SURGERY

Man-Made Hands

Today's artificial hand looks and feels like the real thing. Now what remains is to connect it to the nervous system, giving metal and plastic the sense of touch.

By JOHN W. ROBINSON

➤ ON FILE with the Federal Bureau of Investigation in Washington, D. C., are two sets of the most unusual fingerprints in the world. They match perfectly with those of thousands of American amputees yet they actually belong to only two men.

The prints were donated by two specialists in the design and development of artificial hands, and have been molded into a plastic-like "cosmetic glove." This glove covers many of the mechanical hands of both military and civilian amputees.

The glove is complete with hair and fingernails and is so lifelike that it is almost startling to see when detached. It is one of the latest developments from the Army Prosthetics Research Laboratory at Forest Glen, Md.

The laboratory was set up after the Second World War to carry on the research and development of artificial parts of the body for both the armed forces and the artificial limb industry.

"Making an artificial hand is much more complicated than it might first appear," Col. Maurice Fletcher, director of the Laboratory, explains.

For years, the first thought of artificial hand makers has been to make the hands fully articulated, so that each joint could move just like the normal hand. Many of the early hands were full of pulleys, wires and other mechanical parts.

One such hand was made in Ireland in the late 1600's and is quite an impressive piece of design and craftsmanship. The only trouble with it was that it took three people to operate it.

Streamlined Hand

Today's artificial hand has been streamlined so that it can be operated with a single control cable and is even a few ounces lighter than a normal hand.

A big problem is standardizing the experimental hand so that it will fit the greatest number of amputees and give them all maximum usage. There are 25 separate muscle groups in the human hand and no two people use them in exactly the same way, even when performing the same task.

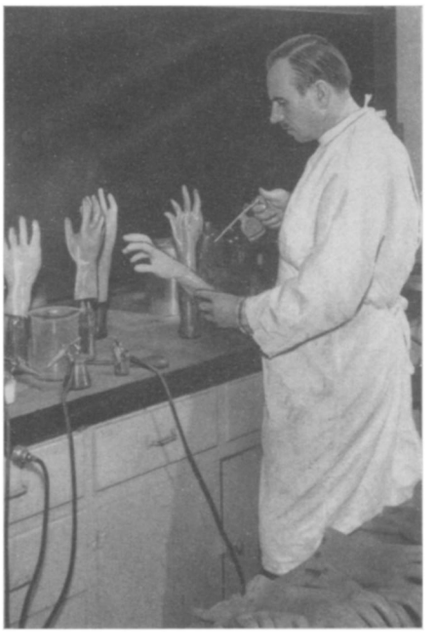
The standard hand in use today is known as the APRL hand. It came out of the Laboratory and into production in 1948. It has kept only the most essential movement, that of prehension. This basic finger movement is one of the main distinctions between man and his animal relatives.

Prehension is accomplished by bringing the thumb, forefinger and middle finger together at the tips, and accomplishes about 60% of all the jobs that a hand performs. Most of the time, the other fingers on the normal hand are just dead weight, so in the artificial hand they have been molded on in a set position, are flexible, and curve slightly toward the palm.

The angle of this curve is one of the many small but important details in the design of the hand. The angle has been calculated so that when the hand closes on an object, the fingers will not eject it outward but rather force it back inside the hand.

The hand is operated by a single cable which can either open or close the fingers when it is pulled. A spring mechanism inside serves to return the fingers to their original position.

The muscle power for the hand obviously has to come from another part of the body and several methods are in use for supplying this force to the artificial part. Some amputees have a shoulder strap which is attached to the hand by a cable. They can then operate the fingers by slightly twisting their shoulders or pushing their arm forward.



LIFELIKE PAINT JOB—After being painted with normal skin tones, these plastic-like "cosmetic gloves" will be pulled over artificial hands developed at the Army Prosthetics Research Laboratory, Forest Glen, Md. The gloves are detail-perfect down to the fingerprints and have the texture of human skin.

Another method which is becoming more fully developed each year is known as cineplasty. This requires the expert cooperation of the surgeon who does the amputation since it involves harnessing the muscles near the stump of the limb so that they can be used for power.

The surgeon constructs a muscle tunnel in such a way that a plastic peg can be inserted through the tunnel from one side to the other. Cables are then attached to the peg on each side so that flexing the muscle tightens the main cable and the fingers move.

Efficiency Needed

An important characteristic of any artificial hand is its efficiency, that is, the amount of work you get out of the hand for the amount put in.

Poor efficiency was one of the main drawbacks in the earlier and more complicated hands. In completely articulated experimental hands at the Laboratory, the efficiency was never much over seven percent. This resulted in so much power being applied to the hands that they usually broke under the strain. The APRL hand has been designed so that it gives approximately 80% efficiency.

Earlier hand models also had a position-locking mechanism on the side which the wearer would have to set with his other hand. This was eventually discarded too, since the whole object of the artificial hand was to make the amputee "bilateral" again, and not to tie up even his good hand with control functions.

Today's artificial hand is good, but it still lacks one of the human hand's most basic abilities, that of being able to feel.

"Putting feeling into a lifeless hand is probably the biggest problem yet to be solved," Col. Fletcher believes.

Not only is the sense of touch needed, but also the feeling of pressure and of knowing the position of the hand and fingers without looking.

A variety of electrical and mechanical gadgets have been designed to solve this problem, but even though they work out in the laboratory, putting them into actual use is another matter.

Putting "Life" into the Hand

A hydrostatic method was tried using two small air-filled balloons connected by a thin tube. One balloon was attached to one of the fingers of the hand and the other was attached somewhere on the wearer's chest. Pressure on the finger balloon would then cause pressure on the chest.

Several of these balloon groups were tried together, one on each finger and the others spaced around the chest. But it became too confusing to the wearer to relate the slight "touch" on one part of his chest with pressure on a certain finger.

"We have to be careful not to exceed the 'hardware tolerance' of the amputee with all these gadgets, or he will just decide to throw them away," Col. Fletcher said.

Another method involved the use of electric buzzers of different frequencies to signal contact with the various fingers. This, too, worked much better in the Laboratory than it did on an amputee.

Future developments may center around stimulating the nerves directly, at some level between the lost limb and the brain. Neurosurgeons can already isolate nerve fibers in the arm which travel down to the finger tips, but getting them stimulated in the correct way is the problem.

Science News Letter, February 15, 1958

SURGERY

Titanium Finger Joint Can Save Amputation

➤ A HINGED titanium finger joint that promises to prevent amputation of the finger in many cases was described to the American Society for Surgery of the Hand meeting in New York.

The device has been used successfully in 14 patients, Lt. Col. Earl W. Brannon, chief of the orthopedic service at Lackland Air Force Base Hospital, said.

The hinged titanium prosthesis, designed to replace irreparably damaged finger joints, is a replica of the normal joint and replaces the entire joint. To date, it has been used only in the small joints of the finger.

It is locked in place by a half-threaded rivet screw. Each section has a triangular stem to be inserted in the finger bones, which keeps the metal joint from rotating. The hinged joint portion is finely bevelled and smoothed to prevent catching or irritating adjacent tissues by its movement.

Various sizes, Dr. Brannon said, now are made for various fingers and for persons of different size hands.

Science News Letter, February 15, 1958

AGRICULTURE

Certified Seed Insures Superior Alfalfa Crop

➤ FOR MAXIMUM benefits from improved varieties of alfalfa, a farmer should be sure to use certified seed.

Dr. Karl Quisenberry, assistant administrator of the U. S. Department of Agriculture's Agricultural Research Service, warns that appearance alone will not show if seed has the improved qualities built into it by plant breeders.

A farmer who purchases and plants seed of "non-certified Ranger," for example, has less than a 50% chance of getting seed of Ranger performance, he said.

A further problem in planting non-certified seed is that especially bred qualities, such as high yield and winter hardiness, may be lost when the variety of grass or legume seed has not been produced, harvested and processed under properly controlled conditions.

Science News Letter, February 15, 1958