NASA TECH BRIEF
Ames Research Center

NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

Convoluted Fabric for Full-Pressure Gloves

The problem:

To develop a full-pressure glove that provides maximum digital dexterity and tactility.

The solution:

Use a convoluted fabric to provide expansive and contractive mobility along the posterior surface of the glove fingers.

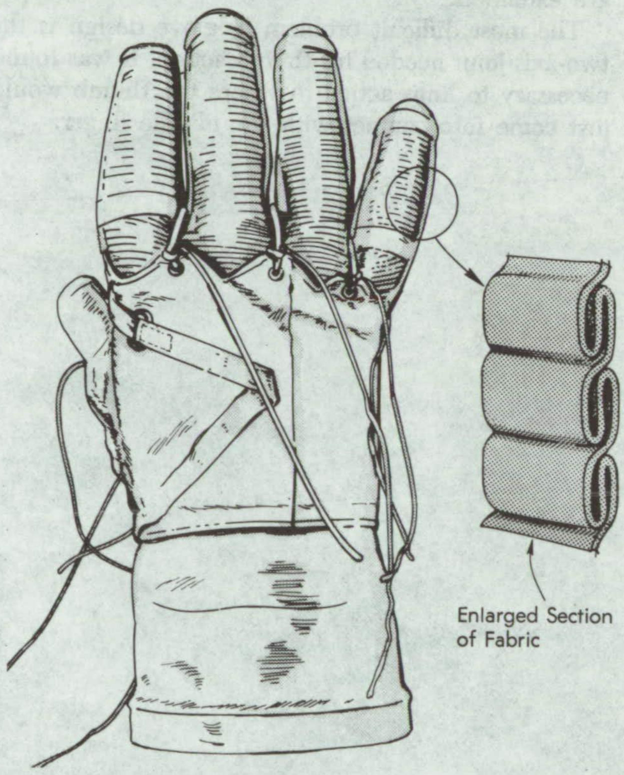
How it's done:

The atmospheric pressure which must be maintained within a space suit so that an astronaut can be exposed to the vacuum of space tends to make the suit act like a balloon; moreover, since the hand and leg parts of the suit tend to remain rigidly extended, the astronaut must expend an inordinate amount of energy to overcome pressure forces when he moves his limbs. Fortunately, techniques have been developed during the past few years which make possible the construction of highly mobile, stable, articulated sections for pressure suits; in the main, these techniques use metal rings and linkages to provide mobilities at low torque.

However, none of the techniques developed thus far for fabricating pressure suits lend themselves to such a reduction in size that a finger or thumb-size joint element can be successfully fabricated and utilized. The small size of the fingers and their closeness to each other preclude the use of linkages or external mechanisms.

The single-axis joints needed to provide freedom of motion of hand and fingers in a glove required development of a special miniconvolute fabric of the configuration shown in the magnified portion of the diagram. The convoluted fabric is made of nylon ripstop coated with Neoprene; the fabric is convoluted on a mandrel and then cured.

The mobile finger elements are tubes molded to the shape of the particular finger; the convolutions



are arranged along the posterior surface of the finger in such a manner that the convolutions are extended when the finger is bent, and retracted to the normal "as-molded" position when the fingers are straight. The configuration of the convolutions is designed to

(continued overleaf)

allow the length along the posterior surface of the finger to double when the finger is flexed at maximum. The anterior surface is made of a smooth fabric-and-Neoprene laminate, since allowance for finger flexure need be made through a forward angle only. The smooth fabric permits a sense of tactility through the pressure barrier when an object is touched or grasped.

Small-diameter conduits of Neoprene-coated nylon (about 3 mm) are mounted along either side of each finger, and an axial restraint cord is run through the conduit from the finger tip to the base of the finger. The diameter and length of the finger element is such that as the finger is flexed, a lateral shift of the axial restraint cord within the conduit compensates for the pneumatic return force. This translation compensates for the spring rate of the finger assembly caused by the volume increase which occurs when the finger is bent and the convolutions of the fabric are extended.

The most difficult problem in glove design is the two-axis joint needed for thumb action. It was found necessary to limit action to where the thumb would just come into contact with the middle finger.

Notes:

1. The following documentation may be obtained from:

   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)
   Reference: NASA CR-114365, Highly Articulate Full Pressure Glove.

2. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B72-10215

Patent status:

No patent action is contemplated by NASA.

Source: William Elkins, Charles Breslin, and Harold Price of Space Age Control, Inc. under contract to Ames Research Center
(ARC-10529)