(1) A horizontal-axis spool mounted in a ball race
(2) A freely suspended coil on a vertical axis.

The wire to be used in the experiments has been purchased from the following two sources:

(1) Brush Beryllium Company annealed wire originating from powder-metallurgy material

(2) The Beryllium Corporation cast-ingot wire as drawn with a nickel sheath (as used in production wire drawing) left intact

(3) Same as (2), but with the nickel sheath removed, followed by annealing.

Chemical pointing of the wire, nominally 0.020 inch in diameter, was readily achieved in a bath of 50 percent ammonium bifluoride (NH_4HF_2) solution under a ventilated hood.

The Brush Beryllium Company has been subcontracted in this program to provide evaluation services on the beryllium wire in all stages of the work. The characterization of the wire to be used in the experiments by room-temperature tensile testing and metallographic examination has been completed and will be included in a subsequent report.

Preliminary trials were made with soft copper wire and Nichrome A to evaluate the load-measuring device, the coiling device, and the uncoiling method. These trials showed the most promising procedure of uncoiling to be the vertical-free-coil method. The trials also showed that the load-measuring and coiling devices performed satisfactorily.

In the initial trials with beryllium wire, the pressure requirements were found to be excessive, and the experiments were stopped before any wire was drawn. Subsequent examination of the die-angle profiles indicated that the entry angle was much smaller than specified, which undoubtedly contributed to the high pressure requirements. The die profiles are to be modified by the vendor.

TENSILE PROPERTIES OF AISI 4340 STEEL AND 7075-0 ALUMINUM HYDROSTATIC EXTRUSIONS

The results of tensile tests on AISI 4340 steel from extrusions made at 20 and 80 ipm are recorded in Table 10. Extruding at a 5:1 ratio tripled the yield strength and doubled the ultimate strength compared with the as-received billet.

The table shows that increasing exit speeds have little effect on tensile or yield strengths, but may actually improve ductility as measured by elongation.

Tensile data for 7075-0 aluminum extrusions produced at extrusion ratios of 20:1, 40:1, and 60:1 are also listed in Table 10. The yield and tensile strengths of the

material in the annealed condition were almost tripled and doubled, respectively, by extrusion at ratios up to 60:1 without any appreciable sacrifice in ductility. Exit speed does not appear to influence mechanical properties at an extrusion ratio of 20:1.

TABLE 10. ROOM-TEMPERATURE TENSILE PROPERTIES OF AISI 4340 STEEL AND 7075 ALUMINUM ROUNDS PRODUCED BY HYDROSTATIC EXTRUSION

Extrusion Ratio	Reduction in Area of Extrusion, percent	Trial	Speed, ipm		Ultimate Tensile Strength, psi	Yield Strength (0.2% Offset), psi	Reduction in Area in Tension, percent	Elongation in 2 Inches, percent
			Stem	Exit				
				AISI 4340 Steel				
5.0	80	167	1	10.0	188.6	163.4	27.9	8.0[a]
5.0	80	189	6	60.0	180.4	151.9	27.8	9.5[a]
5.0	80	315	20	185	179.0	161.7	28.8	13.0
5.0	80	340	80	740	178.8	160.9	29.8	11.5
1	0	As-received bar stock			94.6	55.4	49.0	33.0[a]
				7075 Aluminum				
20	95.0	311	20	740	56.3	40.9	20.8	21.0
40	97.5	318	20	1480	60.2	41.4	39.5	26.0
60	98.3	324	20	2220	61.3	35.0	38.7	24.0
20	95.0	310	80	2960	55.2	40.6	22.9	21.0
1	0	As-annealed bar stock			33.8	15.5	45.2	23.3

(a) Percent elongation in 1 inch.

FUTURE WORK

During the next interim-report period it is expected that work will be continued on the extrusion of shapes, and also, of beryllium rounds and wire. Also, work will commence on the extrusion of TZM molybdenum alloy. In addition, efforts will be made to obtain and prepare refractory alloys and powder products included in the program for extrusion.