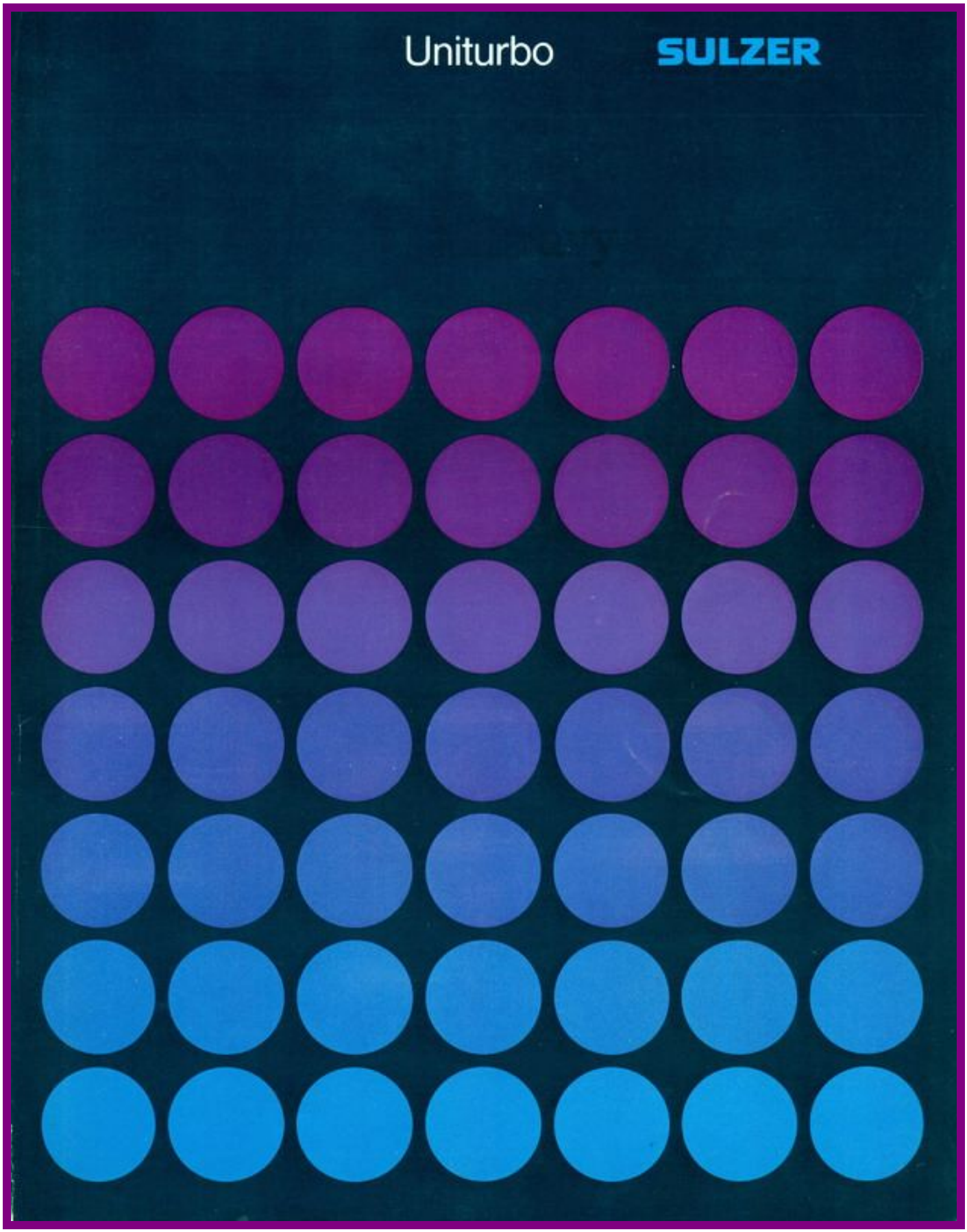
Uniturbo

SULZER



Sulzer Uniturbo® Refrigerating Plants

General

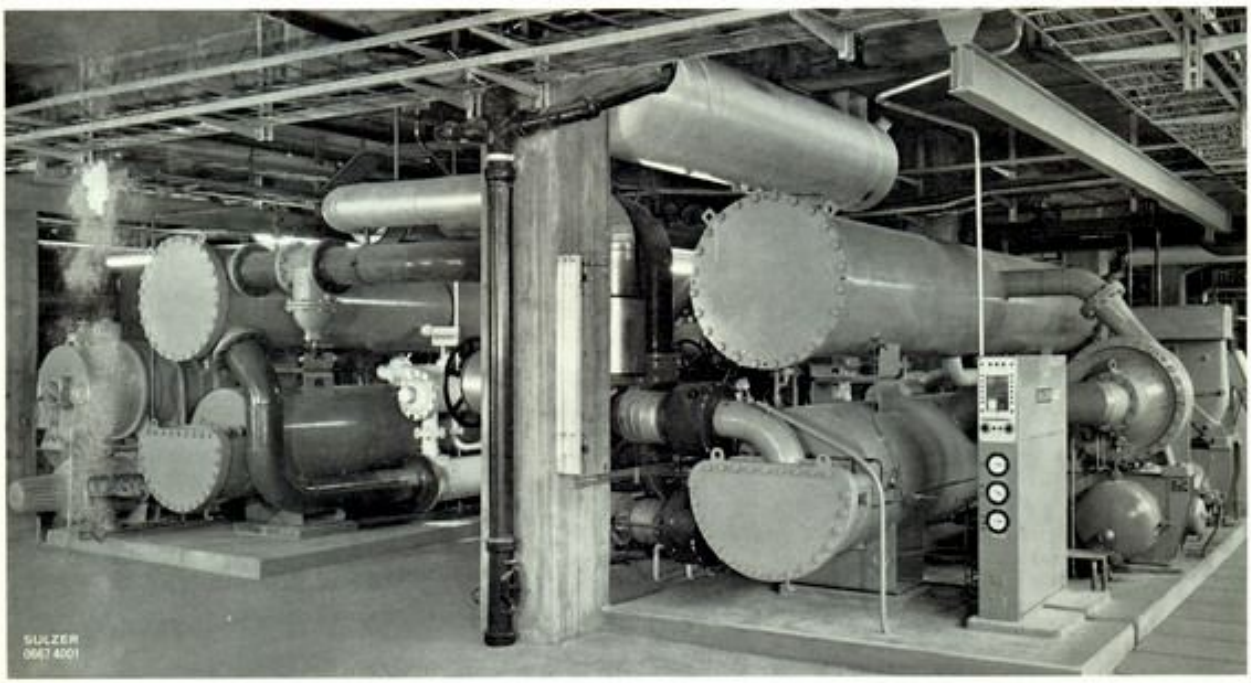
Uniturbo refrigerating plants are the Sulzer refrigerating units employing single-stage supersonic turbocompressors for large refrigeration capacities. They embody decades of experience in the engineering of refrigeration and turbomachinery, and are distinguished by the following principal characteristics:

- operational reliability
- little maintenance
- automatic control, hence little attention
- regulation range 100—10% with high part-load efficiency
- vibrationless running, no extra foundations
- simple and rugged design, yet equal to exacting demands

The compressors and refrigerating equipment are built for pressures allowing the use of most of the (non-toxic and non-inflammable) halogenated hydrocarbons. R 12 refrigerant is employed as a rule. But in special cases other compounds of high molecular weight may be used, such as propane and propylene.
For this reason Uniturbo plants are not only used for refrigeration in air conditioning systems, but are also ideally suited for very big refrigeration capacities at temperatures well below the freezing point of water, as are being demanded on an increasing scale for production and auxiliary installations in the chemical, foodstuffs and allied industries.

Thanks to its special standardized design, permitting high final pressures and low intake pressures, the Uniturbo compressor is particularly suited to cover a very wide field of varied industrial applications, including air conditioning. If halogenated hydrocarbons such as R 12, R 22 and R 13 are used as refrigerants, there is the additional advantage that the evaporator as well as the condenser of the refrigerating machine work with overpressure – even at temperatures far below 0 °C. This dispenses with the purge units otherwise needed. Any leakages in the refrigerant circuit are easily detected. Air and moisture cannot get into the cycle, thus eliminating the danger of corrosion. This enhances the operational reliability at the same time.

Two Uniturbo refrigerating plants each rated 1,400,000 kcal/h at 0 °C in a chemical works.



Main parts of a Uniturbo plant

Compressor impeller

The light-alloy impeller is machined from the solid to high accuracy. To secure maximum efficiency it is provided with a shroud disc to a new design. For normal conditions, as obtain at evaporating temperatures of 0 °C or so and condensing temperatures of about 40 °C, impeller speeds lie between 6,000 and 12,000 rpm according to diameter and working range. For lower evaporating temperatures, calling for higher compression ratios, these impellers can still be used without reservation for speeds of 9,000 to 18,000 rpm.

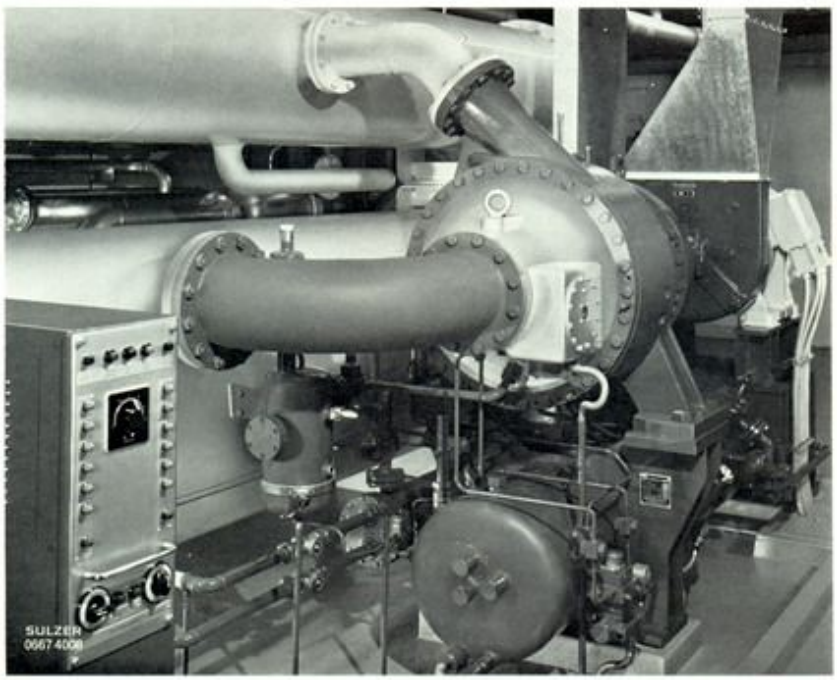
Drive

Uniturbo compressors serving industrial plants have the impeller driven through a coaxial epicyclic gear housed in the same casing. Consequently the shaft seal is fitted on the slowly rotating gear shaft. Its double slip ring design under constant sealing-oil pressure ensures sealing when stationary as well as during operation. The high-speed gear shaft has no bearings, and is centred in the planet wheels. The plain bearings of compressor and gearing are lubricated under pressure from a central oil system. Two- or four-pole electric motors of any pattern or voltage are employed for the drive.

Oil system

There is a central oil supply serving four consumers: bearings, gear toothing, shaft seal chamber and hydraulic regulating system. It has a common oil pump delivering correctly dosed quantities. The oil tank forms a strong base plate for compressor and motor, housing all parts needed to ensure reliable operation: electric oil pump fully encapsulated inside and outside, oil microfilter, overflow valves, thermostatically controlled tank heating and water-cooled oil cooler. Also arranged on the oil tank is the hydraulic control block for operating the oil-pressure-actuated capacity regulation of the compressor.

Uniturbo compressor set of a refrigerating plant rated at 1,000,000 kcal/h, serving the air conditioning system of a printing works.



Schlieren flow pattern at Mach 1.2, with compression shock in the supersonic diffuser.

1 Diffuser vanes
2 Compression shock
3 Leading edge of vane

Capacity regulation

Mechanically, the capacity regulation system is distinguished by its high reliability, precision and rapid response, while thermodynamically it is characterized by high part-load efficiencies from 100 down to 10% capacity. Regulation is effected by varying the amount of refrigerant circulated, by altering the free flow cross-section of the diffuser channels. To maintain a constant temperature in the secondary refrigerant at the evaporator outlet, the system causes a diffuser plate to be displaced axially; this engages the diffuser vanes opposite.

Automatic control

The automatic control system comprises all control, regulating and safety elements needed for plant operation. They are housed in a standardized control console, which is placed in the proximity of the compressor as an integral part of it. The electronic part is arranged in an easily replaceable plug-in unit, which is pushed into the top of the console on guide rails. On the front of this plug-in are all signal lamps and control knobs, clearly visible and accessible.
As a rule the plant is shut down by the safety elements in the following emergencies:

- Compressor motor overcurrent
- Oil pump motor overcurrent
- Evaporating temperature too low
- Condenser pressure too high
- Oil pressure too low
- Oil heating out of action
- Control voltage fails
- Inadequate flow of secondary refrigerant
- Secondary refrigerant temperature too low

Evaporator, condenser, subcooler

The evaporator and condenser tubes are finned on the refrigerant side. On the water side they are easily accessible for inspection and cleaning, without having to disconnect the water pipes. Depending on the secondary refrigerant, the heat exchange tubes may be of copper, steel, brass, cupronickel or other alloys. Any tube is easily replaced when necessary. The evaporator is fitted with a highly effective drop separator, to prevent the compressor aspirating wet vapour. As a rule, Uniturbo plants are provided with refrigerant subcoolers to improve plant efficiency. They are disposed in the cycle so that the liquefied refrigerant is subcooled with water before the expansion valve.

Adjustable diffuser plate.

Application fields

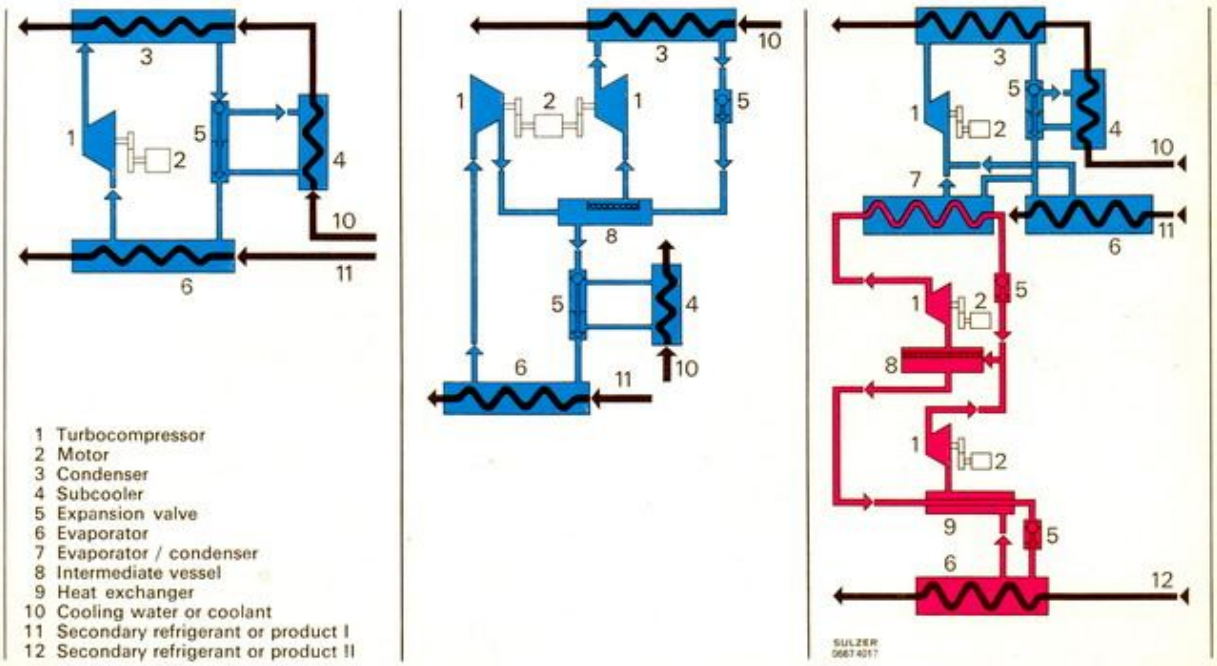
Uniturbo refrigerating plants are suitable quite generally for producing large refrigeration capacities economically. Their duty range referred to normal temperatures—evaporation at 0 °C and condensation at 40 °C—is about 1 to 5 million kcal/h per unit. Uniturbo refrigerating plants are employed on a very wide range of duties in chemical and petrochemical installations, in gas processing, foodstuffs processing, air conditioning, artificial ice rinks, etc. Besides simple single-stage cycles for refrigeration at 0 °C down to –20 °C, for chilling water or brine for the central refrigeration supply in chemical works for example, two-stage cycles with intermediate expansion can be installed for lower evaporating temperatures down to around –50 °C, and multi-stage cycles in cascade for still lower temperatures. To name only a few examples of this kind of installation: precooling of the nitrogen flow in air separating and liquefying plants, liquefaction of ethylene and other low-boiling-point gases, deep cooling of brines for chemical processes.

The diagrams below show only a few of the possible configurations.

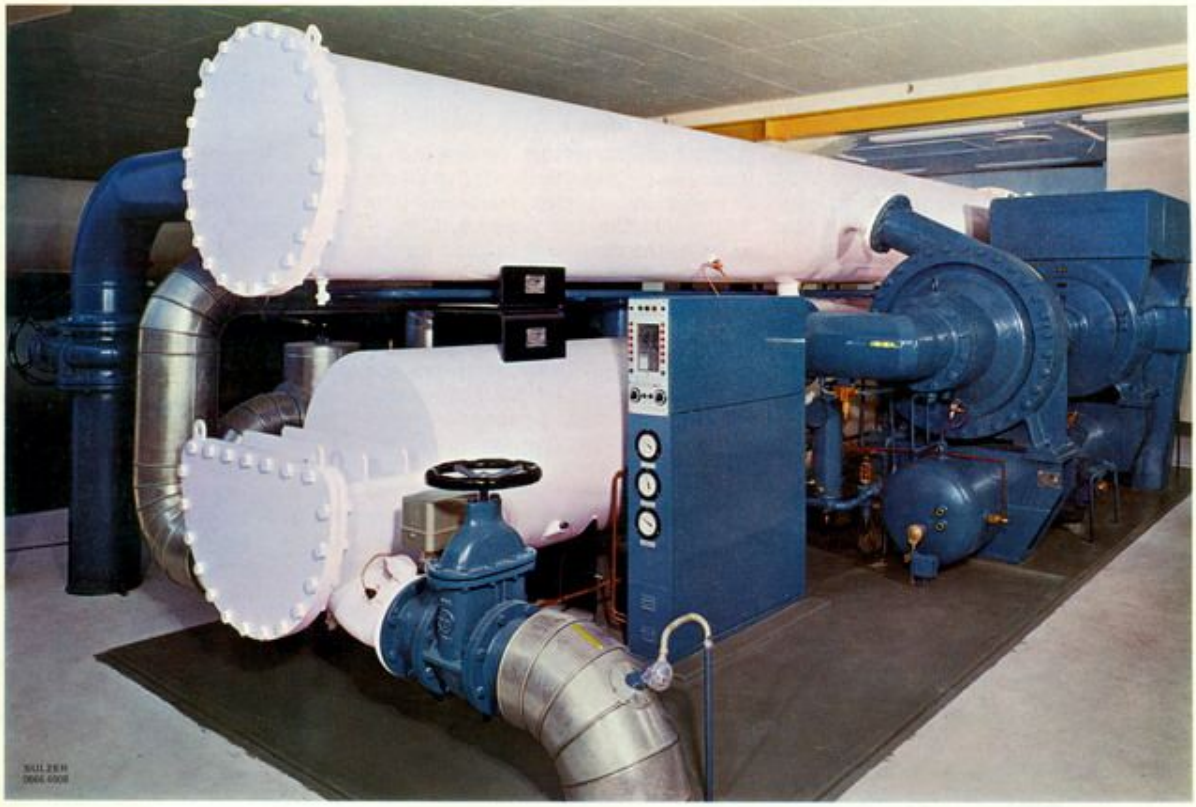
Development

In connection with future development in the construction of turbo-refrigerating plants, the close collaboration between Escher Wyss Limited and Sulzer Brothers Limited should be mentioned. The single-stage turbo-refrigerating compressor introduced by Escher Wyss in recent years is designed for capacities from 500,000 to 1,200,000 kcal/h per unit, and is based on similar principles to the Sulzer Uniturbo compressor.
It thus constitutes a very useful extension to the lower end of the performance range of the Sulzer Uniturbo refrigerating compressors.

Typical Uniturbo refrigerating plant configurations



1 Turbocompressor
2 Motor
3 Condenser
4 Subcooler
5 Expansion valve
6 Evaporator
7 Evaporator / condenser
8 Intermediate vessel
9 Heat exchanger
10 Cooling water or coolant
11 Secondary refrigerant or product I
12 Secondary refrigerant or product II



Our production range

Turbo and dry-piston compressors
Foundry products
Diesel engines
Gas turbines
Refrigerating plants, artificial ice rinks
Fans and blowers
Planning of thermal power plants
Steam boiler plants
Equipment for reactor plants
Heating and air conditioning
Pumps and pump-turbines
Penstocks and distributors
Pressure spheres
Process engineering plants
Gamma irradiation equipment
Weaving machines
Industrial electronics

One of two Uniturbo refrigerating plants rated at 2,000,000 kcal/h each, in the air conditioning plant of the Sulzer tower block.

® = Registered trade mark

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