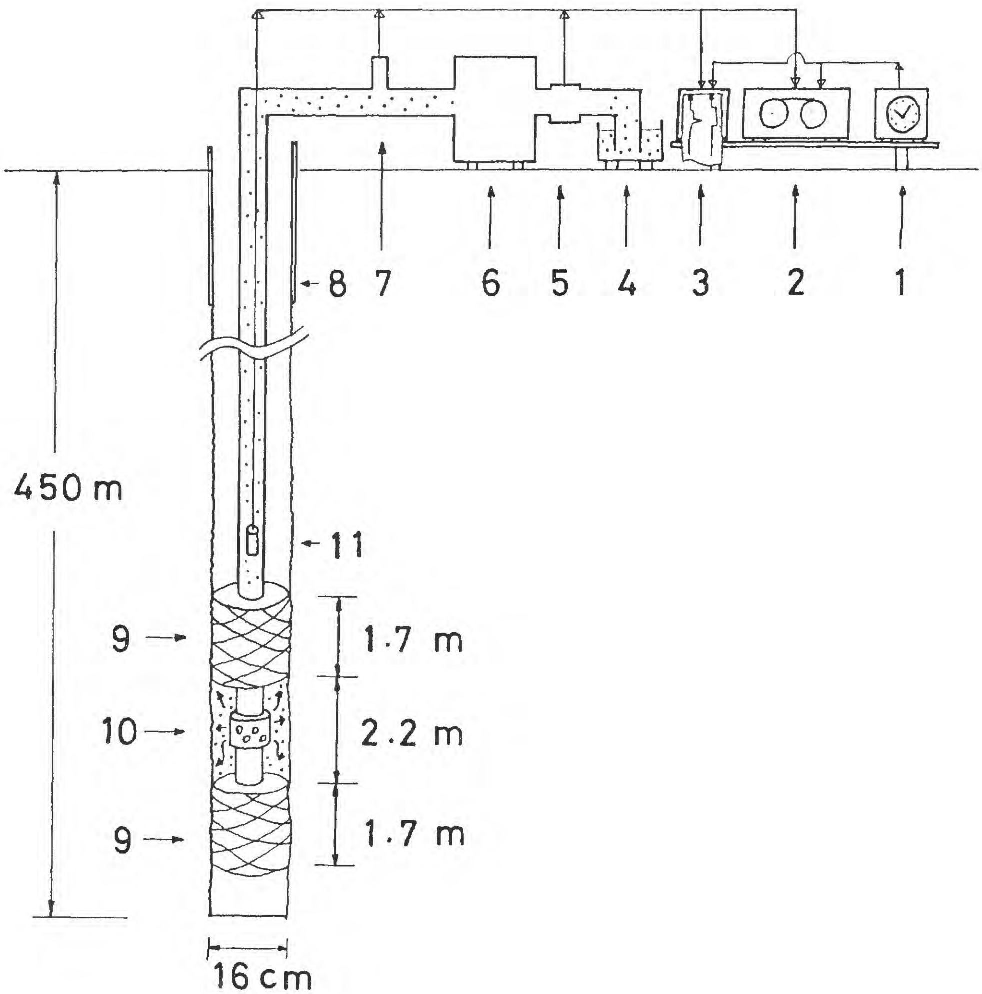

Fig. 3 Equipment for hydraulic fracturing. 1: Clock, 2: Magnetic tape recorder, 3: Multipen chart recorder, 4: Water tank, 5: Flow rate meter, 6: Water pump, 7: Pressure transducer, 8: Casing pipe (16 cm, 50 m), 9: Inflatable packers, 10: Fluid outlet, and 11: Downhole Pressure transducer with a hydrophone.

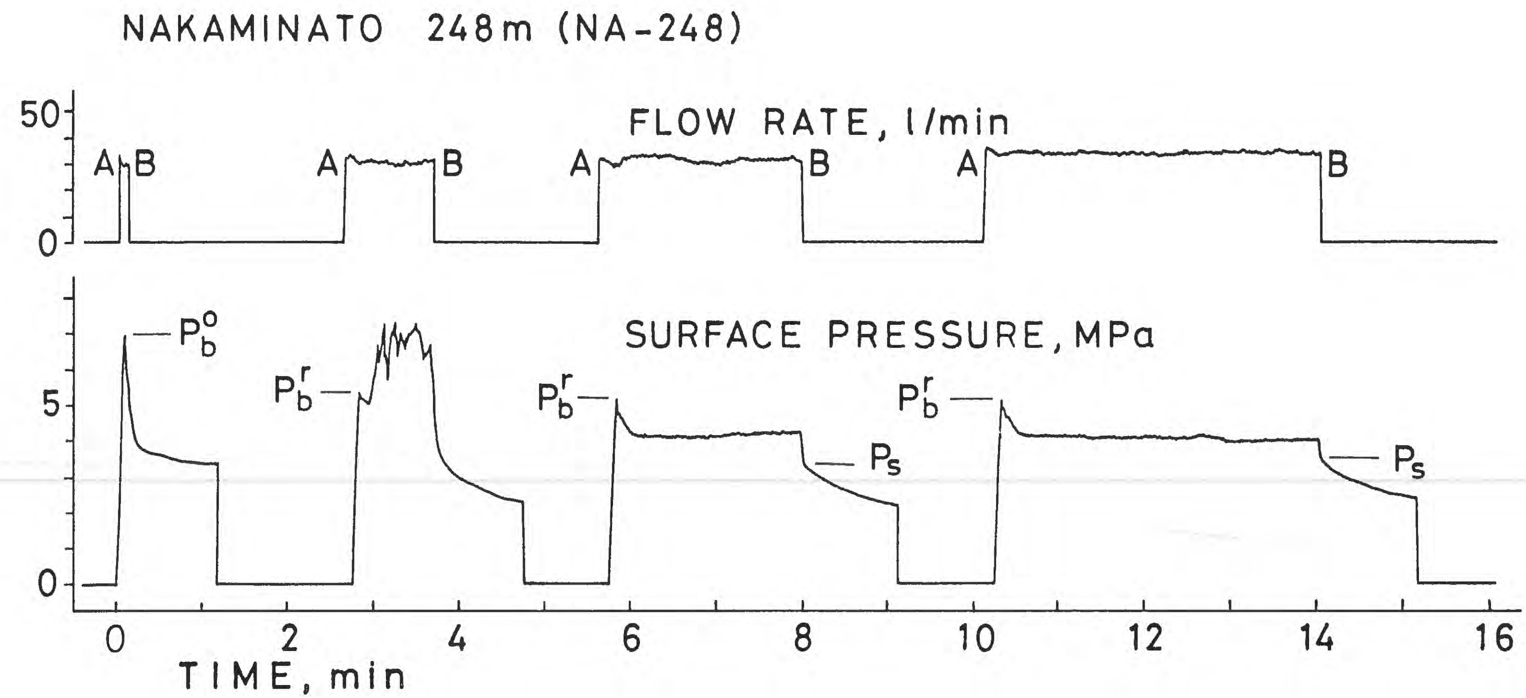

Fig. 4 Typical records of water pressure and flow rate vs. time plot (at 248 m in the Nakaminato well). Pumping was maintained in each injection cycle between points A and B. P_b^o: Breakdown pressure, P_b^r: Reopening pressure, and P_s: Instantaneous shut in pressure.

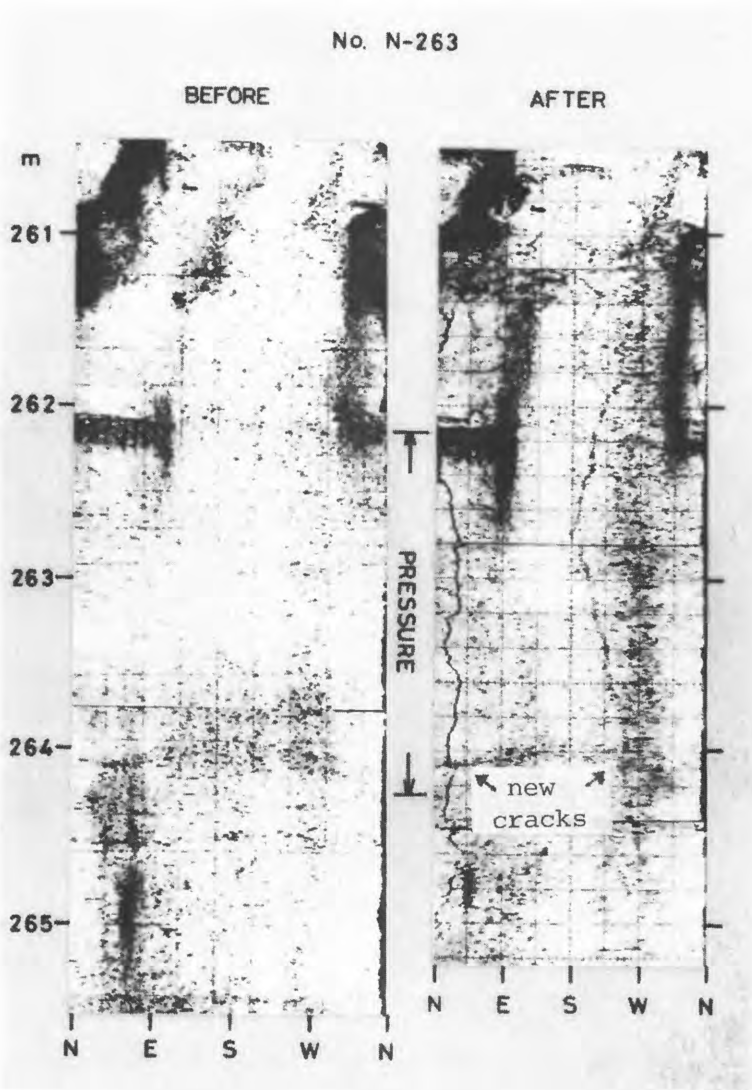

Fig. 5 Comparison of ultrasonic borehole televiewer log taken before hydraulic fracturing (left-hand picture) with that taken after hydraulic fracturing (right-hand), which shows new vertical cracks created by hydraulic fracturing. Nishiizu, 263 m depth.

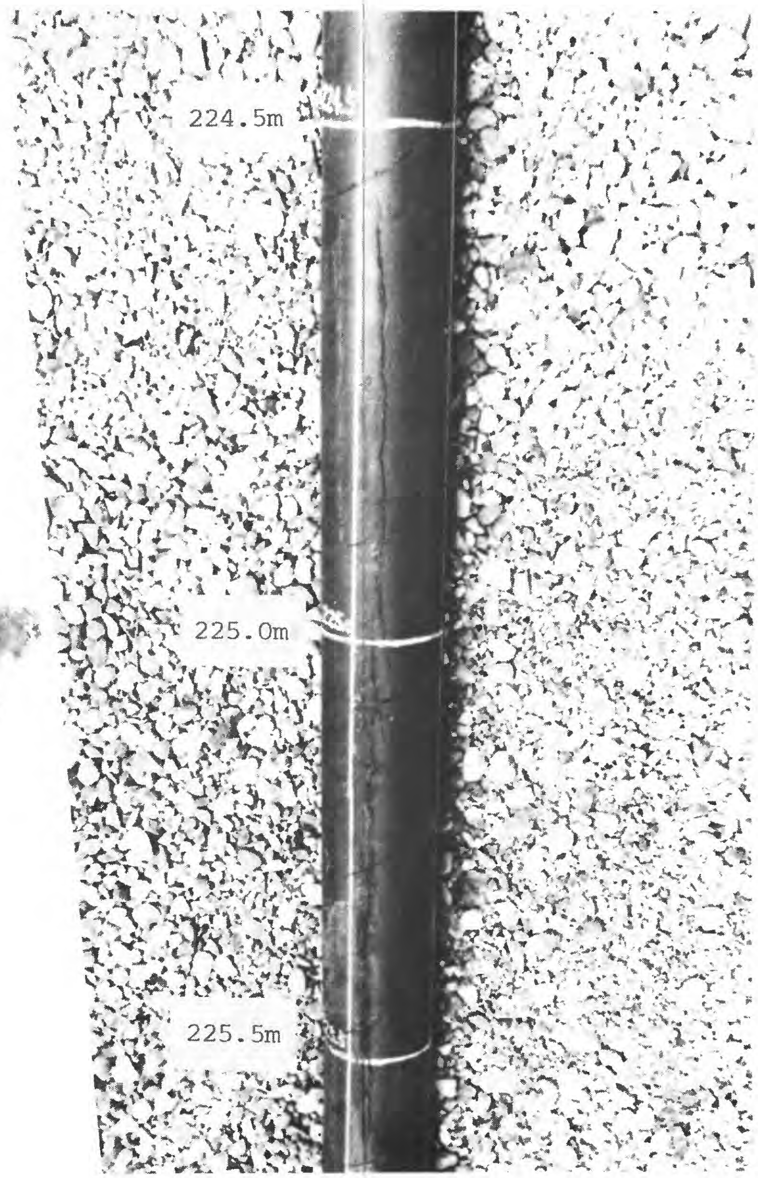

Fig. 6 Newly created cracks printed on the impression packer for the 225 m deep experiment at the Okabe site.

TABLE 7. SUMMARY OF RESULTS OBTAINED AT ELLALLONG COLLIERY

Test No.	Initial Shut-In MPa	Subsequent Shut-In MPa	Range of estimate of σ_3[1] MPa	Crack Initiation Press. MPa	Comments
01	7.0	6.5	6.5-7.0	32	
Results from overcoring			Approx. 7.0 MPa		Overcoring result for approximate vertical stress

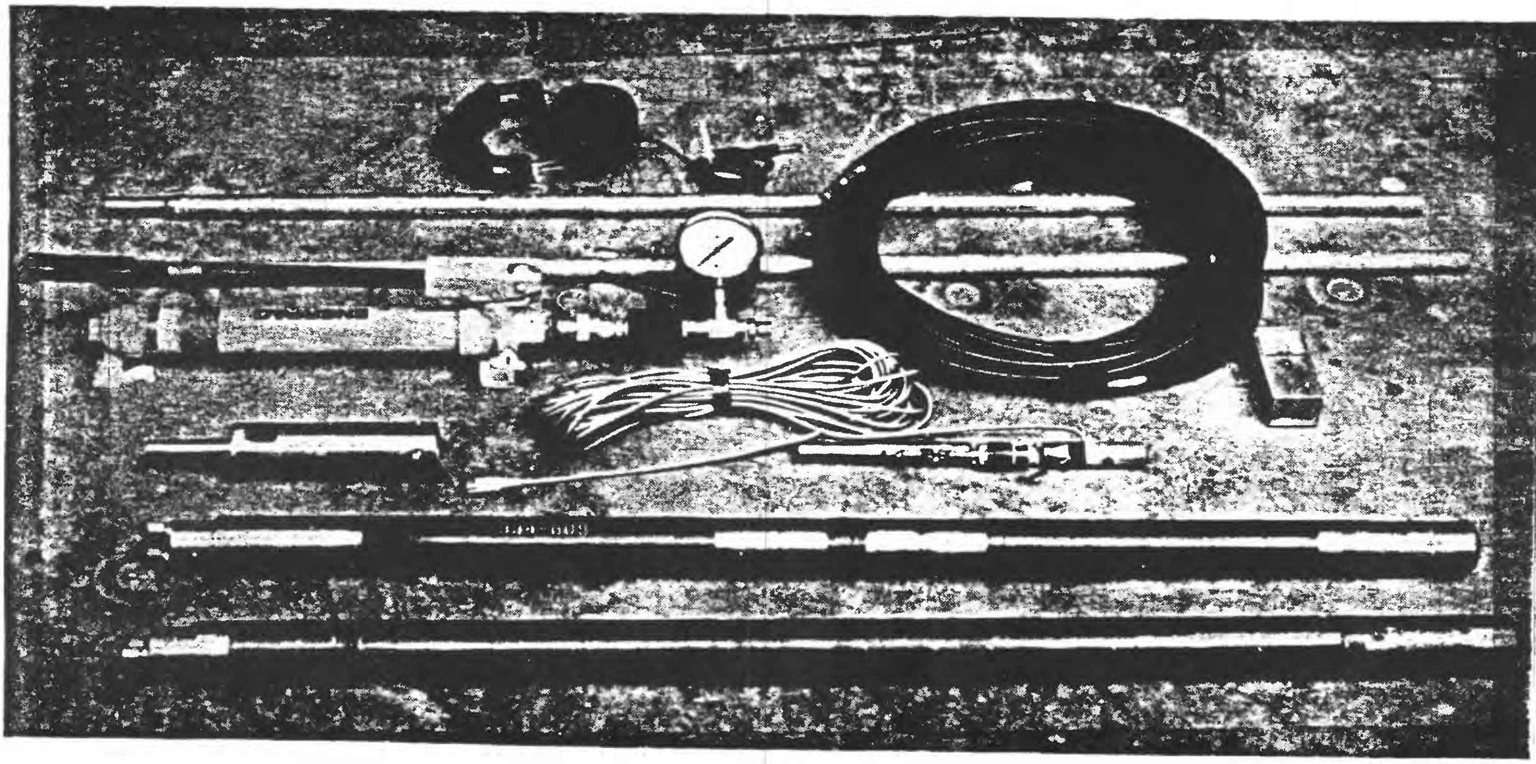

Figure 1. Equipment for underground testing, from top: Installation rods, hand pump, hoses, fracturing tool and impression packer. The sonic detector was used in early applications to help in detection of crack initiation, but was not found necessary.

Figure 2. Typical experimental arrangement for underground tests, showing pumps and clockwork pressure recorder.

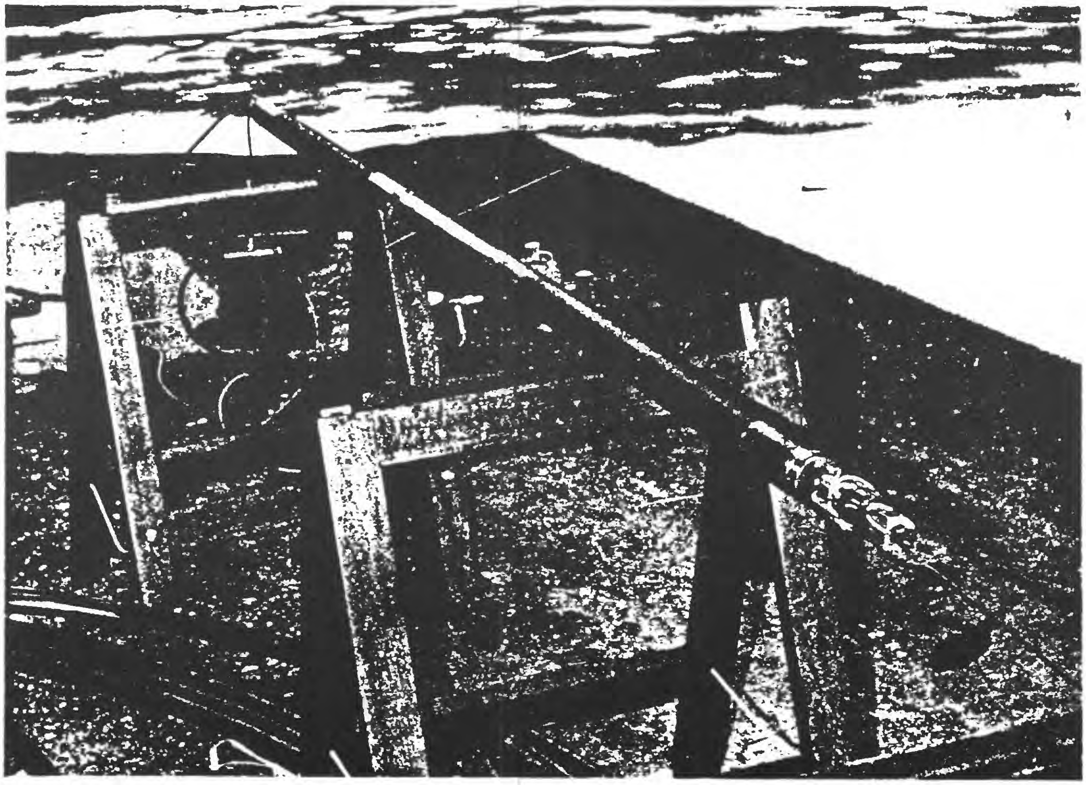

Figure 3. Fracturing tool for surface use, showing hydraulic hose and instrument cable.

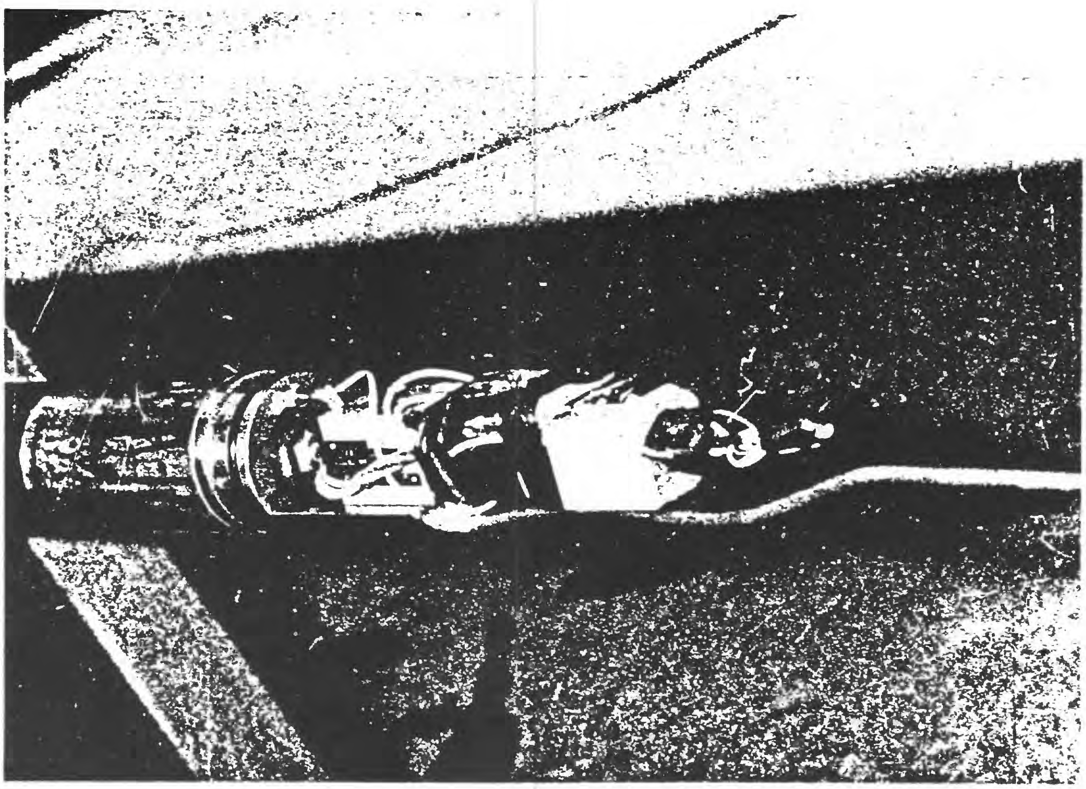

Figure 4. Detail of down-hole pressure transducers and solenoid valve for surface fracture tool.

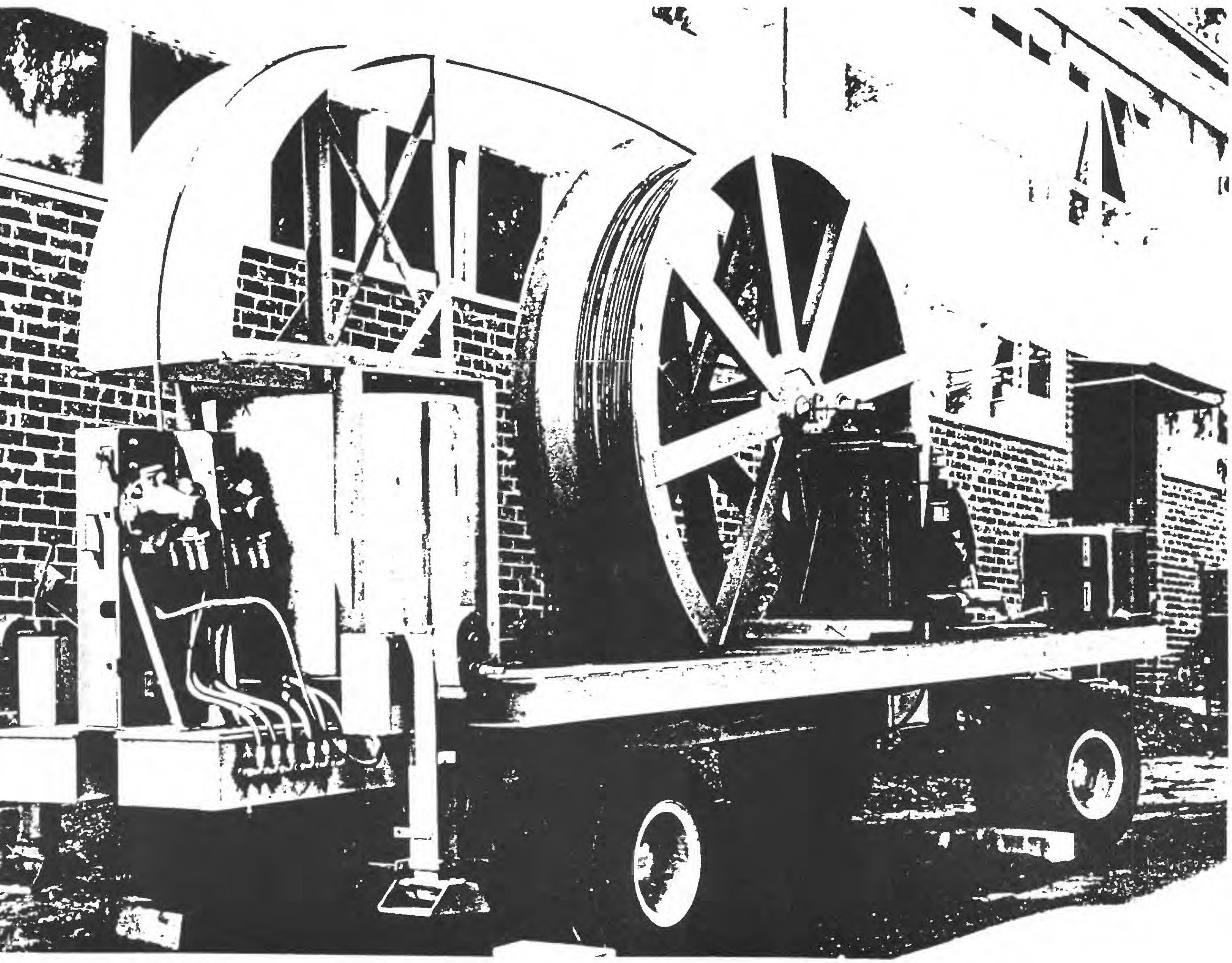

Figure 5. General arrangement of "Endless Tubing Unit"

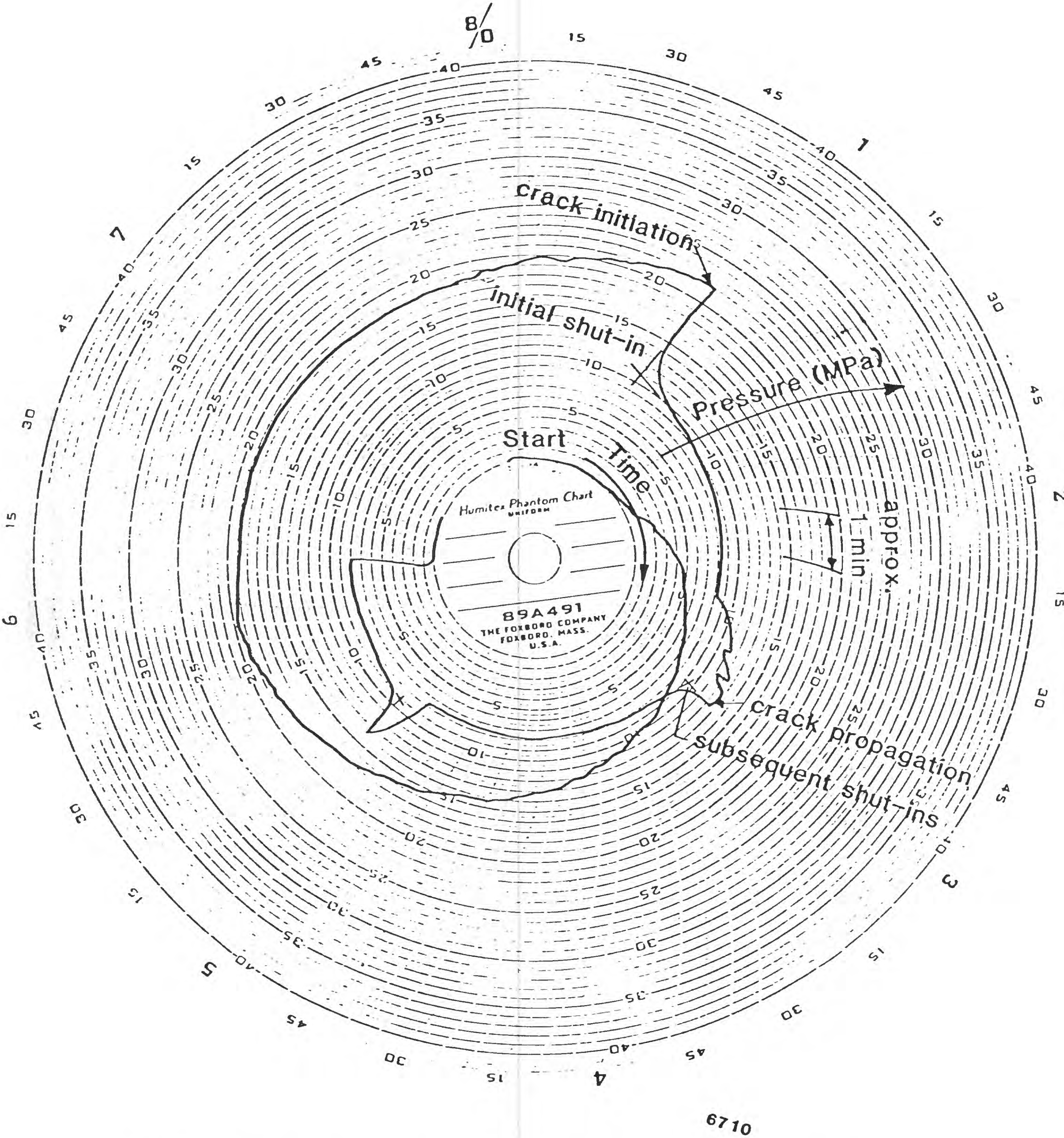

Fig. 7.- Typical pressure record obtained during testing at Tahhmoor Colliery, N.S.W.

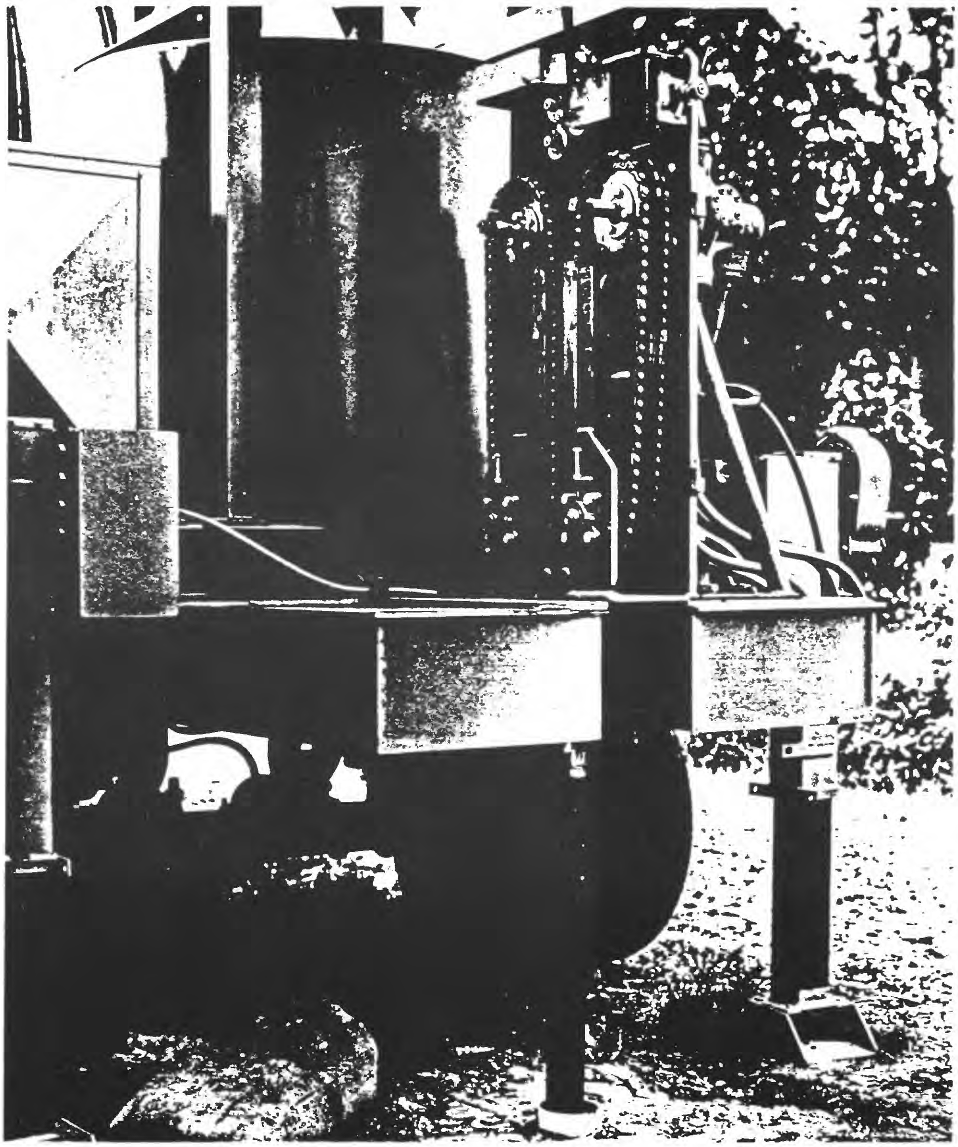

Figure 6. Detail of injector head on "Endless Tubing Unit".

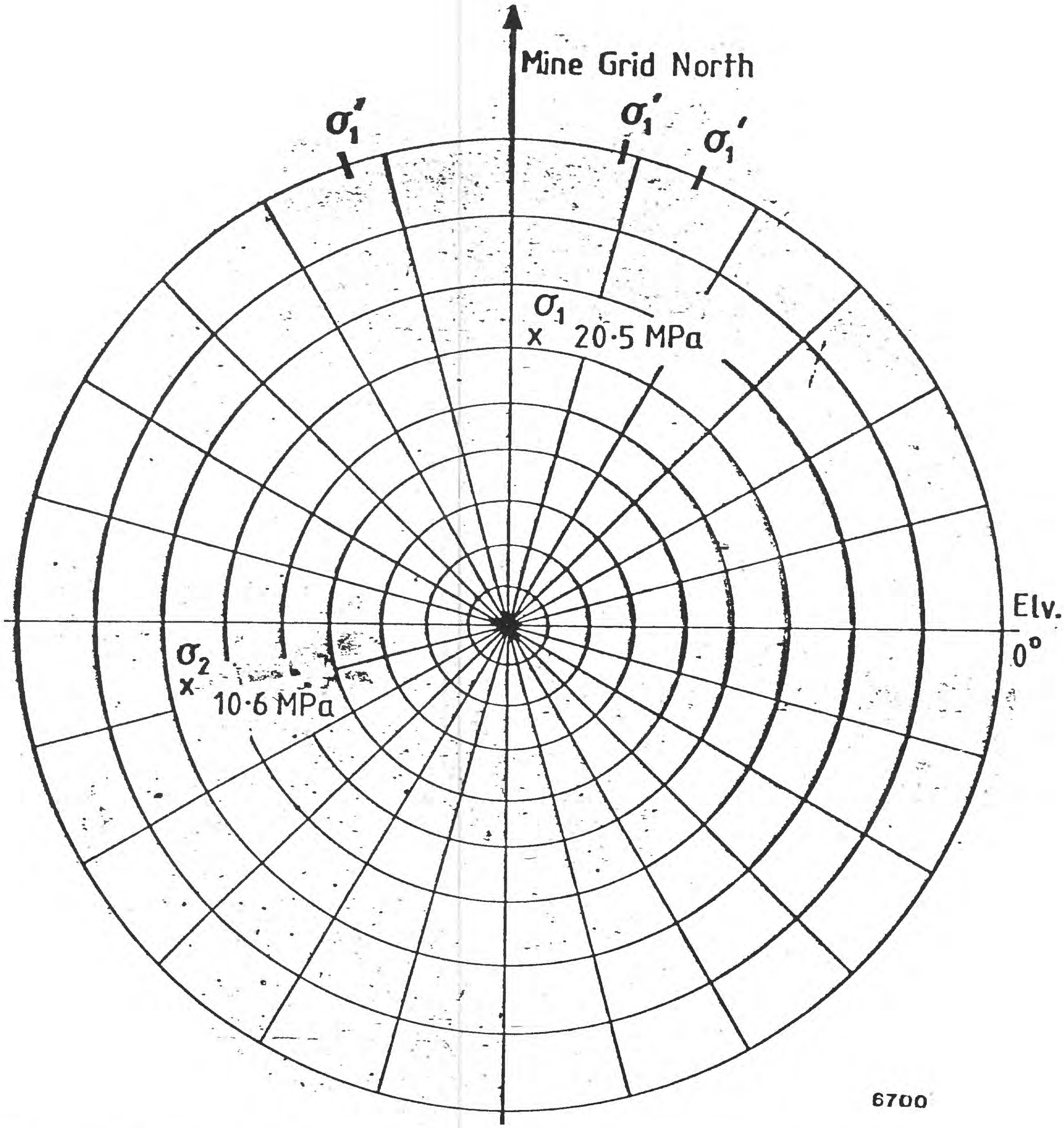

Fig. 8.- Summary of orientation information obtained during testing at Tahhmoor Colliery:

- σ_1' is major secondary principal stress component in horizontal plane indicated by fracturing (orientation assumed to correspond to crack orientation)
- σ_1, σ_2 are near horizontal principal stress components determined by overcoring.