ATTACHMENT #7

THE GENERAL TIRE & RUBBER COMPANY

CHEMICAL DIVISION

TO	J.R. Mudd	FROM	P.L. Allen
ATTENTION	Ashtabula Staff R.W. Laundrie W. Walker	DATE	April 25, 1974
		SUBJECT	Plant Breathing Air Compressor and Distribution System

Summary:

In compliance with applicable OSHA standards and NIOSH recommendations, a plant breathing air system has been designed and is on order. The system consists of the following:

1. A compressor system capable of supplying air to a minimum of 50 personnel.

2. A sorbent bed and filter capable of removing hydrocarbon contaminants.

3. Sufficient continous flow full face air line respirators to provide protection for plant operating personnel.

Discussion:

On March 11, 1974, the National Institution for Occupational Safety and Health, (NIOSH) issued their "Recommended Occupational Standards for the Manufacture of Synthetic Polymer from Vinyl Chloride."

In part this recommendation states that employees who enter a reaction vessel shall be provided with and required to wear a full face supplied air respirator of the continous flow or pressure demand type, in accordance with OSHA standard No. 1910.134.

The afore mentioned article states that a breathing air system shall consist of a breathing air compressor followed by a suitable purifying sorbent bed and filters capable of providing grade D breathing air, as discribed in the "Compressed Gas Association Commodity Specification G-7.1-1966". (see attachment)

The breathing air system proposed by the writer will in fact meet or exceed all the afore mentioned regulatory standards, and could be expanded in the event that future needs warrant it.

At this point an in depth analysis of the system complete with flow rates, etc. will be provided.

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A. Compressor System.

The proposed compressor system will consist of four water sealed rotary compressors, each capable of 70 scfm at 60 psig. As previously stated this will provide respirable air for a minimum of 50 plant personnel. The exact number will be determined by the type of mask used and employee exertion.

1. Water seal compressors were chosen for three main reasons. The first being that they have a unique ability to scrub impurities found in the inline air. Second that the air would leave the compressor saturated with water vapor. Third, that the air would leave at ambient temperatures eliminating the need for an after cooler.

2. Four smaller compressors were chosen over one large unit for the following reasons.

a. The increased reliability of four units over one large units ie.,the failure of one compressor would only result in a 25% reduction of the system capacity.

b. Multiple units can be more easily taken out of service and maintained.

c. The units can be started up as demand requires there by resulting in an energy savings.

B. Filter and Sorbtion Beds.

For the purifying system a ceramic filter separator followed by an activated carbon adsorbtion bed was chosen. In the system, as proposed two units will be used, one on standby and one in service. This system will be capable of providing the 280scfm of air to a point well below 1ppm. At full contamination rate each purifier should last a minimum of three months.

C. Distribution System and Respirators.

At this time it is the intention of the writer to provide breathing air to the following areas:

1. Polymer Building (both upstairs and downstairs)
2. Monomer Pump House
3. Monomer Unloading
4. Tank Farm Area.
5. THF Area
6. Boiler House Control Room.

1. The distribution system as planed will consist of a three inch header from the warehouse building to the monomer area. Distribution branch lines will consist of two inch pipe.

Using the above line sizes, an over all system pressure drop from purifier to mask should be less than 3 psi. If at a later date the system capacity was doubled the same distribution header could be used with a maximum pressure drop of 6 psi.

2. Carbon steel welded and flanged pipe will be used throughout the system. Carbon steel was chosen of galvanized due to possible toxicity problems of the zinc coating.

3. "Shrader" type quick connect couplings will be used on all branch air drops for easy connection under pressure to an air line. These couplings are not used for any other purpose in the plant, and therefore there will be no possibility of the user connecting his line to the wrong pipe.

4. All piping will be color coded per OSHA standards to further eliminate any possibility of hook up to the wrong line.

5. Constant flow full face respirators have been chosen as the standard for this plant. The air usage with these masks is greater than with the demand type, however; the constant flow provides both cooling and protection against leakage.

6. Pending issuance of OSHA's permanent work rules, bubble suits may have to be purchased for maintenance personnel who man be working on contaminated equipment.

7. Finally, it is recommended that one full face respirator be purchased for each plant worker. This is due to the stringent regulations which OSHA has imposed for cleaning and disenfecting face masks.

Conclusion

It is the writer's opinion that the afore mentioned system will full fill and exceed all applicable Federal and Industrial standards for breathing air systems.

It should be noted at this time that the air provided to the user at his mask will be pleasantly cool, clean, and at an approximate relative humidity of 20%. This will reduce or eliminate complaints arising from the drying out of the mucous membranes.

T.L. Allen, Prod. Supt.

TLA:bjn

AIR SPECIFICATION

1. SCOPE

1.1 This document describes the specification requirements for air, including atmospheric air and air synthesized by blending oxygen and nitrogen in the proper proportions. It is different from other gas specifications because atmospheric air is not a manufactured product but is naturally occuring. Atmospheric air contains a large variety of trace constituents on many of which it is impractical to set individual limits. However, this specification qualifies certain grades of air by limiting the concentrations of specific trace constituents.

2. CLASSIFICATION

2.1 Types — Gaseous air is denoted as Type I and liquid air as Type II.

2.2 Grades — Table 1 presents the component maxima, in ppm (v/v) unless shown otherwise, for the types and grades of air. A blank indicates no maximum limiting characteristic.

TABLE 1

Limiting Characteristics	TYPE I (GASEOUS)									TYPE II (LIQUID)	
	GRADES										
	A	B	C	D	E	F	G	H	J	A	B
% O_2 (v/v) Balance Predominantly N_2 (Note 1)	atm.	atm.	atm/ 19-23	atm/ 19-23	atm/ 19-23	atm/ 19-23	atm/ 19-23	atm/ 19-23	atm/ 19-23	19-23	19-23
Water		none condensed (per 5.3.1)	note 2	note 2	note 2	note 2	note 2	note 2	1 −10.4°F		note 2
Hydrocarbons (condensed) in Mg/m³ of gas at NTP (Note 3)		none (per 5.4.1)	5	5	5						
Carbon Monoxide			50	20	10	5	5	5	1		5
Odor			see 5.1.5	see 5.1.5	see 5.1.5	see 5.1.5	see 5.1.5	see 5.1.5	see 5.1.5		none
Carbon Dioxide				1000	500	500	500	500	0.5		5
Gaseous Hydrocarbons (as methane)						25	15	10	0.5		10
Nitrogen Dioxide							2.5	0.5	0.1		0.5
Nitrous Oxide									0.1		
Sulfur Dioxide							2.5	0.5	0.1		0.5
Halogenated Solvents							10	1	0.1		1
Acetylene									0.05		0.5
Permanent Particulates											—.15

Note 1: The term "atm" (atmospheric) denotes the oxygen content normally present in atmospheric air; the numerical values denote the oxygen limits for synthesized air.

Note 2: The water content of compressed air required for any particular grade may vary with the intended use from saturated to very dry. If a specific water limit is required, it should be specified as a limiting dewpoint or concentration in ppm (v/v). Dewpoint is expressed in temperature °F at one atmosphere absolute pressure (760 mmHg). To convert dewpoint °F to °C, ppm (v/v), or mg/liter, see 7.1.

Note 3: No limits are given for condensed hydrocarbons beyond grade E since the gaseous hydrocarbon limits could not be met if condensed hydrocarbons were present.

What the Vape-Sorber Does:

The Selas Vape-Sorber operates in two stages:

(1) Automatically removes water, water-oil emulsion, free oil in droplet form and dirt from compressed air or gas lines.

(2) Removes oil vapor and free oil in the form of mist and fog by passing the compressed air or gas through an effective adsorbent. Vape-Sorbers are designed to allow for sufficient contact time to enable adsorbent to effectively pick up all of the oil vapor and free oil in form of mist and fog.

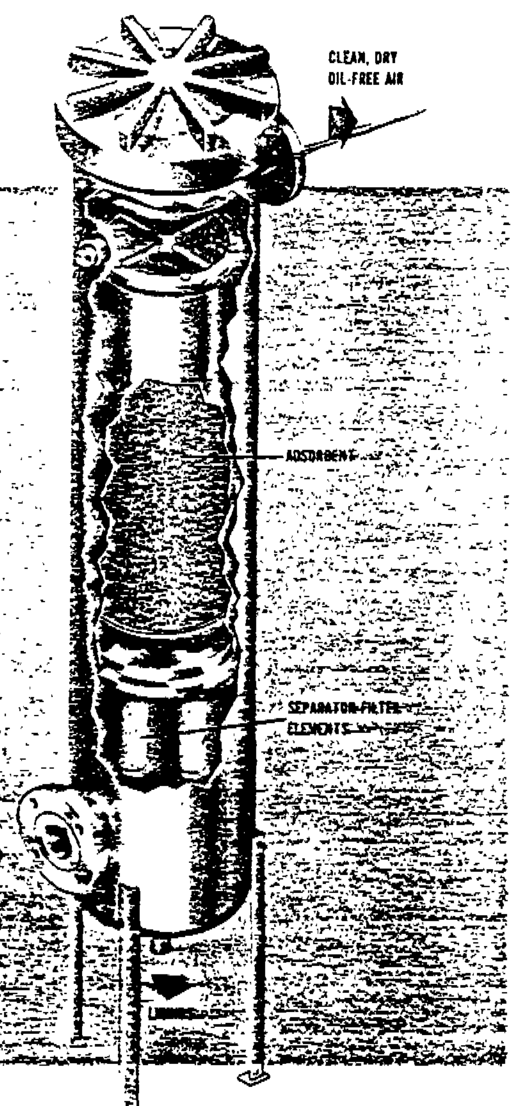
How the Vape-Sorber Works:

For the removal of water, water-oil emulsion and dirt, the Vape-Sorber utilizes basic principles of capillary physics and surface chemistry for effective liquid-gas separation. It is quite different from and more effective than, so-called simple filtration methods and techniques employing change-in-flow-direction or centrifugal-force principles. Its high efficiency remains constant throughout periods of both high and low flows.

Phase separation is accomplished by means of controlled-porosity, water and emulsion-repellent, ceramic elements. Compressed air or other gas entering the Vape-Sorber, passes through the liquid-repellent element, where it is stripped of liquid contamination and dirt. Droplets coalesce on the surface of the element because the diaphragm action is stronger than the pressure drop across the element.

The rejected phase drops to the bottom of the Vape-Sorber and is ejected from the system by simple mechanical means. The air or gas, laden with oil vapor and free oil in form of mist and fog, but free of water, water-oil emulsion and free oil droplets, passes through a specially prepared adsorbent and is stripped of the oil (vapor, fog and mist) by simple and effective adsorption.

Thus, the processed air or gas is completely free of all contamination with the exception of water vapor.



Construction of the Vape-Sorber

The Series I VAPE-SORBERS are compact, functionally-designed units engineered for in-line point-of-use installation. They can be supplied either in carbon steel with cast steel head, or in nickel-plated brass with cast-brass head. Series I units have a disposable canister.

Series II VAPE-SORBERS are equipped with "O" ring type heads for positive sealing.

Series III VAPE-SORBERS have single-bolt quick-opening heads, and offer easy accessibility to filter elements and adsorbent.

Both Series II and Series III units are designed and built according to Code requirements and can be "inspected and stamped" upon request.

GENC 21430

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SIHI

...mpressor systems

The OIL FREE COMPRESSOR SYSTEM is supplied complete with galvanized pressure tank to ASME code, fitted with gauge glass, pressure gauge, pressure switches, relief valve, silent check valves, shut-off valves, service liquid strainers, regulating valves, solenoid shut-off valves, intake silencers, discharge air and water separators and water traps, complete with intermediate piping. Available for separate wall mounting is an electrical starter or duplex control panel.

system are covered by the comprehensive SIHI authorized service are available coast to coast.

OIL FREE AIR — Requires no internal lubrication, discharge air from a SIHI Liquid Ring Compressor is FREE FROM OIL, CARBON or PLASTIC PARTICLES!

SCRUBBED™ CLEAN by the action of the liquid ring within the compressor the AIR DISCHARGED may be FREE EVEN FROM IMPURITIES DRAWN INTO THE PUMP SUCTION!

ELIMINATION OF FILTERS — made possible by the SCRUBBING ACTION described above.

DRIER AIR — is supplied from a liquid ring compressor when compared to a conventional reciprocating or rotary vane unit. Due to the MINIMAL TEMPERATURE RISE ACROSS A SIHI COMPRESSOR the air or gas usually discharged is APPROXIMATELY 25°F ABOVE the temperature of the INCOMING SERVICE LIQUID. As the saturated discharge air has a lower temperature, the corresponding dew content is lower, ELIMINATING THE USE OF AFTER COOLERS and enabling considerable ECONOMIES to be made IN DRYER SELECTION AND OPERATION.

PULSATION FREE AIR SUPPLY — due to ELIMINATION OF RECIPROCATING COMPONENTS.

VIBRATION FREE OPERATION — requiring NO SPECIAL FOUNDATION due to rotary action as opposed to reciprocating forces.

LOW STARTING TORQUE — permits considerable ECONOMIES IN ELECTRICAL STARTING AND CONTROL COMPONENTS.

MAINTENANCE COSTS REDUCED — due to the ELIMINATION OF PISTONS, RINGS, SLIDING VANES, INTERNAL CONTACT OF COMPONENTS, METALLIC, CARBON, PLASTIC OR OTHERWISE.

SIMPLIFIED INSTALLATION — because the SIHI pumps and accessories are MOUNTED ON A REMOVABLE DECK WHICH MAY BE READILY DETACHED from the pressure tank. THE SIHI SYSTEM CAN USUALLY BE INSTALLED AFTER BUILDING CONSTRUCTION AND CLEANING of the proposed location is completed.

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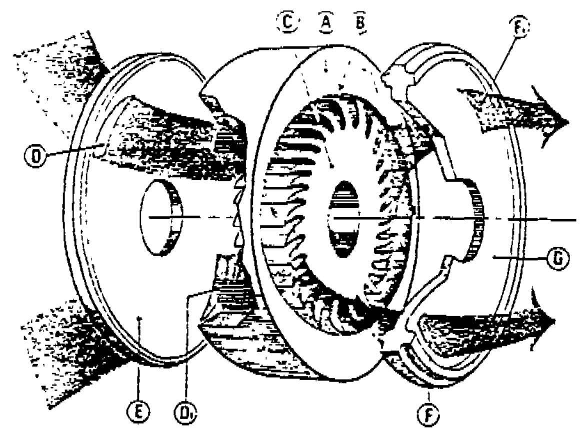
the principle of SIHI double acting liquid ring pumps



The above illustration is intended to depict the operating principle of the SIHI double acting liquid ring pump only and should not be considered for engineering details of construction.

Half of the total air or gas entering the stage enters through suction port (D) at which point the service liquid is retracting from the root of the passing impeller blades. This air or gas is carried between the impeller blades and as the service liquid (due to eliptical shape) commences to completely immerse the impeller blades to their root, the air or gas is compressed and discharged from the pump via discharge port (F).

Concurrently a similar action takes place involving the remaining fifty percent of the air or gas through suction port (D_1) and discharge port (F_1).

As in the SIHI single acting pump the pump body (A) is round externally. However, note that the internal periphery of the body is eliptical (B) the centre of which coincides with the centre line of the shaft mounted impeller (C). Due to centrifugal action, service liquid introduced to the compressor assimilates the eliptical shape of the internal periphery. By controlling the depth of the service liquid the impeller blades are totally immersed at six and twelve o'clock, whereas all but the blade tips are exposed at three and nine o'clock during each revolution.

By locating the suction ports (D), (D_1) in a strategic position in the suction port plate (E) and the discharge ports (F), (F_1) in the discharge port plate (G), a suction/compression cycle is completed with each 180° of rotation.

There is no metal to metal contact during this complete cycle thus the need for internal lubrication is eliminated. During the compression cycle, heat is being imparted to the service liquid which is carried away by the introduction of additional cool service liquid. The amount of coolant supplied is synonymous with the amount discharged to the separators.

The double acting principle is utilized for high pressure compressors because the points of highest pressure are diametrically opposed hence a radially balanced shaft loading reduces deflection and facilitates the application of mechanical seals.

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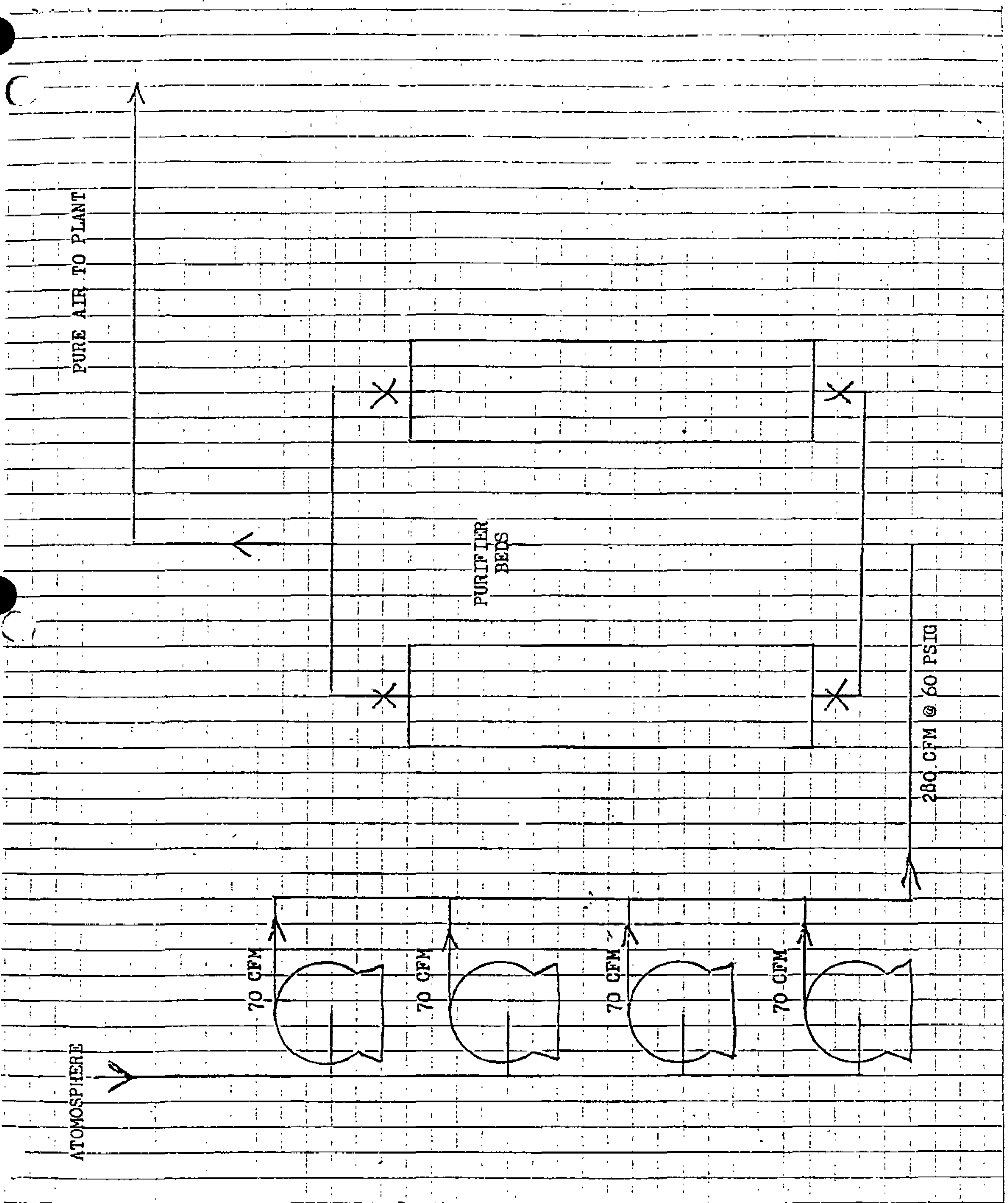
PURE AIR TO PLANT
PURIFIER BEDS
280 CFM @ 60 PSIG
70 CFM
70 CFM
70 CFM
70 CFM
ATOMOSPHERE

SIEMEN & HINSCH

SIHI

the principle of SIHI double acting liquid ring pumps

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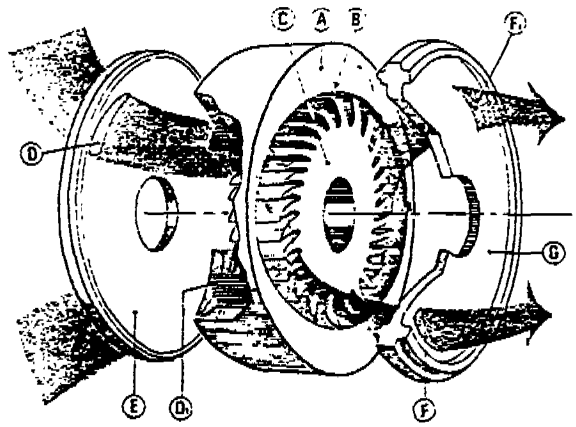

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CUSTOM PACKAGE CAPABILITIES | SYSTEM DIMENSIONS | ELMO & SIGGI SYSTEMS & SPECS | COMPRESSOR SYSTEMS | DOUBLE ACTING PRINCIPLE

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