NOTICE OF APPROVAL
AVIS D'APPROBATION

G-104

OTTAWA November 27, 1973.

CANADIAN METER COMPANY, BASE VOLUME INDEX
CONTINUOUS INTEGRATORS MODELS 100 and 200

Apparatus

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Static pressure ranges, psig (Bourdon Elements)	0-15,0-30,0-45,0-60,0-100,0-150. 0-300,0-500,0-1,000 and 0-1,200
Base pressure, psia	14.73
Temperature range	-20°F to +140°F
Temperature system	Mercury filled with case compensation and 6 foot length armoured capillary
Base temperature	60°F
Proving circle capacity, cu. ft. per rev.	5, 10, 100 or 1,000
Volume registers	Two, cyclometer-type counters; displayed number of digits depends on the capacity range of the device
Operating temp. limits (Model 200 only)	0°F to +120°F

Description

The Base Volume Index Continuous Integrator, Model 100, is designed to sense the line pressure and temperature of the metered gas and automatically and continuously, apply the required pressure and temperature multipliers to provide the metered volume registration at declared base conditions. This function is achieved through the employment of a dual ring and disc type integrating mechanism. The device is driven directly by a gas meter to which it is attached in place of a standard register.

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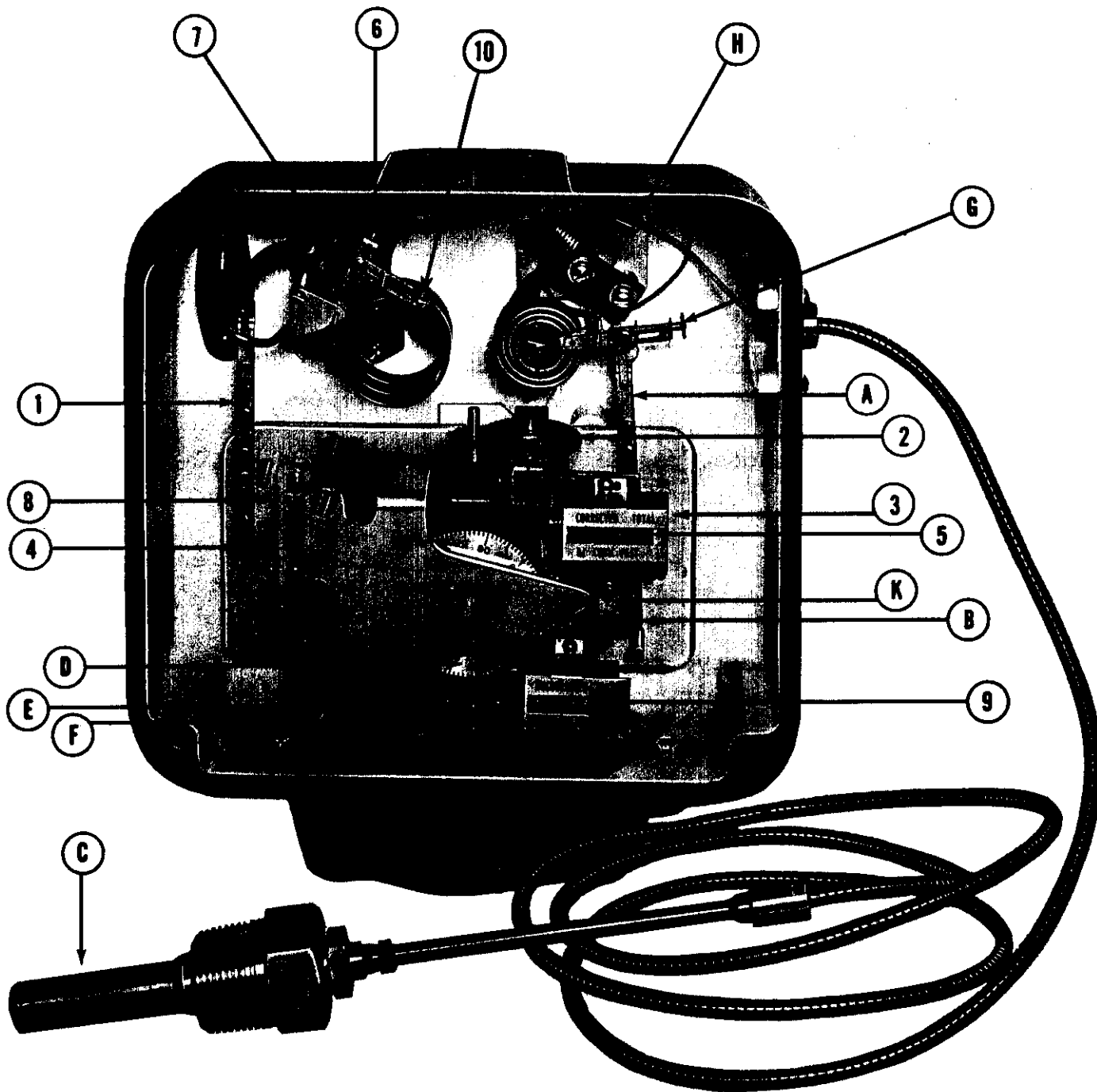
PRESSURE SYSTEM

1. Pressure Link
2. Calibrating Dial
3. Corrected Counter Mask
4. Pressure Ring Yoke
5. Output Counter
6. Span Adjusting Screw
7. Zero Adjusting Screw
8. Pressure Scale
9. Input Counter
10. Linearity Link

TEMPERATURE SYSTEM

A. Temperature Link
B. Temperature Ring Yoke
C. Temperature Bulb
D. Calibrating Disc
E. Proving Pointer
F. Proving Scale
G. Span Adjusting Screw
H. Zero Adjusting Screw
K. Temperature Scale

The Base Volume Index Continuous Integrator, Model 200 performs the same function as the Model 100, however it incorporates an additional capability of providing a printed record of 36 daily or hourly intervals of the corrected volume on a 4.5 inch diameter circular chart. The battery operated print-out mechanism incorporated in the BVI-CI Model 200 is similar to the Print-Out Module, Type 101, approved in Circular G-58, dated December 31, 1970 and reference should be made to that circular for further details and description of operation.

The integrating mechanism consists of five principal parts, namely an input shaft, an output shaft, a common disc and two rings, all made of hardened, ground steel. Various components of the integrator are clearly marked on two illustrations forming part of this circular.

In operation, the input shaft is geared to and driven by the meter. The input shaft drives the first ring, which in turn, drives the common disc. The common disc drives the second ring, which in turn, drives the output shaft. These internal drives are accomplished by friction and pressure is maintained between the components by two load springs of approximately 12 pounds each.

The first ring is guided by a yoke which is controlled by a link attached to the output arm of a -20°F to +140°F temperature system. As the temperature varies, the position of the first ring on the disc changes proportionately. It takes very little force to reposition the ring, since the yoke steers it like the front wheel of a bicycle. As soon as the ring is tilted, it attempts to straighten itself in line with the guiding hole in the yoke. This results in a smooth guidance system with no perceptible backlash.

The ratio of the diameters of the various parts is so calculated, that when the first ring is positioned, 0.900 of an inch from the center of the common disc, it will take exactly three turns of the input shaft to make the common disc rotate exactly one turn. It can be pointed out that the output side is made to the same dimensions, so that if the two rings are positioned equidistant from the common center, the output shaft will rotate exactly once in the opposite direction for each input shaft revolution.

A base temperature of 60°F is assigned to the 0.900 radius mentioned above. If the temperature drops, the ring will move toward the center of the disc resulting in a greater number of revolutions of the center disc. Higher temperatures will have the opposite effect. This completes the temperature correction.

The second ring is guided in the same manner as the first ring. Its yoke is controlled by a link attached to the output arm

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DUAL RING OPERATION
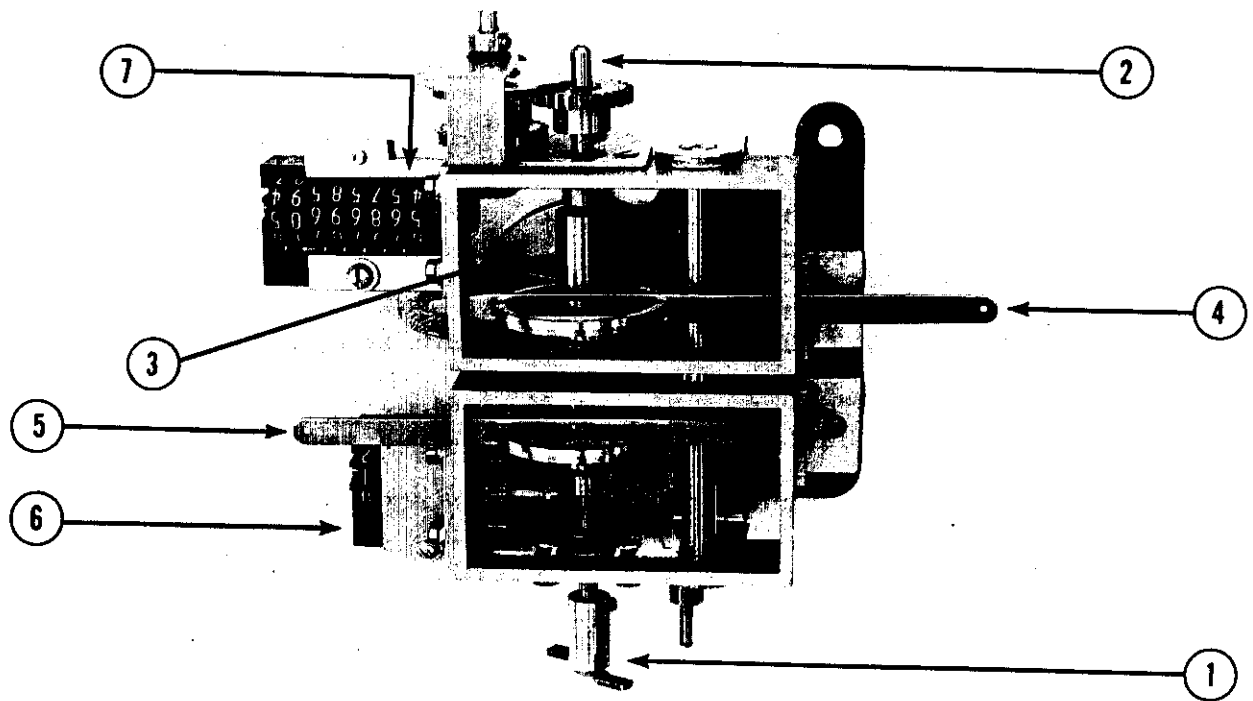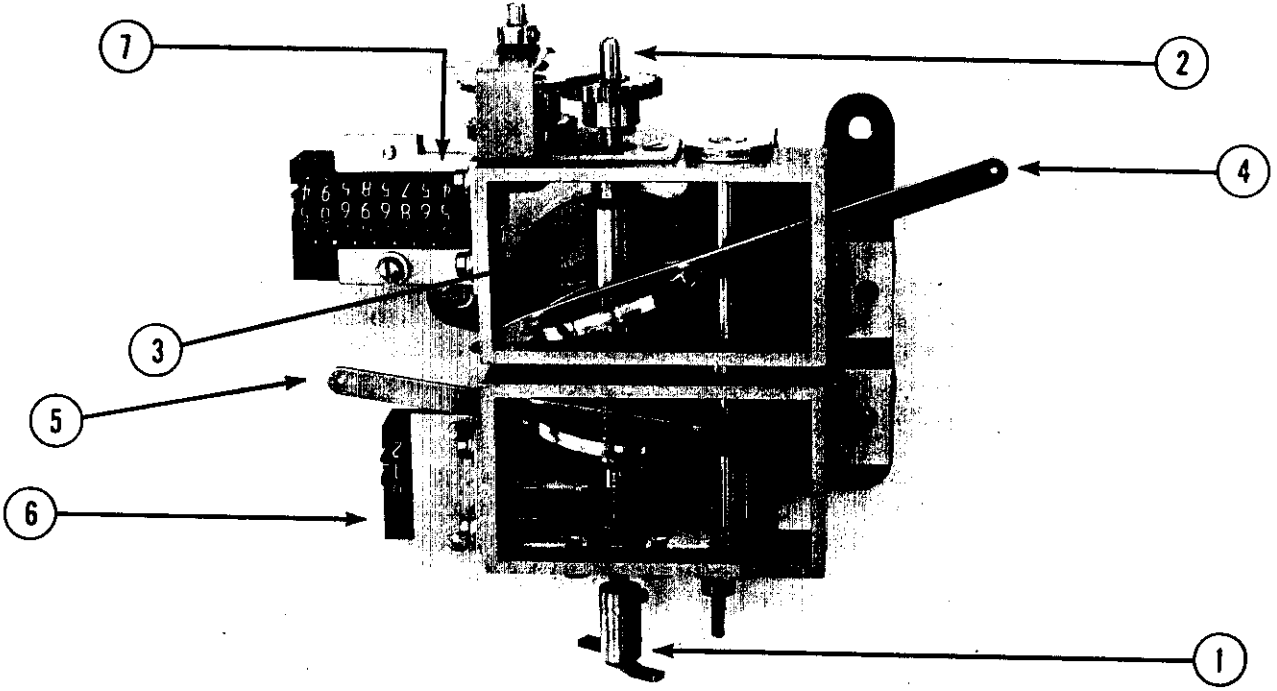
1 - INPUT SHAFT

2 - OUTPUT SHAFT

3 - COMMON DISC

4 - PRESSURE YOKE AND RING

5 - TEMPERATURE YOKE AND RING

6 - INPUT COUNTER (UNCORRECTED TOTAL)

7 - OUTPUT COUNTER (CORRECTED TOTAL)

of a pressure element (Bourdon Tube). At full scale absolute pressure, the ring will be positioned 1.000 inch from center. At any other absolute pressure, the ring position will vary proportionately. At the full scale position (1.000 inch radius) the output shaft will turn 3.333 times for each revolution of the center disc. By means of appropriate change gears the range of the instrument can be altered to suit various pressure ranges. This completes the pressure correction.

A proving hand is attached to the input shaft for calibrarion purposes. An input counter is geared to the input shaft to provide an uncorrected registration. The circumference of the disc is marked with 100 divisions for calibration purposes. A dial is mounted on the final change gear for calibration purposes.

An output counter is geared, through change gears, to the output shaft to provide a corrected registration. Masks are provided for both counters so that they can be read in appropriate units (e.g. tens, hundreds, thousands, etc.).

The manufacturer's Product Data Bulletin No. 213-001 provides complete information with regard to the extent of the masking that is required for pressure ranges and proving circle capacities, etc., and reference should be made therein when verifying BVI-CIs.

The BVI-CI model 100 is designed to accommodate only clock-wise rotation of the input shaft. An adaptor plate is required for counter clockwise rotation. This instrument is adapted to accept a VPT gauge or a Print-Out Module, approved under circulars G-71 and G-58 respectively.

There are two versions of BVI-CIs in existence. Those of the earlier production have metal-glass covers and require a bi-metallic, temperature compensating element in the static pressure link, which connects to the pressure ring yoke. A separate illustration shows this compensating element, which must be in-cluded in all units of this version for pressure range up to an including 600 psig. And the later production version, with re-designed pressure linkage system, which does not require the bi-metallic compensating link. This later version has a green trans-lucent plastic cover and may be differentiated from the original line by the serial number which shall be forefixed with the designation VC-I for Model 100, and VC-2 for Model 200. The serial numbers begin from 100 in each case. The BVI-CI Model 100 in this later version can accept a VPT gauge or a Print-Out Module.
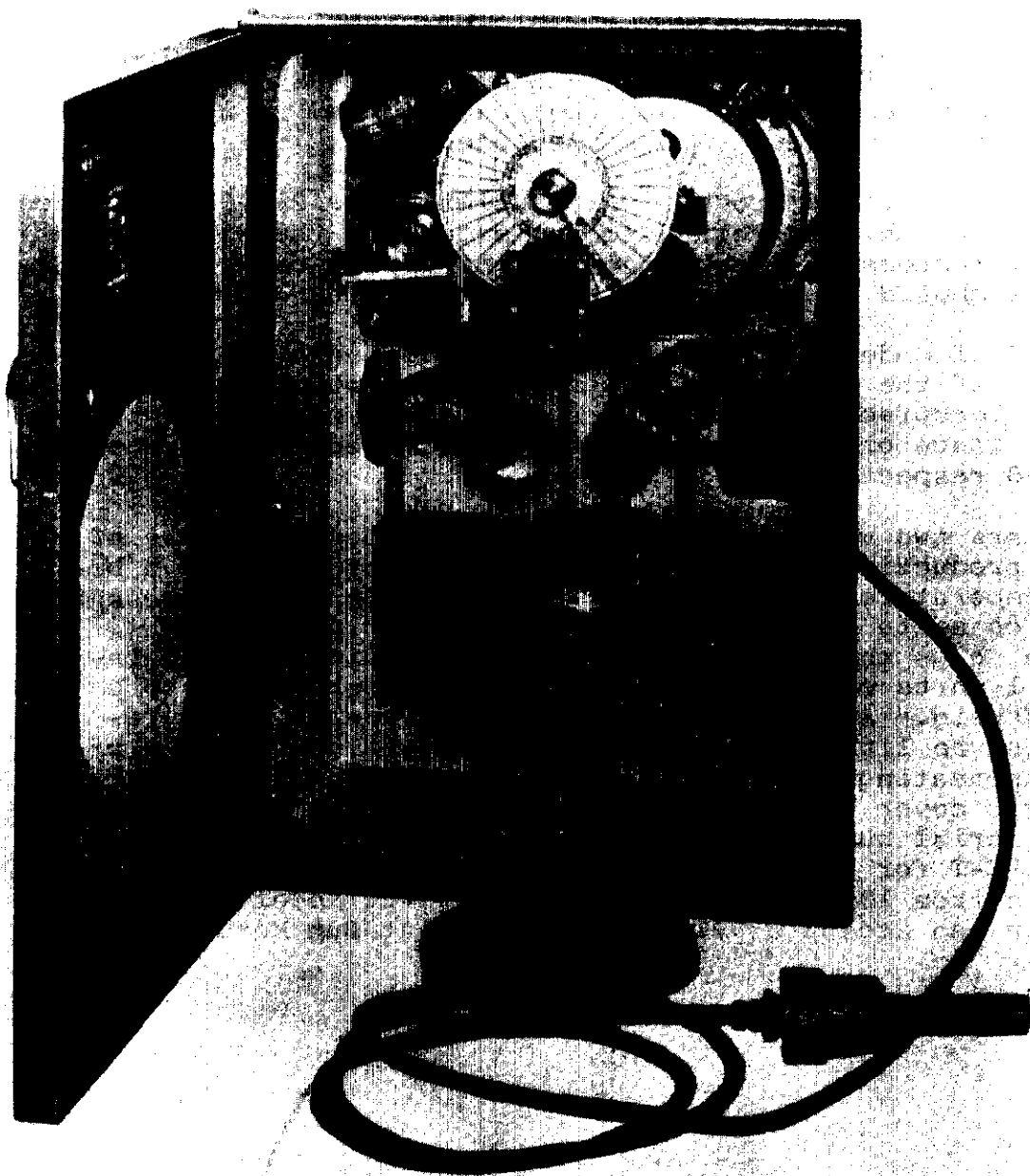
The computation of the volume of a gas, at the contract
temperature and pressure, which has been registered in cubic feet
at line conditions is based on the ideal gas laws modified by a deviation
factor available in the form of a Supercompressibility factor (Fpv),
determined according to the A.G.A. Gas Measurement Committee Report
No. 3, Orifice Metering of Natural Gas.

The general equation for converting the meter readings at
line conditions to a contract base pressure and temperature is
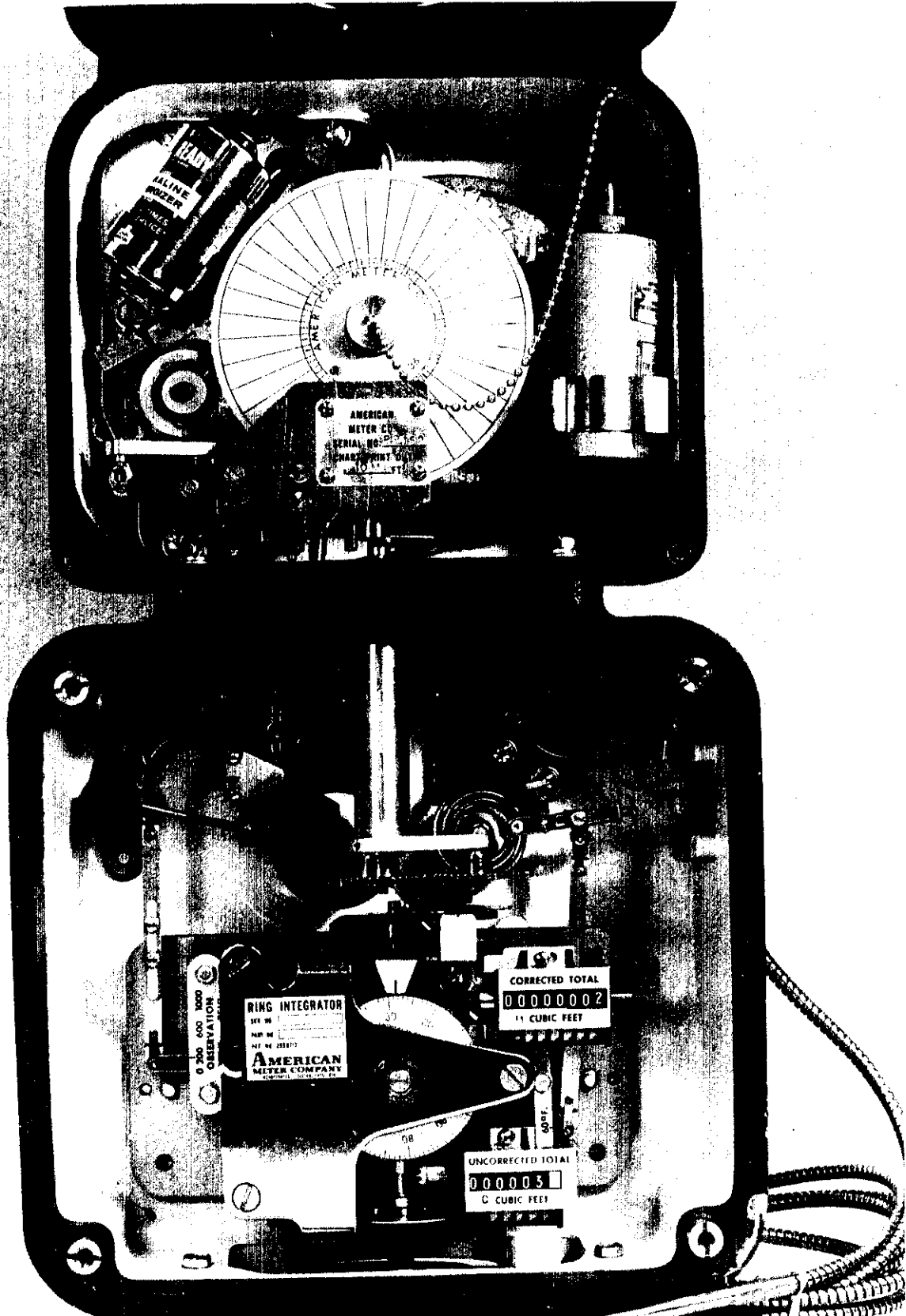
$$Qs = Qd \; Pm \; Tm \; (Fpv)^2$$

Qs = Quantity of gas at the contract base pressure and temperature,
cu. ft.

Qd = Actual (displaced) gas passed at existing meter conditions,
cu. ft.

Pm = Pressure multiplier
= $\dfrac{\text{Weighted average existing gauge pressure + barometric pressure}}{\text{absolute pressure base}}$

Tm = Temperature multiplier
= $\dfrac{\text{Temperature base + 460}}{\text{Weighted average flowing gas temperature + 460}}$

Fpv = Supercompressibility factor based upon the weighted average
gas pressure and temperature and the normal composition of
the gas. The composition is represented by its specific
gravity, its content of nitrogen and carbon dioxide and
its calorific value as used in the derivation of Fpv values.

The Base Volume Index "Continuous Integrator" does not make
automatic correction for the Fpv factor. The selection of a
weighted average Fpv factor for use with the corrected register
read-out should be based on a record of the flowing gas volumes,
temperatures, and pressures. Whether such record is available or
not, the variations in pressure and temperature normally existing
in the line must not introduce an error greater than ±0.5% in the
selected $(Fpv)^2$ factor.

It should be noted that careful adherence to the manufacturer's
instructions is required when operating the BVI-Continuous In-
tegrators and particular attention should be paid to the proper
direction of rotation of the input shaft, and to the fact that the
input shaft must be rotating before any changes are made in the
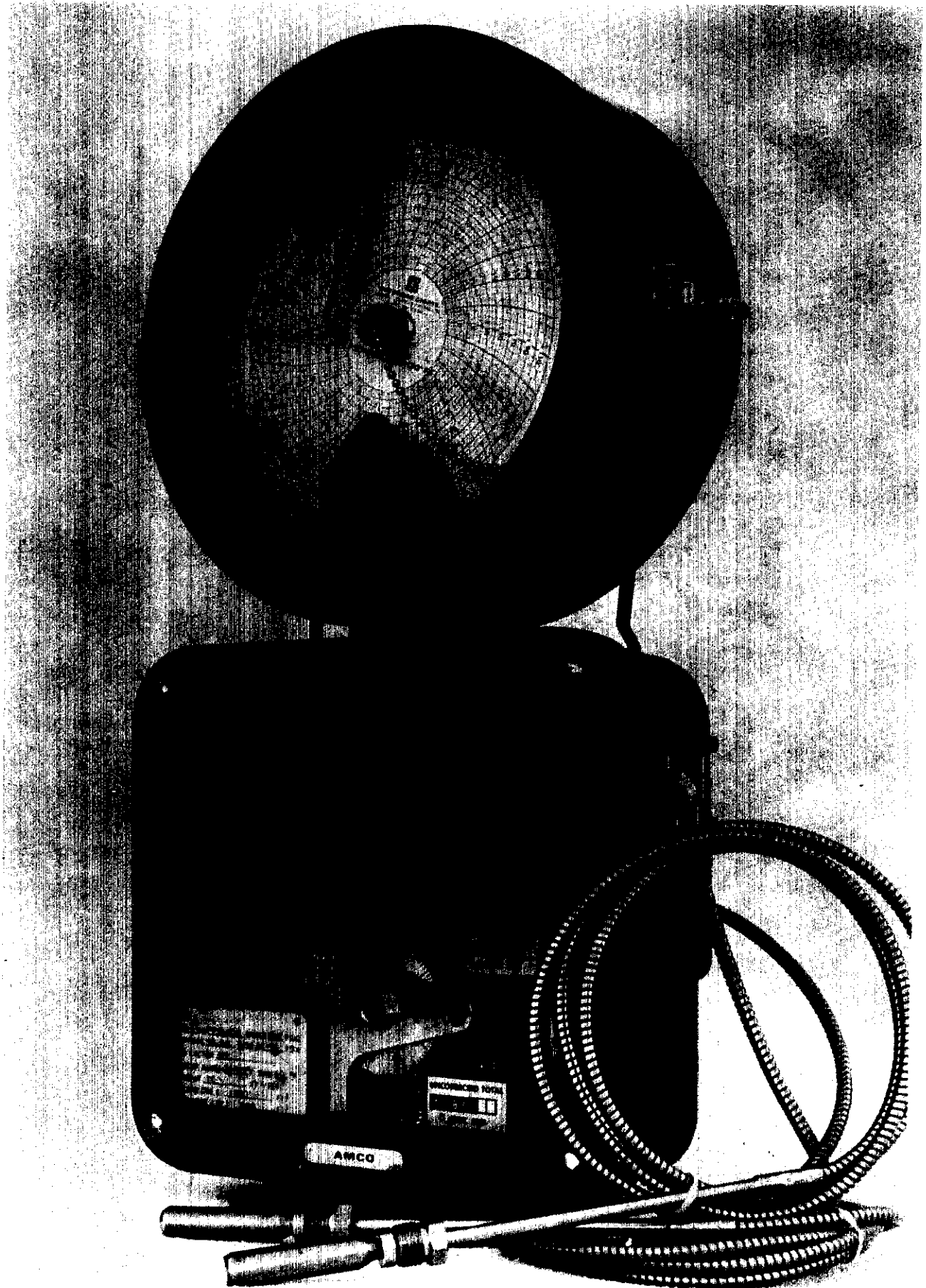applied pressure and temperature.

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