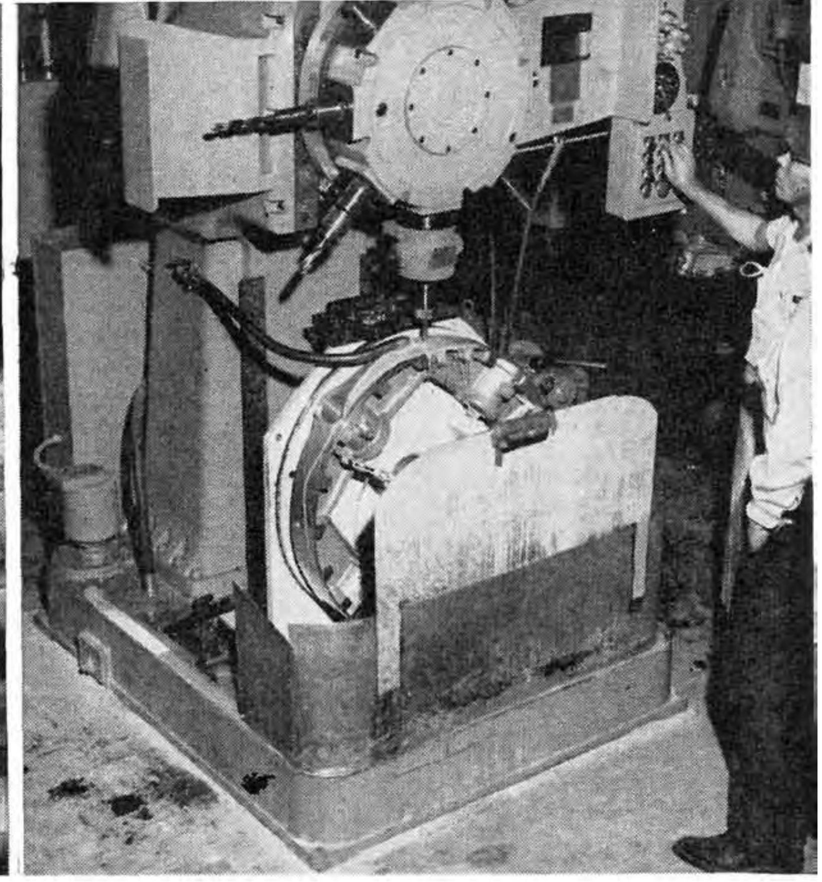



ROUGH aluminum and magnesium castings (left), trucked to Douglas from subcontractors in New York, New Jersey and Pennsylvania, are checked for flaws with X-ray unit. After large diameters are machined on vertical turret lathe, castings are drilled and tapped (right).

Douglas Tailors Plant for Nike Hercules

By Michael Yaffee

Charlotte. N. C.—Producibility factor of the Army's Nike Hercules surface-to-air missile has resulted in a Douglas Aircraft Co. plant designed exclusively for missile production and believed to be the largest effort of its kind in the United States.

Douglas engineers claim that because of plant design and the missile's producibility, the Charlotte Division produces the missile at less cost than anticipated by Douglas. The reasons:

- **Exclusive design** has no commitments to existing equipment, set floor plans or established procedures.
- **High rate** of production.
- **Tooling** made especially for missile production.
- **Lessons learned** in the manufacture of similar vehicles.

Before Douglas moved into the Army's Charlotte Ordnance Missile Plant, the company held a number of conferences with the Army and with representatives of Western Electric Co., the prime contractor for the Nike family of missiles. It was then decided how the plant was to be rehabilitated and what new construction was needed. On Dec. 20, 1954, Douglas signed a facilities contact with the Philadelphia Ordnance District for design and operation of the Charlotte plant.

Thus, where many plants simply fit missile production into existing facilities and often spread it widely around existing production lines, the Charlotte plant was designed solely for integrated missile production.

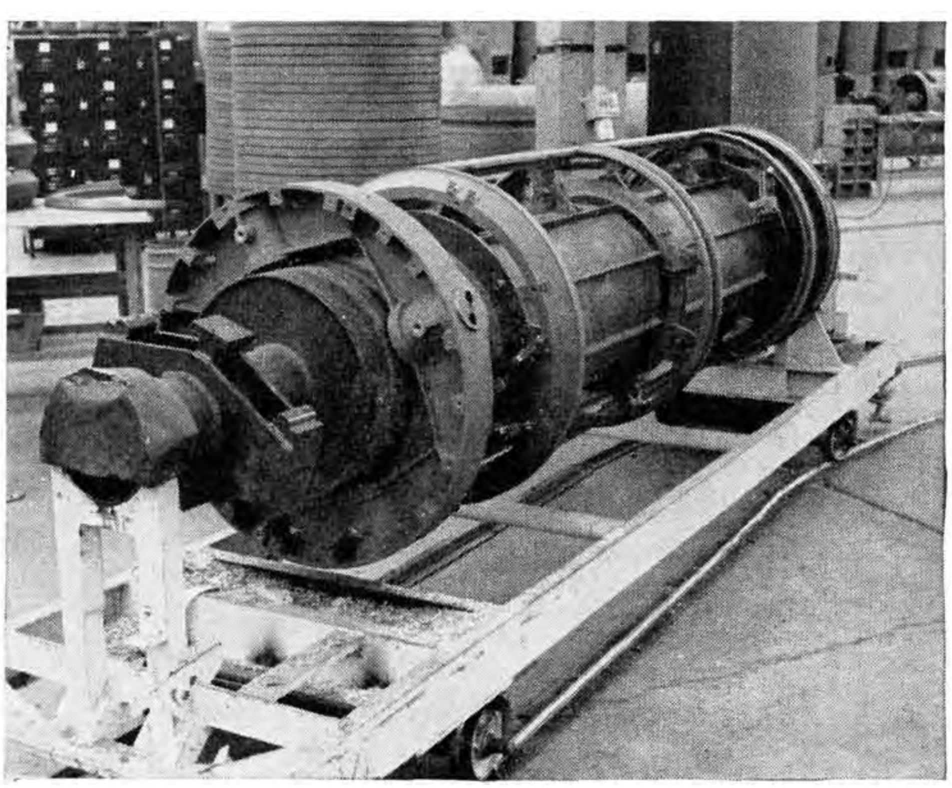
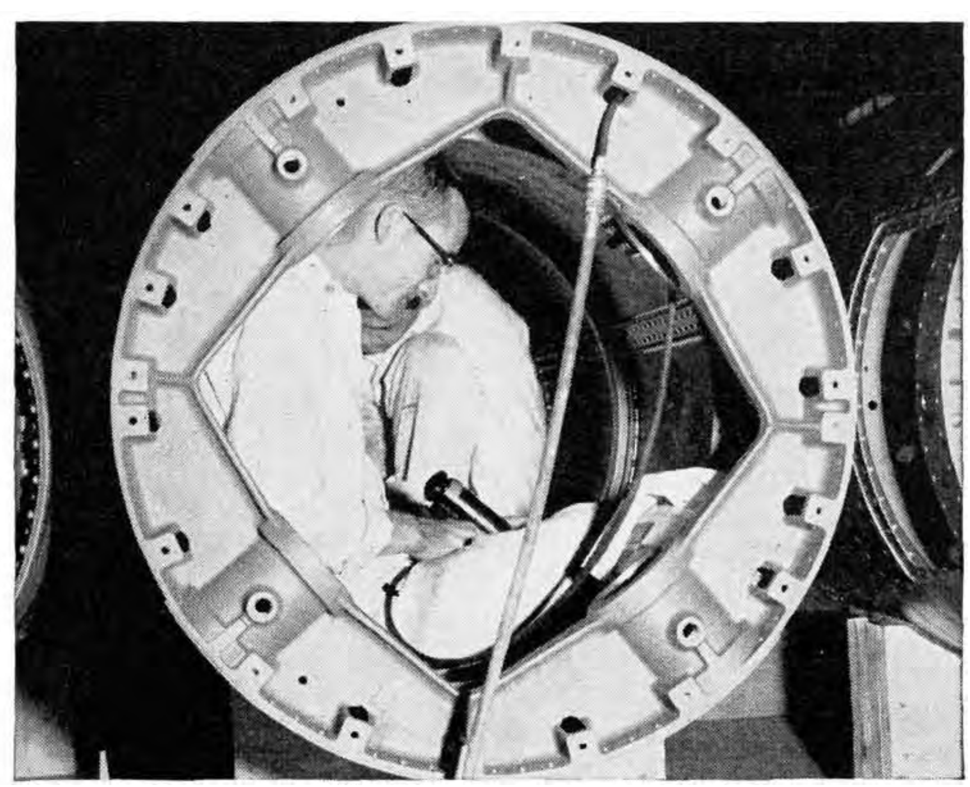
Douglas, uncommitted to existing floor plans or equipment, was able to carry out extensive cost studies to find the most efficient way of producing missiles.

At the same time the 35 Douglas employes who were transferred from Santa Monica, Calif., to form the nucleus of the new operation brought with them missile production experience gained from work on Sparrow I, Honest John and Nike Ajax.

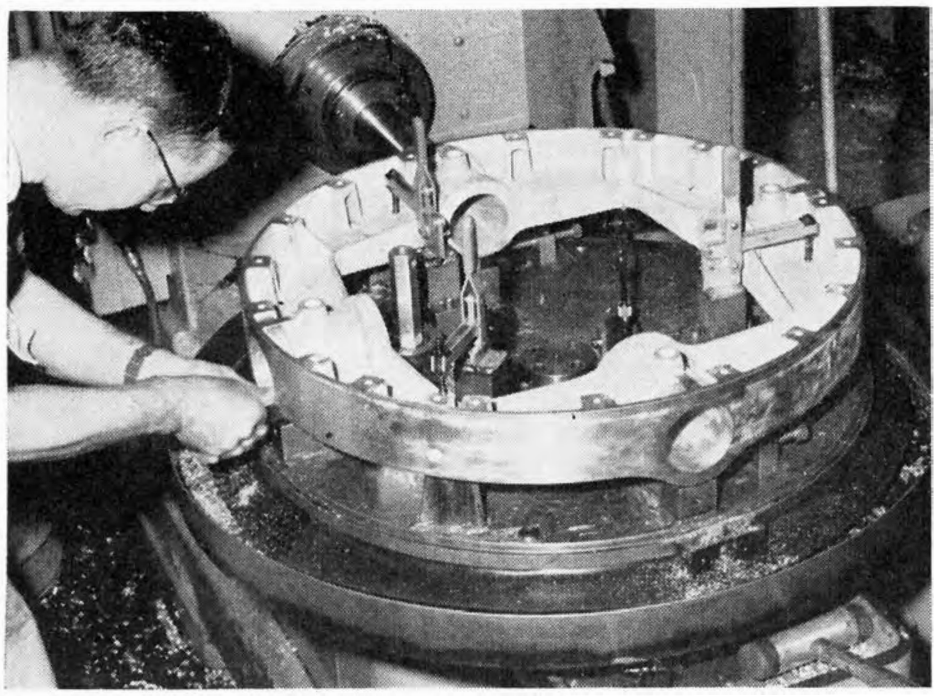
The design of the Ajax, of course, had been set and there was little that could be done to alter its production. It wasn't until the Hercules went into production that the Charlotte plant was really to come into its own.

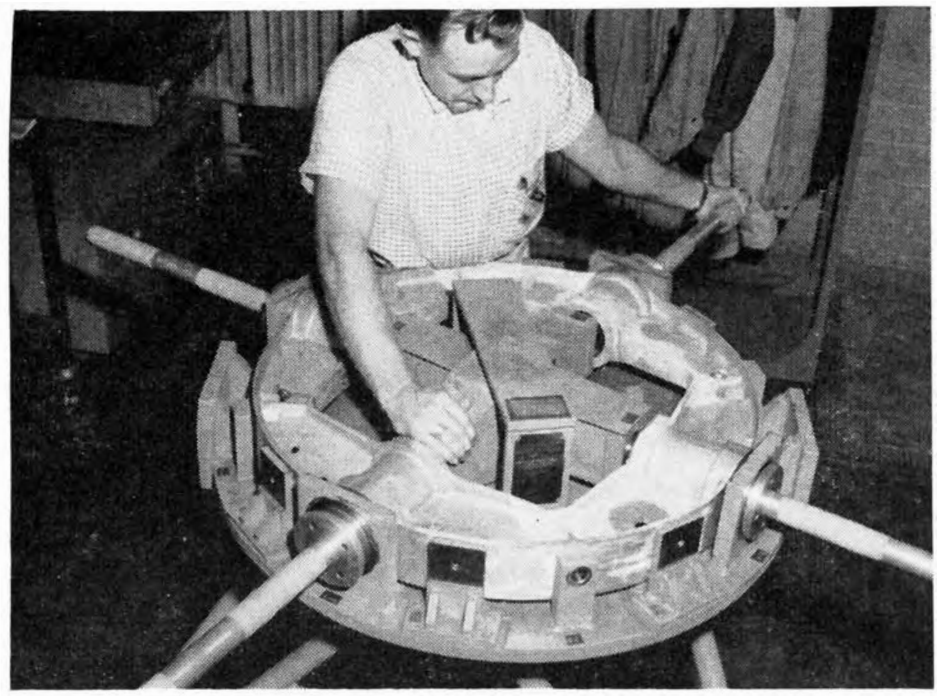
Minus booster, the Nike Hercules is 27 ft. long. Body diameter is 32 in. Missile skin is aluminum throughout; main and center fins also are aluminum, while elevons and forward fins are magnesium.

The skeleton of the airframe con-

HERCULES airframe begins to take shape when machined and painted castings are placed on assembly fixture (left). After skin panels are riveted on, workers enter main engine section to shoot silastic sealant into seams (right).





BORE-MATIC unit (left) machines casting bores to size. After inspector checks castings with production inspection gage (right), they get alodine treatment and then are covered with zinc chromate primer.

sists of a series of narrow cylinders and a small number of longitudinal stiffeners which serve as the load-carrying members of the vehicle. The cylinders are cast from either aluminum or magnesium to save weight and the time and cost of extensive machining. Stiffeners are extruded from the same materials for the same reasons.

Aerodynamic heating and stress determine the choice of casting material at some specific joints in the airframe. But generally, selection of cylinders is decided on a cost-weight basis. As a result, most of the castings in the Nike Hercules airframe are aluminum.

Airframe sections begin to take shape when the longitudinal stiffeners are joined to a series of spaced cylinders ringing a horizontal assembly fixture. Skin panels are riveted to the cylinders and stiffeners. External protrusions are later shaved flush to give an aerodynamically smooth skin. Joints and seams are sealed with silastic material to keep rain and dirt out.

Two of the three main body sections are bolted together at the plant. The third, which contains the warhead, is added at the missile launching site for purposes of safety. For the same reason, the solid propellant sustainer, which is fastened to the castings in the first two body sections, is not inserted until the Hercules is in the field.

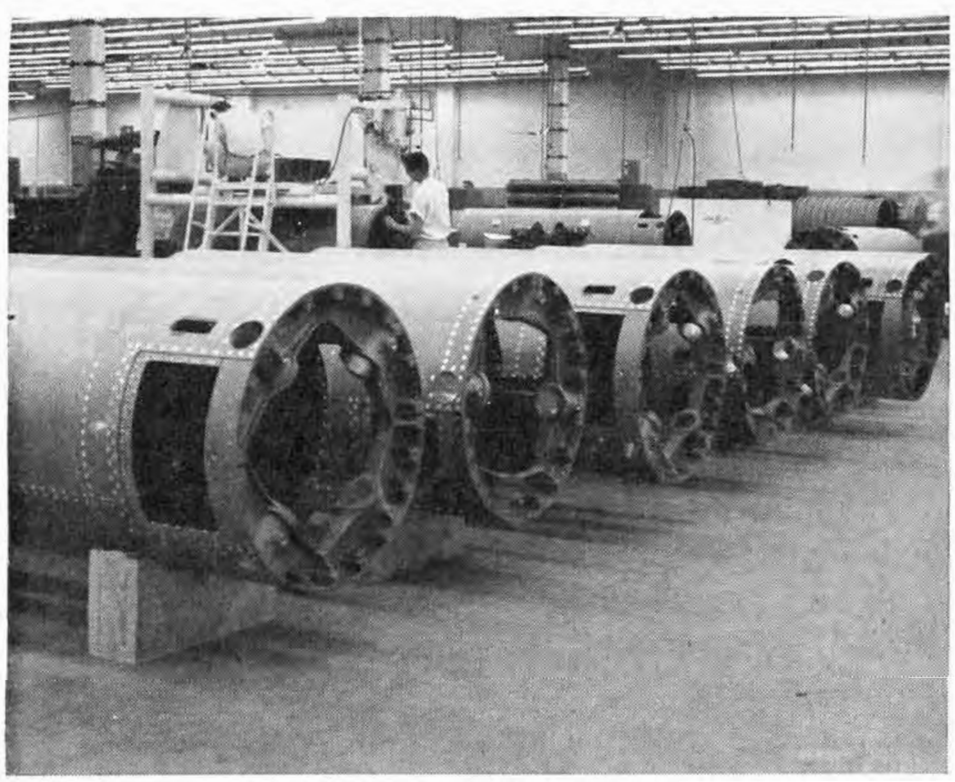
Trapezoidal Sheet

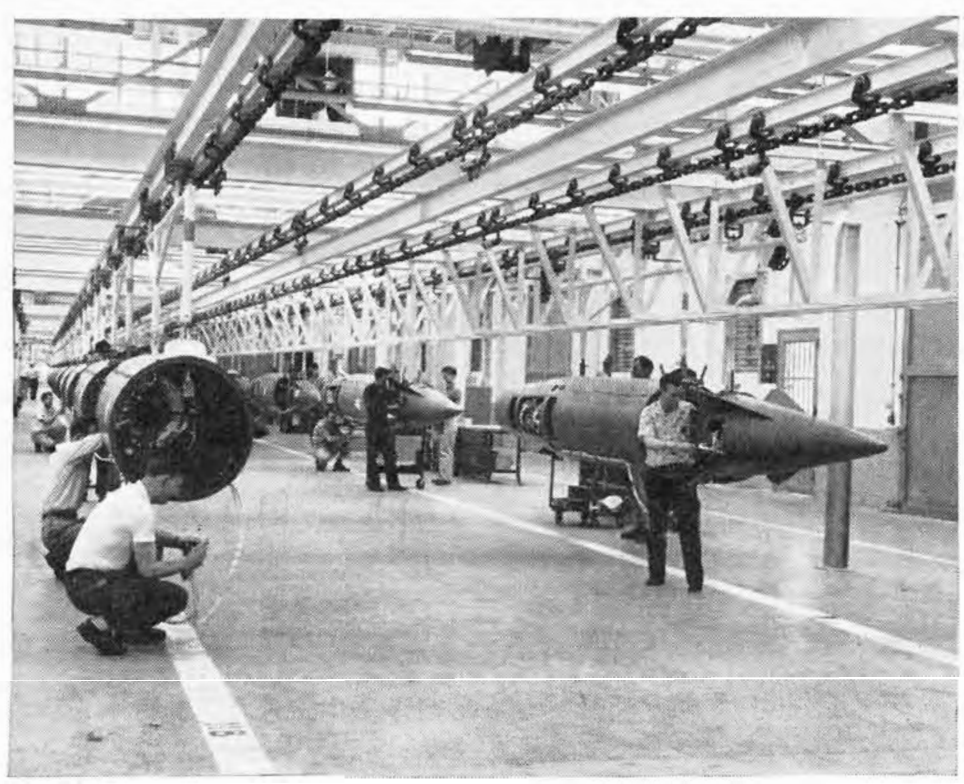
The trapezoidal aluminum sheet, which is used for the nose cone, is first roughly shaped on a long, small diameter roll which drops into a rectangular trough. Three men slide the sheet slowly across the trough as the roll keeps dropping, forcing the sheet to curve upward. When half the sheet is curved, it is removed and turned around. The half that is still flat is then fed across the trough and curved to meet its opposite edge.

The fully curved sheet is seam welded into a rough nose cone. This is dropped into female half of a large bulge die which is sunk to floor level. The male half of the die is inserted; the cover secured and the cone is blown out to the required dimensions at 600 psi.

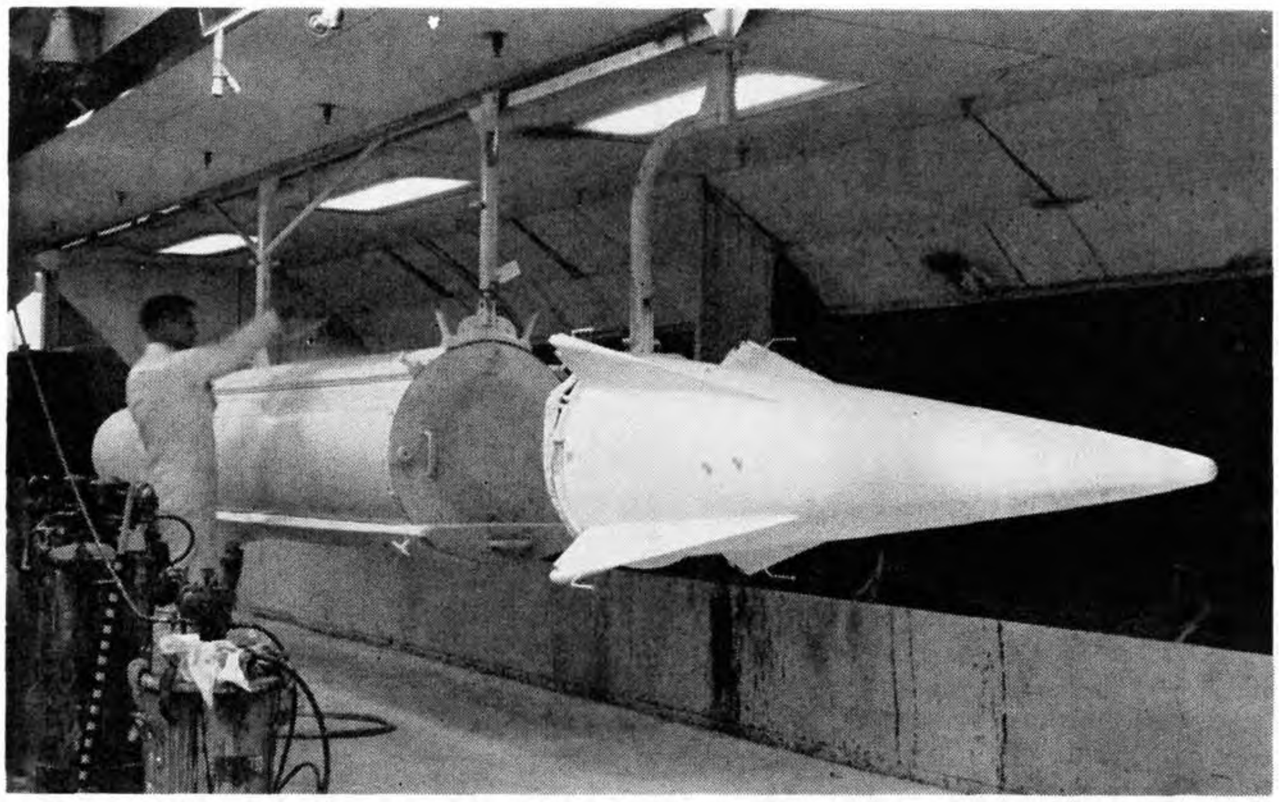
Welding is kept to a minimum in the construction of the Nike Hercules. Initial cost studies indicated that riveting was preferable in terms of man hours and facilities, particularly at Charlotte where Douglas was starting from scratch. Welding affects the straightness of a part, for example, and valuable man hours were sure to be lost just straightening welded items out.

The choice of cylinders as the main internal, load-carrying elements was another matter. The alternative was to start with aluminum or steel bar stock. While the bar stock would provide the strength needed for internal load carrying members, it would also have to undergo extensive machining to pare away the excess weight. Use of bar stock, it was decided, might be practical in missiles that were to be

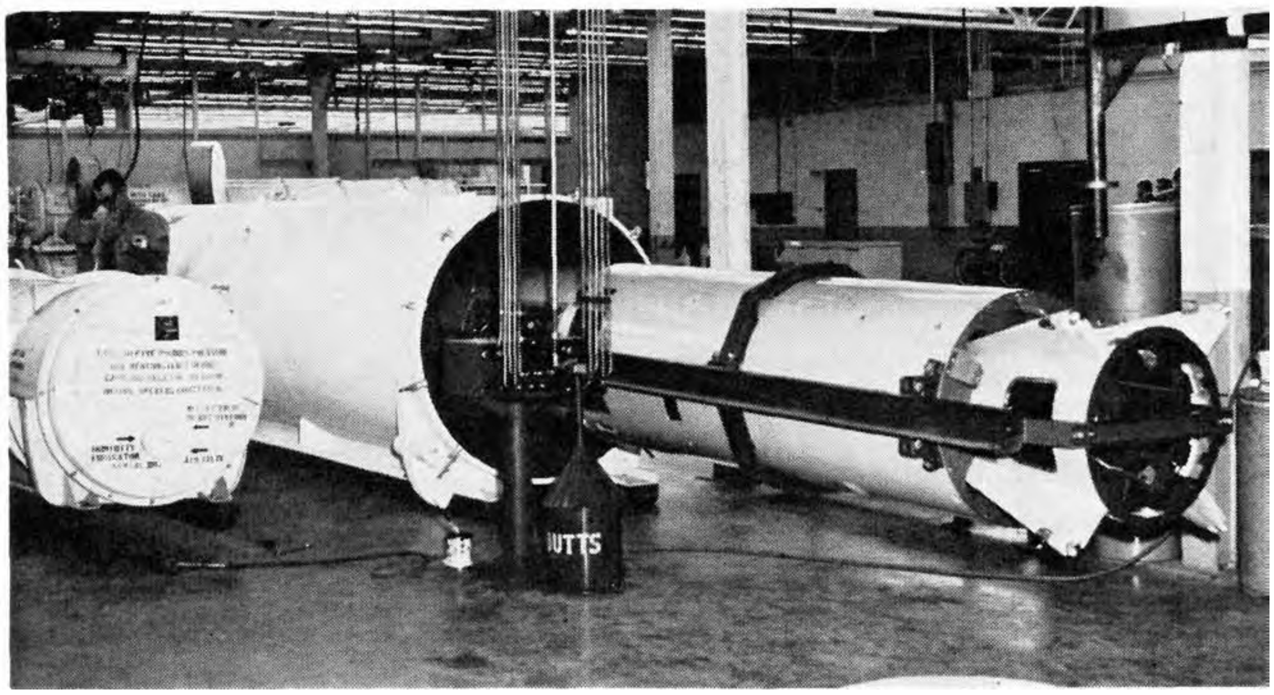




FINISHED airframe sections (left) are hoisted onto overhead monorail for final assembly. As sections move along hairpin-shaped course, workers install internal mechanisms and insert cable harness for the guidance and control package (right).



MAIN engine section and nose cone of Nike Hercules get finish coat of white as they move through continuous paint and drier set-up in final assembly building.



READIED for trip to missile site, nose cone is reversed and inserted into main body section which then goes into special shipping container.

produced in very small quantities.

But for a large scale operation such as the Hercules, studies definitely indicated the use of castings, Douglas states. They are comparatively inexpensive to produce, in large quantities, light in weight, and require a minimum of machining. And with the development of special tooling, much of which Douglas makes itself in a well-equipped machine shop at the Charlotte plant, castings permit rapid missile production. In one operation, for example, the cast cylinder is placed flat-side down; a multiple spindle is lowered and simultaneously drills many holes through the cylinder wall in a 360-deg. pattern.

The use of special tooling, in turn, is made economically feasible by the high rate of production in the Hercules operation. Design and manufacture of the Hercules, for example, is similar in many ways to that of conventional manned aircraft; but the comparatively low production rate of the latter makes hand operations more attractive. In a case where an aircraft part required a number of similar holes, for instance, they would likely be drilled in sequence by hand rather than by a machine with a coordinated hole pattern.

Missile Experience

Veteran in the airframe business and with missile experience dating from 1941, Douglas was able to bring much valuable knowledge to bear on the Nike Hercules operation. But the experience most directly applicable to the production of the Nike Hercules derived chiefly from Douglas' work on the Honest John and on the Nike Hercules, according to Donald Jamtaas, chief engineer at Charlotte Division. Honest John approaches Hercules most closely in size; Ajax, in internal structure.

An important carryover from the Ajax program cited by Jamtaas, for example, is the overhead conveyor line used in the final assembly of the Hercules. In its early work, Douglas used dollies extensively to move missile sections. The switch to an overhead conveyor enabled the company to get rid of most of the dollies and unclutter the floor. Even more beneficial, it raised the airframe sections to eye-level, permitting workers to install equipment and run the required tests faster, more easily and with less physical strain.

At the same time, the differences between the Hercules and other missiles are as significant as the similarities. The construction of the Ajax airframe, for example, differs noticeably from that of the Hercules. The smaller Ajax body is made up to a large degree of long tubular castings bolted together. These castings, which are almost fully machined, form both the load carrying structure and the external surface. Cost and weight of such a structure, Jamtaas declares, would be prohibitive for the larger Hercules airframe.

Soviet Union Reports ICBMs in Production

Moscow—The Soviet Union's intercontinental ballistic missile has reached production status, it is claimed here. A report that the USSR is now producing ICBMs was buried in a single sentence of an 88-page outline of Russia's new seven-year plan. "Production of intercontinental ballistic rockets has been successfully set afoot," it said.

The plan carried no further reference to missiles of any type although it did state in the same paragraph that "preparations are being made for travel to celestial bodies."

Since the Soviet announcement last August of an ICBM launching, Premier Khrushchev has several times indicated it is in production but this is the first definite claim to such status.

Also included in the seven-year plan is a forecast that air travel will increase approximately sixfold in the Soviet Union during the coming seven years. It asserts the introduction of large turbojet and turboprop airliners will be responsible for making air transport one of main categories of passenger transport in the USSR. To handle these modern aircraft, more than 90 airports are being built or modernized, the report said.

The network of feeder lines will receive particular attention during the seven-year period between 1959 and 1965, the outline of the plan indicated.

In fields allied to aviation, the plan called for sharp boosts in the output of the plastic and aluminum industries as well as substantial increases in electronic and machine tool output.

Output of metal-cutting machine tools is to reach between 190,000 and 200,000 in 1956—an increase of 1.4 to 1.5 times over 1958. This will include