

TRIP REPORT TO INDUSTRIAL
LABORATORIES

1. Consolidated Vacuum Corp. - Rochester, N.Y.
2. Bell Telephone Labs. - Holmdell, N.J.
3. Sperry Gyroscope Co. - Greatneck, N.Y.
4. Vacuum Electronics Corp. - New York, N.Y.
5. Bell Telephone Labs. - Murray Hill, N.J.
6. Westinghouse Electric Co. - Pittsburgh, Penn.

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Lowloss Circular Waveguide

Waveguide consists of a circular pipe two inches in diameter for the frequency range 35 - 100 KMC. The test frequency is 50 - 60 KMC. Guide may be either smooth or with insulated wire helix wound inside.

Instrumentation

Special techniques have been developed to test the behavior of circular waveguide, the most effective is a short pulse technique which is used to measure the velocity of propagation of wave. A discontinuity does not reflect energy but only causes a mode conversion with all the energy propagating in the forward direction. Mode conversion is the prime difficulty since this interferes with the information signal.

Discontinuities

1. Circular discontinuities cause a series of TE_0 modes to be generated.
2. Bends generate the TM_{11} mode, but may be suppressed by a dielectric on the inside of the pipe.
3. Additions of the discontinuities can be very serious if they occur at a beat frequency for two different modes of propagation.
4. Tapers can cause mode conversion, however, if they are made according to a cosine squared law no mode conversion occurs.

Connections in Circular Waveguide

Joining Sections

Since the fields are such for the dominant TE_{01} mode which we are trying to preserve it is possible to make connections by means of a syphon bellows. The bellows behave as a filter for higher order modes. Since no longitudinal field propagates it is not necessary to provide good r-f contact across the surface. However, since straitness is important good lapped surfaces are used.

Couplers

Couplers can be made by conventional techniques by putting a series of holes in the wall of the waveguide with a form of mode suppressor in

the area such as a helix. Coupling coefficient may be as high as six db.

Mode Suppressors

Mode suppressors may be either reflective or absorptive to prevent reflected power from causing further interference. Mode conversion is the limiting factor in designing a circular waveguide system. The most effective filter yet designed is a helix wound of insulated copper wire which is held in place by a fiber glass insulation on the walls of the tube.

Method of Manufacture

A stainless steel tube is chrome plated and ground to a high polish. The helix is then wound of .020 to .030 insulated wire on the mandrel. A coating of two layers of fiber glass, one of which is coated with carbon is then applied. The assembly is then inserted into a ground steel tube, evacuated to the fore vacuum pressure and the space between the mandrel and the tube filled with epoxe material. After a twenty-four hour bake at 150° F the mandrel is removed by pulling. The end surfaces are then machined to provide continuity and a parallel joint. Bulk resistivity of graphite material is one ohm per square.

Tolerance

The inside dimension of the wire is held $\pm .0005''$ which is possible by the above method of construction.

Loss

The radio frequency attenuation with helix is 10 to 20 per cent greater than theoretical, however, it is lower than obtainable with a smooth copper pipe. Loss is 2.9 db per mile.

CONSOLIDATED VACUUM CORP.
Rochester 3, N.Y.

Method of Measuring Backstreaming

The backstreaming of an oil diffusion pump can be measured by placing a metal container directly above the pump being checked. It is necessary that all the surfaces on which oil collects be properly cooled. The collection surfaces consist of the chamber walls and a funnel placed within the chamber. The entire surface is coated with oil and backstreaming is then measured in the steady-state condition.

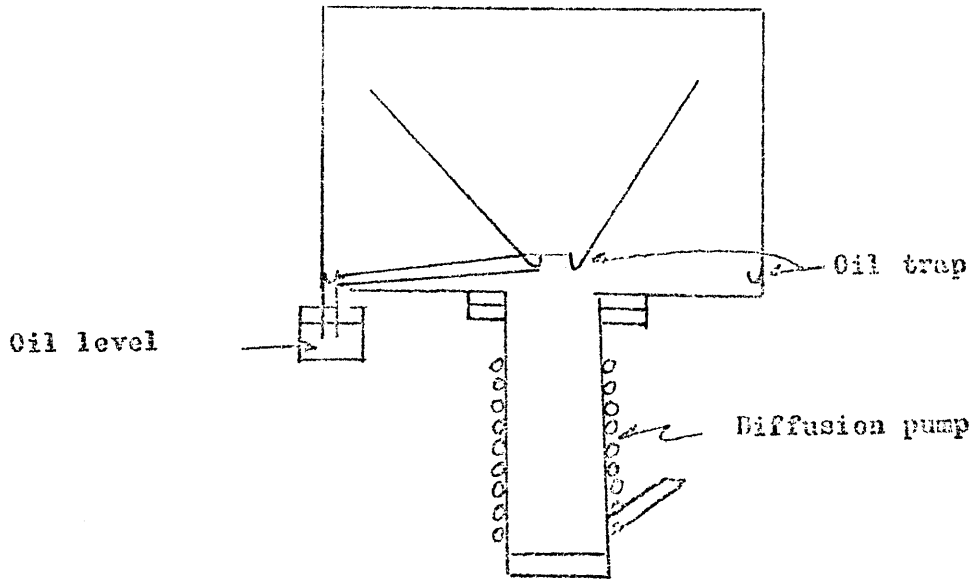


Fig. 1

The backstreaming rate for a 6 inch diffusion pump is .07cc/hr. The factors affecting backstreaming are:

1. Pump body temperature
2. Jet design
3. Oil temperature

Water cooled diffusion pumps, in general, have a lower backstreaming rate due to better cooling.

Comparison of Various Methods of Trapping

Several manufacturers have experimented with the use of zeolyte as material to trap oil vapors from diffusion pumps. CVC has used a trap consisting of six baffles three containing zeolyte and three metal baffles. The zeolyte is located such that oil vapors must come in contact with a zeolyte surface.

The best pressure obtainable to date has been 2×10^{-10} mm Hg. The life of the trap depends on bake cycle and also on pump conditions. A pressure of 2×10^{-9} mm Hg has been obtained for several months after a 6 hr. bake.

Three different trapping systems were constructed to check the merits of each.

1. A single L.N. thimble trap
2. A double L.N. thimble trap
3. A zeolyte trap system.

Lowest pressure

The same ultimate pressure was obtained with each of the systems after bake. However, the single L.N. system decayed first then the double system, the zeolyte system did not decay below 10^{-9} mm Hg for a period of several months.

Cost

The zeolyte system is reasonable to construct and can be built to any dimensions hence not limiting the conductance through the system. Since no L.N. is needed to maintain low pressure maintenance is held to a minimum.

Vacuum Seals

The most often used metal seal at CVC is the aluminum O-ring. The limitation with this seal is during high temperature cycling. The highest temperature obtainable is about 450° C. The seals always leak after bake, but may be tightened to prevent leak. They are not practical for large diameter seals.

Use of Teflon

Teflon has been used in systems which are baked to 150° C. The seal was in the form of an O-ring with close fitting metal surfaces toward the high vacuum side. They do not believe that teflon gives off vapor. However, they have not been able to obtain a pressure below 10^{-8} mm Hg with teflon in a system.

Pumping Speed

It has been shown that the pumping speed of a gas is proportional to the square root of the mass of the atom. This is not true with the now pumps of the PMC variety, which seems to indicate that an efficient pump is efficient for all gases whereas an inefficient pump is poorer for some than for others.

All Metal Valves

CVC is working on an all metal valve which would be suitable for baking to 400° C in the open position. The novel feature of this valve is a hard spring steel worker which expands into a stainless steel wall. The clearance between the disk and the wall is .005". Since the seat is radial it may be moved along the length of the body in small increments.

Baffles

They are currently manufacturing a baffle which may be either water cooled or cooled with liquid nitrogen. This baffle is of the chevron type. A point of interest is the cooling along only one surface which is adequate.

Leak Checking

It is not possible to leak check a vacuum system with acetone at pressures lower than 10^{-8} mm Hg.

SPERRY GYROSCOPE CO.
Great Neck, New York

Extended Interface Cathode

Methods have been developed to obtain high currents per square cm from an oxide cathode for long pulses and long life times using the extended interface cathode. Pure powdered nickel is sintered and pressed into the surface of a nickel cathode button. A thin suppression of coating is then applied and is absorbed into the sintered nickel.

Cathode Conversion

Ceralloy paste is included in an appendage to the main tube. When Ceralloy is heated to 600° C during bakeout and the cathode activated the CO₂ is attracted in a one-way chemical reaction. Cathodes may be converted in twenty minutes with Ceralloy and an 5 ℓ/sec ion pump. One milligram of Ceralloy is used for each milligram of coating.

Metal Valves

To obtain a metal valve suitable for baking, a stainless steel knife edge is used which presses into a copper seal. The seal is annealed during the bakeout. These valves have been made in sizes up to three quarters of an inch. A torque wrench is used to assure proper torque. No information is obtainable on leak rate or possible cycles.

Charcoal Pumps

A charcoal pump is used to start the Vacion pump. This consists of a corrugated glass cylinder with an inner screen to hold the charcoal to the walls. The entire unit is 14 inches long and 3 inches in diameter. The assembly is put in liquid nitrogen to cause pumping.

Ion Pumps

Sperry has designed an appendage pump which is small and suitable as a gutter after the tube is pinched off or to measure pressure. Pumping speed is one liter/second, and is supplied with a transistorized battery operated supply which can be shipped with the tube. They now feel that there is a definite pumping speed per cell which is independent of cell size.

The pump is constructed in a circular configuration. The anode consists of a titanium rod.

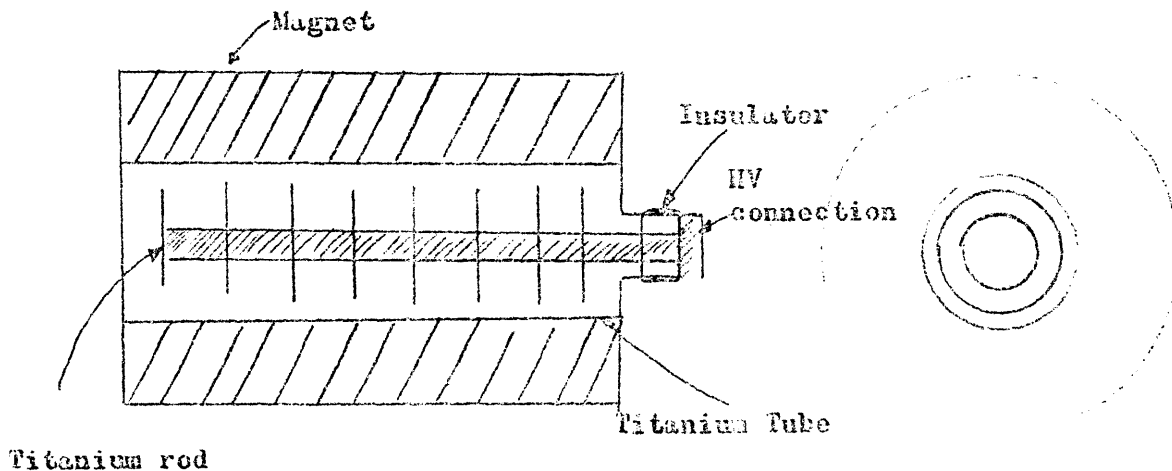


Fig. 2

VACUUM ELECTRONIC CORP.
New York

Zeolyte Traps

Pressures of the order 10^{-10} are possible in a completely sealed system with all metal gaskets, however, with teflon in the system the lowest pressure obtainable was 2×10^{-8} . The lowest pressure was maintained for 90 days with decay, however, during this time the size of the pellets was reduced, and also a slight discoloration was noticed. However this did not seem to affect pressure.

Metal Seals

Veeco has successfully used a .020 gold wire in the form of a ring. The ring is joined by brazing a pure oxygen flame. The wire is placed in the corners of stainless steel flanges to provide the seal.

WESTINGHOUSE ELECTRIC
Pittsburg, Penn.

Processing Teflon

Teflon is processed for high vacuum use before machining by raising to a temperature of 370° C in a vacuum furnace. At this temperature teflon will shrink and become almost clear with an opalescent coat. The contraction is about 15 per cent, but not uniform in all directions. To prevent further shrinking it is annealed twice during the processing time. It will change only several thousandths during the second cycle.

A Teflon Valve

A valve of the Alpert design using teflon has been built. Teflon must be held without constraint during the bake cycle. The leak rate is of the order of 10^{-10} mm/sec. As many as 10 closures have been made successfully without increasing torque. The outgoing products of teflon consist mostly of CF products up to mass 250. No fluorine is present.

Metal Seals

Westinghouse uses a .030" diameter gold wire which forms a gold diffusion seal when crushed between corners of stainless steel flanges.