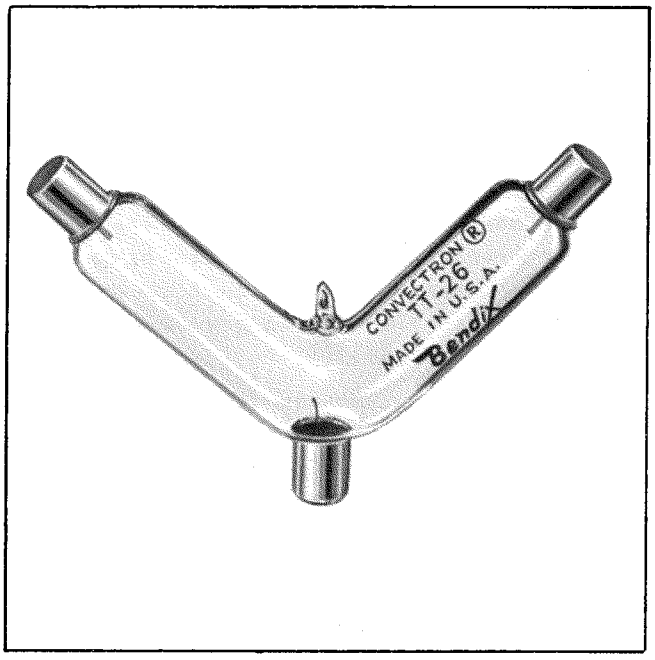
Y-TYPE D-C CONVECTRON



RATINGS

Nominal Supply Voltage	8 volts
Maximum Supply Voltage	10 volts
Nominal Sensitivity (within 1° of null)	10 Mv./Deg.
Time Constant	0.1 sec.

PHYSICAL CHARACTERISTICS

Connections	Small Cap RETMA C1-1
Dimensions	See outline drawing on reverse side

OPERATION DATA

Bridge Supply Voltage	Resistance per Arm
2 Volts	31 Ohms
4 Volts	41 Ohms
8 Volts	67 Ohms
12 Volts	95 Ohms

DESCRIPTION

In order to overcome the drawbacks inherent in other devices for determining a vertical reference, Bendix Red Bank has developed an electric device known as the Y-Type D-C Convectron which offers new possibilities as a vertical sensitive element. It is a non-emission type tube, operating on direct current, and is capable of giving an appreciable electrical signal relative to its position about the vertical. It consists of a sealed glass bulb with grid caps mounted at the end of each arm and at the base of the tube. The envelope is filled with a gas, such as argon, and contains a single nickel filament running centrally through each arm to a spring support in the base which serves as a center tap for the filament.

When the tube is used in a bridge circuit as illustrated, (see over), the filament carries sufficient current to heat it to an average temperature of about 400° C. This heat leaves the filament by (1) metallic conduction, (2) gaseous conduction, (3) radiation, and (4) gaseous convection. The percentage of heat leaving by the first three means is comparatively small, while that leaving by convection is large. Convection currents rise along the vertical and so pass the filament at whatever angle it happens to be relative to the vertical. The relative rate at which the filament loses its heat because of these convection currents, and consequently the filament temperature, depends on this angle.

Since the filament material is nickel which changes its resistivity with temperature, the bridge is thrown out of balance as the tube is moved from the vertical position. The vertical, or null position is any position where the two sensing elements form approximately equal angles with the vertical and produce a zero output signal. This condition is satisfied at each quadrant so the tube will have a sinusoidal output with rotation, the signal reversing polarity at null. This permits using the tube to control servo mechanisms or instruments because the signal has sense as to whether the displacement is to the right or to the left of null.

The Y-Type D-C Convectron overcomes the problems inherent in the old methods for obtaining vertical refer-

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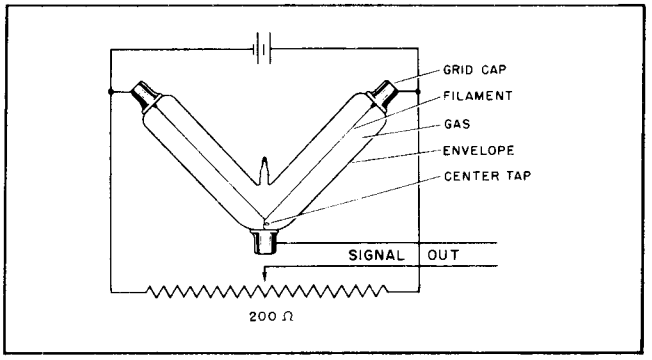
ence. It has no moving parts and gives an electric signal directly without oscillation. The time constant of the tube is about 1/10 of a second. It draws less than 1 watt for a bridge supply voltage of 10 volts. The displacement signal is about 10 mv per degree at null. The noise level is zero. As the supply voltage to the bridge circuit is increased, the tube sensitivity is increased until the bridge supply voltage becomes about 8 volts. Further voltage increase may reduce sensitivity and null stability. With a bridge supply of 8 volts, a change of ± 5% in supply voltage will not cause the null to shift more than 1 millivolt.



TYPICAL BRIDGE CIRCUIT

It is possible to obtain a stronger signal by using two tubes to complete the bridge. However, this procedure is recommended only if the two tubes used are matched so as to provide the best results.

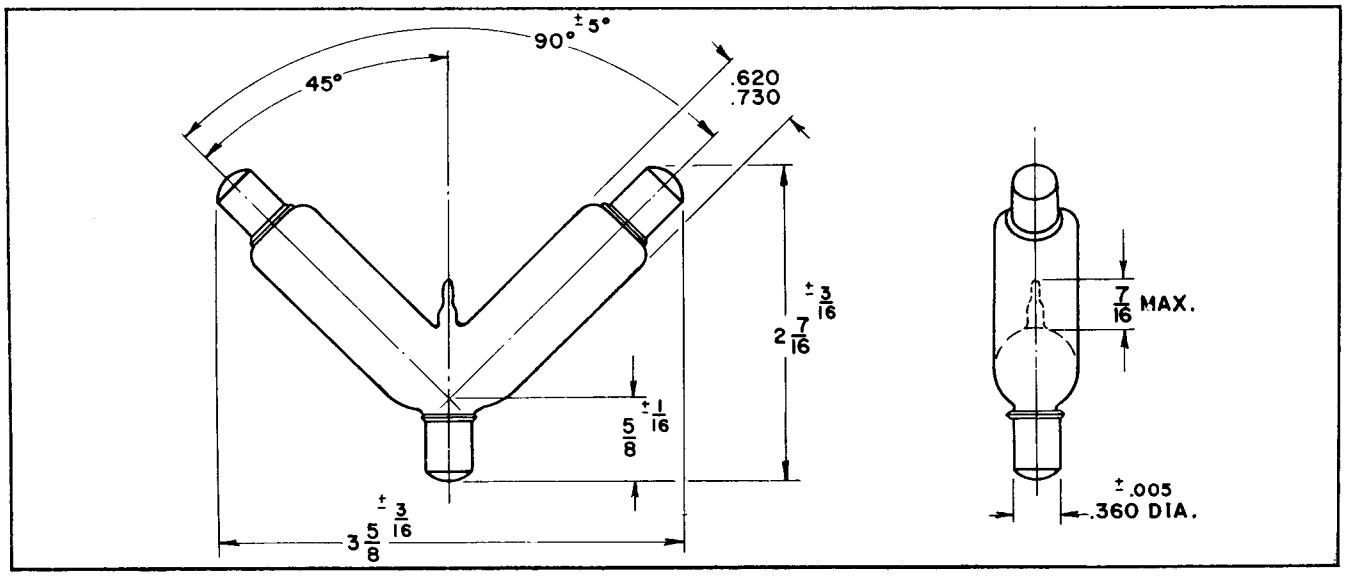
The null is affected by the ambient temperature and bridge supply voltage, and is likely to shift during an extended period of time. If suitable precautions are taken to prevent random air currents from striking the tube and to maintain close regulation of ambient temperature and supply voltage, a null shift of less than six minutes of arc may be expected during continuous operation.

Like the plumb line and liquid level, the convectron tube locates the accelerating forces acting upon it. For stationary installations this force is the force of gravity alone and, hence along the true vertical. When two different accelerating forces are acting on the tube, it will locate their vector component. If the plumb line, liquid level, or the convectron, for example, were spun in a centrifuge in a horizontal plane so that the centrifugal force was equal to the force of gravity, the vector component would be 45 degrees off the vertical and would be so located by each of these mechanisms. The Y-Type D-C Convectron does not replace the self-erecting gyroscope but can be used to monitor the gyroscope because its time constant is much less than that of the gyroscope. The difference between these two devices is made clear by considering the Y-Type Convectron as acting much like a short arm pendulum while the self-erecting gyroscope acts like an extremely long arm pendulum.

In addition to the operational differences already mentioned, the Y-Type Convectron is sensitive to changes in magnitude as well as direction of the acceleration. One of these tubes displaced 10 degrees from vertical, giving a signal of 50 mv under an accelerating force of 1 g, will give a signal of 80 mv under an accelerating force of 2 g.

During free fall the output signal from the convectron is zero because thermal convection currents no longer exist within the tube and, in the absence of thermal convection, the filament temperature is not affected by the position of the tube. (Under this condition other vertical indicating devices are inoperative as well.) But, should the tube be accelerated toward the earth faster than 32 feet/sec/sec, it will again become operative. In other words, the tube is sensitive to vertical forces because essentially it is an accelerometer.

The performance characteristics of these tubes make them adaptable to numerous applications in the instrument and industrial control fields.



OUTLINE DRAWING