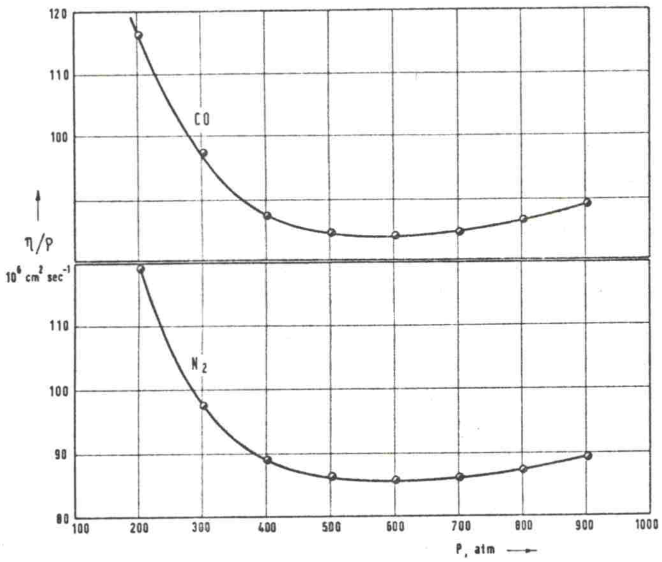

Fig. 2. Experimental values of momentum diffusivity, η/ρ.

ues of the binary diffusion coefficient, $D_{CO,\,N_2}$, calculated with Equations (6) and (12) by our viscosity measurements. The circles indicate our experimental values of $D_{CO,\,N_2}$ previously measured at the same temperature by the dynamic method (2).

EXPERIMENTAL

Equipment

A viscometer has been built by the Servizio Geochimico, AGIP—Direzione Mineraria, Milano, which satisfactorily compromises accurate measurement and simple operation. Figure 3 shows the main elements: reservoirs a and b, gas capillary c and mercury tube d. These are connected forming a rigid parallelogram, in which mercury and a known quantity of the gas are confined. By automatic control the rigid parallelogram can rotate around point O to assume four inclinations (see Table 5), allowing as many viscosity measurements at the same pressure.

The gas volume forced through the capillary during one run is determined by timing the motion of the mercury level between the two contacts e_1 and e_2.

TABLE 5. CHARACTERISTICS OF THE VISCOMETER. INDEX 0 REFERS TO ZERO VALUE OF THE INCLINATION ANGLE, θ, (SEE FIGURE 3)

$S_0 = 4.909$ sq. cm. $\epsilon_0 = 1.486$ cm. $V = V_0 = 7.295$ cc.

Inclination	$\cos\theta$	$S = S_0/\cos\theta$ sq. cm.	$\epsilon = \epsilon_0 \cos\theta$ cm.	h_1 cm.	h_2 cm.
1	0.9976	4.921	1.482	6.312	3.348
2	0.9934	4.942	1.476	10.464	7.512
3	0.9641	5.092	1.432	24.179	21.315
4	0.9062	5.417	1.347	38.525	35.831

Instrument Equation

The instrument equation has been provided because of the difference in construction and operation characteristics between our instrument and other similar devices [that is Eakin's jointed parallelogram device (*14*)].

A preliminary analysis proves the friction losses of laminar flow negligible in comparison to that at the inlet length of the gas capillary which caused by the initial acceleration of the fluid and the change of the velocity profile from a uniform to a parabolic distribution (*15*).

Since the gas capillary and the mercury tube are conical at both ends (cone angle = 1/20), it can be assumed that the entrance and the exit energy losses compensate each other under adiabatic flow conditions.

Thus, neglecting the change in the specific volume of the gas during its displacement, the motion can be described by:

$$\text{mercury} \quad \Delta P = -\rho_{Hg} g h + \frac{8\eta_{Hg}\, v_{Hg}\, L_{Hg}}{r^2_{Hg}}$$

TABLE 4. COMPARISON BETWEEN OUR EXPERIMENTAL DATA AND THOSE CALCULATED BY EQUATIONS (5), (12), (13)

P int'l. atm	N₂ at 50°C. $\frac{P_{tot.}\overline{V}_i}{RT} - 1$	$\left(\frac{b}{\overline{V}}\right)_i$	η, 10^6 poise calc.	exp.	CO at 50°C. $\frac{P_{tot.}\overline{V}_i}{RT} - 1$	$\left(\frac{b}{\overline{V}}\right)_i$	η, 10^6 poise calc.	exp.
201	0.4644	0.3535	219.6	235.7	0.4265	0.3544	230.0	232.8
301	0.6819	0.4919	257.4	267.4	0.6660	0.4931	258.9	264.3
401	0.8702	0.6044	296.5	300.0	0.8671	0.6034	294.8	296.9
501	1.0382	0.6944	333.0	334.7	1.0451	0.6925	330.5	330.9
601	1.1875	0.7708	368.7	368.8	1.2112	0.7659	364.8	364.3
701	1.3459	0.8350	402.6	401.3	1.3734	0.8278	398.3	399.0
801	1.5008	0.8907	436.3	434.0	1.5287	0.8805	430.9	430.0
901	1.6460	0.9398	469.5	467.7	1.6878	0.9286	464.8	467.4

$$\text{gas} \qquad -\Delta P = \rho g h + \frac{8\eta v L}{r^2} + \beta\rho v^2 \qquad (14)$$

ΔP denotes the pressure drop corresponding to the height difference, h, (see Figure 3) between the interfaces mercury-gas in reservoirs a and b, ρ and v indicate the density and the mean velocity of the gas through the capillary of length L; ρ_{Hg} and v_{Hg} are the corresponding quantities for the mercury displaced through the tube of length L_{Hg}. The term $\beta\rho v^2$ represents after Langhaar (*16*) the friction loss at the inlet length of the capillary, being β a dimensionless factor which can vary from 1.11 to 1.18 (*17*).

One introduces into Equations (14) the equality between the volume flow rates of the gas and of the mercury:

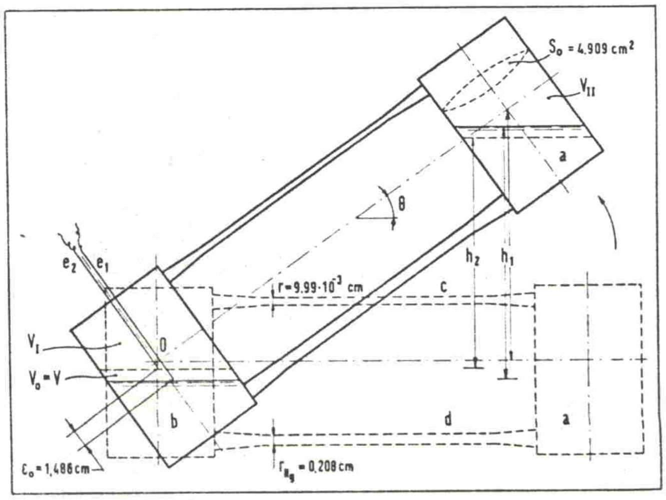

Fig. 3. Layout of tne viscometer for measurements up to 1,500 atm.