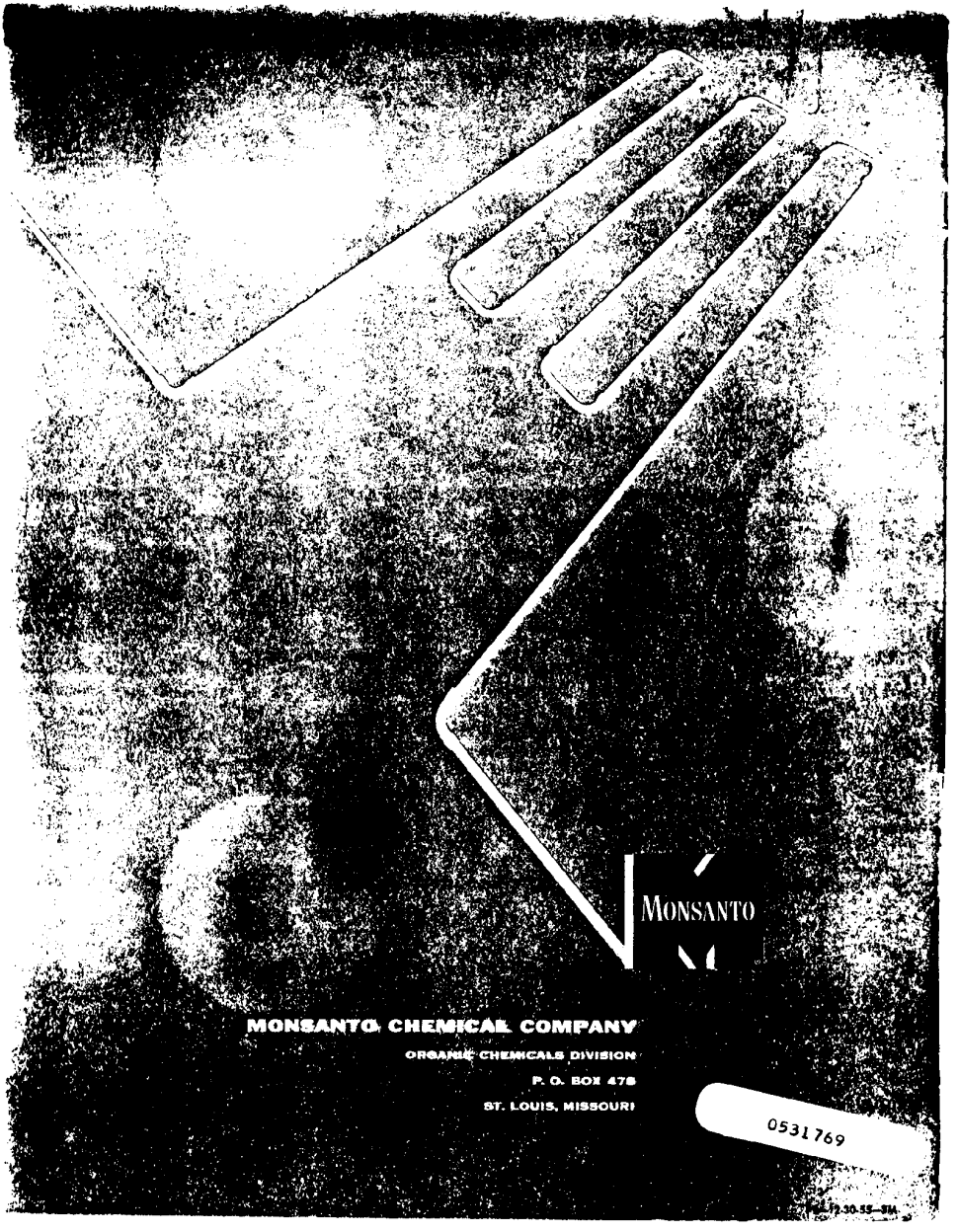

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