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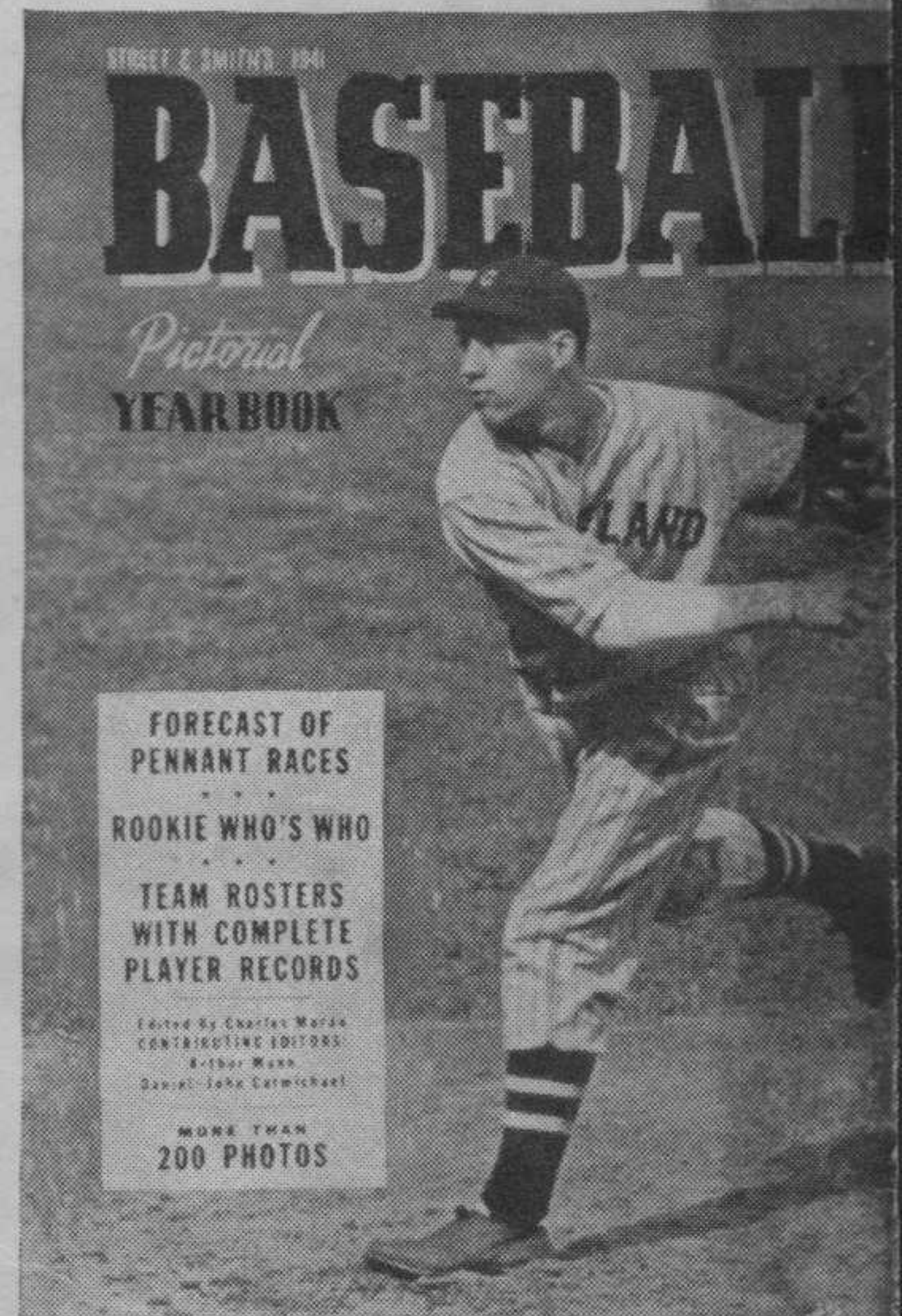
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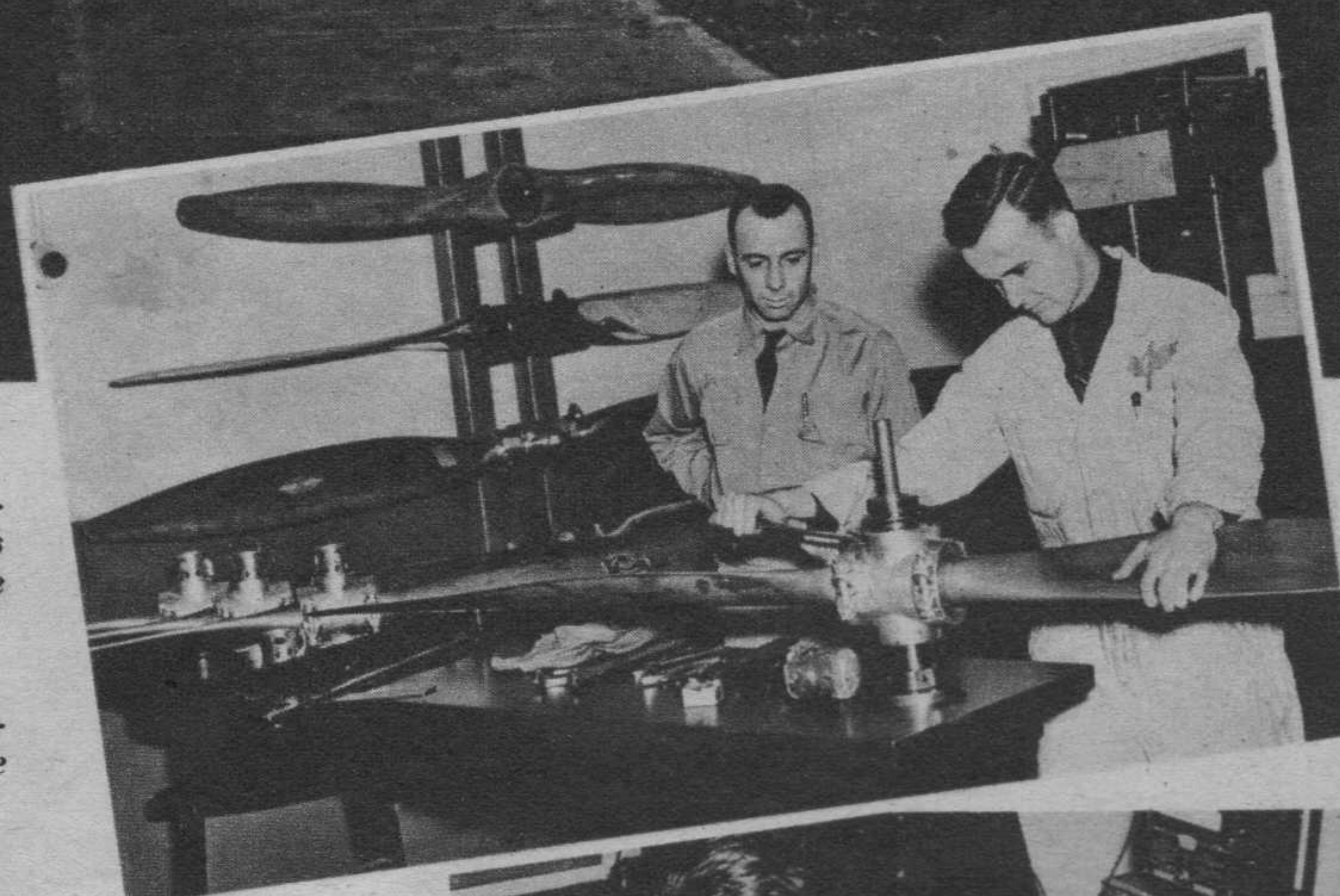
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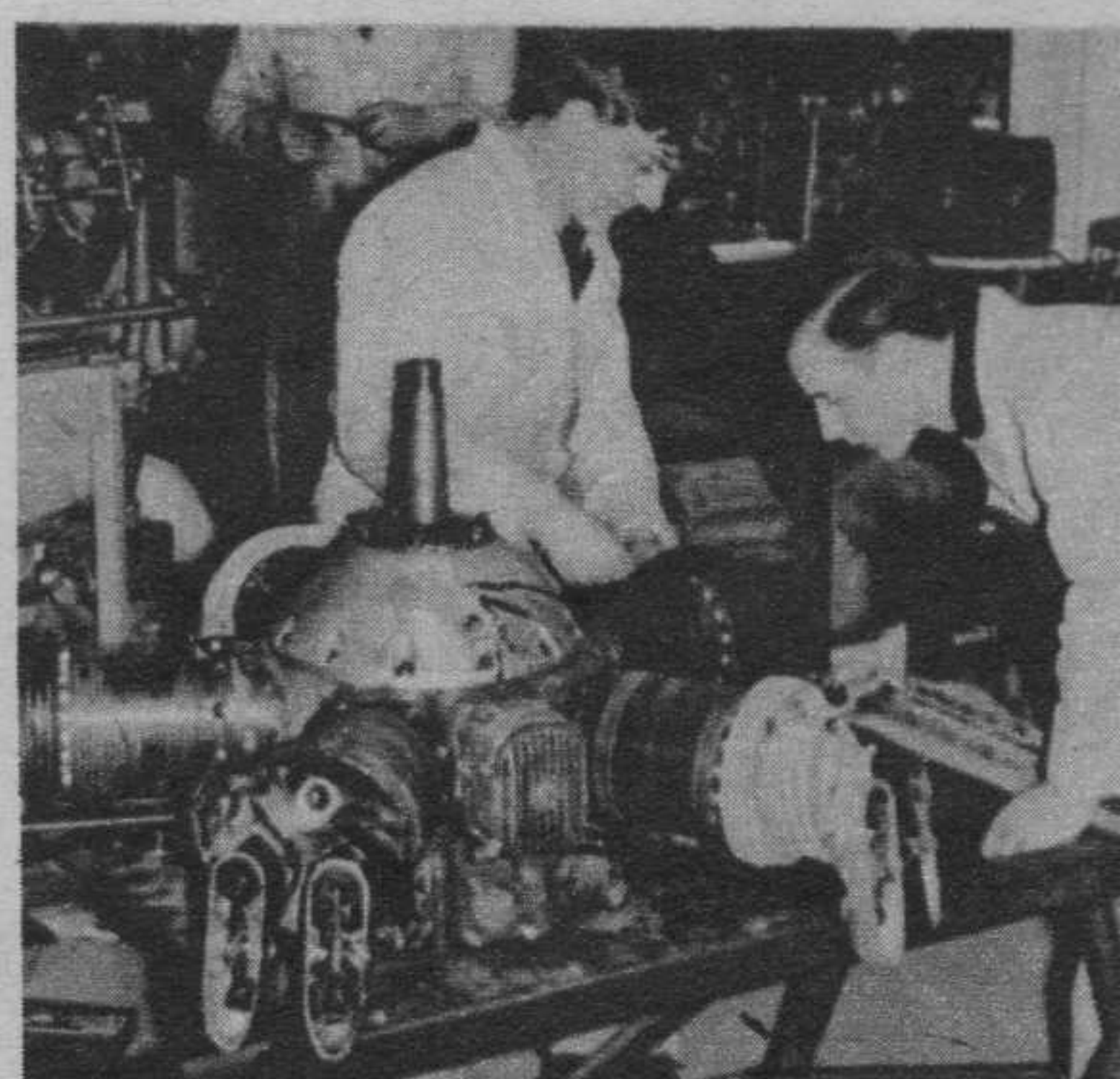
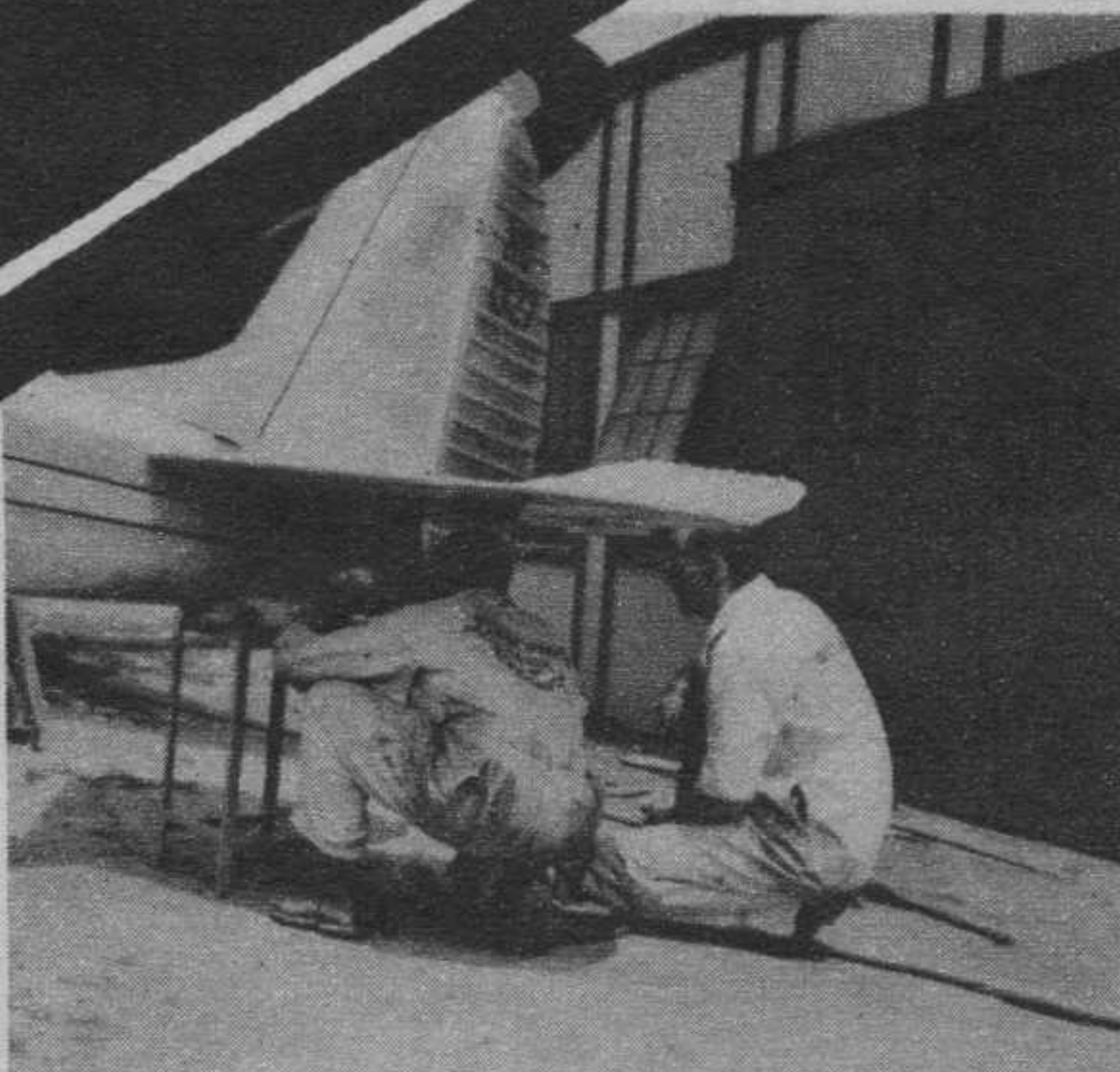
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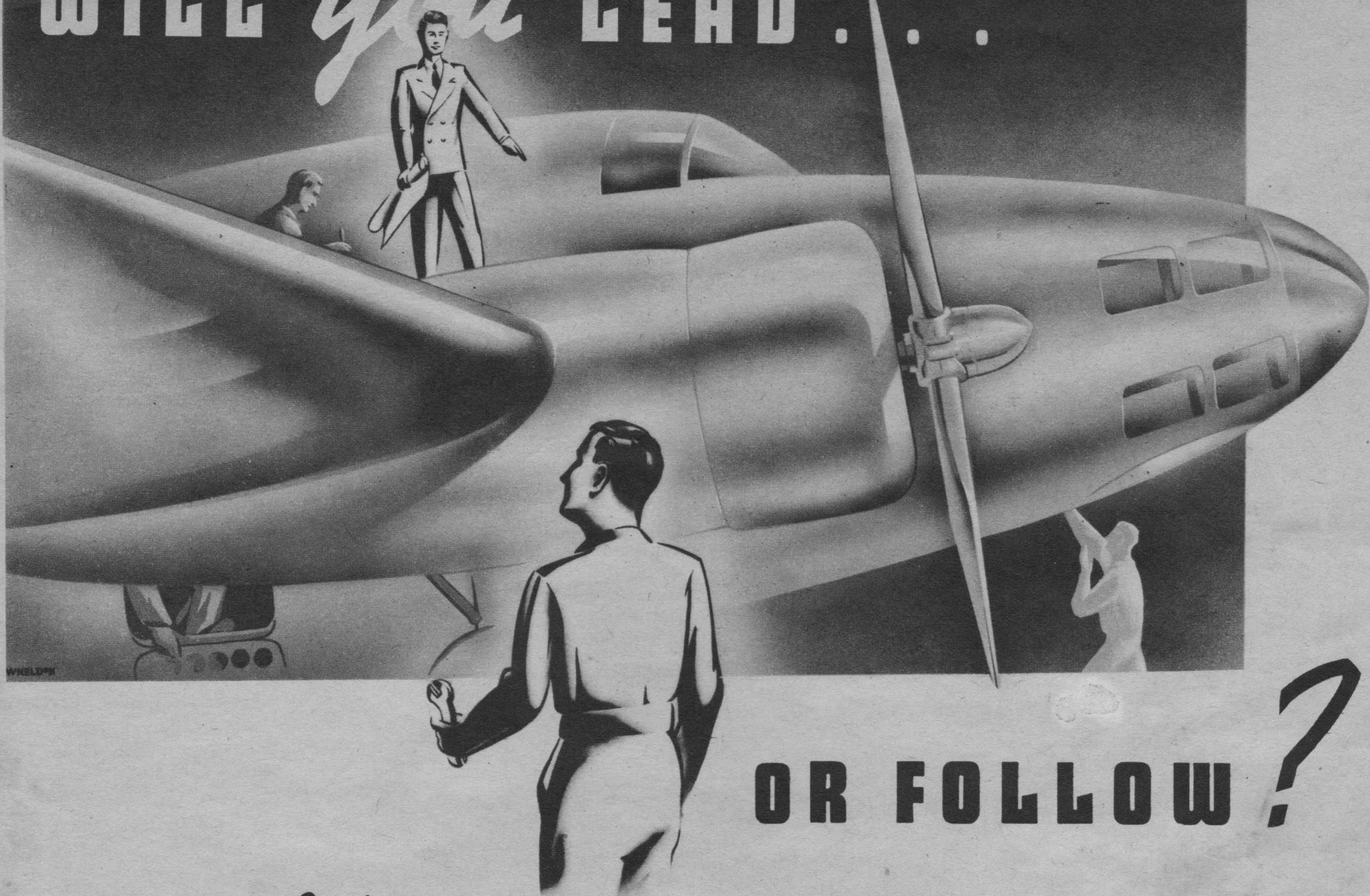
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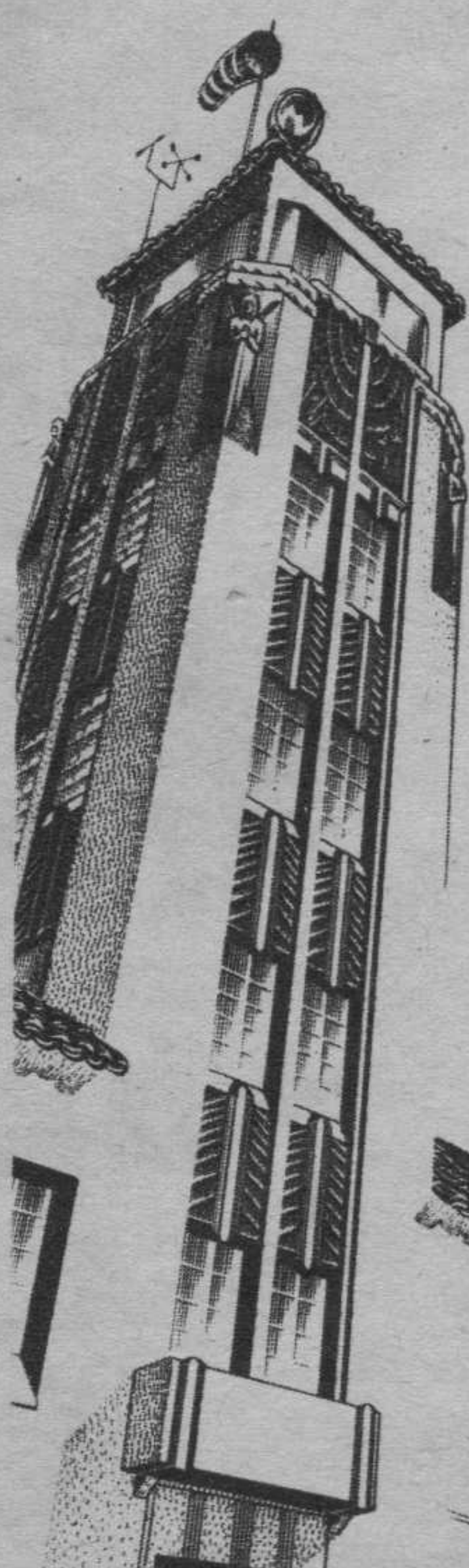
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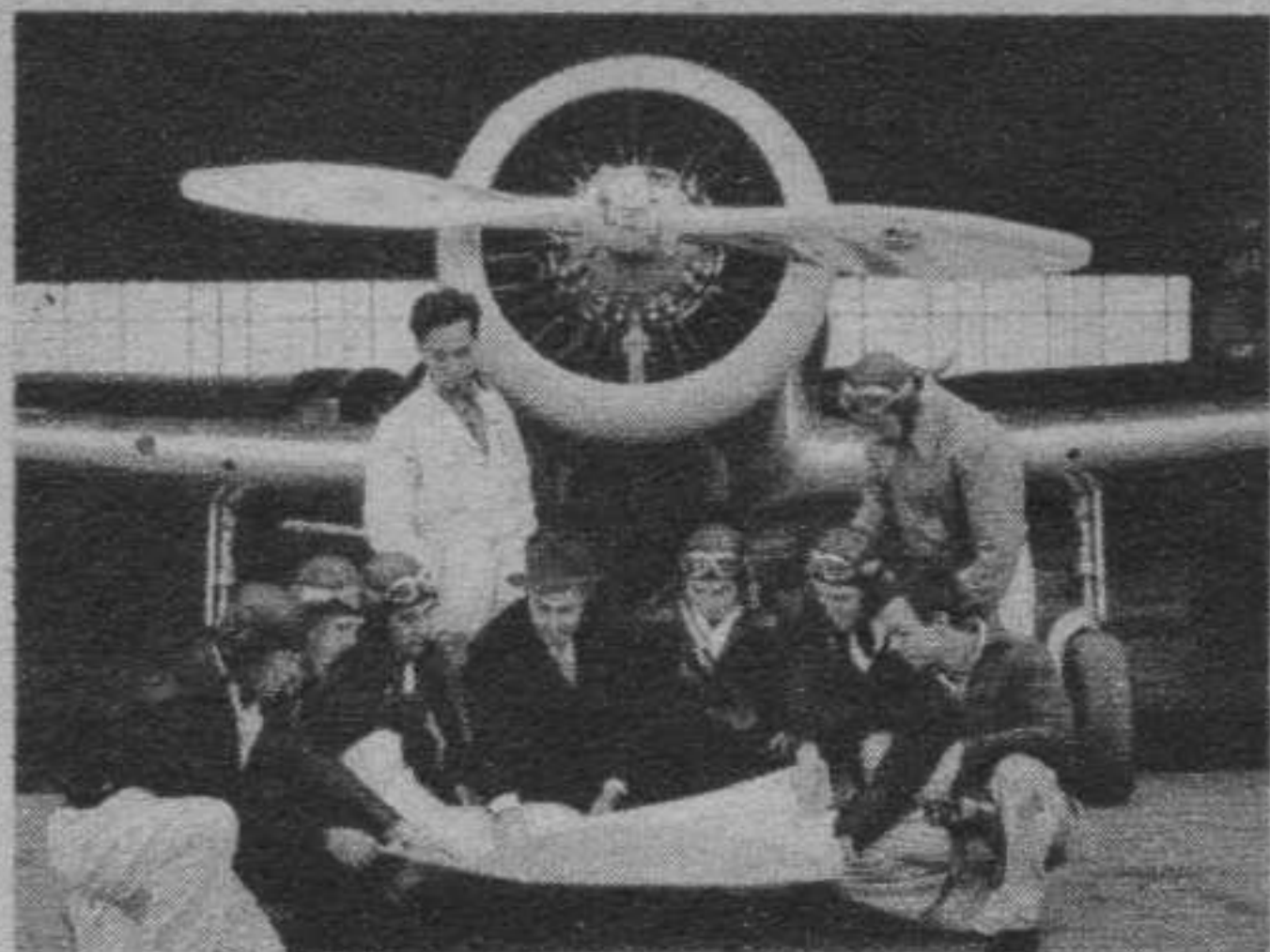
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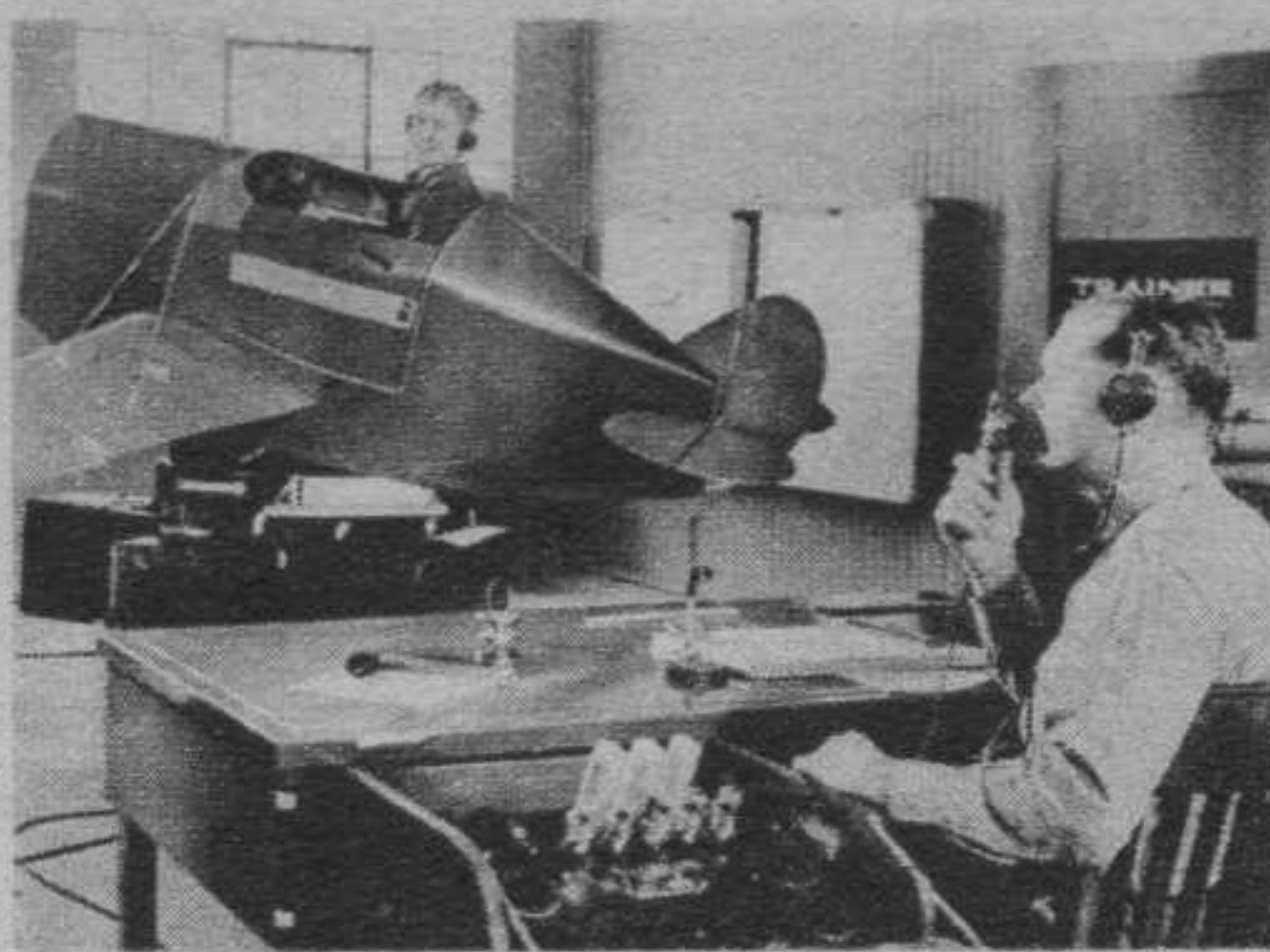
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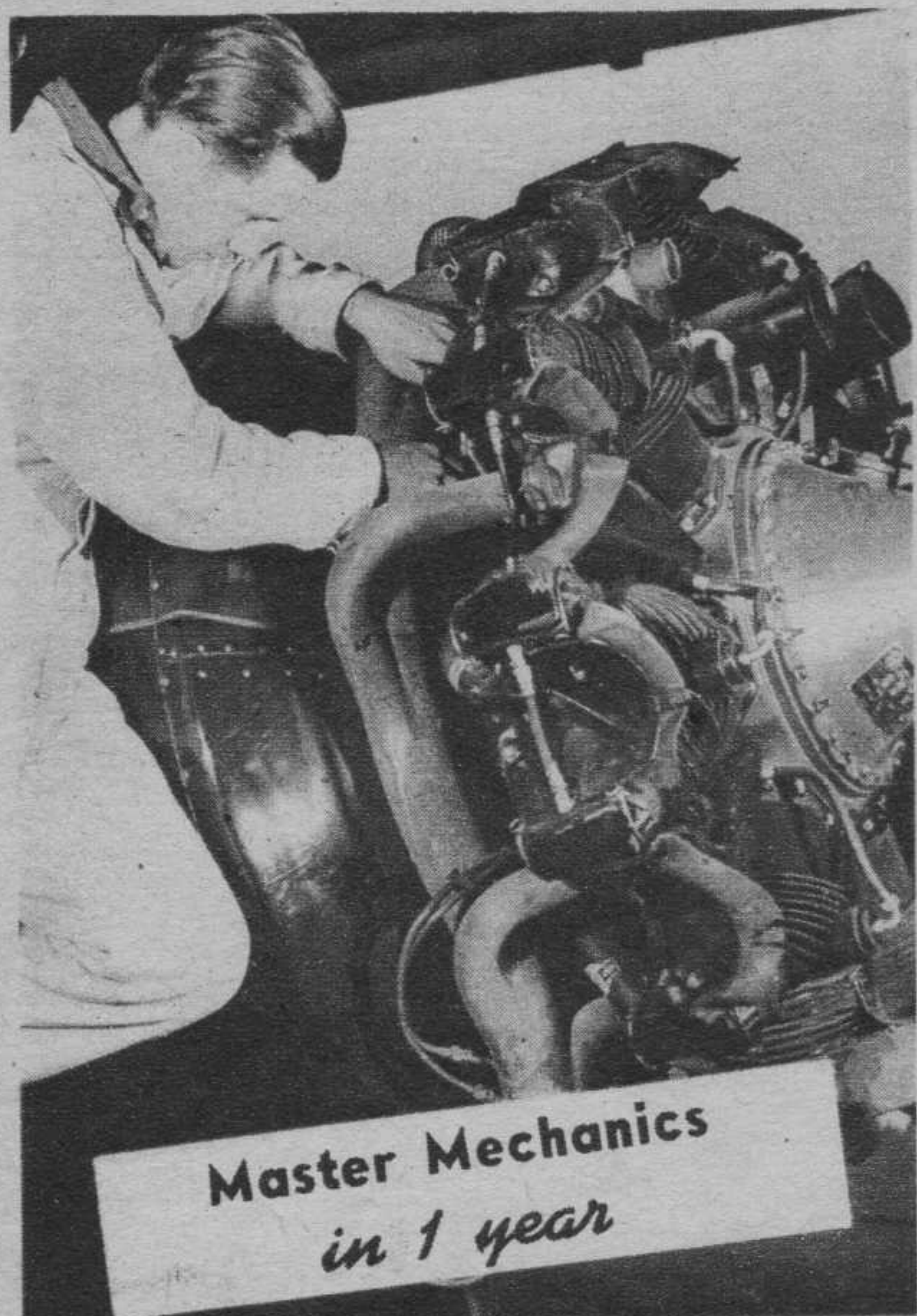
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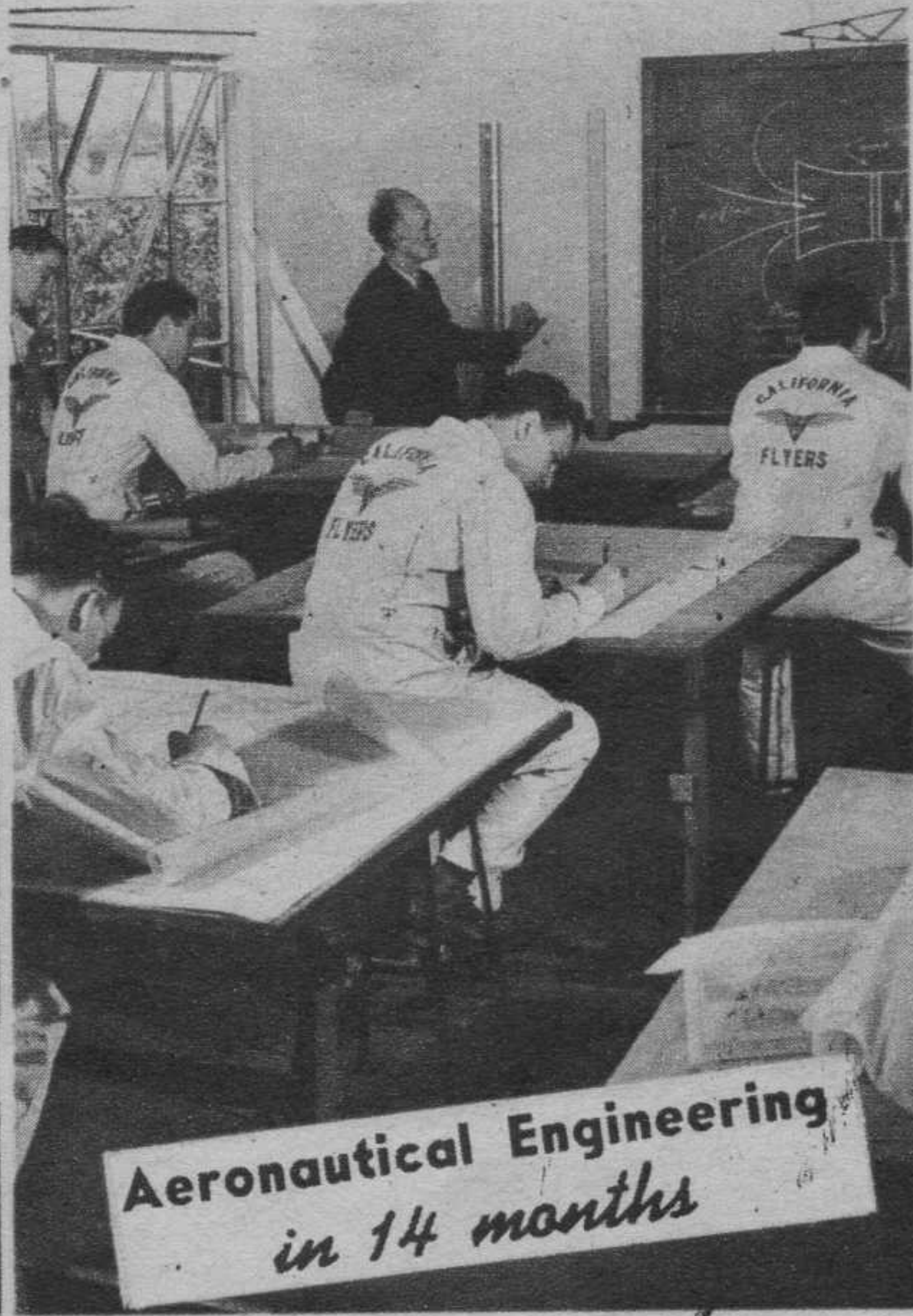
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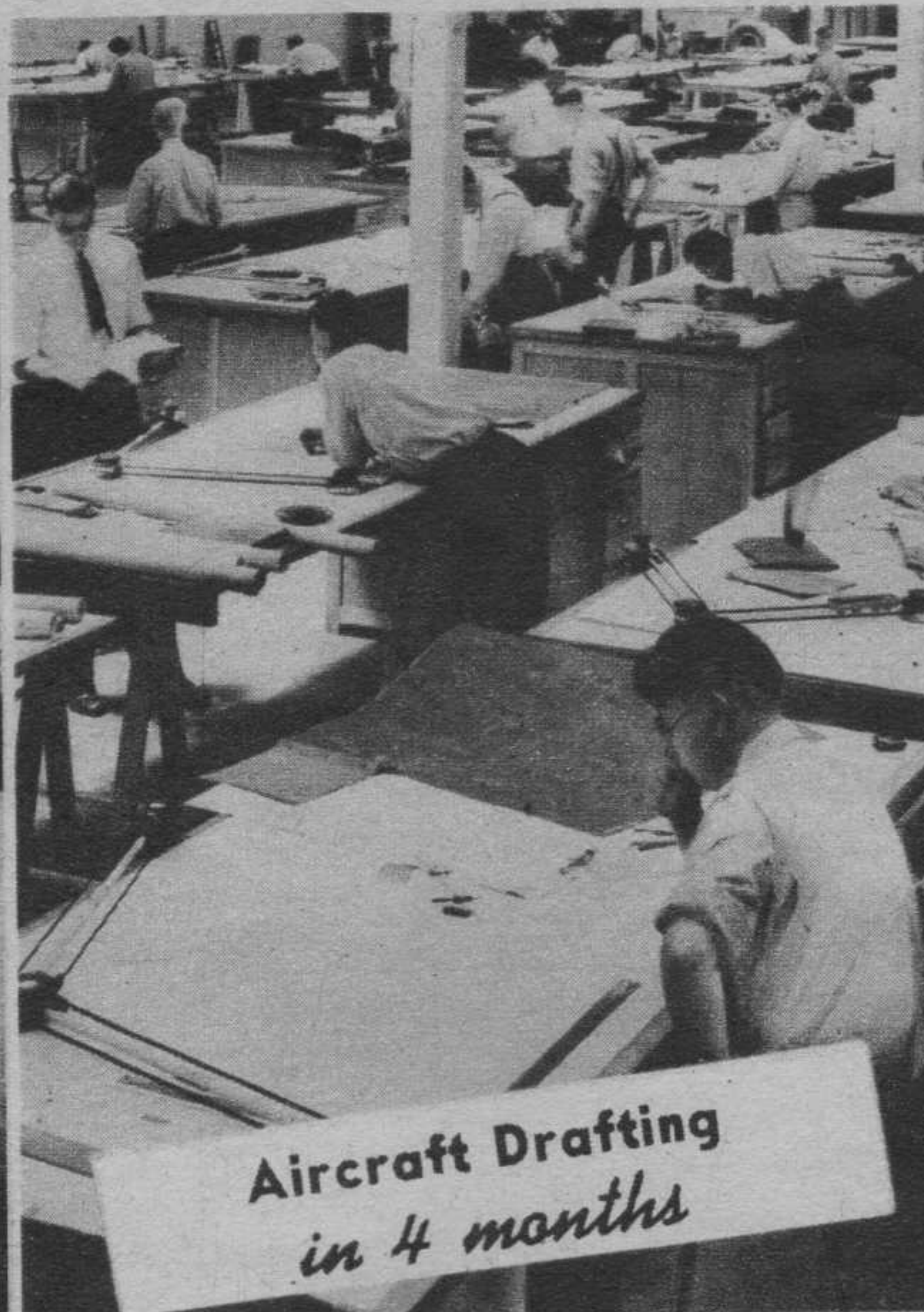
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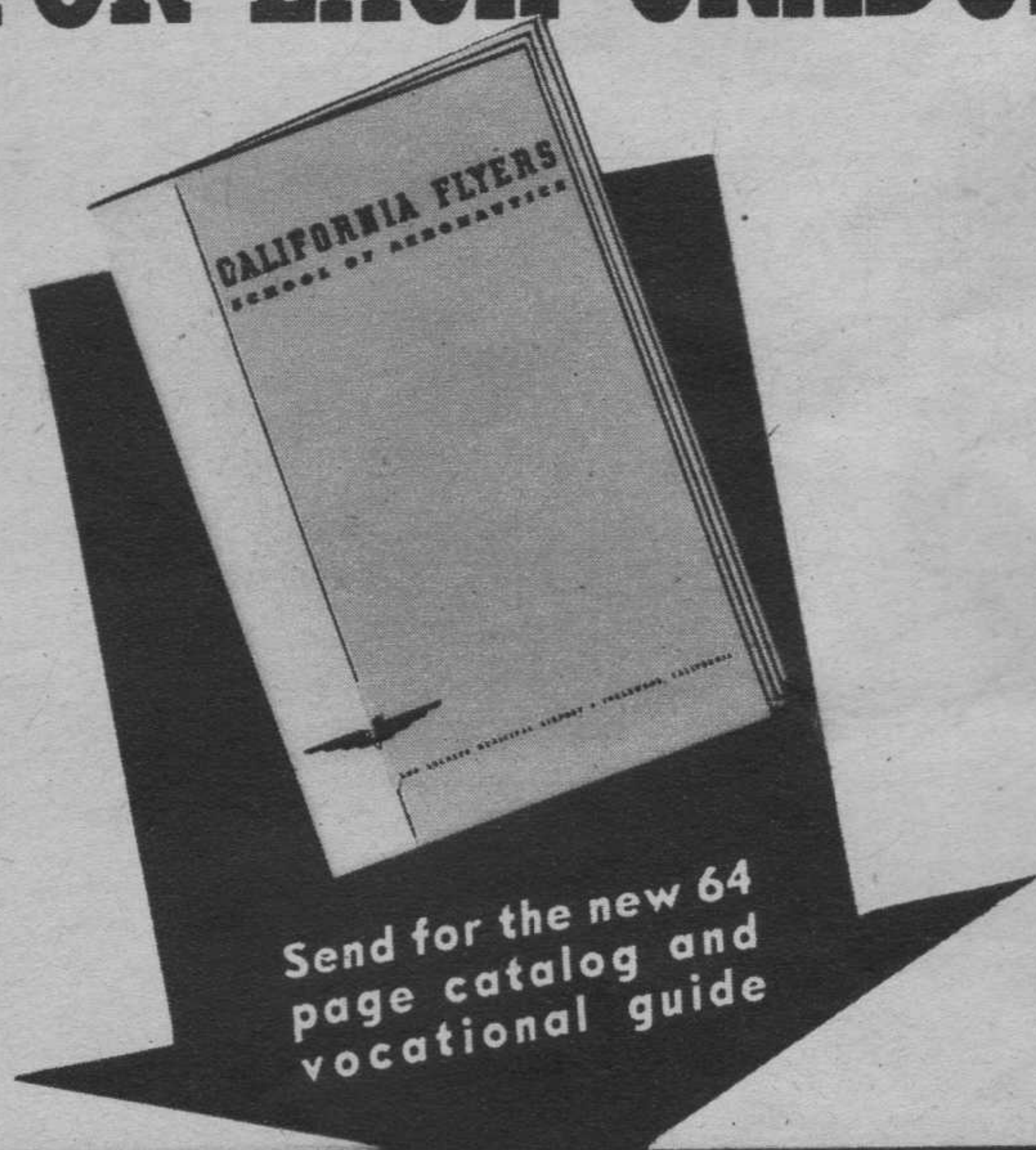
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From all points of the compass come interesting items of aviation. This page is reserved for a cross section of them.

RECENTLY in Toronto, as a guest of Trans-Canada Air Lines, we visited "Little Norway" where the Norwegians are being trained. We were much impressed by the completeness evident, from the Fairchild training planes, P-36s, and Douglasses, right down to the pretty Norwegian nurses in the infirmary. The earnestness of the officers and men was most impressive, and particularly their appeal for our help in letting it be known that they are still taking in young Norwegians interested in joining the Royal Norwegian Army Air Force.

The Royal Canadian Air Force field at Malton Airport was a fascinating place, too. Here under the guidance of members of Dominion Skyways (Training) Limited, the R. C. A. F. cadets are being rushed through their training period in DeHavillands and Avro Ansons. The streams of yellow training ships, slightly reminiscent of the Jennies of 1917-18, made the

field look warlike indeed. A grim reminder of training incidents was the pairs of showshoes still lashed to the rear of the twin-



engined Ansons. It is here the Elementary Flying Training School and Air Observer School is maintained, according to the huge signboard at the entrance to the field. We noted that the red, white and blue air corps insignia on this sign had been changed so that a red maple leaf formed the bull's-eye in the center.

It is from Toronto that Trans-Canada Air Lines operates its new nonstop route to New York, and we mean *nonstop*, for we came from Toronto to LaGuardia Field in one hour and thirty-nine minutes, the new Lockheed Lodestar hitting over 260 m. p. h. some of the way.

One incident at Malton Field was indicative of the stringent rules in force. We were being conducted through by genial Captain E. B. Woollett, operations secretary, when one of the group asked if he might look at a computer being used by one of the cadets. The cadet, wary, asked the captain if there were any regulations about that particular instrument being seen, and the captain gravely assured him it was not too hush-hush. The gang took a look and then broke into a grin—the computer had the familiar trademark of Air Associates, U. S. A.

★ ★ ★

A few days ago we were invited to Stratford, Conn., to take color movies of Igor Sikorsky's amazing helicopter. After having seen it fly, taken pictures of it, looked at them on our own screen, and reading all about it, we still find it

hard to believe! As Mr. Sikorsky says, "It does not go *almost* straight up—it goes *straight* up!" It can hang still in one spot for



hours, fly in any direction, and we mean just that. Equipped with the flotation gear it wore the day we were at the plant, it can take off from land, descend upon water, and then return to land. Wheels are only needed for re-

turning it to the hangar, for it has no take-off run. Castered cradles solve the taxi problem when floats are used. See the two-page spread by Rolfe in this issue.

★ ★ ★

Two copies of the British *Aëro Modeler* just came in and it is interesting to note that the R. A. F. runs a full-page recruiting advertisement in the magazine. Apparently English model builders are recognized as more than just small boys. The sooner it is generally realized that the majority of the model builders of America are a serious group of young men actively engaged in the study of aviation, the better it will be for both builders and the indus-



try. Where else will the industry find its future designers and engineers, and where else could the U. S. army air corps find

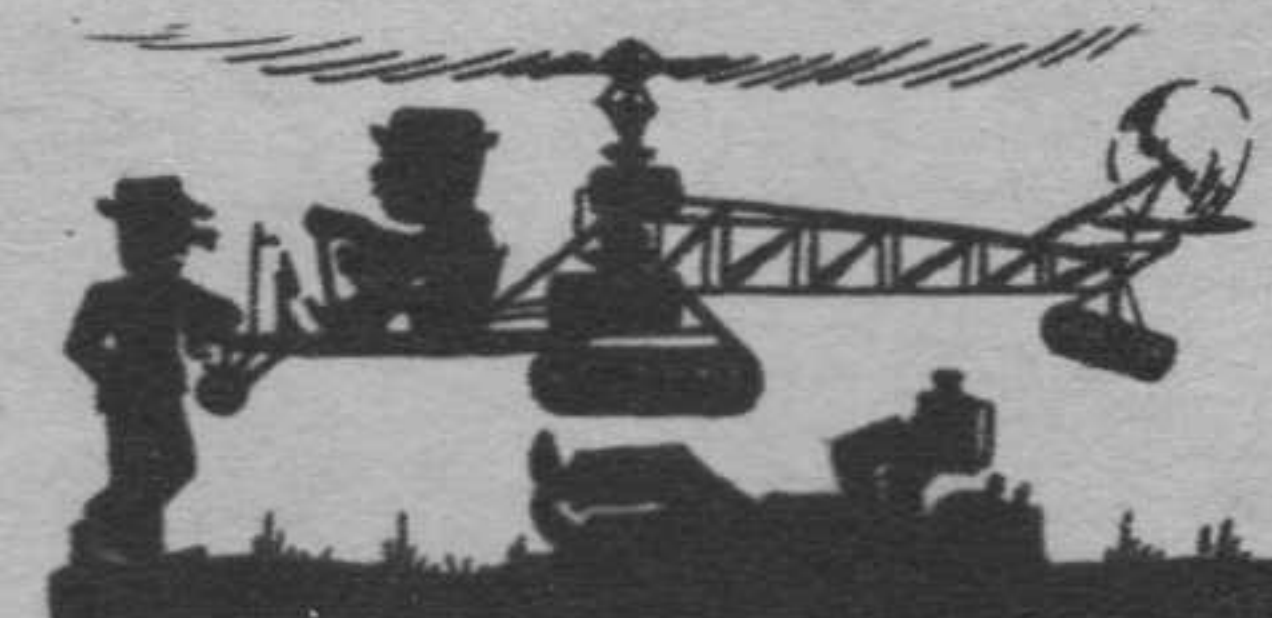
a likelier bunch of cadets?

★ ★ ★

Writer John R. Hoyt ("You Try Dive-bombing!", "Interceptors Up!", et cetera), dropped into the office a few days ago. While here he took Editor Winter up in a navy job he was ferrying back to Michigan where he is a navy instructor. The flight took place at Floyd Bennett Field, which is a hop, skip and jump from the Atlantic on one side and Brooklyn on the other. Pilot Hoyt seemed fascinated with the sandy shore line below and, the better to see, went round and round in a tight turn. After landing said Hoyt, "That's the first time I've seen Coney Island."

★ ★ ★

A much delayed letter from a member of the staff of *The Aëroplane*, British air magazine, recently arrived. A few excerpts might be interesting:



"... the candid opinion of British pilots on American aircraft. Although there has been a bit of trouble with some of them and others have not been adequately armed or armored, in general they do seem to be making a very favorable impression over here. Of course, the Lockheed Hudson has done magnificent work and the Boston is also doing very well, and its derivative, the Havoc night fighter, is now helping to cope with these night bombers, the sound of which I can hear overhead as I am writing this at the moment. In fact we have just had a couple of bombs very close to this office since I started this letter, but so far we have escaped, thank goodness.

"Your April issue of *Air Trails* has just arrived. I have not had time to look through it in detail, but the 'Prone Pilots' article looks particularly interesting as we learn that a new German fighter (Heinkel) is being produced on those lines. Boeing B-17C's and Consolidated Liberators are now reaching this country after making exceptionally fast time across the water. They will certainly prove useful. That life line across the Atlantic is vital to our cause."

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A. T. AUGUST, 1941



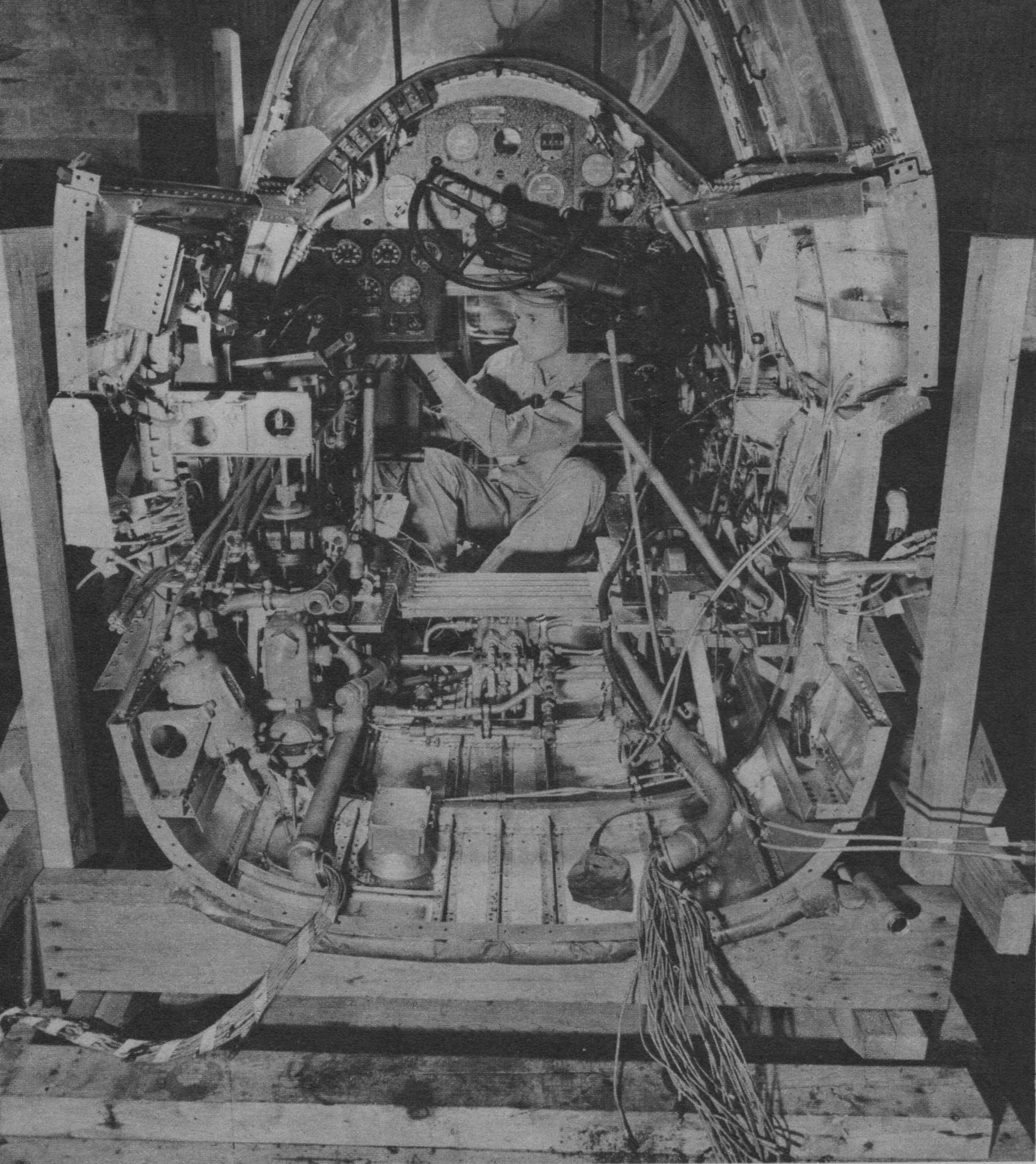
The B-26, air corps medium bomber, climaxes 32 years of manufacturing for Glenn Martin.

BOMBERS BY MARTIN



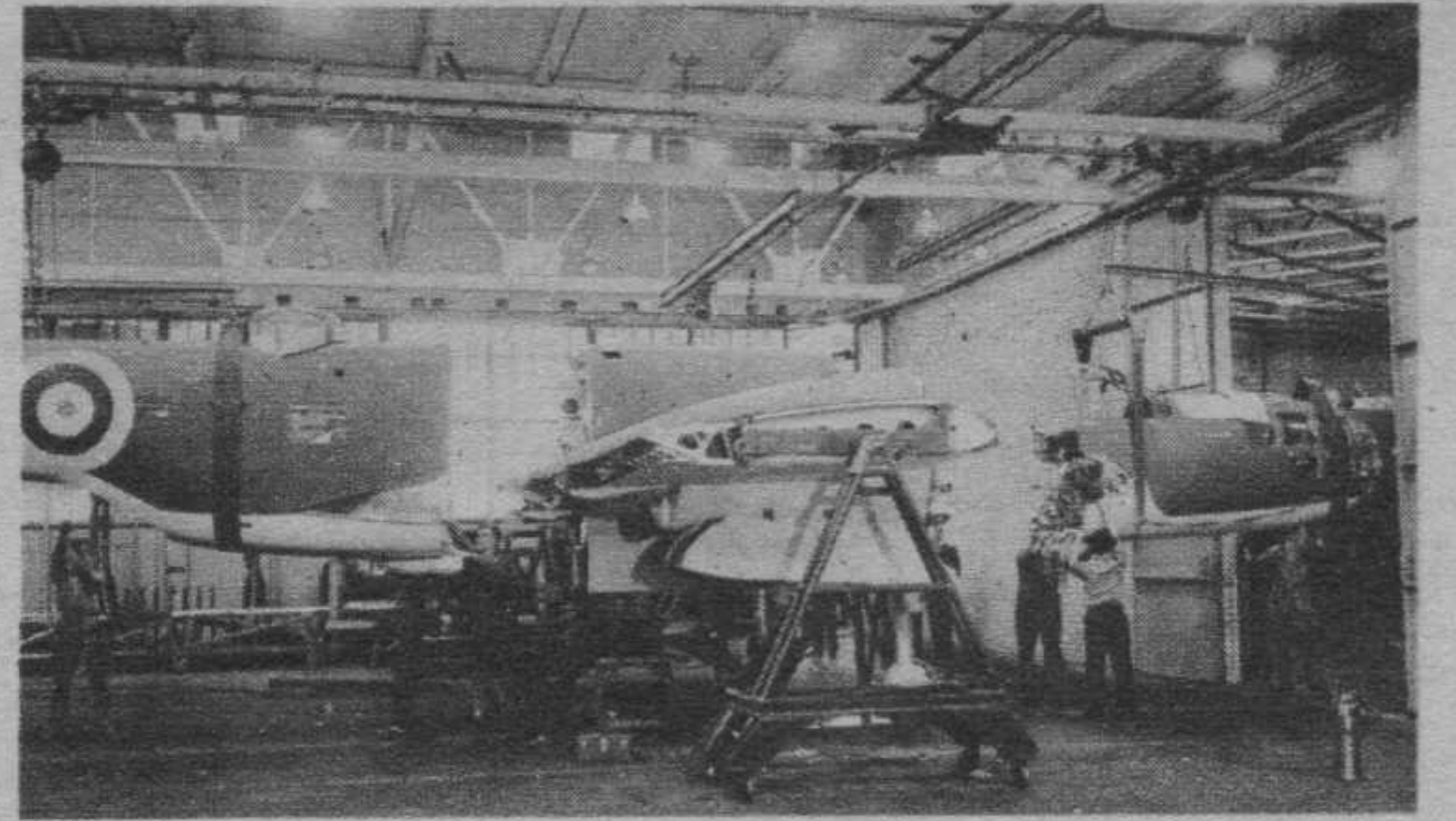
Glenn L. Martin, with models of B-10 and post-war Martin bomber.

BUILDERS of dependable aircraft since 1909, Glenn L. Martin's first airplane was made in an old church. The latest Martin planes, British Marylands and Baltimores, army B-26s and navy PBMs, roll off the production lines in the giant Baltimore plant where approximately 17,000 workers are now employed. By 1942 a new bomber assembly plant in Omaha and further plant additions at Baltimore will boost the pay roll to 42,000 workers and floor space to 5,192,725 square feet—equivalent to twenty-four square blocks in Manhattan. Martin, one-time barnstormer, has followed the up-and-down manufacturing trail for thirty-two years from California, to Cleveland, to Baltimore. The post-war Martin bomber and recent B-10 were marvels in their day. Now under construction is the greatest of Martin ships, a four-engine navy flying boat rumored the biggest ship in the world.

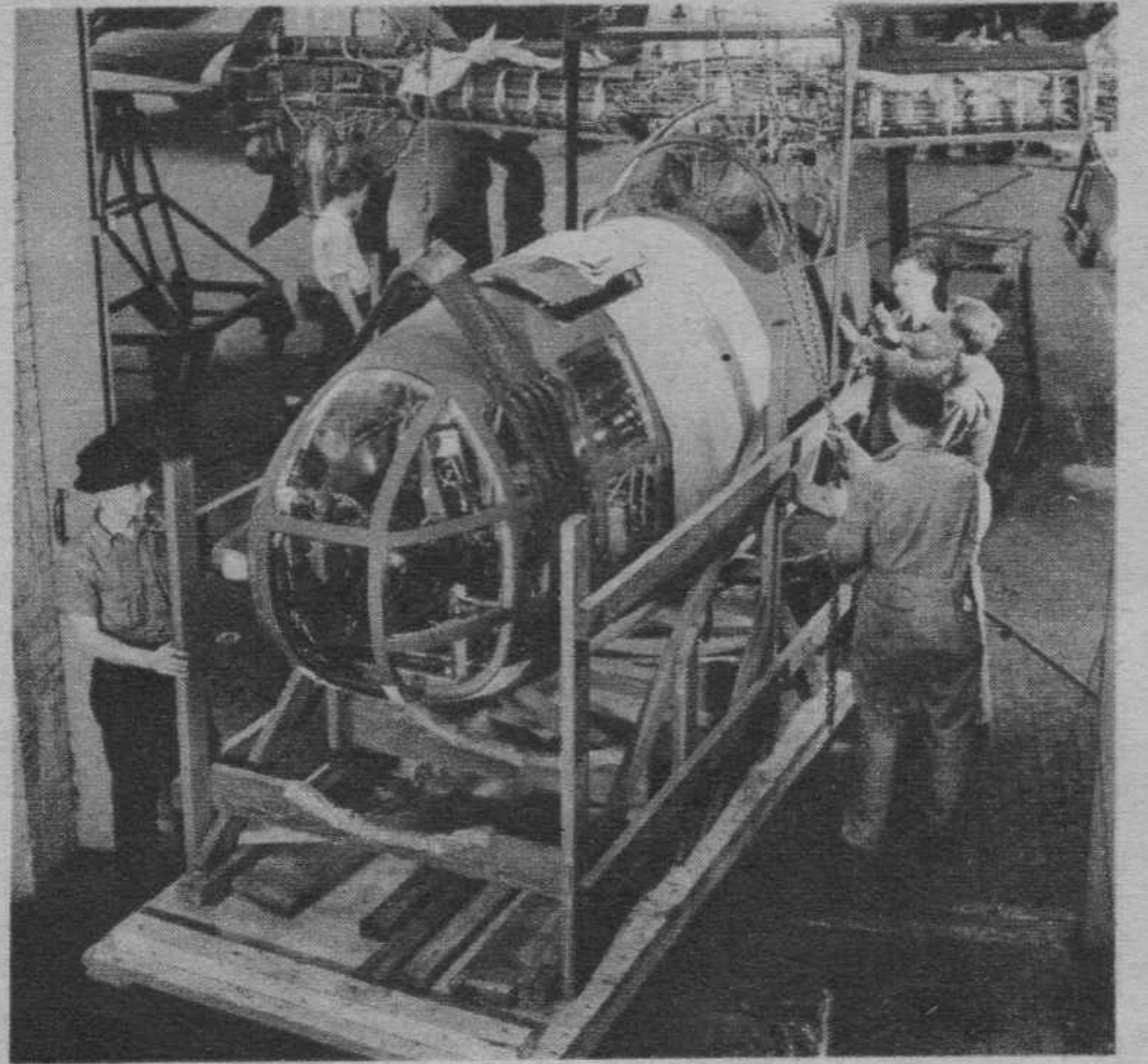


Planes aren't autos. Strength, light weight, and the complex gadgets of war make a light bomber a machine of 25,000 individual parts and some 150,000 rivets. This is nose of British Maryland.

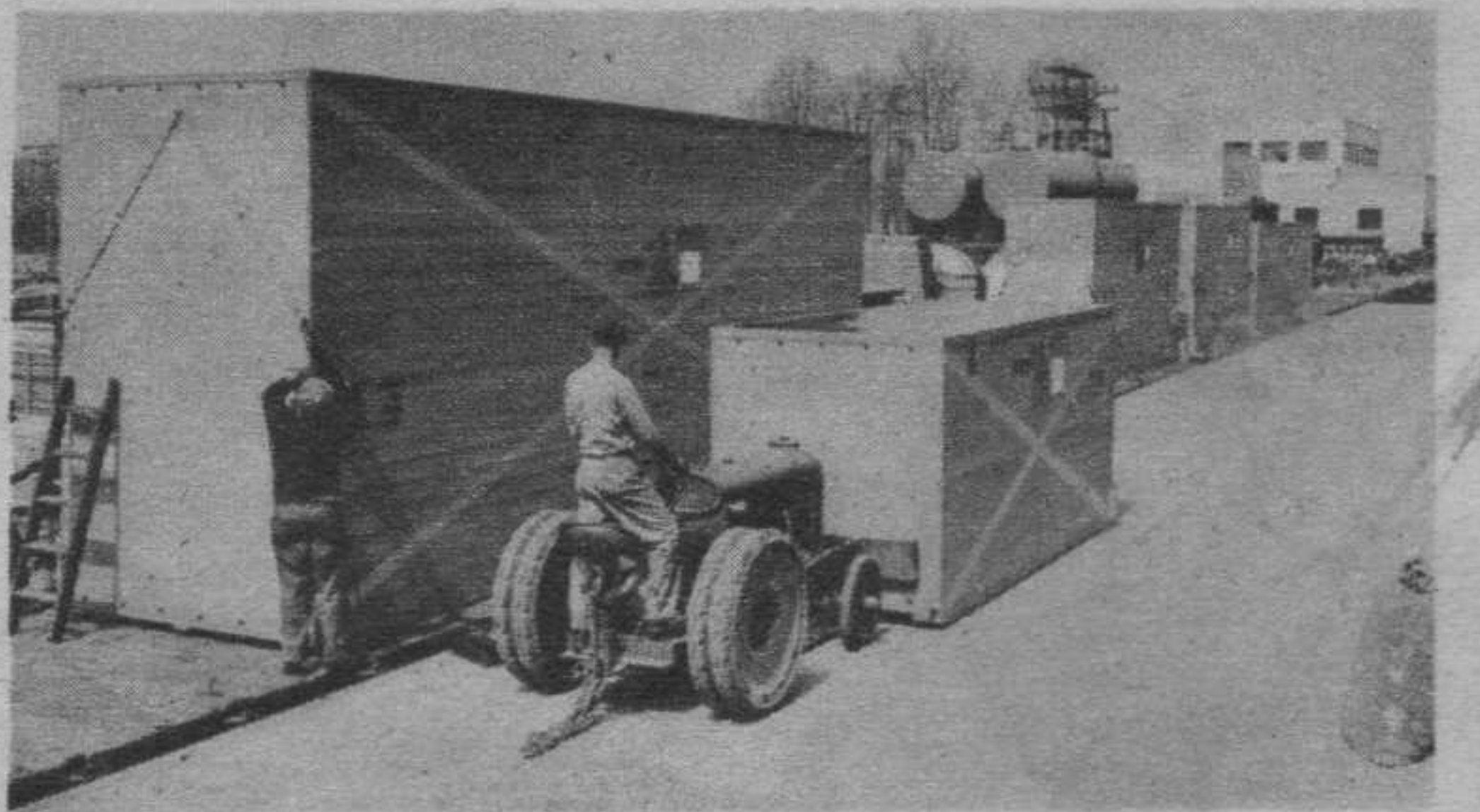
CRATING A BOMBER



Nose, center section and tail section of Maryland come apart for shipment for Great Britain.



Bundles for Britain. Nose section of a Maryland attack bomber being loaded into packing crate.

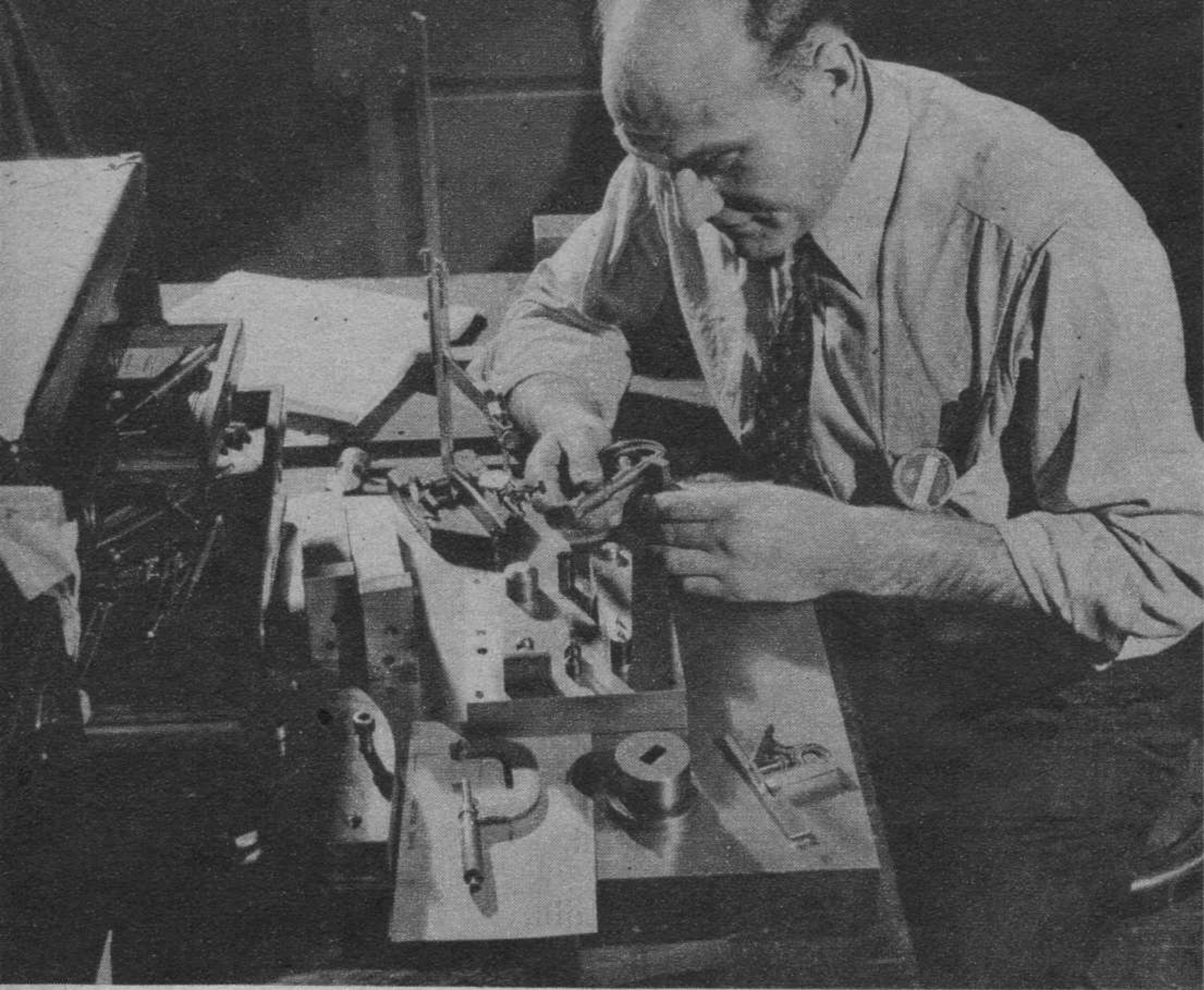


Off to the wars. Every day a trainload of airplanes in packages departs for points unknown.

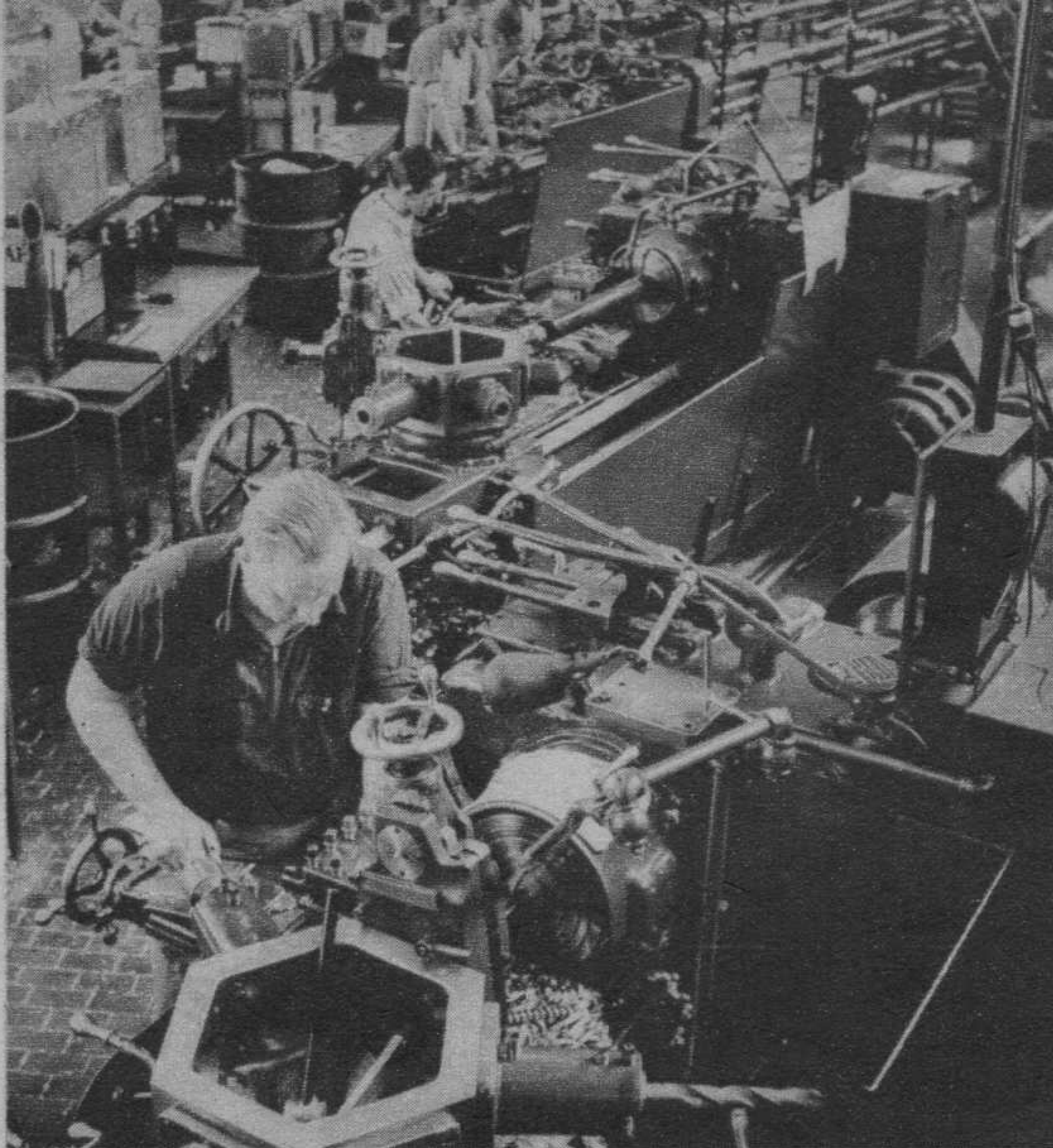


Design at Martin is a never-ending job for many hundreds of engineers and draftsmen. Note small mock-up of a bomber section in the lower right corner.

(Continued on Next Page)



Toolmaker's craft is one of oldest in the industry. This expert is measuring to extreme tolerances a tool intended for a Martin bomber. Skilled toolmakers are much in demand.



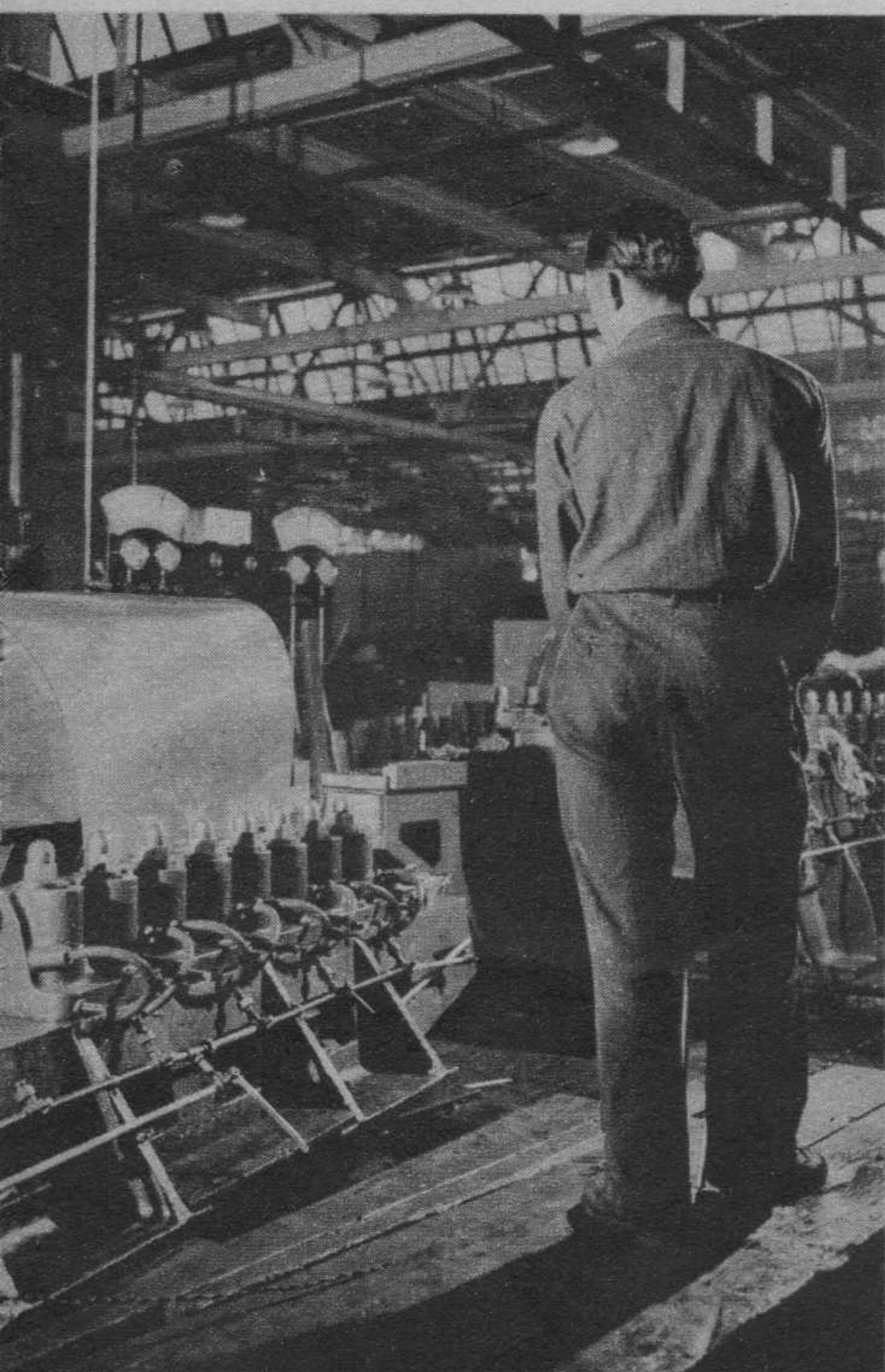
Worth their weight in gold, these highly flexible machine tools in the Martin shops machine castings and forgings to the thousandth of an inch.



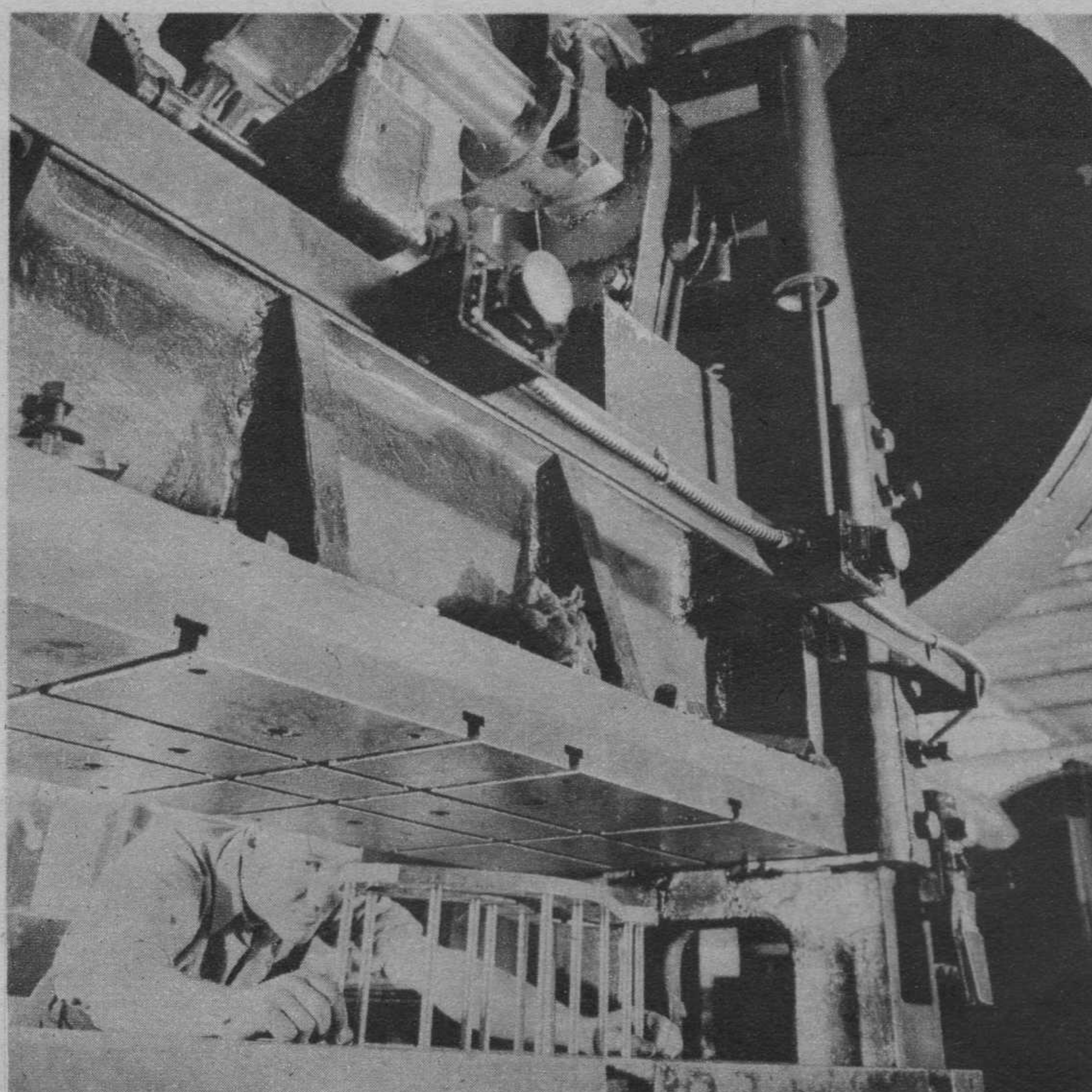
Sawyer, modern style. Richard A. Pilling sets up one of the band saws which cuts heat-treated aluminum alloy as easily as it does wood.

BOMBERS BY MARTIN

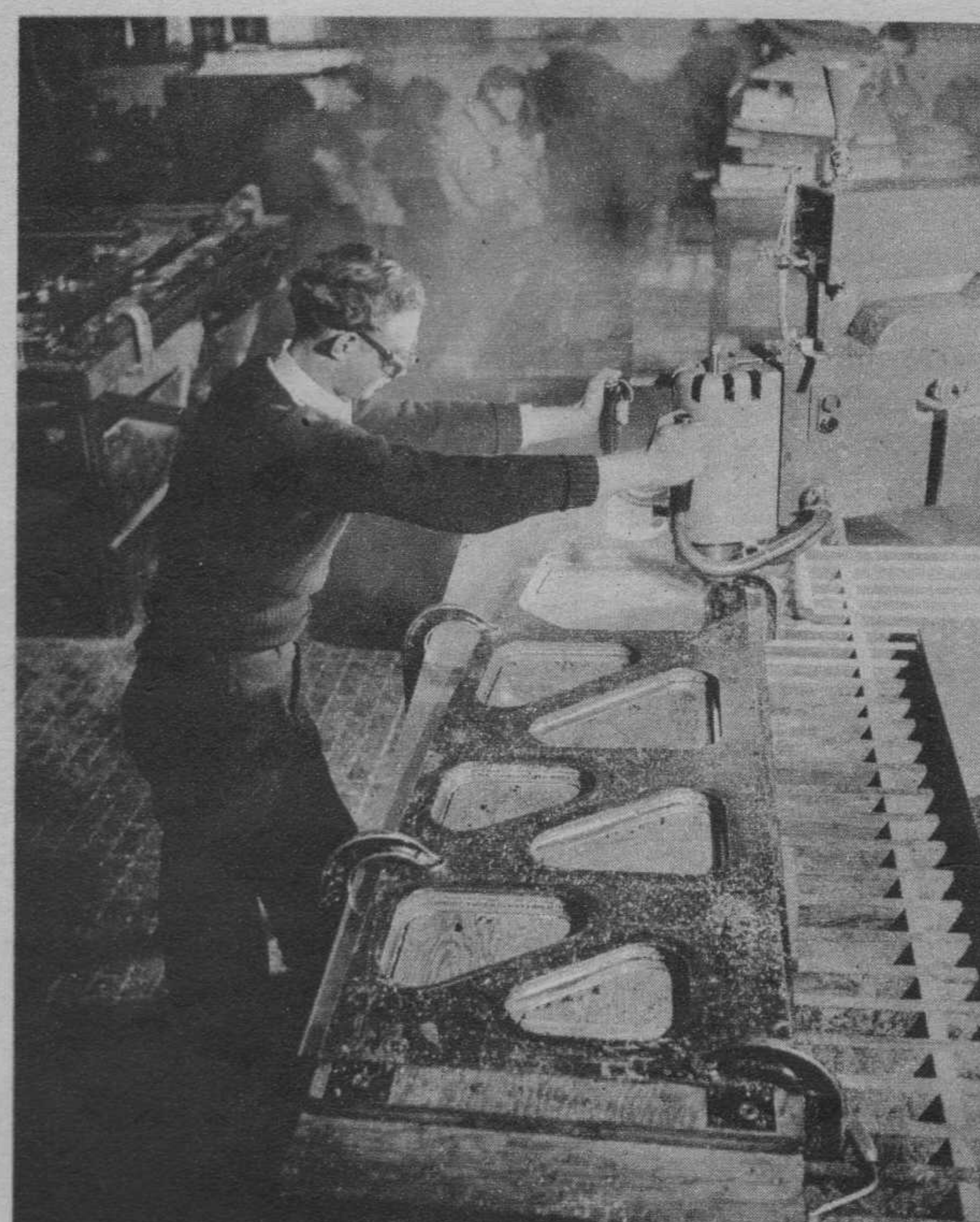
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Jaws of metal-stretching press hold metal sheets; forms press up against them to form sections of covering.

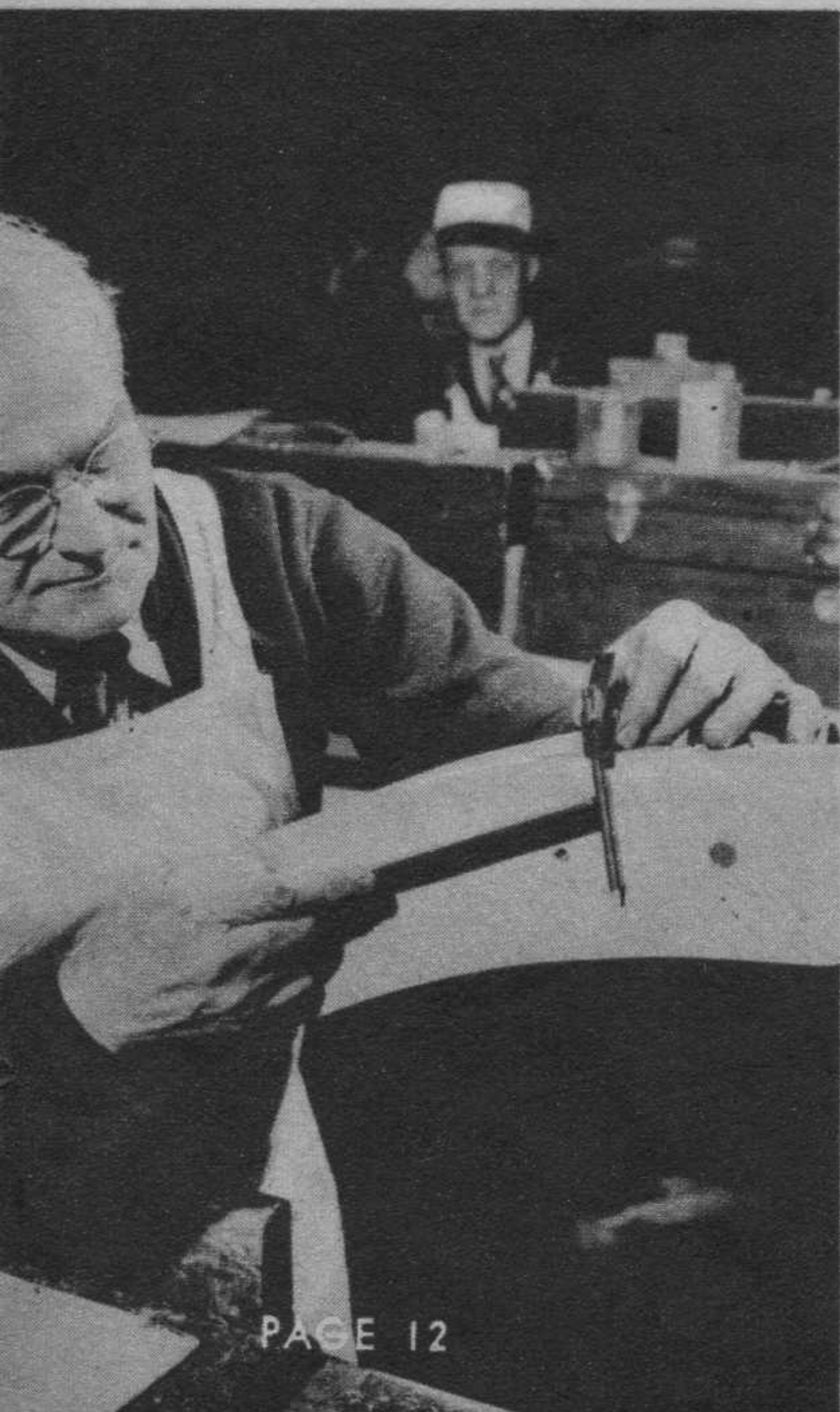


Punch press. One of a battery of powerful presses which form out metal parts rapidly. An operator sets a die for the job. Acres of machines of every description work right around the clock at Martin.



Intricate shapes are cut by power router. Eight to twelve sheets aluminum alloy are sandwiched between wooden patterns to serve as guide.

"Oldsters" like this make all sorts of wood patterns, forms, "mock-ups" before production.



Drop hammer. One of thirty-odd power drop hammers in Martin drop-hammer department smashes out a section of airplane contour.

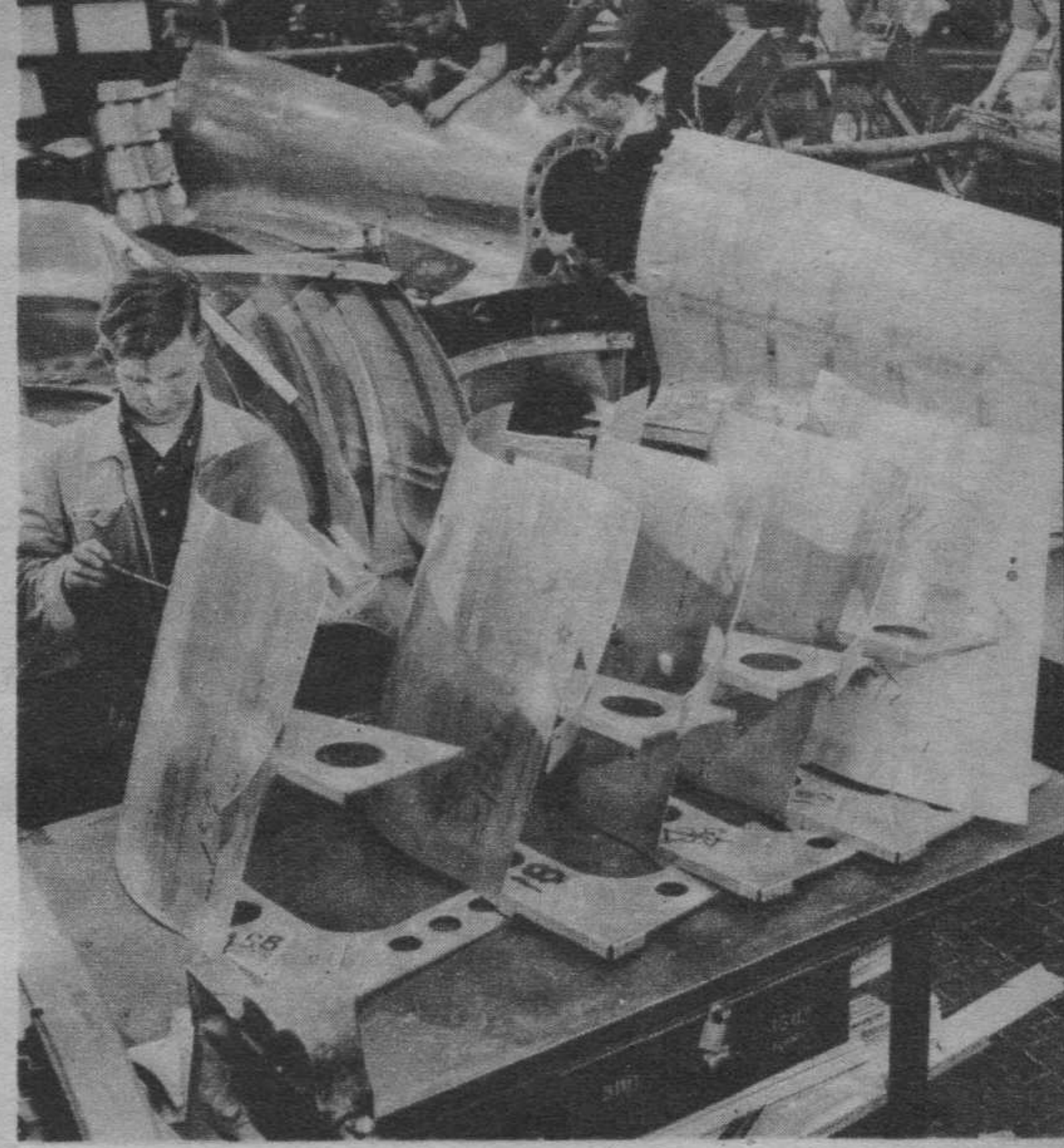
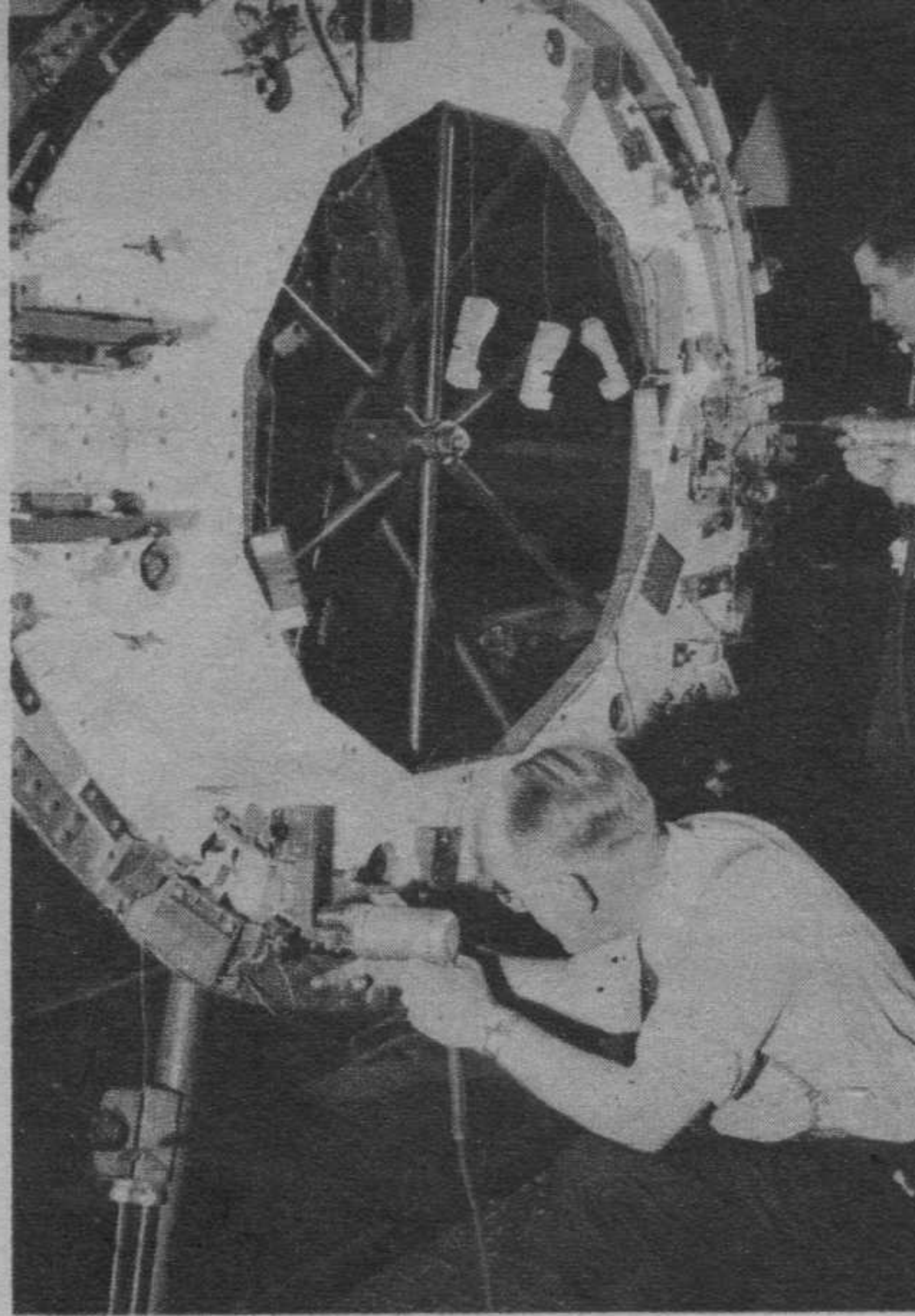


Finishing touches. A plaster mold gets final polish before being turned over to the sand molds to be made into a drop-hammer die.



Man from Mars? A melter pours hot metal to be transferred to small sand molds for drop-hammer dies.



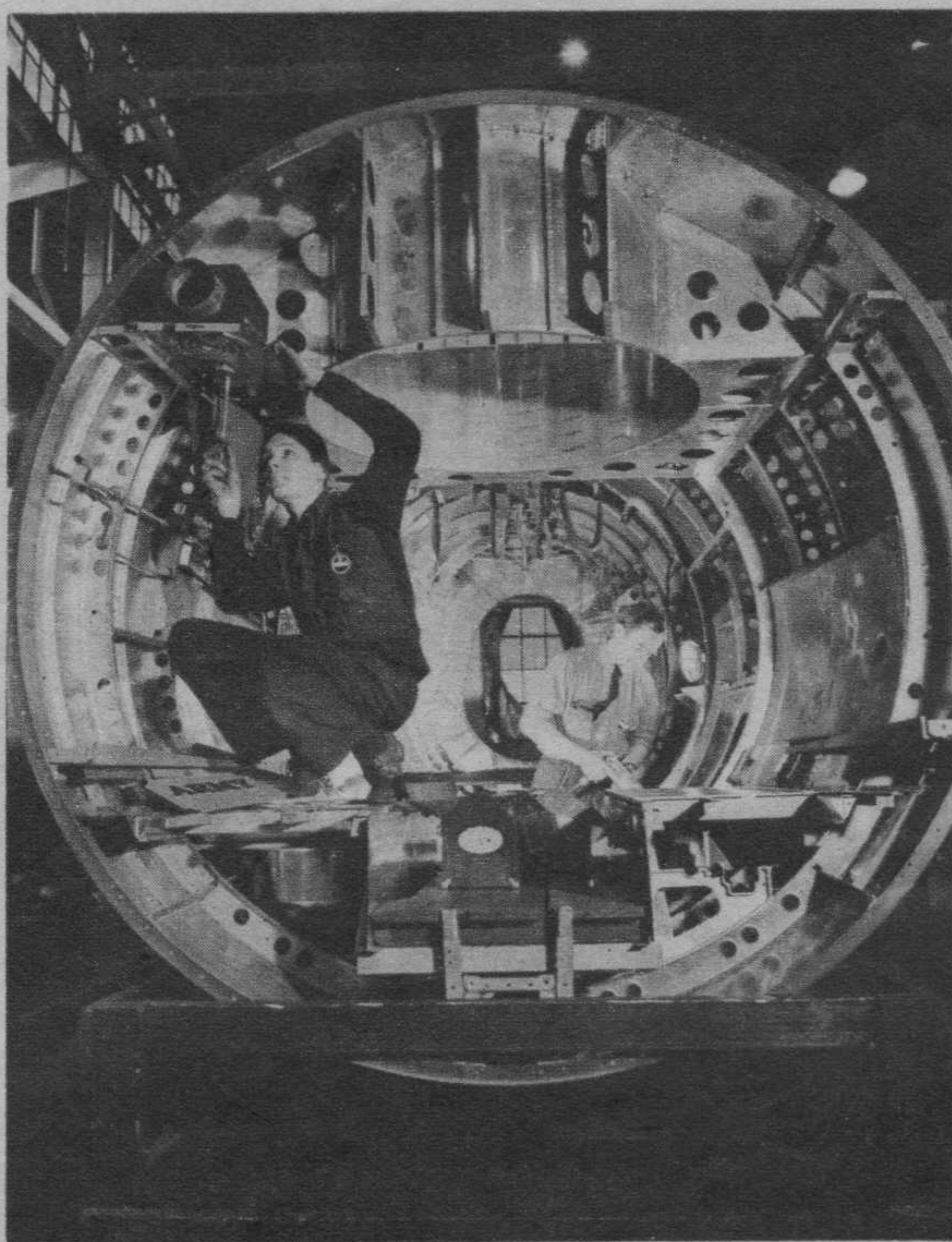
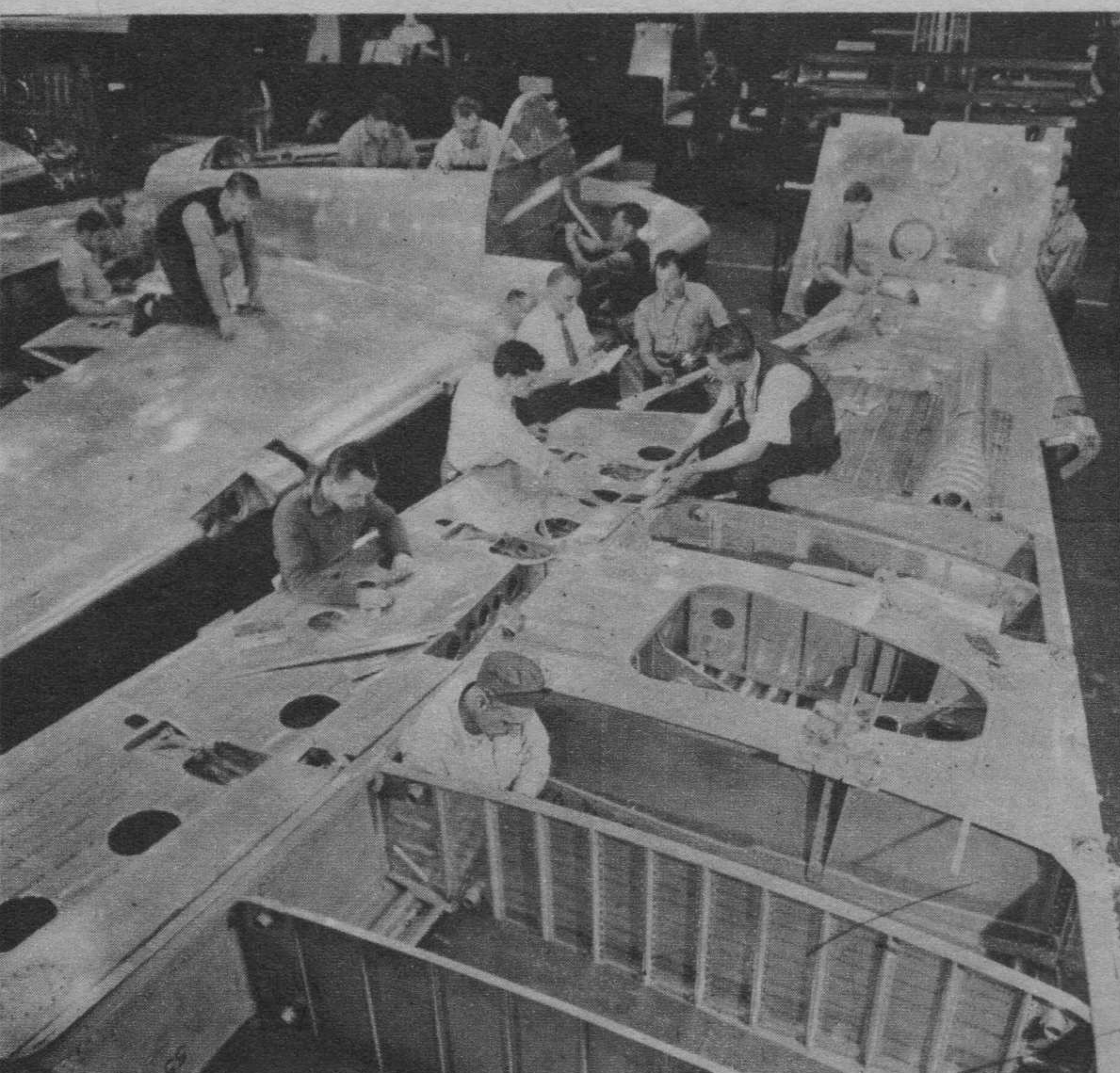


High shine. Zinc die destined for the drop hammer is ground to closer dimensions and polished for contour.

Skilled operator trims sheet metal part. Many manufacturers encourage special aviation training in local schools.

Wheel of fortune. Here a rib for B-26 is formed on a wheel fixture that permits men to work at any elevation.

Sub-assembly. Hundreds of such operations form 25,000 parts into sub-assemblies which ultimately come together as finished B-26.



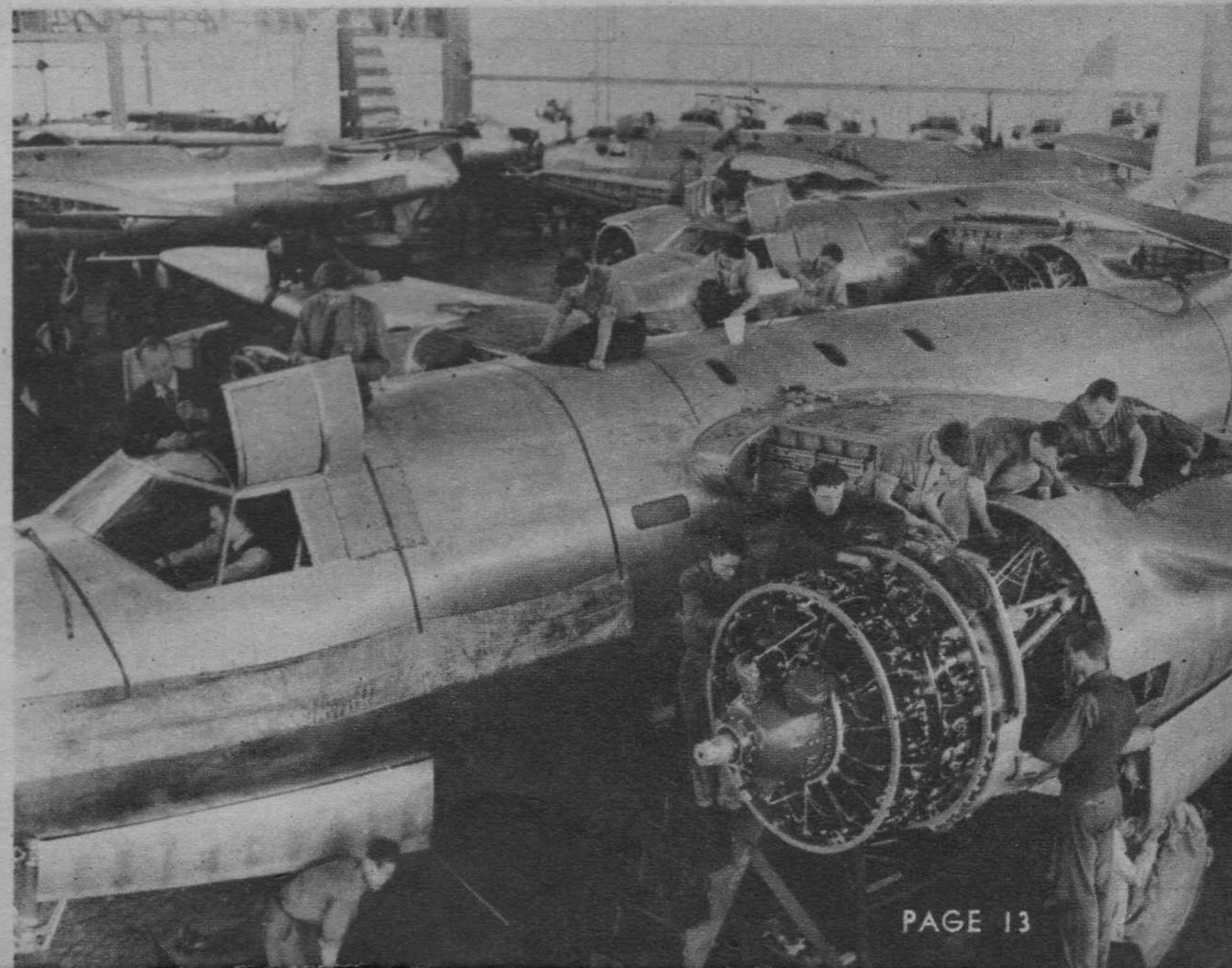
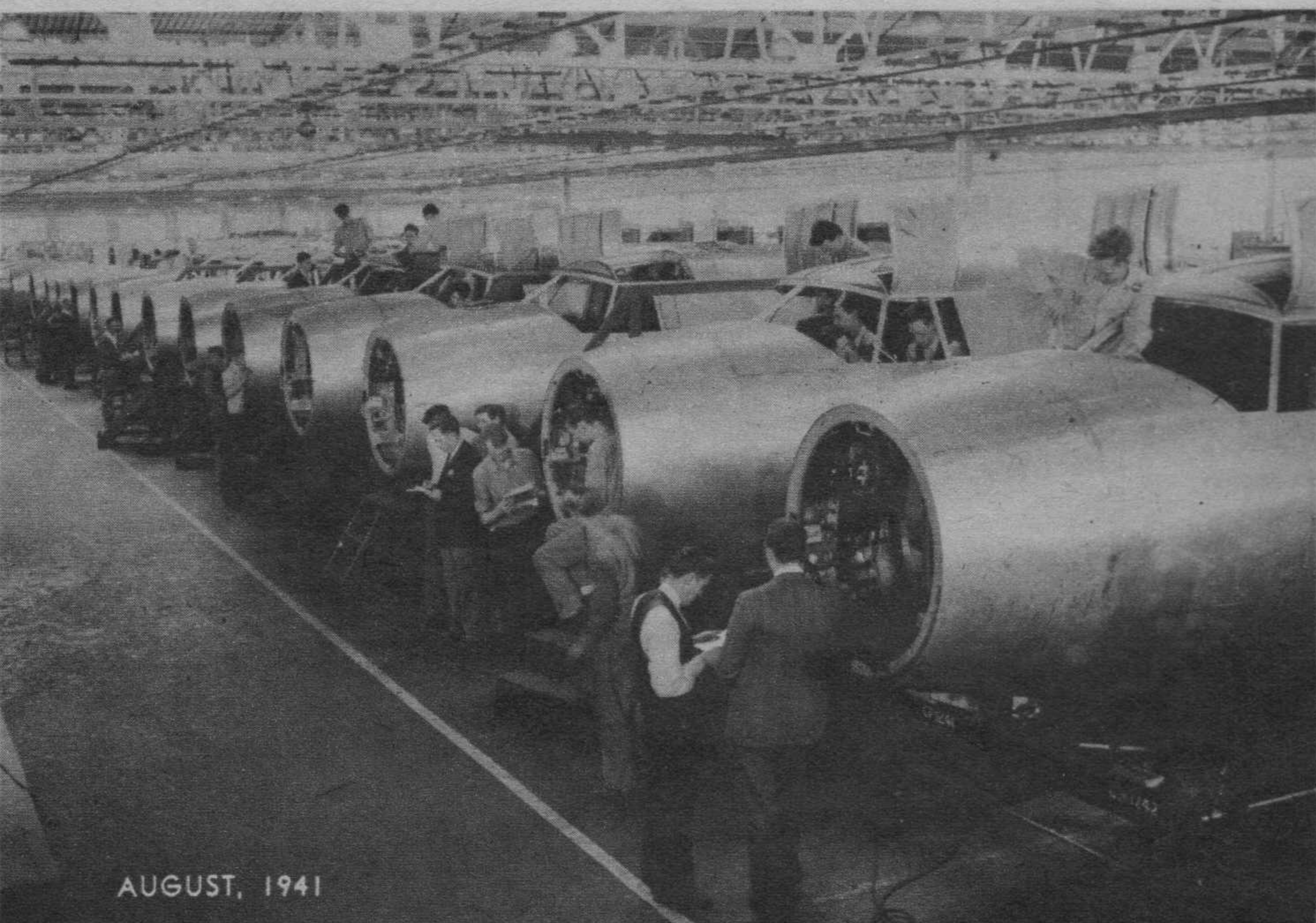
Pinions. Wings for the B-26 are assembled from many sub-assemblies and the smooth metal skin is fitted on. Installation of control wires, electric wires, "plumbing," and so forth, goes on from this point.

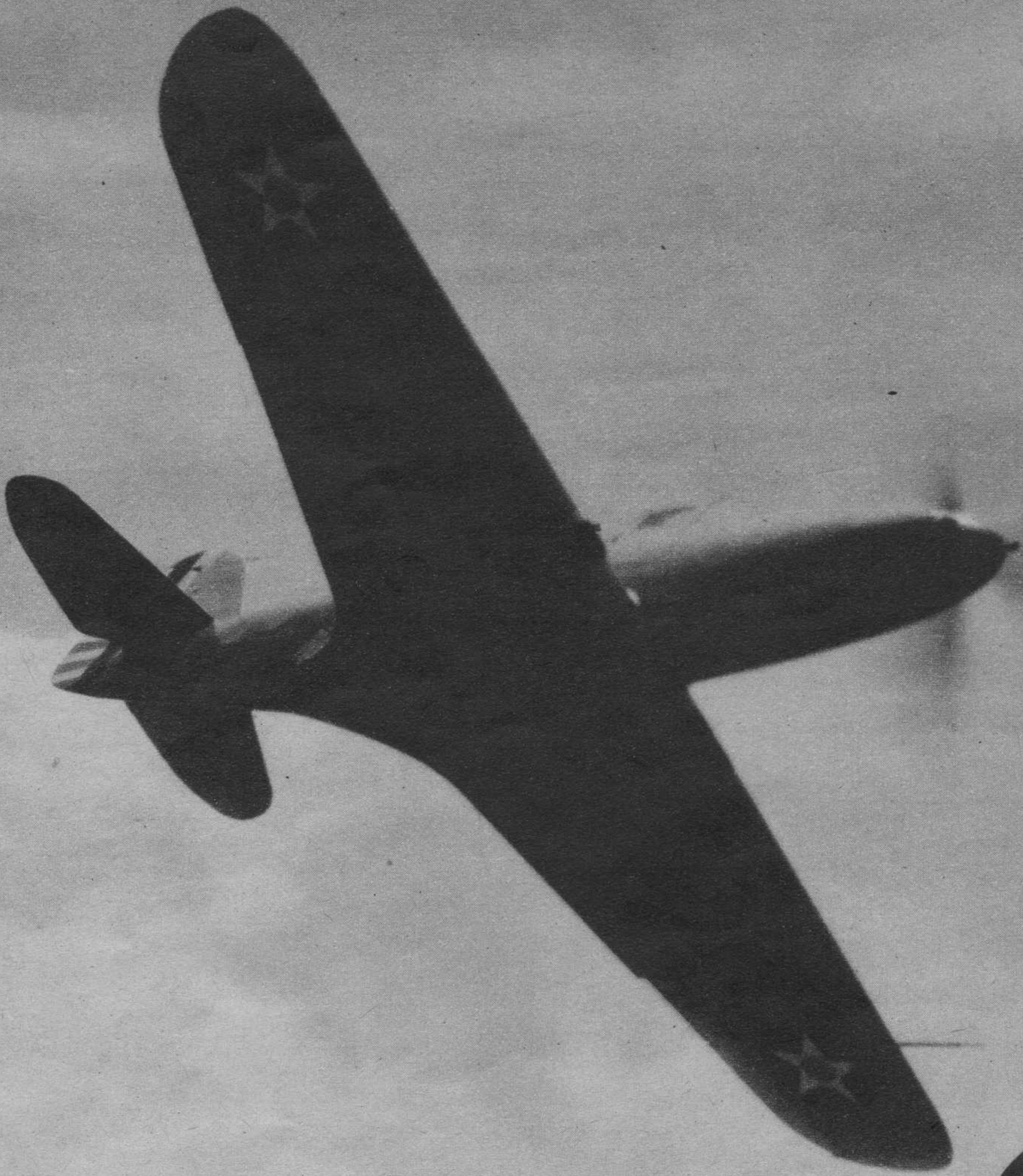
Gadgets. Miscellaneous equipment is fitted into the tail section of the B-26. Well in top foreground is for a power turret. Tail turret can be seen in the far rear.

Modern Jonah emerges from the metal maw of B-26 tail turret section being readied for its turn on assembly line.

Mass production. A line of B-26 noses moves toward final assembly. This gives some idea of quantity of bomber production. The trick in mass production of airplanes is to complete smaller assemblies as far as possible before bringing them together.

Swarm of workers put the finishing touches on a flock of B-26s on final assembly floor. Here are installed 2,000 h. p. Pratt & Whitney Double Wasp air-cooled engines. Martin B-26 was one of first American types bought off the drawing board.





SUPERCHARGED PILOTS

BY JOHN R. HOYT



Fighting face. The Mayo mask devised by Drs. Lovelace and Boothby of famous Mayo Clinic enables our fighters to work at five and six-mile altitudes.

High-altitude fighting is bringing about new technique, equipment and even diet. Today's war pilot must know how to handle himself in two places—up and 'way up.

FROM sea level to 30,000 feet is no slight jump. Yet a modern interceptor fighter takes a pilot up there at a mile-a-minute clip; that means an upward speed faster than any elevator, airplane or balloon can ascend, of such a rate that the blood commences to liberate nitrogen bubbles.

So great is the change in pressure at 25,000 feet that a glass of ordinary drinking water bubbles like soda water as the gases are freed. A similar change is taking place in the veins of the pilot, who begins to feel like a diver who has been brought to the surface too rapidly. As everyone knows, this is called the "bends," or caisson disease, and is extremely painful. But, unlike the diver, a pilot cannot be decompressed at 30,000 feet, and therefore suffers from two things—nitrogen in the blood stream and lack of air to breathe.

How little air is present at altitudes about 10,000 feet, or about two miles, is scarcely realized until one tries to move or exercise at high altitudes. In fact, the very lack of oxygen is so insidious that one doesn't realize that anoxia (oxygen starvation) is going on until it is too late to do anything about it. Of course, many of us have tried to climb at 8,000 feet and noticed how short of breath we were, but very few have sat in an air-

plane and climbed to altitudes of such height that insufficient oxygen was present to accommodate normal needs.

The lack of air at 25,000 feet is such that a candle cannot burn. The flame becomes so small that it is just a shadow, becoming extinguished at 26,000 feet. As a pilot climbs his fighter to such heights, he notices no lack of air, and absolutely no choking or smothering is felt. Most laymen believe that lack of air would cause one to die a horrible death, with all the symptoms of being choked into insensibility. Nothing could be further from the facts.

The first thing a pilot notices is a lightheadedness, a kind of incoherency. Things happen in a sort of daze, and there are endless moments between the inception of a thought and the act itself. The lack of oxygen is insidious because the pilot cannot tell that he is going to pass out! The fact is, that there is a diminishing amount of carbon dioxide present, and the lack of this gas tends to decrease automatic breathing. The pilot therefore breathes less rapidly, less deeply, and does this in spite of the fact that he should be breathing more rapidly, because there is less air to breathe.

To illustrate the point, read the following account of a

pilot who actually lost consciousness at 25,000 feet:

"We took off in formation. Pilot A led, he in his Grumman fighter and I in mine. Fastened to the top wing of each plane was a camera gun, loaded with a few feet of film. Each picture represented a shot, and each shot could be fired by squeezing the trigger on top of the stick, just as we fired the machine guns. Inside the camera was a tiny clock that was photographed when the picture was taken; this indicated which pilot fired first, and eliminated any argument about who shot down whom. The object was to do unto him as I would be done by, only to do it first.

"We climbed to 10,000 feet, where I started taking oxygen. We had only the old-fashioned pipes, that is, a tube leading to an oxygen tank. We held the mouthpiece or pipe between our teeth, which was not only very tiring, but very wasteful of oxygen. It has been proved that we consume only a small portion of the oxygen we inhale.

"I regulated the oxygen valve to give me a generous supply, as I knew I'd need it when I began the fight with Pilot A, who

before. He was boring up toward me, climbing at full throttle, trying to diminish the altitude between us. I knew that if he did so, I was licked.

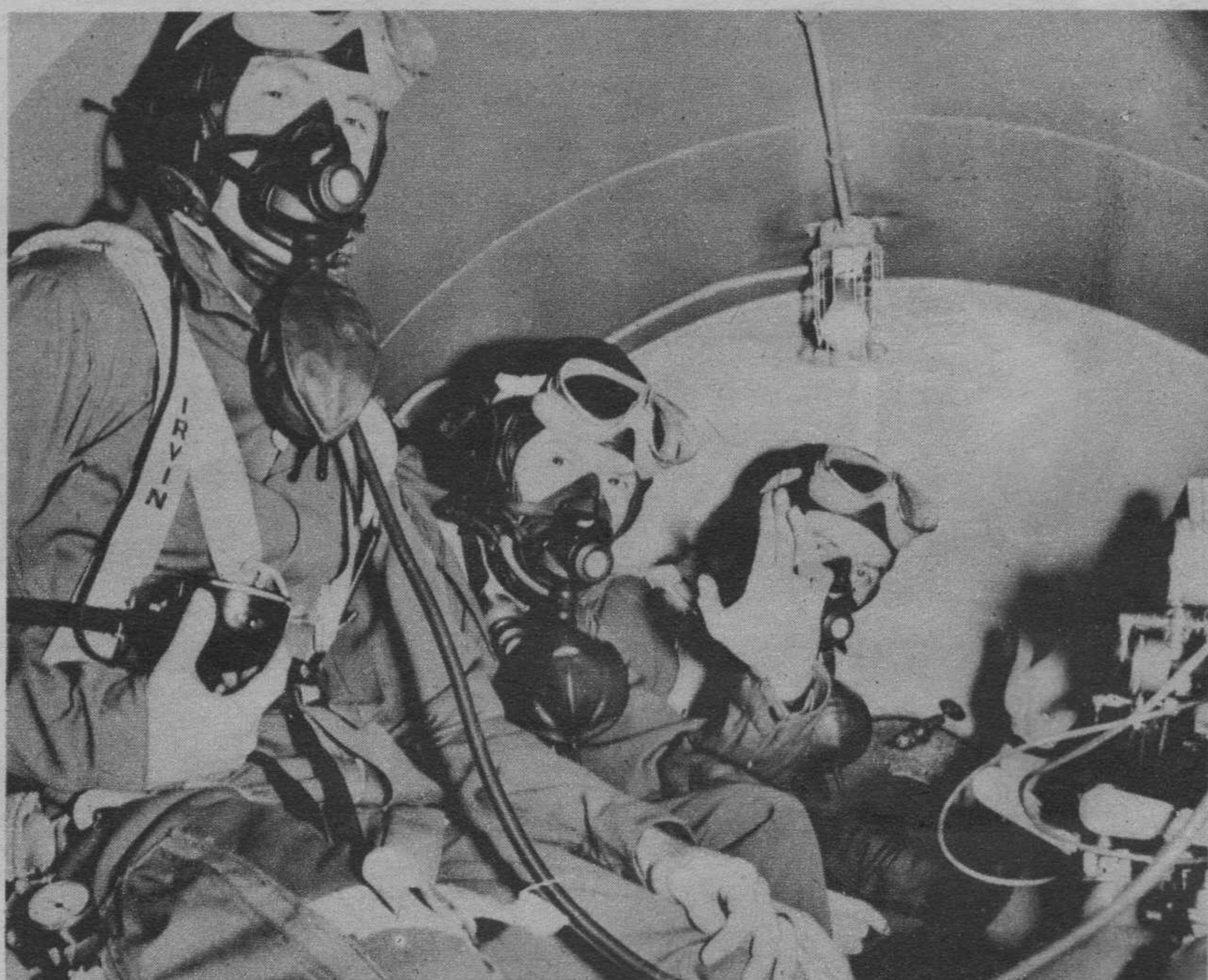
"An idea came to me that if I changed my pace, cut the engine, stalled and munched down on him, I would be able to overcome the disadvantage! I did so, closing the throttle slowly, then starting a turn. As every pilot knows, a plane turns more rapidly when it is slower, and therefore I was able to turn inside of Pilot A. At the same time I was flying so slowly that I lost altitude quickly, and the first thing A knew, I was directly behind him taking pictures of his plane from about fifty yards' distance. His plane loomed in my sights like a barn.

"I then picked up the microphone to speak, to tell him that it was his turn to fly above me. But in doing this I took the pipe from my mouth, and as I talked to Pilot A I must have dropped the pipe. I vaguely recollect making a mental note to finish my statement to A, and then to reach down for the pipe. I finished my remarks, or thought I did, and reached down for the pipe.

"It seemed a long way down there, and very dark. Then it



Test run. Before an actual strato-hop crews must exercise for thirty minutes breathing pure oxygen. This washes nitrogen away, preventing "bends."



With nitrogen removed from systems pilots in Boeing altitude chamber are "flown" to 35,000 ft. Complete flying equipment is used in tests to simulate real flight.

was supposed to have a very good reputation as a dogfighter. We passed 15,000 feet, and I felt normal. At 18,000 feet, I adjusted my controls and checked all the pressures. The engine was operating beautifully, and everything seemed in order. The air was cold, but not too penetrating. Pilot A led well, and the sun glinted on the yellow top wing with its black chevron and squadron marking. The two red, white and blue stars on each tip, the yellow tail, the black nose cowling were some of the last points I remembered.

"At 22,000 feet Pilot A signaled to break up. I nodded and turned to the right. He kept on going, while I climbed to 23,000 feet, at which altitude I would fly over him and begin our mock engagement. Being the higher plane I was supposed to have an advantage, although Pilot A had defeated several other pilots the day before who had flown from higher altitudes.

"At 23,000 feet I turned back. The oxygen regulator was giving me ample oxygen, the engine turning up full power, and camera gun ready. I looked down, picking up Pilot A directly under me. I wiggled my wings to signify I was ready, pressed the trigger to take a photograph of the clock and register the time our engagement started. Then I dipped my wings and rolled down at Pilot A.

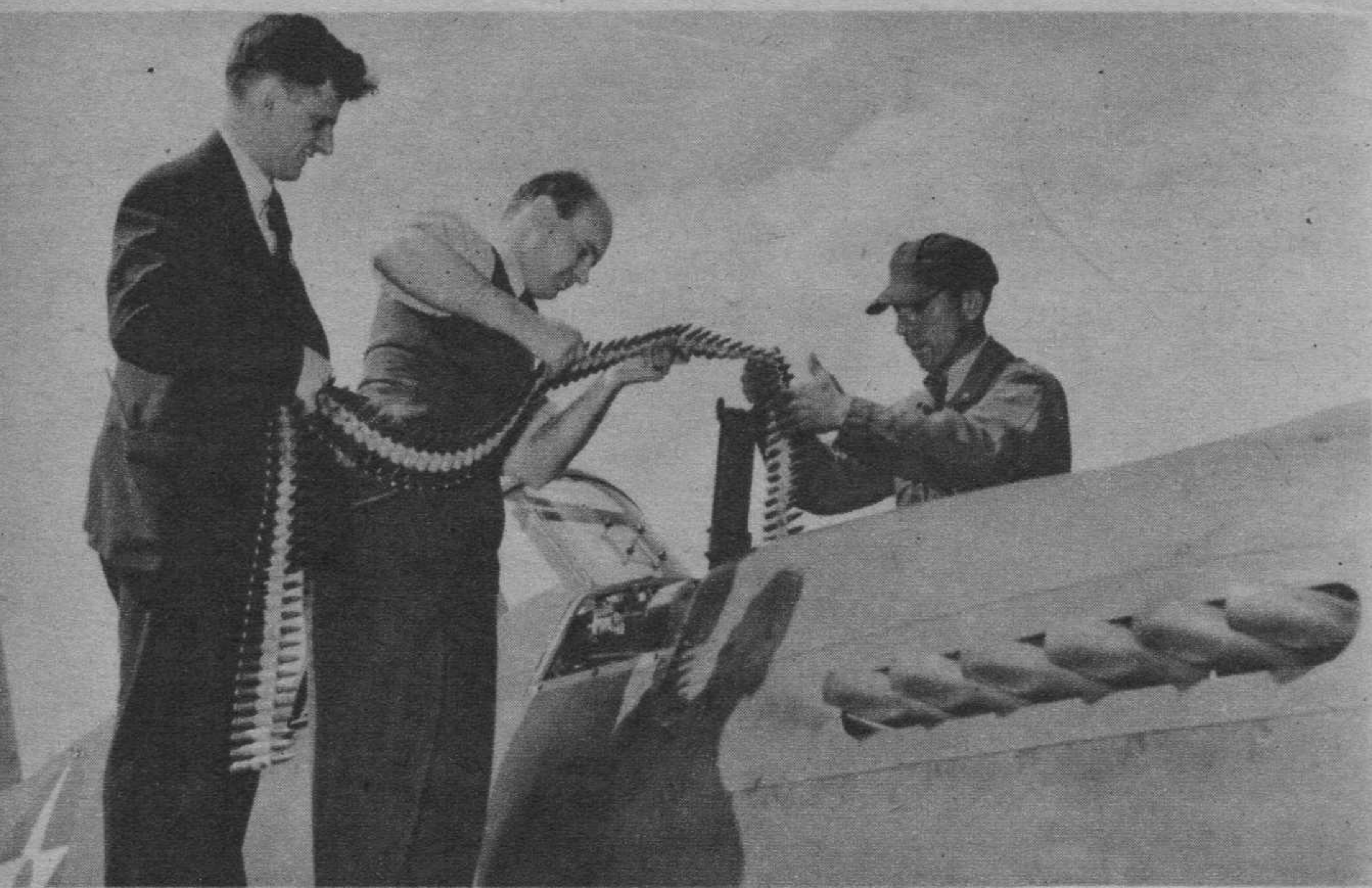
"Like the canny dogfighter he was, A turned and circled against me. That constituted a 'scissors' movement and ended with me directly above him and in the same relative position as

seemed as though I was being pressed down hard in my seat, and my head weighed a ton. After a minute I could lift it, and did so. Everything was very hazy, and the motor was turning up 3,000 revolutions per minute. The altimeter read 10,000 feet, and there was smoke coming from the engine. The air speed was dropping off from 300 knots, and through my befogged mind came the realization that I had dived off *three miles of altitude*.

"The radio was full of voices. I concentrated real hard, and finally knew it to be Pilot A, calling me frantically. I answered something, which he later told me was this: 'Doan feelsa hot . . . gonnalandnow . . . berrrgrrump O. K.!' That was how intelligently I was thinking. On the way back things cleared up a little. I found the field, circled it, and was about to land when a voice repeated over and over, 'Wheels down . . . wheels down . . . wheels down—' Dully I seemed to sense that something was not all right, so I gave the gun to her and went around. Halfway around I realized that my wheels were still up, so I lowered them after five minutes of effort. I took five minutes to do what ordinarily takes ten seconds.

"I landed normally, taxied to the line and stumbled out. The \$10,000 engine was a wreck, but the plane O. K. I took the rest of the day off, although things got back to normal within twenty-four hours."

The whole point to the narrative is this—one (*Turn to page 33*)



Loading up. Gun tests are a regular part of Wright Field routine. These experts are loading fifty-caliber guns in Curtiss P-40 for fire test.



Fire! With tail lashed down in flying position, experts and observers gathered about, even lying on wing, P-40 cuts loose with all guns at once. Target in sandpit beyond.

THE real test of air power is using it. You can't measure a nation's strength in the air by its capacity for production. You've got to "get 'em into the blue." Good ones, the best that man and machine and science can produce. Planes that fly high and fast and far. Ships that can take it. This is the task facing Uncle Sam today. Our airplanes are being built to last. American pilots shouldn't fly in anything but the finest and safest aircraft that money can buy. This is the way of a democracy that places life and the chance to live and enjoy it as an individual above all else.

The job is far from being an easy one. Planes are material

At Wright Field the army is packing a year's worth of test flying into 150 dynamic hours. Hear those engines roar!

BY DOUGLAS INGELLS

SERVICE TEST — *Rush!*

things built from thousands of parts; put together from a plan. Like boats or automobiles, some of them are good, some not so good. They need the "bugs" taken out of them. And the big problem is to decide which ones are best. It must be done quickly. Labor, raw materials, facilities, machines, money—these things are plentiful here. But time is more precious than gold because bombers, pursuits, fighters are needed now.

At Patterson Field in Dayton, Ohio, only a few miles from the location of the bicycle shop where the Wright brothers built the first airplane, the army is evaluating its new warplanes. That roar you hear in the sky is the noise of wings under test.

The latest pursuit planes, and bombers, Lockheed's twin-engined interceptor, the P-38; Lawrence Bell's Airacobra, the P-39; Republic's 2,000-horsepower Thunderbolt, the XP-47B; Curtiss' YP-42 with the air-cooled twin-row Wasp experimental engine; the North American B-25, Consolidated four-engined B-24 with the Davis Airfoil; Boeing's latest B-17D Flying Fortress; the Douglas A-20A and Glenn Martin's fast, heavily armed and armored B-26—all of them are undergoing a rigid, exacting and accelerated test program by Uncle Sam's flight test experts. Special crews from various tactical squadrons—pursuit pilots, bomber pilots, bombardiers, machine gunners, and mechanics—have been brought to the field to fly the ships through 150-hour test trials. Night and day the motors roar.

The army has been forced to cram engineering, design and experimental development into a much shorter period than ever before. As soon as the first three types of a new plane are delivered three crews are assigned to the ship for accelerated service testing. They keep it in the air constantly for 150 hours, day and night. This is to take the place of the former service

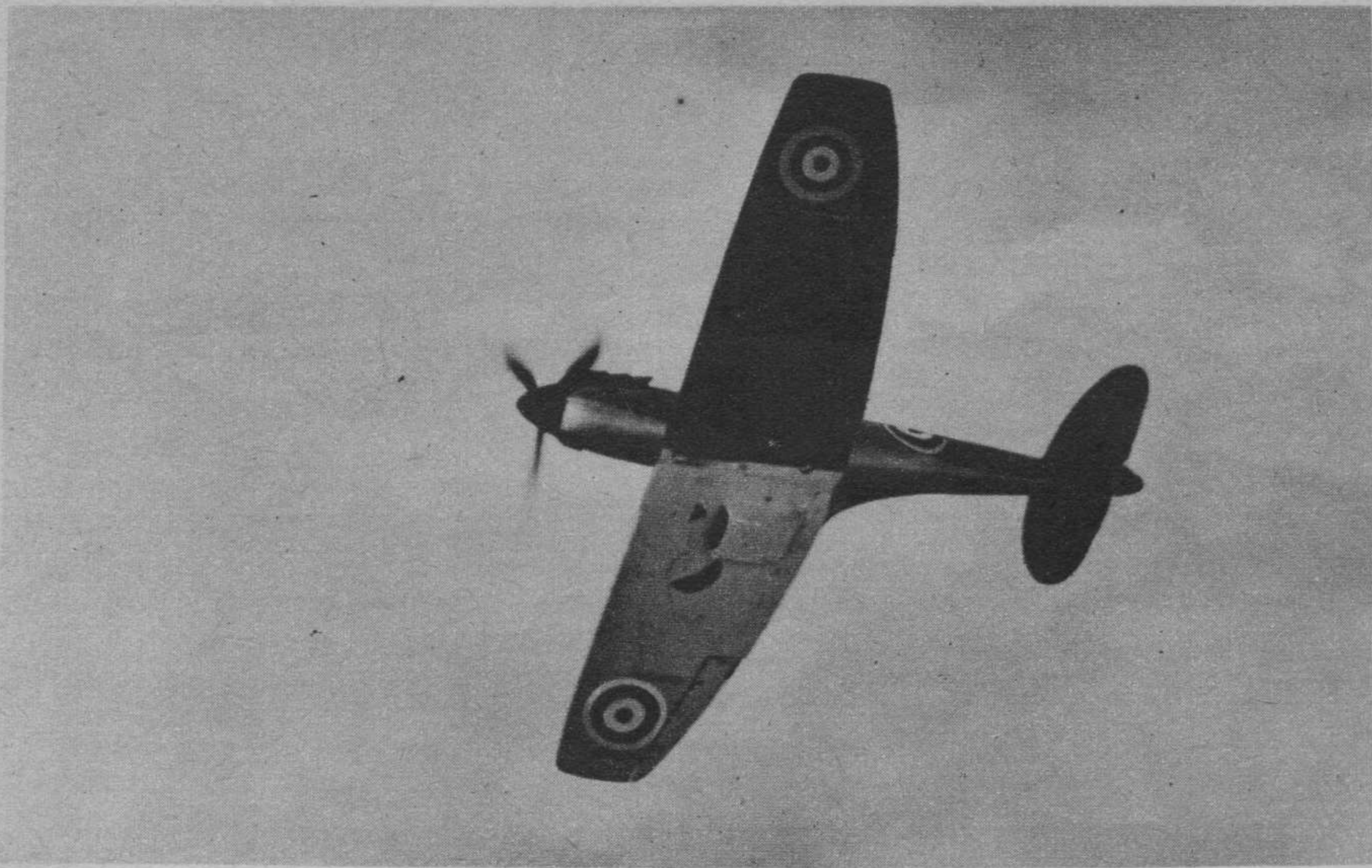
test period of one year. Now it takes three weeks or less. In addition, the airplane manufacturer, the engine builders, the propeller and accessory people are represented at the proving ground to see if anything goes wrong with their respective units. If the slightest trouble occurs, they get in touch with their factory engineers by telephone and it is soon ironed out.

According to Brigadier General George C. Kenney, assistant chief of the air corps materiel division at Wright Field that has jurisdiction over the testing of all new equipment, the two or three-year experimental stage needed to develop a new airplane from blueprint to getting it into the air has been slashed to eighteen months. "I know of one plane, the Martin B-26 bomber," Kenney says, "that was on the back of an envelope less than a year and a half ago. Army engineers took one look at the blueprints and told the manufacturer to go ahead as fast as possible with mass production."

This is an example of how rapidly the U. S. aircraft manufacturers are "getting into the stride" for turning out airplanes by the thousands. Kenney predicts that by early spring of 1942 America's goal of 50,000 planes a year will be surpassed. In order to do this it is necessary to speed up the testing of new models; hence the accelerated tests at Patterson Field.

Planes are outmoded quicker than automobiles, because there are so many factors about them we don't know until they are brought out in actual tests. For instance, added strength means added weight; more weight means less lift which in turn means limited altitudes. On the other hand, if you cut down on weight you lose strength; lose strength and you lose combat effectiveness, lose this and you stand to lose both plane and pilot. It is a case of six of one and half a dozen of another—a continuous





New British Spitfire III is a result of improvements learned from combat use of earlier models. Note square wing tips. American tests speed up improvements.



Step on it, boys, here's the boss! Major Stanley M. Umstead, Uncle Sam's chief test pilot, emerges from a Flying Fortress after a check flight. He directs all tests.

cycle of problems that create other problems that make the airplane an intricate, delicate piece of machinery.

There are three types of airplanes in use by the air corps: standard service airplanes, those in actual use by the various tactical organizations, in wings, groups and squadrons throughout the United States; service test airplanes of somewhat improved designs, and finally experimental airplanes of still better performance than the service test equipment. The latter group are the planes that "get the works" at Patterson Field.

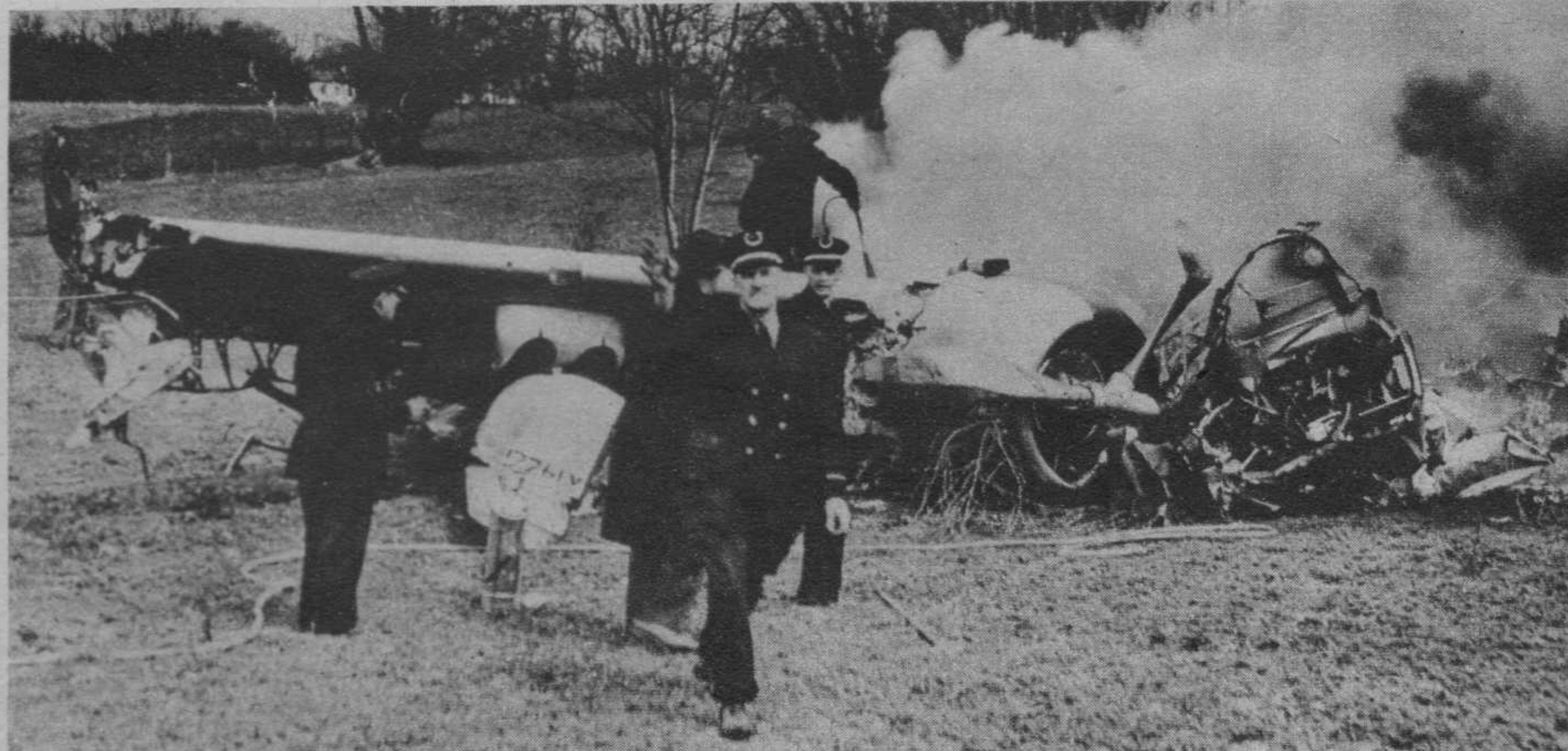
Pursuit ships get different treatment from bombers. The big ships are treated more gentle, because pursuit planes cost from \$35,000 to \$76,000 apiece; bombers from \$257,000 to \$2,000,000. Pilots take the pursuits and interceptors, race them across the field and literally "yank" them upward to altitudes of ten, twenty, thirty and even forty thousand feet. Straight up they climb at 5,000 feet a minute. Up to the sky where the air is thin and scarce, where it's cold and clear and the universe lies at your feet. Here, in this vast arena of space, Uncle Sam's test pilots learn the real worth of America's new warplanes.

Banks, snap rolls, dives, Immelmans, spins, every conceivable maneuver is tried at terrific speeds. Engines whine and propellers scream. The sky is rent with the staccato blasts of horsepower on the loose. Can they take it? Will the wings shear off at 600 m. p. h. straight down? How high, how fast and for how long will they fly? How much fuel does the engine burn? What about prop manipulation and adjustment at high altitudes? Maneuverability? Egress—can the pilot get out if something goes wrong? The army wants facts for the answers and only by actual flying, hard grinding hours of it, can the results be satisfactorily obtained.

Each test produces definite results. For instance, the army learned that pilots flying in the fast pursuits like the P-38, Airacobra, or the P-40, when they banked the ships at high speeds suffered momentarily a blackout. That is, for about thirty seconds the pilot couldn't see because blood rushed to his head and blotted out his vision. He could feel and move and co-ordinate his muscles on the controls, but actually he was blind. (This happens to pilots who fly the fast ships in the European skies, and apparently it can't be licked.) But accelerated tests at Patterson Field produced a new idea.

Think what it would mean if that thirty-second blackout period could be eliminated. In that half minute six guns could pour out 500 rounds of ammunition each into an enemy. Such an advantage would be decisive in aerial combat. Study of reports turned in by pilots who had tested the planes under combat conditions caused army men to ponder the problem. Finally someone suggested that the rudder controls on the fast ships be placed in the roof of the cockpit so that the pilot's legs were propped up over his head, letting a gradual amount of blood rush there and prepare him for the quick blood burst of the rapid bank or turn. It was tried and it worked. The pilot became woozy for seconds, but he kept his vision. There was no complete blackout.

(Turn to page 18)



Hey, no pictures! This half-million-dollar experimental bomber DIDN'T make the grade, although five-man crew escaped. Crashes like this save lives later.

(Continued from previous page)

But there was a catch to it. Experts in the aëro medical research laboratory at Wright Field who study human reaction to flight shook their heads dubiously. "It won't work," they said. "The human body can stand only so much. Let the pilot fly in this position more than several hours a month and you'll kill him—his blood cells will turn to water." That is only one of the hundreds of disappointments Uncle Sam runs into when he puts his war birds to test. It is for this reason that millions of dollars are spent each year in an effort to produce the best airplanes possible.

Structural strength is another factor. Airplanes have to be built strong. Pilots take the small fighter ships upstairs and dive them at terrific speeds to see if the wings pull off. Experts on the ground in static test laboratories have set the dive ratio—speed at which an airplane can be dived safely—from compounded figures relative to weight, strength and stress, et cetera. But sometimes they are wrong. Planes don't fly on paper. So test pilots dive them and pull them out and see if they remain whole. Oftentimes they don't; a wing snaps, an engine tears loose, an elevator or aileron develops flutter. Anything can happen, and when it does pilots hit the 'chute. The farmers and civilians in the rich Miami Valley near Uncle Sam's testing center think it nothing unusual to see parachutists in the sky.

When crashes occur, the army has a special crash investigation board that carefully scrutinizes the twisted remains of what was once a P-40, an Airacobra or a new bomber. The experts will tell you that some of the most ingenious devices now on the modern warplanes have been the outgrowth of serious crashes. Somewhere in the wreckage a piece of metal shows signs of having been melted by overheated wires; certain rivets show they couldn't take it, a motor-coolant radiator "gets in the way." Any one of a thousand little things produces changes in design so that it might never happen again. Pilots who are alive today owe their safety to pilots who died another day.

Probably more than any other location in the country, Dayton has its share of plane crashes. They are not normal crashes because airplanes aren't treated normally. They are dived to find the limit of their diving endurance, flown fast to find their maximum speed, turned, yanked, twisted, climbed in a grueling test program. Engineers put water in gasoline to see what happens. They dilute oils. They fly ships until the fuel runs out, then see if the reserve supply cuts in the way it should. In-line motors are tried out in ships designed for air-cooled motors; radials are tried out in planes built for in-line motors. That is the reason for experimental airplanes.

The findings of a crash board are interesting. The reports are confidential, sometimes they get out, however. For instance, in the case

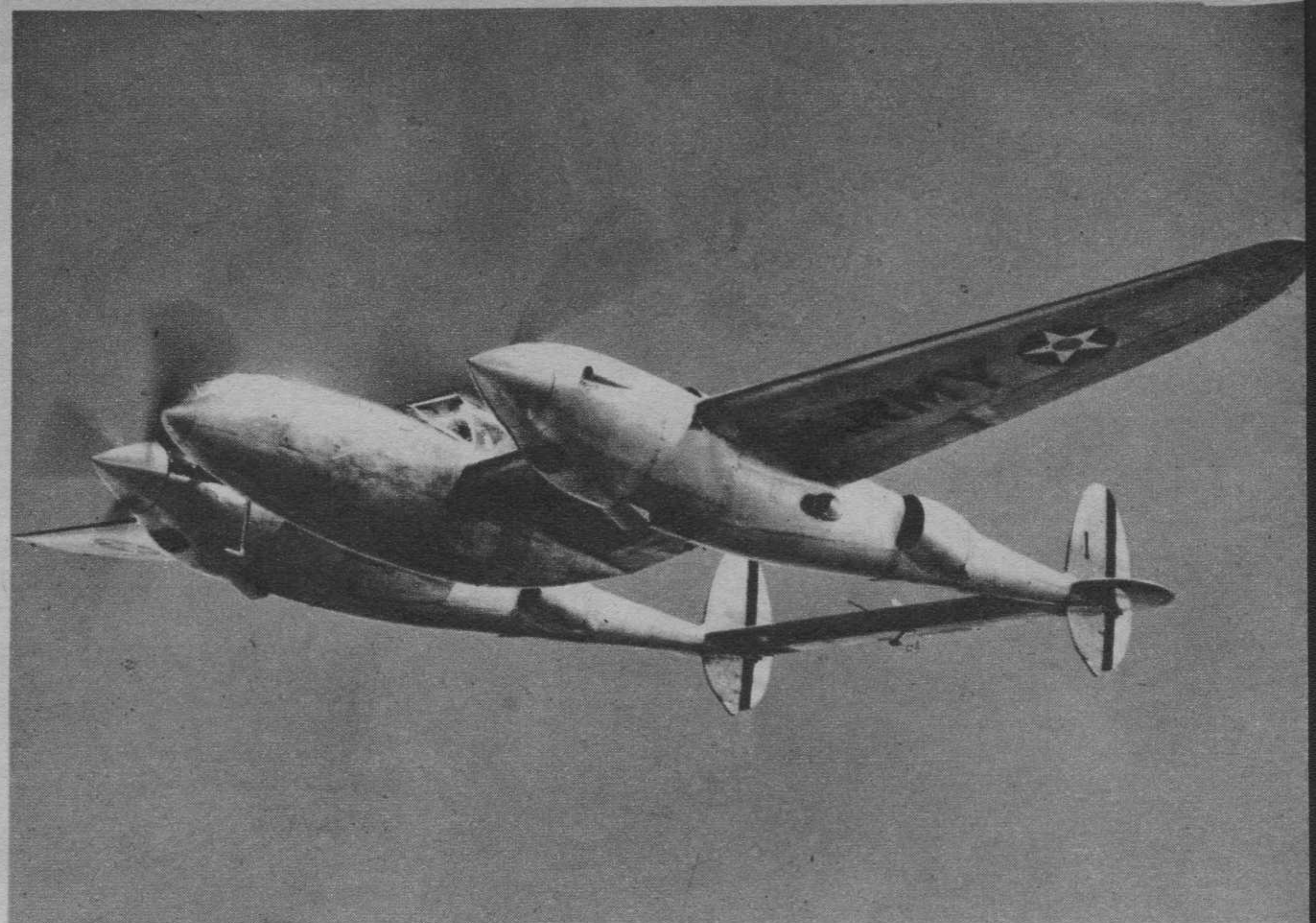
of a P-40 crash, the ship was overdived. Tests were being run to see if the canopy that covers the pilot would work when automatically controlled by a new device in a dive. From scattered pieces of wreckage test board engineers learned that the ship had disintegrated in the air. Windstream at 470 m. p. h. had torn loose the canopy, shot it back striking the elevator, ripped off the elevator and jerked the ship into a quick snap roll that tore off the wings. A test pilot was killed, his 'chute failing to open. Another pilot has already tested a new improved device, and it works, because the experts knew what what was wrong, and how to correct it.

With big bombers, it's different. You can't whip bombers around the sky like the small fighters. They are cumbersome things even at 350 m. p. h. Pilots take them aloft and see how far and how high they can fly. Altitude and range are the principal things. The army has its eye on stratosphere bombing. Big Flying Fortresses are flying at altitudes up to 40,000 feet at the test field. It took a long time to get them up that high. But the new ships are doing it. They have been streamlined, blisters cut from their sides and replaced by slide panels, nose turrets eliminated and smoothed down so there is no projection. To really get proper testing the bombers carry full loads. Real machine guns with real bullets. Pilot, copilot, radio operator, mechanic or crew chief, two, three and four gunners, and bombardiers. Weight equivalent to a bomb load is carried.

Endurance testing is the hard routine. The big bombers take off with full fuel load and stay in the air, flying over a triangle course that takes them from Dayton to El Paso to Indianapolis to Dayton, a total of 3,200 miles. The entire flight is made at altitudes above 15,000 feet. Pilots wear oxygen masks. They can eat only certain foods because their digestive organs don't function the same at the higher altitudes. They smoke cigarettes, but the smoke tastes bad. Sleeping is uncomfortable. Talking is hard on lips, already parched from sucking on wooden oxygen stems. But most of all, just sitting, hour after hour—and they will tell you the time drags—is the hard part about it. But pilots, like the airplanes they fly, must be able to take it.

How about armor and armament? The planes that are being flown and tested at Patterson Field are the very latest, with six machine guns on the pursuits, as many as eight on some of the bombers, and revolving turrets, bulletproof tanks—all the devices that have been the outgrowth of the war abroad. Take the P-39. It packs more fire power and more armor plating than any ship in the skies, according to the test pilots who fly it. A 37-mm. cannon fires through the propeller hub, and surrounding the cannon, all in the nose of the ship, are four heavy-caliber guns.

(Turn to page 33)



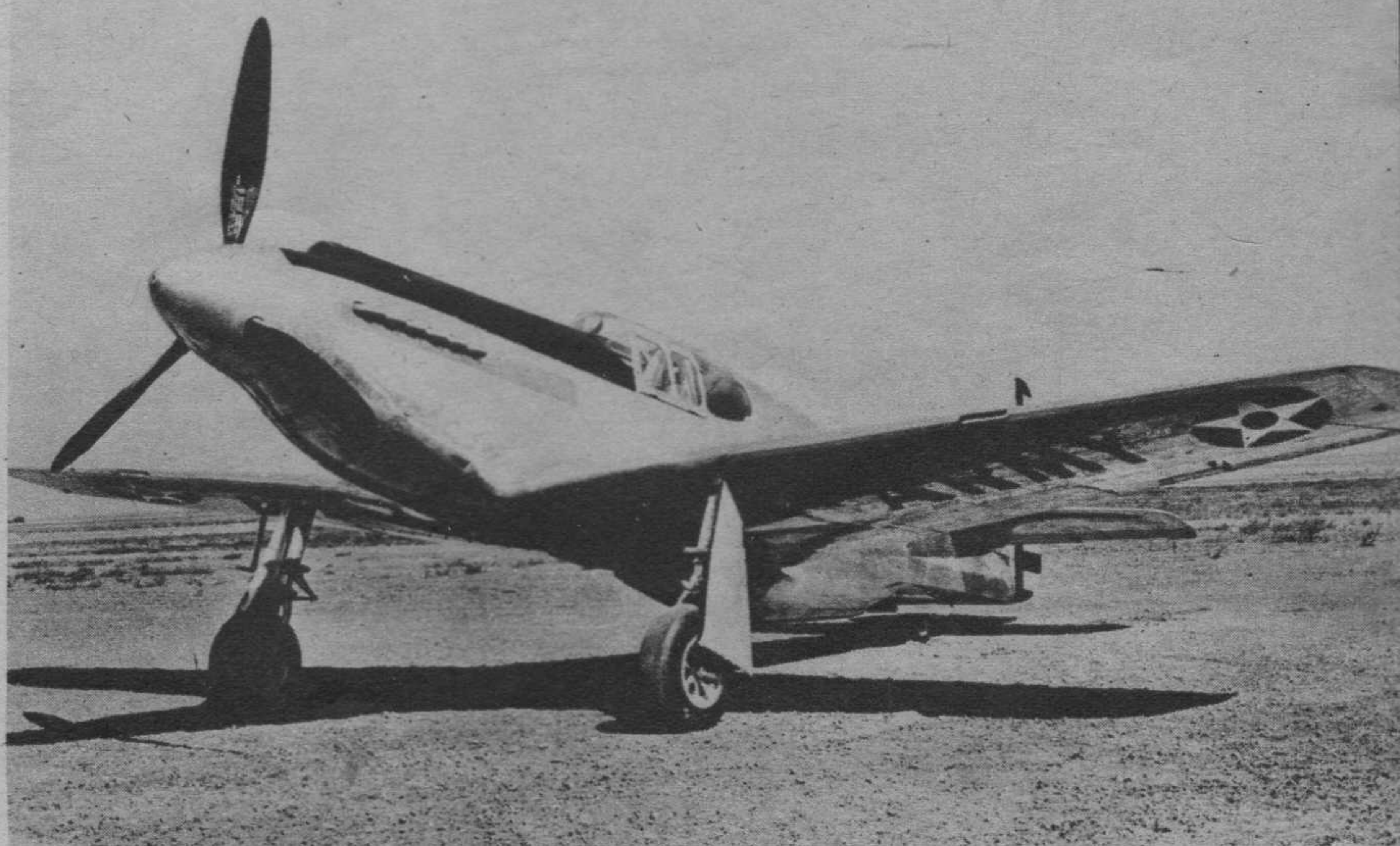
Our fastest production job, the Lockheed P-38, powered with liquid-cooled Allison engines has machine guns and cannon in center nose. Speed is over 400 m. p. h.

SEEN AT WRIGHT FIELD

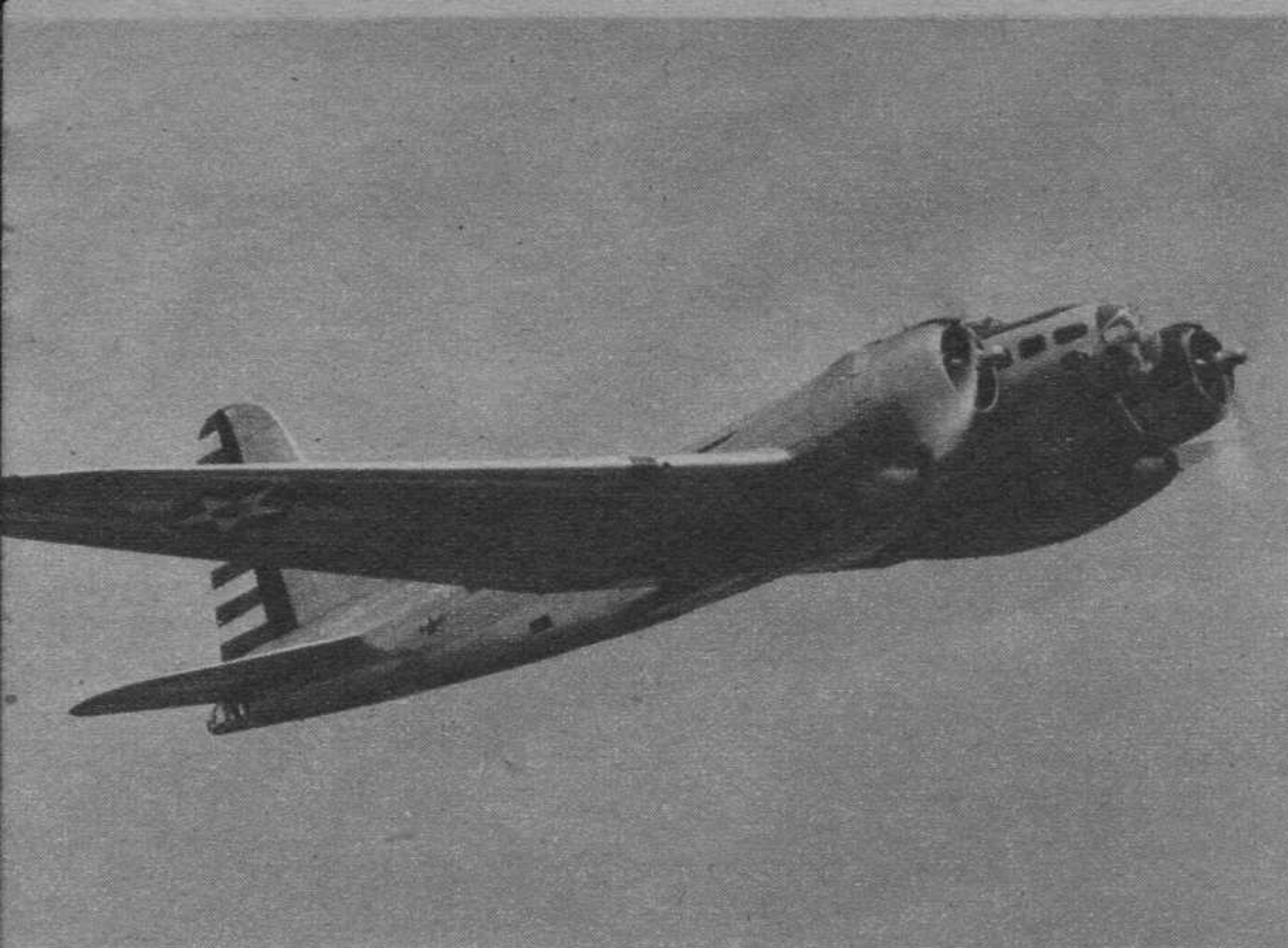
Some of our newest ships being tested at Wright Field as seen by our photographer during a recent visit.



Army goes air-cooled. First 2,000 h. p. single-engined fighter is the XP-47B by Republic. Heavily armed and armored, it is said to have service ceiling of 8 miles.



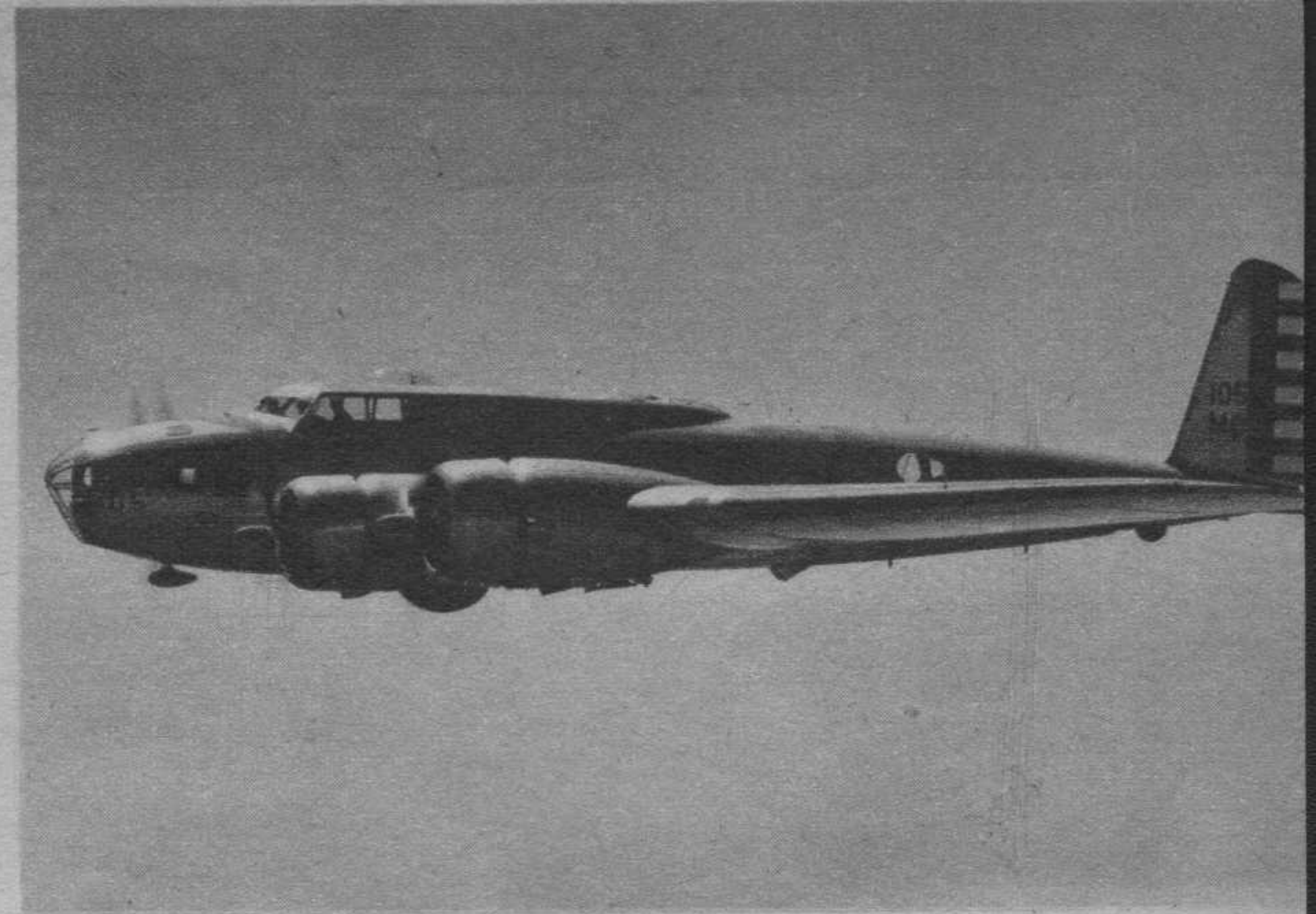
Indian fighter up-to-date. The North American XP-51 "Apache" being tested by the army is also Allison-powered and will be heavily armed. Note belly radiator.



Twin-engine medium bomber by Douglas. B-23 with tail turret is an improved version of the Douglas B-18A.



Twin-engine fighter. Douglas A-20A has speed of 325 m. p. h. Nose guns fire forward from streamlined coverings.



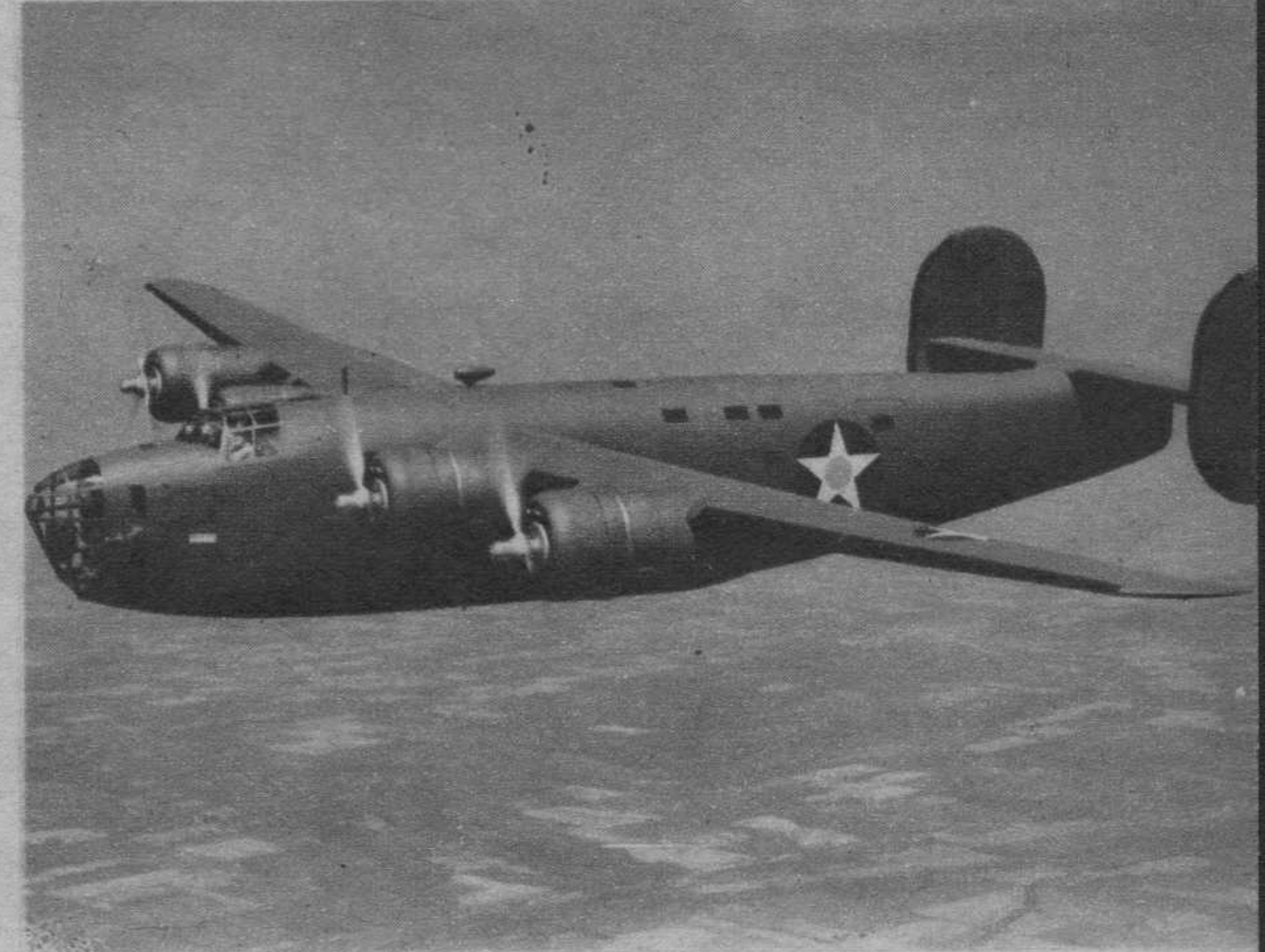
The Boeing B-17C heavy bomber, equipped with leak-proof tanks and armor, has new flat blisters on sides.



New basic trainer. Fleetwings XBT-12 has top speed of 195 m. p. h. Spot-welded steel fuselage gives strength.



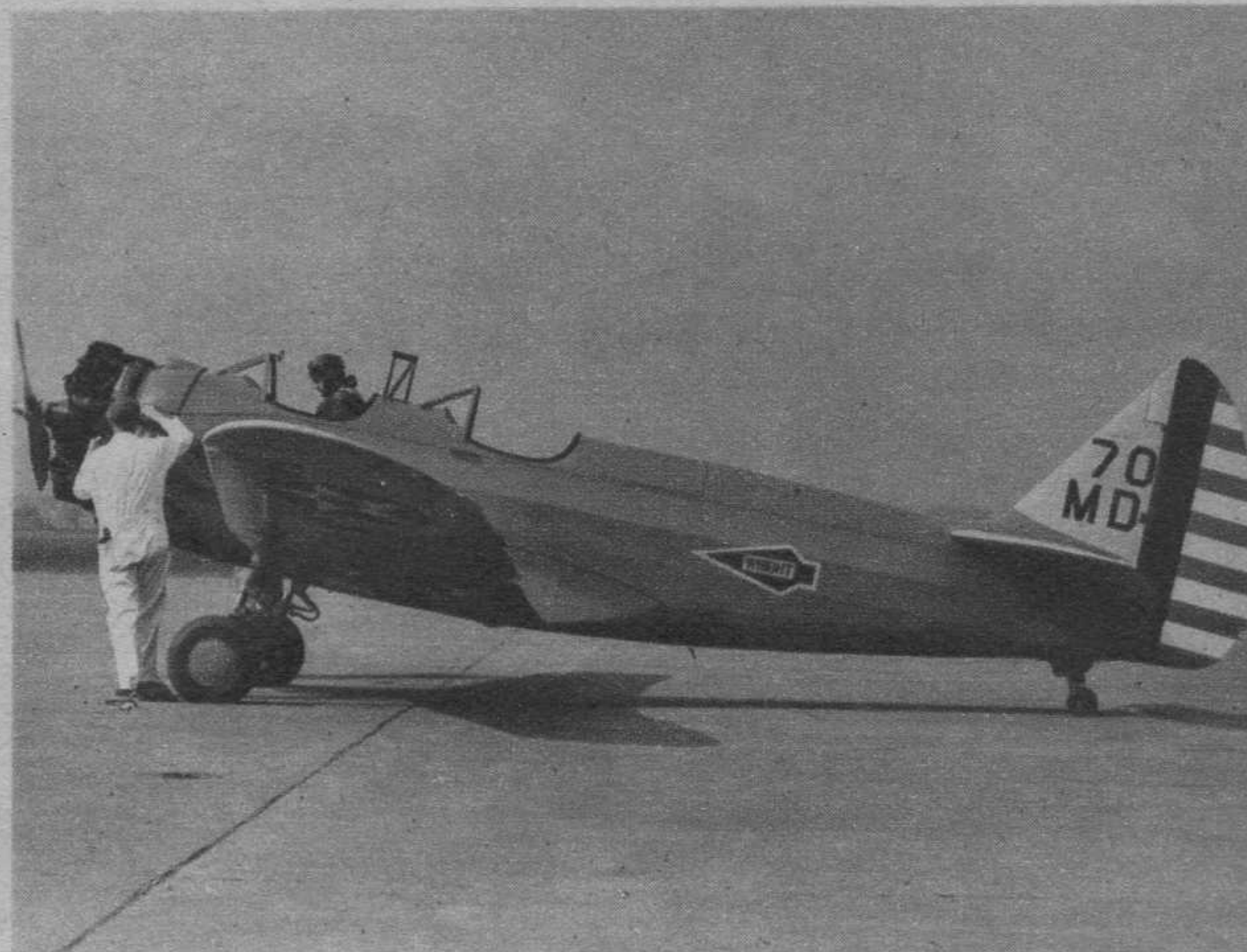
Twin-engine bomber. The North American B-25 has a speed of well over 300 m. p. h. Note the tail turret gun.



Army gets B-24s. Under the name Liberator, England has received many Consolidateds. Has tail turret.



For officers' use. This Beechcraft AT-7 will be used for light transport work and training of aerial navigation.



Tough trainer is the Fairchild XPT-23. This primary trainer also bears the materiel division insignia, MD, on tail.



Still used here and abroad. This P-36A by Curtiss has speed of 323 m. p. h. and 1,000 mile cruising range.



Giant killer. The Bell P-39 with Allison in rear of pilot has a shell gun in nose, as well as many machine guns.



Flying sunroom. This Vultee BT-13 trainer has fully inclosed cockpits. Full radio equipment is used in training cadets.



Designed for observing. The famous North American O-47A is kept up-to-date. Speed is 243 m. p. h.

GUNS WIN BATTLES

BY TRACY
RICHARDSON



To the gunner protecting the tail goes the responsibility of coping with surprise attacks.

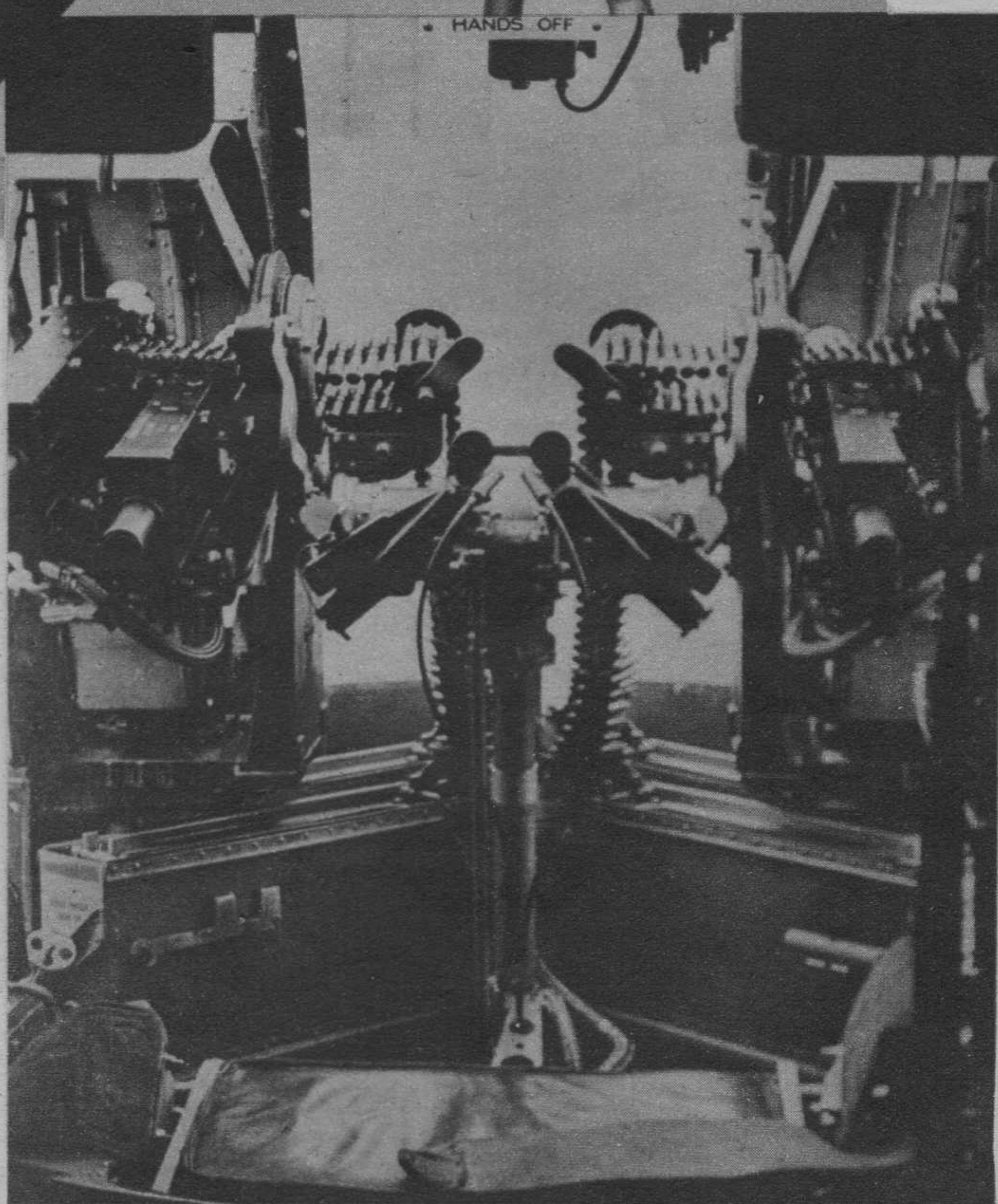
First of all the air marksman must know his equipment. A veteran instructor introduces you.

ARIFLE is only as deadly as the marksmanship of its user. A modern combat plane without a marksman pilot is but an expertly flown target for its adversary.

In the aerial combats of World War I when guns mounted upon fighting planes were effective mainly at close range, and numbered not more than several to a plane, the outcome of each contact with the enemy depended largely upon piloting skill. Guns jammed easily, were poorly mounted and often inadequately equipped with sights. As a result, piloting and surprise attack made up for poor marksmanship.

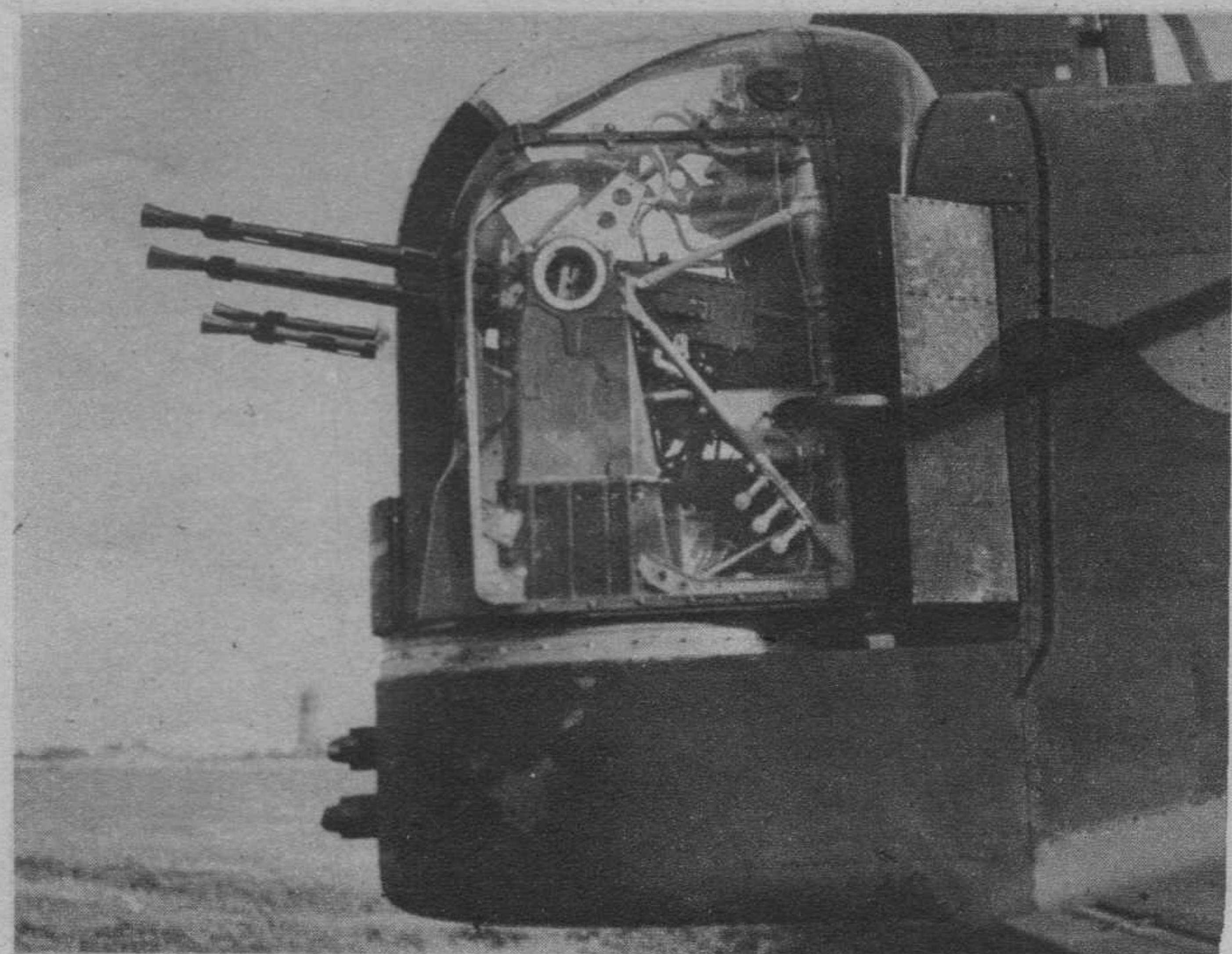
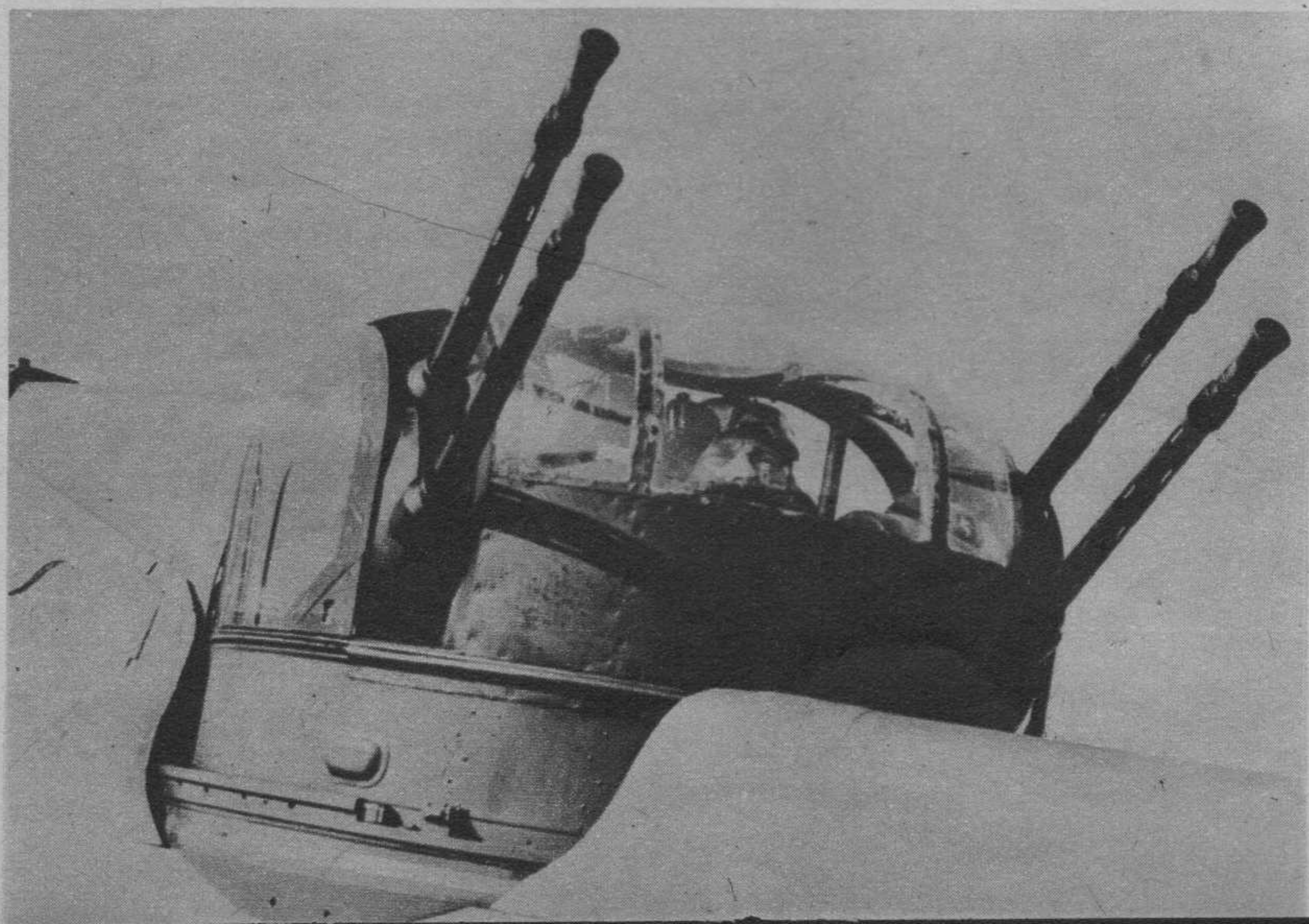
It is true that the better-known aces were all good marksmen, and spent many hours at the butts to perfect their skill, but you will also note that they were tops in flying skill. Many a good marksman never lived to prove it for lack of the piloting skill possessed by an equally good shot in his adversary's cockpit. On the other hand, many a poor marksman overcame this handicap by using his flying skill to bring him into a position where even his mediocre shooting ability did the trick.

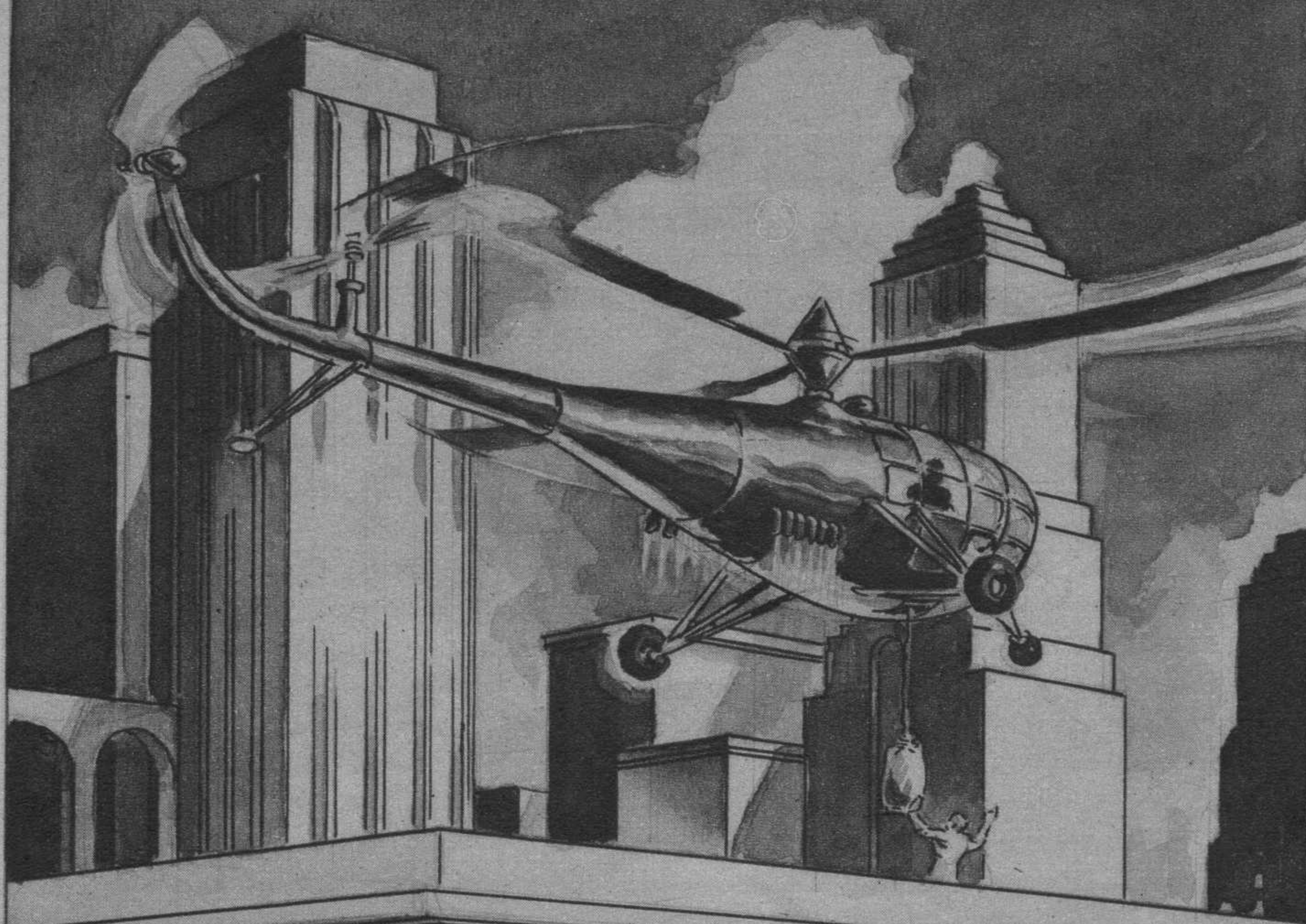
It's different today. The speeds of modern combat planes, the decreased "on-target" time and armorplating make the real aerial marksman top man in air warfare. Flying skill is still imperative, but the ability to call shots without fail and put them *(Turn to page 30)*



Behind the tail guns. Inside the four-gun turret in the tail of a Whitley bomber. Two guns on either side. Ammunition and triggers in center. Below—Side view of same turret showing the four guns. Sides of turret are of plexiglass for better gunnery visibility.

Bad news night or day. The four-gun turret of the Boulton Paul Defiant fighter.





COMMERCIAL AIRPORT SHUTTLE FOR PASSENGERS AND MAIL



PUBLIC POPULAR FLYING AND TAXI SERVICE. CAN GET IN AND OUT OF ANY PLACE LARGE ENOUGH FOR ROTORS TO SWING

VERTICAL FLIGHT HAS A FUTURE!

MAIN ROTOR — 28 FEET DIAMETER — IS ARTICULATED FLEXIBLY TO THE ROTOR HEAD IN MUCH THE SAME WAY AS THAT OF THE AUTOGIRO. — IT IS ENGINE-DRIVEN TO ROTATE AT A CONSTANT SPEED OF 300 R.P.M., GIVING A BLADE-TIP SPEED OF APPROXIMATELY 250 M.P.H. THUS ELIMINATING ALL POSSIBILITY OF STALLING EVEN AT ZERO FORWARD SPEED. — ASCENT AND DESCENT ARE EFFECTED BY INCREASING OR DECREASING THE PITCH AND A FREE-WHEELING DEVICE PERMITS ALL ROTORS TO CONTINUE IN AUTO-ROTATION SHOULD ENGINE FAIL.

ROTOR HEAD AND PITCH CONTROL MECHANISM

DOUBLE VEE-BELT DRIVE TO AUXILIARY ROTORS

BEVEL GEAR BOX

TWO-SPAR ROOT

FUEL TANK

MAIN ROTOR PITCH CONTROL LINK

CONTROL COLUMN IS MOVED IN NORMAL AIRPLANE FASHION TO MAINTAIN LONGITUDINAL & LATERAL CONTROL. — FORE & AFT MOTION ALTERS PITCH OF HORIZONTAL AUXILIARY ROTORS SIMULTANEOUSLY IN SAME DIRECTION AND SIDE TO SIDE MOTION DIFFERENTIALLY ALTERS PITCH OF THE SAME BLADES

GEAR BOX

RIBBON ATTACHED TO POST SERVES AS CRUDE FLIGHT DIRECTION GAUGE

INSTRUMENT PANEL

BLOWER

90 H.P. HORIZONTALLY OPPOSED FRANKLIN ENGINE AIR-COOLED BY BLOWER BLAST DEFLECTED DOWNWARDS OVER CYLINDER BANKS

EXHAUST

SHOCK STRUT

WHEELS REQUIRE NO BRAKES

DOUGLAS ROLFE

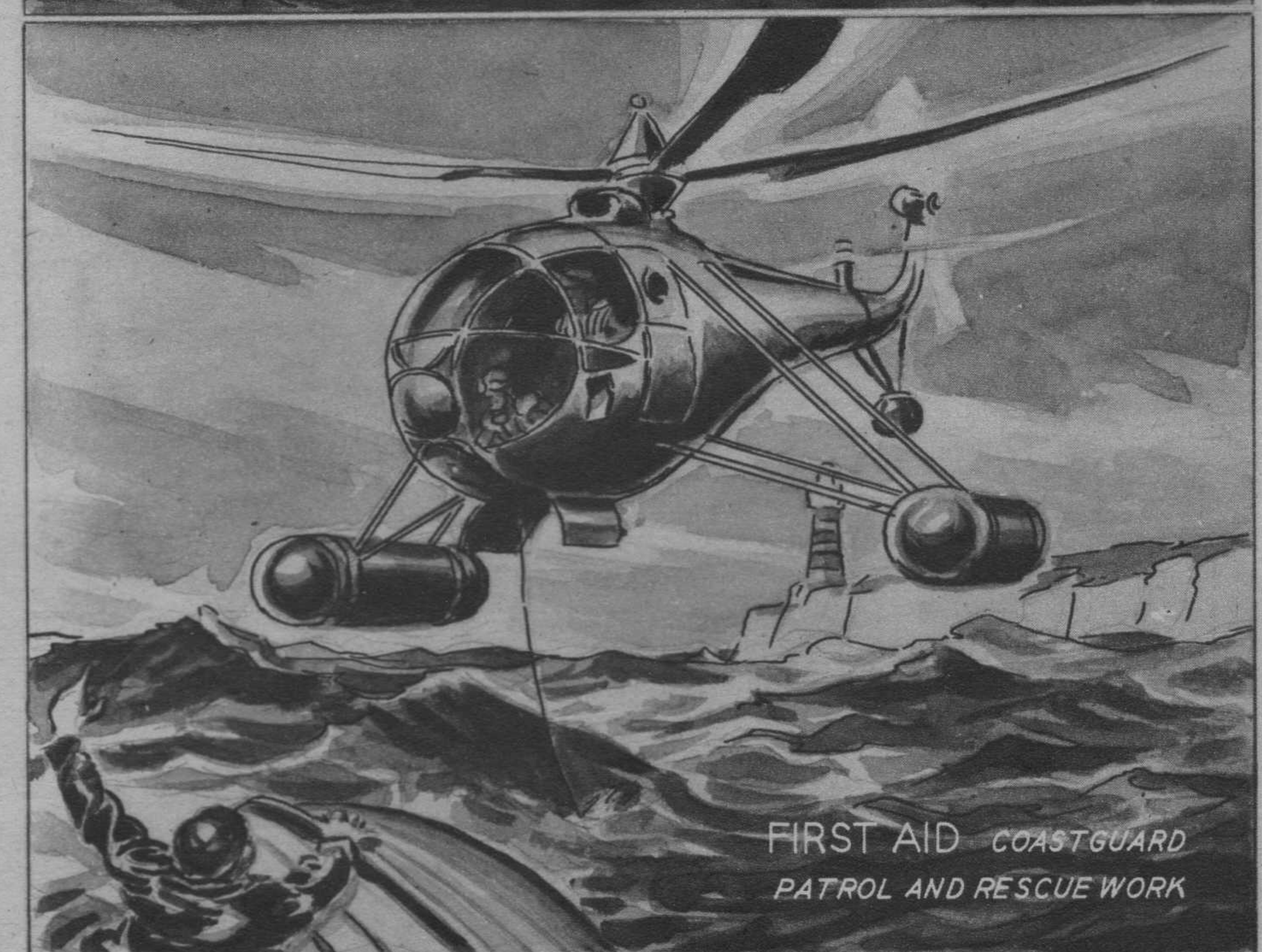
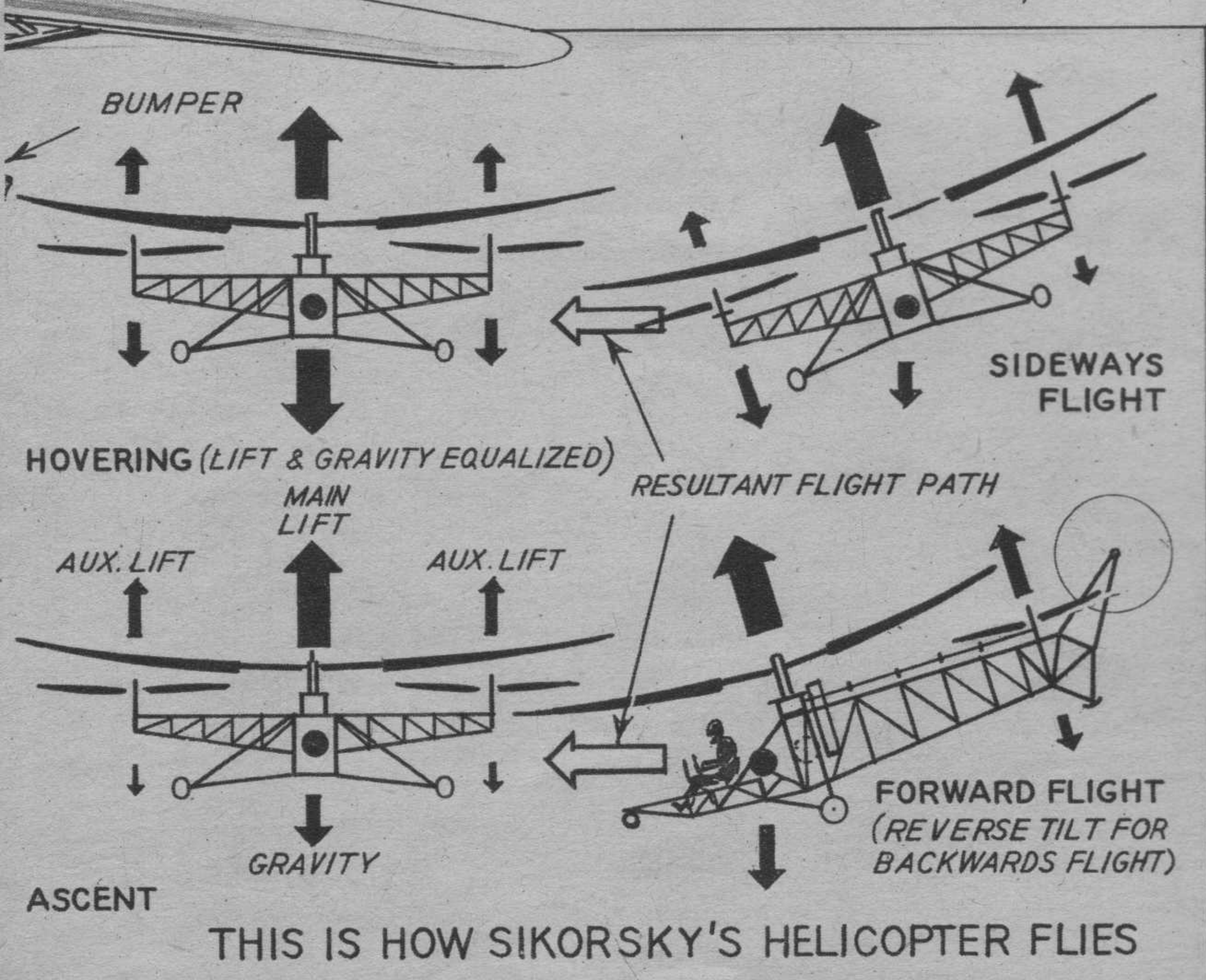
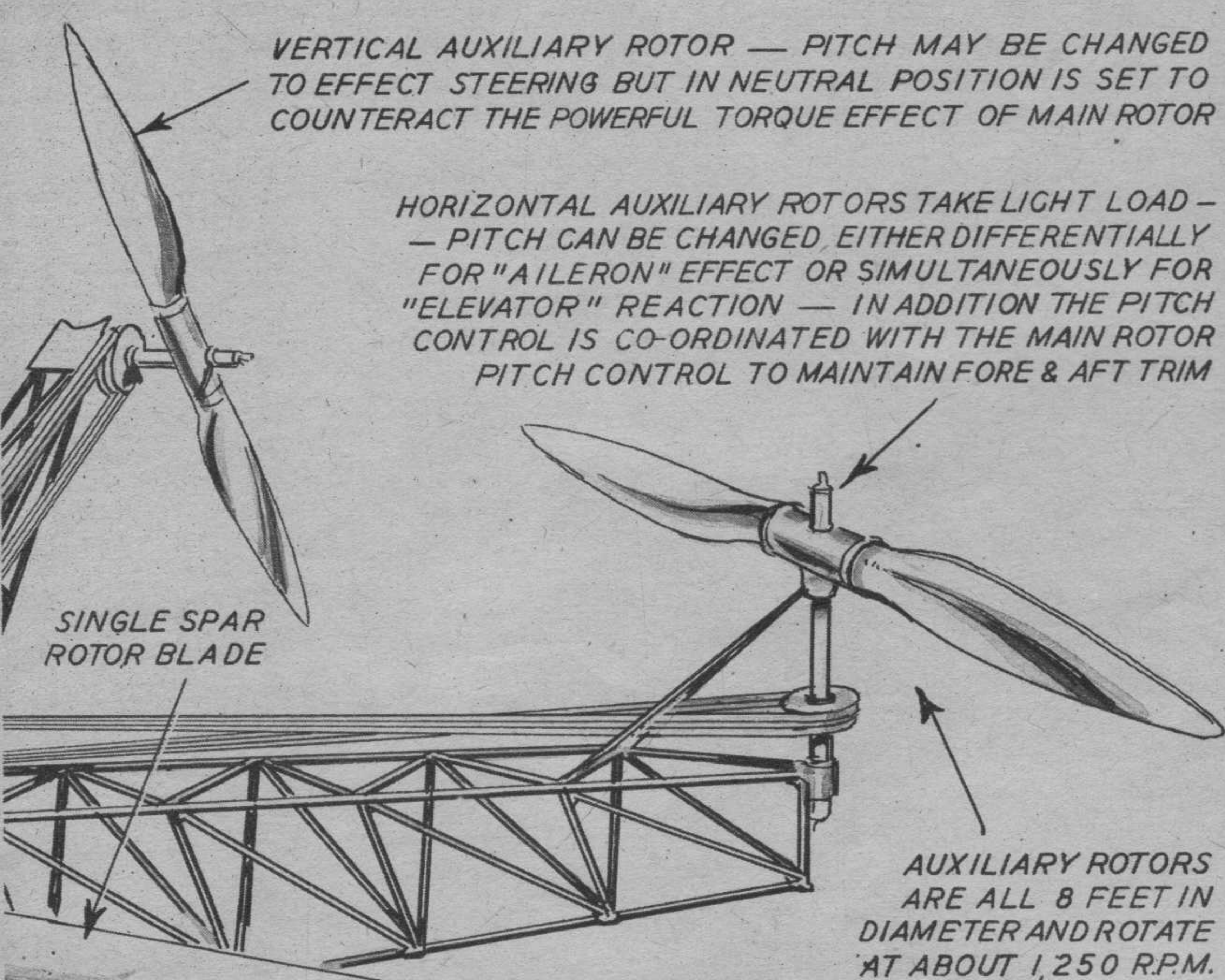
SWITCH

HAND THROTTLE

BUMPER

ACTION OF RUDDER PEDALS ALTERS PITCH OF VERTICAL ROTOR TO GIVE, IN EFFECT, NORMAL AIRPLANE STEERING

MAIN PITCH CONTROL LEVER IS INTERCONNECTED AND SYNCHRONIZED WITH THE ENGINE THROTTLE SO THAT AN INCREASE OR DECREASE IN PITCH AUTOMATICALLY PRODUCES A CORRESPONDING INCREASE OR DECREASE IN POWER DELIVERED TO THE MAIN ROTOR



ESSENTIAL FEATURES AND CONTROLS OF THE SIKORSKY-VS-300 HELICOPTER ARE EXPLAINED IN THE DRAWING AT LEFT. THE VS-300 RECENTLY BROKE ALL EXISTING HELICOPTER ENDURANCE RECORDS AND WILL BE DEVELOPED

FUTURE DESIGNS WILL BE SIMPLIFIED, CLEANER LOOKING AND HIGHER POWERED BUT PROBABLY WILL REMAIN COMPARATIVELY SLOW. DESPITE THIS, HELICOPTERS HAVE A DEFINITE PLACE IN AVIATION AS SUGGESTED IN SKETCHES

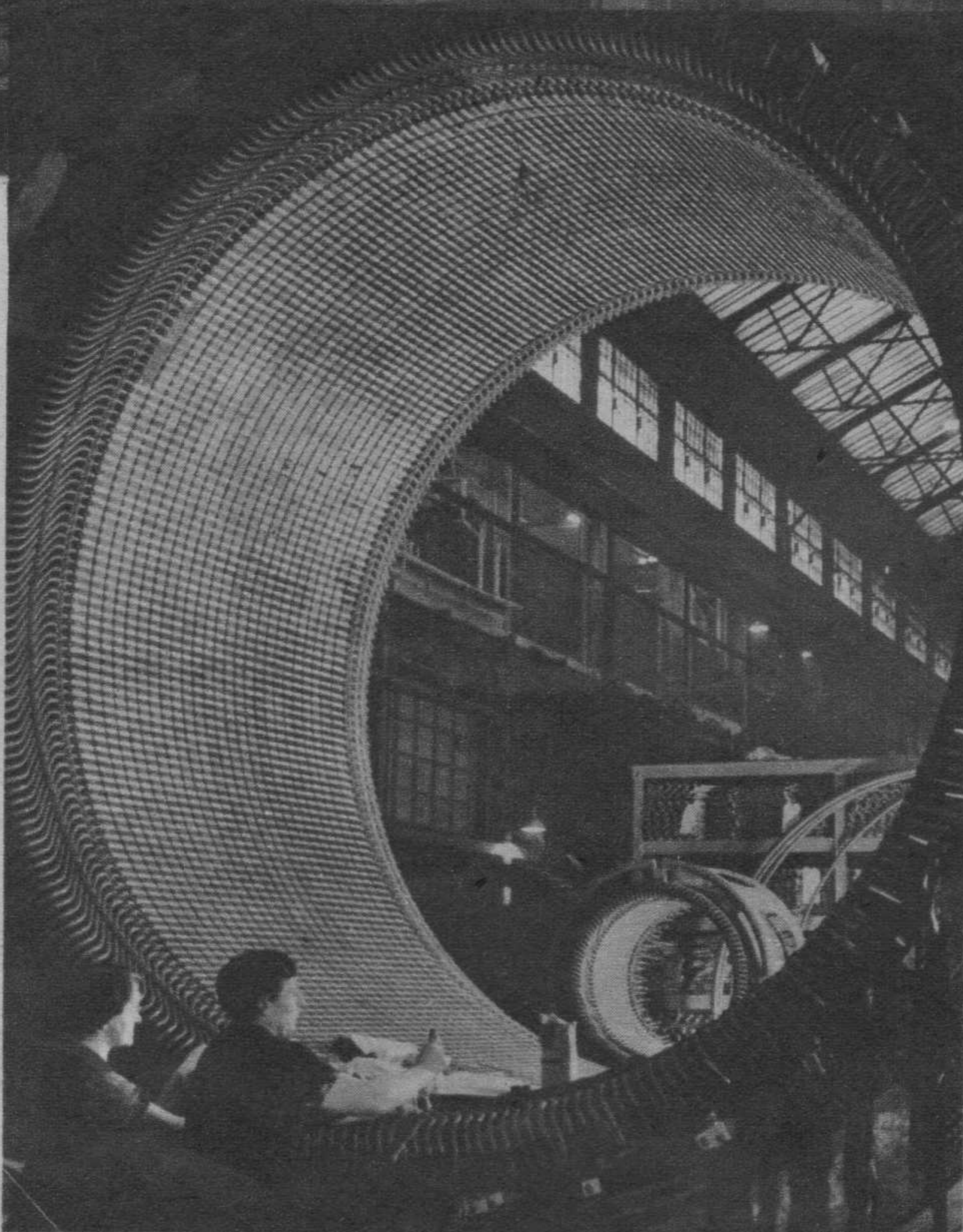


Eventually full-size ships are tested in this giant N. A. C. A. tunnel. But models do pioneering.

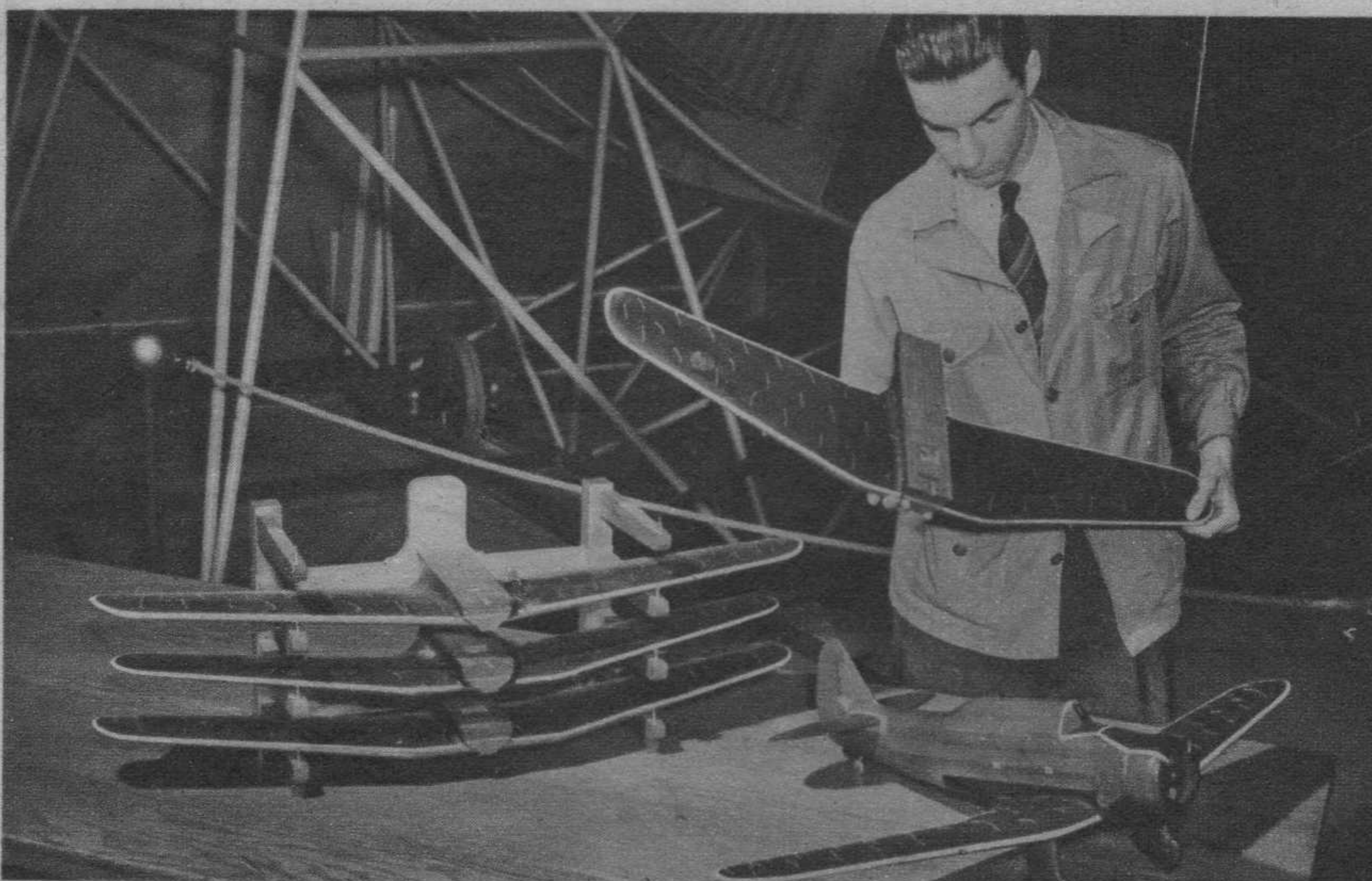
STRAWS IN THE

Big warplanes from little models grow. Uncle Sam learns a lot of flying characteristics from those miniature test ships flown in wind tunnels.

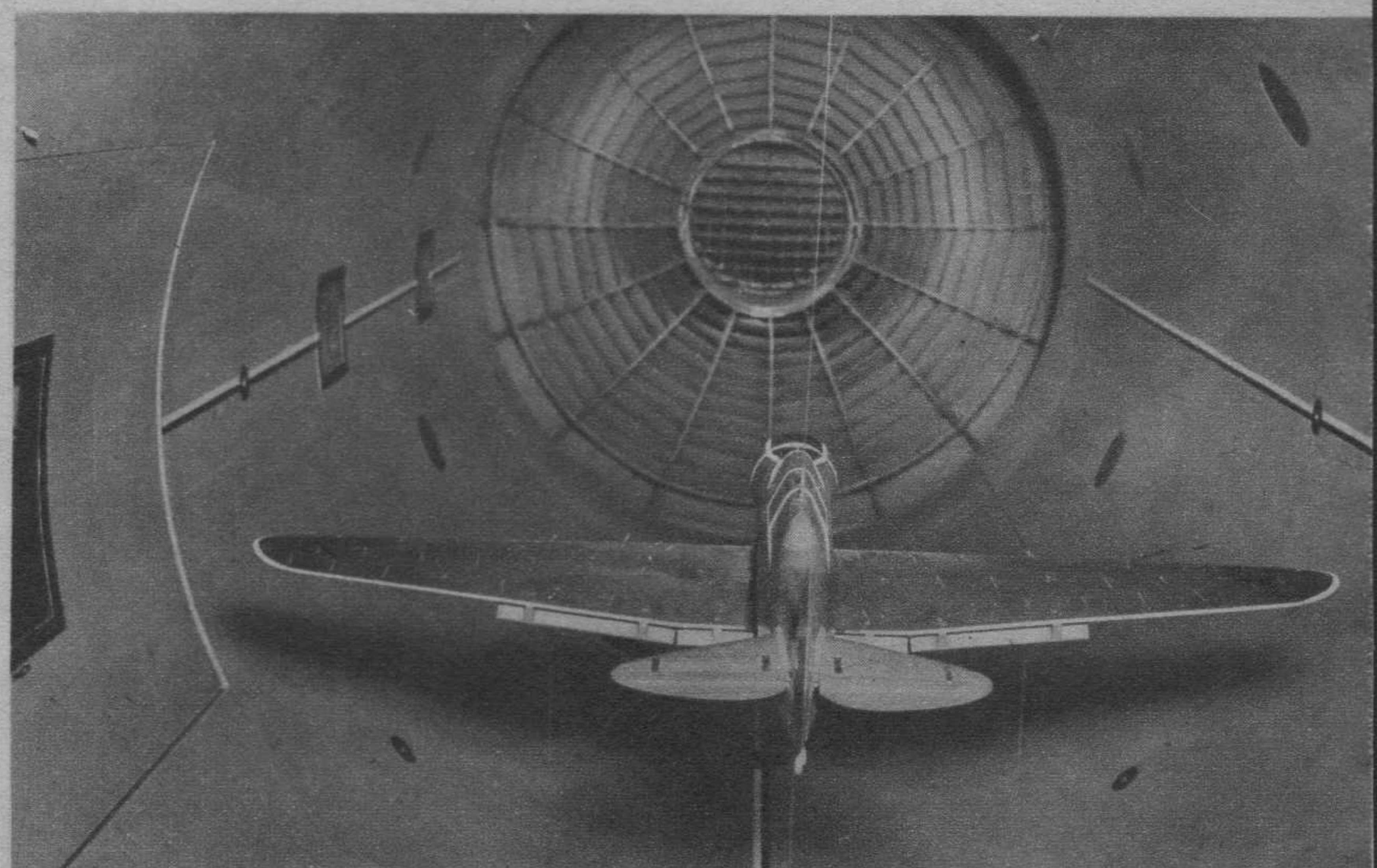
BY DOUGLAS J. INGELLS



Power to blow away. This is stationary part of the 40,000 h.p. fan motor to drive the propellers at Wright Field tunnel.



Now try this one. Various wing shapes are tried out on some fuselage model to determine efficiency of different wing designs. Tiny yarn tufts give data on air flow.



Sitting in a draft. The model with wing attached is suspended in tunnel ready for test. This particular model has scale flaps built in to test their effectiveness.

BOMBERS, pursuits and fighters that you or I won't see in the air for at least three years are flying today. They are unusual planes, incorporating radical shapes and designs, but some of them are destined to be the great ships of tomorrow. Right now they are small models suspended in wind tunnels "getting the works" under the scrutinizing eyes of the army's crack designers and aeronautical engineers.

You may not know it, but no small portion of that money the American taxpayer puts out each year for national defense is spent for model planes. Uncle Sam spends hundreds of thousands of dollars annually to pay skilled craftsmen who fashion from woods and metals precision-built models of new warplanes, and the whole process in the long run saves millions.

Let's start at the beginning.

Say General Blank of the army air corps receives a confidential report stating that a foreign country has developed a new high-speed bomber that will do 400 miles per hour and cruise for 3,000 miles without refueling. (He'd be mighty surprised if he learned of such a plane.) However, here is the birth of the idea. After reading that report he decides that the United States should have a plane that will do 450 miles per hour and cruise for 4,000 miles. That may be stretching a point, but Uncle Sam's designers are continuously trying to keep "at least three years ahead of the parade." And they are doing it.

But back to our story. Conferences with fellow officers and engineers produce specifications which are turned over to aircraft manufacturers who have government contracts and to Wright Field engineers for them to design this new superplane. Plans are drawn by designers in the experimental engineering section at the materiel division—Wright Field—in Dayton, Ohio,

an airplane's flying characteristics before going into the cost of building a full-size ship." Full-size experimental airplanes, by the way, cost as much as \$1,500,000.

From small models in wind-tunnel tests, engineers can, by mathematical calculation and the appliance of specified and proven formulas and delicate instruments, determine the flying features of a large-scale airplane. Manometers, instruments whose measurements can be translated into pounds of pressure exerted per square foot and other delicate testing devices are connected to the model when it is in the tunnel. Thus, aerodynamic forces can be accurately measured. Engineers can tell how heavy a load the wing will lift, how fast the ship will fly and whether or not design changes will produce a more efficient airplane.

On one particular type of model bomber that was being tested in Wright Field wind tunnels, a small piece of putty that was placed in just the right spot on the wing where it joined the fuselage increased the plane's speed by nearly twenty-five miles per hour.

Take the Airacuda, for instance. This pusher-type fighter of Larry Bell's went through one of the most grueling series of model tests of any plane for the last several (Turn to page 36)

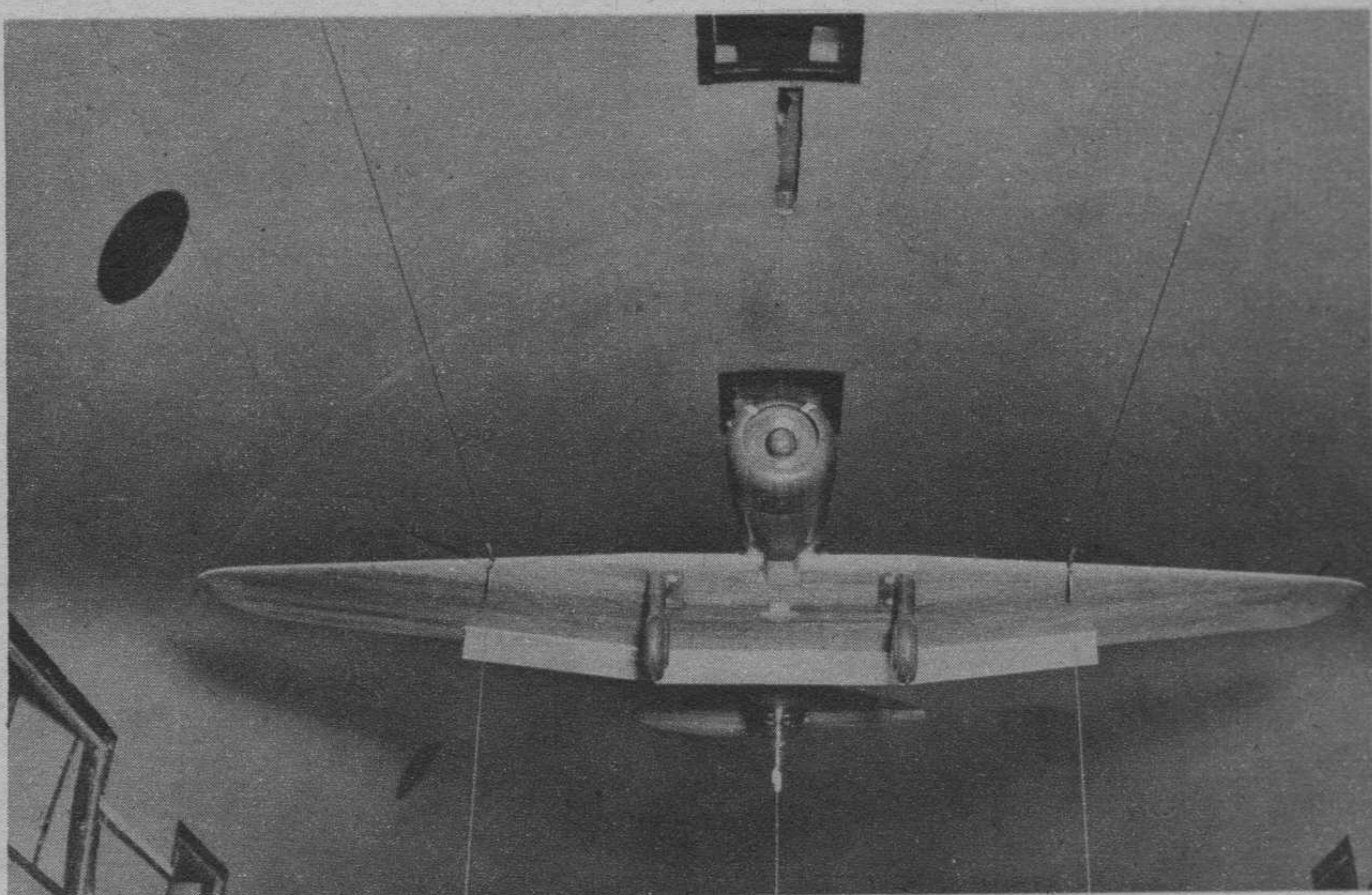


and estimates are made on the new plane's performance. All of this, of course, is done "on paper." But from these rough sketches the best designs are selected and models of them are made.

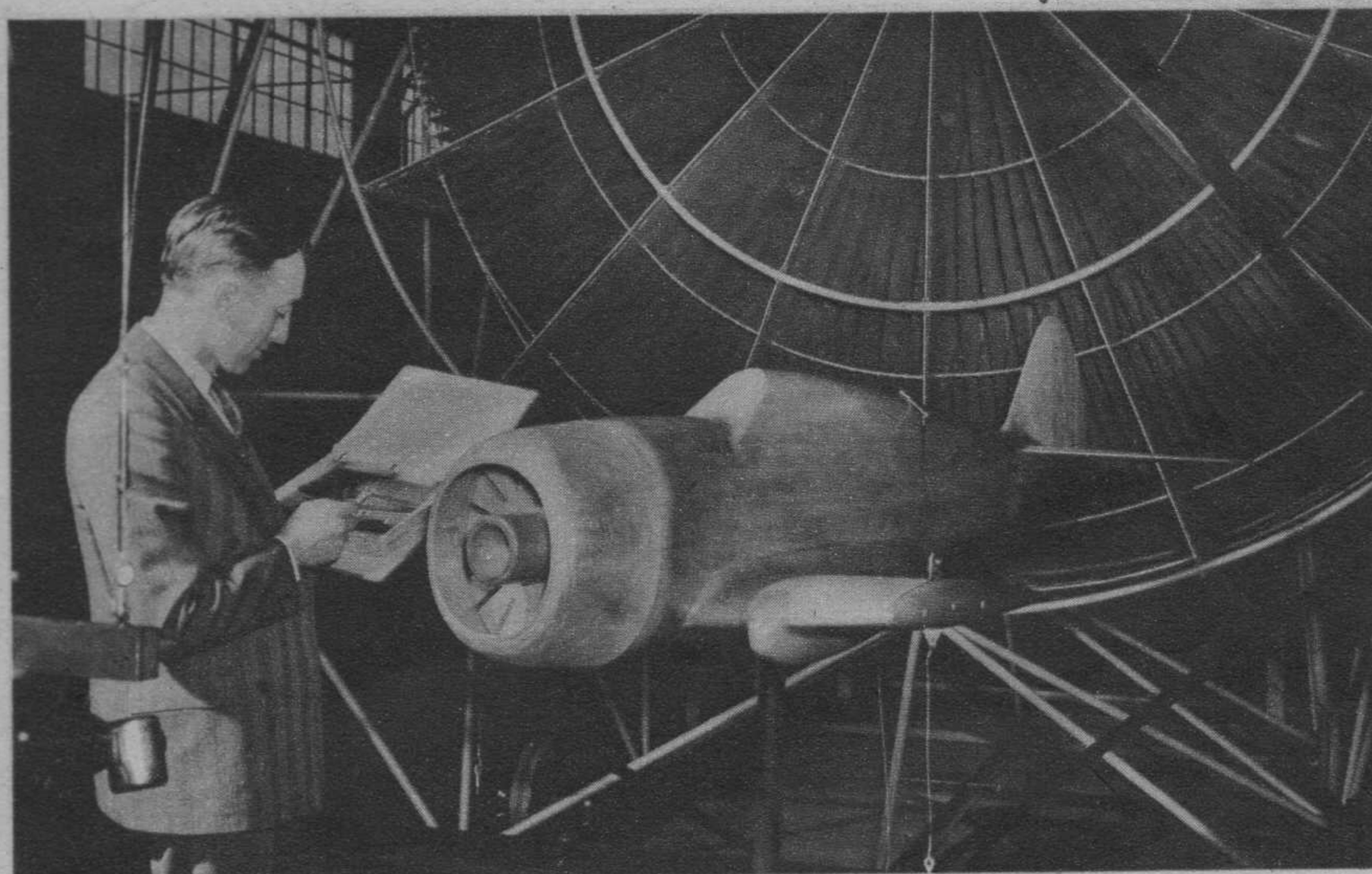
These models vary in size and cost. Some are small with only three or four-foot wing span; others are built as large as twenty feet or more. Some cost only \$200, and seldom less, while others run as high as \$2,000, depending upon the amount of work hours required in their construction. "The purpose of building these models," an army officer in charge of the section explains, "is to give the engineer and manufacturer an idea of



Long-range observation. Peering through telescopic instruments, the expert keeps check on the action and attitudes of model in tunnel.



Front view of same model shows fine wires supporting it in the air streams. These wires actuate delicate scales that register drag, lift, stability and other data.



Final check. An engineer goes over a big scale model fuselage before test in the wind tunnel. Many of these models have movable control surfaces.

WHAT'S YOUR QUESTION

QUESTION: Could you tell my friend and me the difference between interceptor, fighter and a reconnaissance plane? D. C. and R. B., Alhambra, Calif.

Answer: An interceptor is usually a single-place machine powered by one or two engines. It has an exceedingly fast rate of climb and a high speed, and its object is to intercept bombing planes and bring them down before they can attack their objective. A fighter plane, while it can be an interceptor, is usually a highly maneuverable single-place machine whose object is to engage the attacking airplanes and bring them down. It may not be as fast as the interceptor, but its exceptional maneuverability makes it a very dangerous adversary. A reconnaissance plane is a multiplace airplane whose job is to photograph and gain information as to the movement of the enemy, the location of its airdromes, supply bases, artillery emplacements, communication centers, et cetera, and to relay this information to headquarters so that tactical problems on future action can be figured out.

Question: Could you tell me what a pitot tube is used for? And could a person wearing glasses get into the army air corps? C. M., Milwaukee, Wis.

Answer: A pitot tube is a tube

with an open end located usually on the wing of the airplane away from the slipstream of the propeller, and is connected with the air speed indicator located on the dashboard. It either has a coaxial tube surrounding it or a closed tube placed parallel to it. The closed tube has perforations in its side and is subject to static pressure, the open tube measures the impact pressure, and the speed of the air is determined from the difference between the static and impact pressures, this being interpreted in miles per hour on the dial of the air-speed indicator. A person wearing glasses cannot receive flight training in the army air corps.

Question: Could you please tell me the addresses of the following aircraft companies: Douglas Aircraft Corp.; Curtiss-Wright Corp.; Airplane Division; Grumman Aircraft Engineering Corp.; Glenn L. Martin Co.; Boeing Aircraft Corp.; Seversky Aircraft Corp. and Consolidated Aircraft Corp. H. B., Bronx, N. Y.

Answer: The Douglas Aircraft Co., Inc., is located at Santa Monica, Calif. Curtiss-Wright Corp., Airplane Division, has two factories, one located at Buffalo, N. Y., and the other at St. Louis, Mo. Grumman Aircraft Engineering Corp. is at Bethpage, L. I., N. Y.; Glenn L. Martin Co., Baltimore, Md.; Boeing

Aircraft Corp., Seattle, Wash. Seversky Aircraft Corp. is now the Republic Aviation Corp., Farmingdale, L. I., N. Y. Consolidated Aircraft Corp. is in San Diego, Calif.

Question: In your estimation which is the most formidable and fastest pursuit ship among the Vultee Vanguard, Curtiss P-40, Bell P-39 and Lockheed P-38 and the Republic P-43? Also the most formidable medium bomber among the Lockheed Hudson, North American B-25, Martin B-26 and Douglas B-18?

Answer: Among the pursuits there is a close tie between the Bell P-39 and the Lockheed P-38, although one ship is a single-engine fighter and the other a twin-engined interceptor. Among the bombers the Martin B-26 has an edge on the others you mention.

Question: In the February, 1941, issue of your magazine there was an article called "You and Your Idea." I followed its instructions and took my drawings to my nearest air corps station and gave them to an officer. He said that he could not do anything for me. Could you tell me the next step I should take in order to submit my idea to the U. S. army air corps? L. C., Jersey City, N. J.

Answer: Send your drawings to the U. S. Army Air Corps, Materiel Division, Wright Field, Dayton, O.

Question: Can you tell me where I can get the book "I Wanted Wings," and do you know when the picture is coming out? E. P., Carney, Mich.

Answer: The book "I Wanted Wings" by Beirne Lay is published by Harper & Bros., 49 East 33rd St., New York City. The picture of that name has already been released.

Question: Would you please send me a list of books covering the following subjects: installation and maintenance of radio equipment in aircraft and installation and maintenance of aircraft instruments (Sperry gyroscope, et cetera). Corp. B. McC., Fort McClellan, Ala.

Answer: We suggest the following two books: "Aeronautical Radio" by Myron F. Eddy, published by Ronald Press Co., 15 E. 26th St., New York City, and "Airplane Instruments," by E. Molloy, Chemical Publishing Co., 148 Lafayette St., New York City.

Question: Will you please let me have information on the Stinson 105 and the Stinson SR-7? With what instruments are they equipped? W. J. V. V., Chicago, Ill.

Answer: The latest Stinson 105 has a wing span of 34 feet. The top speed is 115 m. p. h., cruising speed 110 m. p. h., landing speed 47 m. p. h. The service ceiling is 13,000 feet. Ship is powered by a 90 h. p. Franklin engine. Maximum range with 20 gallons of gas is 450 miles. It is equipped with an altimeter, air-speed indicator,

oil pressure and oil temperature gauges, tachometer, ammeter, compass and fuel gauge. The SR-7 has a span of 41 feet, 7½ inches. Equipped with a 225-h.p. Lycoming engine, its top speed is 142 m. p. h., cruising speed 136 m. p. h., and landing speed 55 m. p. h. The service ceiling is 13,000 feet and cruising range 400 miles. The standard instrument equipment is similar to that of the 105.

Question: Could you tell me the model and make of the two airplanes shown in the pictures which I sent you? D. C. H., Riverside, Calif.

Answer: The biplane shown in your photo is a Curtiss-Wright Sport powered by a five-cylinder Wright J6 engine of 175 h. p. The open-cockpit monoplane is a Stinson Model O powered by a Lycoming engine developing 215 h. p. Neither of these models is built any longer.

Question: I would like to know what companies sell gliders in kits and how much do they cost? W. J. Hennig, Minn.

Answer: The following glider manufacturers sell ships in kit form: Bowlus Sailplanes, Inc., San Fernando, Calif. The kit sells for \$425. Briegleb Aircraft Co., Inc., Van Nuys, Calif. Their kits of the BG-6 sell for from \$210 to \$465. Kits manufactured by both companies can be bought on installments. Another manufacturer making a kit is Midwest Sailplanes, 15100 Woodward Ave., Detroit, Mich., which sells its product for \$500. Crating and shipping charges are extra.

Question: I would like to know what subjects should be taken up in high school in preparation for aeronautical engineering and aeronautical drafting. H. C., Ruston, La.

Answer: We suggest that you take up mathematics, physics, chemistry and mechanical drawing.

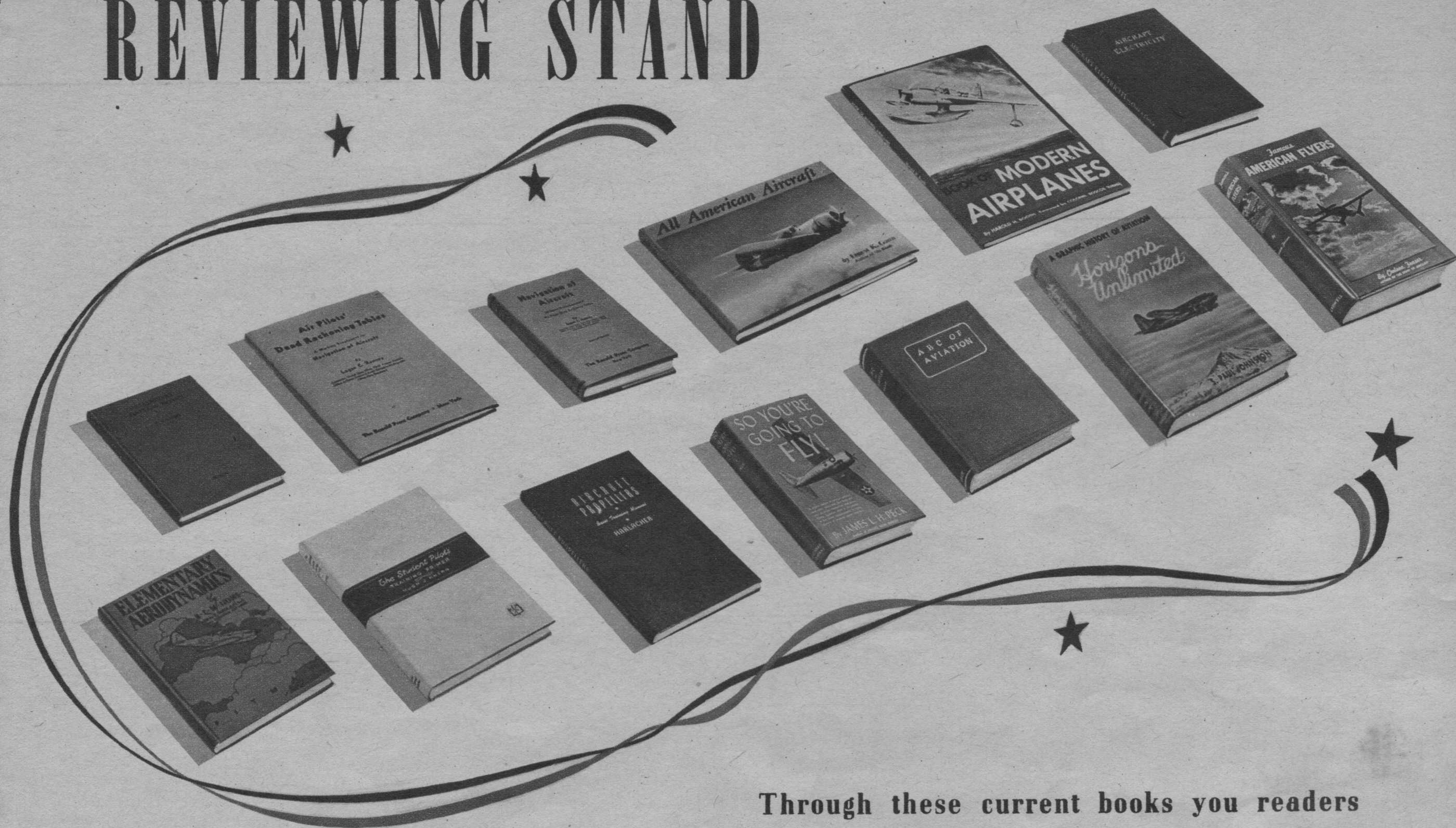
Question: Could you tell me the physical qualifications and requirements for a private license? R. S. Huntington, Ore.

Answer: For the above information write to the Civil Aeronautics Authority, Washington, D. C., and ask them to send you their Bulletin CAR-20.

Question: Where can I buy models of .30 and .50-caliber machine guns and also a 37-mm. antitank gun? Where can I buy photos of the Bell Airacobra, Airabonita, Lockheed P-38, Bell XFM-1 and Vought Sikorsky SB2U-1? R. P. B., Brooklyn, N. Y.

Answer: We do not know where you can buy models of the above guns. Try contacting Gun Model Co., 2908 N. Nordica Ave., Chicago, Ill. For pictures of the Bell ships write to the Bell Aircraft Co., Buffalo, N. Y. For the Lockheed, Lockheed Aircraft Co., Burbank, Calif. Other photos you may be able to buy from Rudy Arnold, Floyd Bennett Field, Brooklyn, N. Y., at ten cents each.

REVIEWING STAND



Through these current books you readers may extend your knowledge of aviation.

Preliminary Airplane Design. By R. C. Wilson. (Pitman Pub. Corp., \$1.) Obviously intended for the serious student of aviation interested in becoming proficient in at least the rudiments of aircraft design, this book appears excellent. It is based upon a successful method developed for the air corps, and although simplified, gives the design student a good and complete basic working knowledge, from the free-hand sketch of projected aircraft to the computation of the characteristics of its component parts. Various charts and tables of weights are included.

Aircraft Propellers, Basic Training Manual. By Carl M. Harlacher. (Aero Publishers, Inc., \$2.85.) Written in the popular question and answer formula, this manual prepared by a propeller instructor in the air corps division of the Curtiss-Wright Technical Institute gives the reader a good general knowledge of standard propellers. It covers in an understandable way the construction, maintenance and repair of all common types of air screws. Of particular interest to mechanics and those connected with propeller repair stations.

So You're Going to Fly! By James L. H. Peck. (Dodd, Mead & Co., \$2.50.) With all the money being spent at the present time on military aviation, training and production, there is need for a comprehensive book on the aviation set-up and its various activities. "So You're Going to Fly!" will answer many questions regarding air operations and strategy. Much of this material will be familiar to Air Trails readers, for the author has appeared in our pages from time to time. A highly informative book on modern aviation and its activity. Many photos.

The Student Pilot's Training Primer. By Hugh J. Knerr. (D. Van Nostrand Co., \$2.) Obviously taking a tip from Assen Jordanoff, Author Knerr has chosen to illustrate his book with many semihumorous diagrams and illustrations to clarify flight problems and points of aerodynamics. While this book might be considered elementary, it is excellent for those at whom it is aimed.

Elementary Aerodynamics. By D. C. M. Hume. (Pitman Pub. Corp., \$1.50.) This author, a group captain, Royal Canadian Air Force, has chosen a subject that is usually difficult to make lucid to the average layman, but he has succeeded in doing this, provided the layman has a working knowledge of rather advanced mathematics. A unique treatment of this subject is advanced by an author's digest of each chapter at its conclusion, enabling the reader to review at a glance the purpose of the material contained in each chapter. A series of test questions for personal check by the reader conclude the book.

Famous American Flyers. By Chelsea Fraser. (Thomas Y. Crowell Co., \$2.50.) This collection of biographies suffers for lack of illustrations of the many famous names that fill the nearly 350 pages of text. Although this lack of illustration (seven photographs and several small maps) might prevent the popular appeal that it might otherwise have, this excellent handling of an always popular subject should make it an invaluable addition to every aviation library. Much of the material was gathered from relatives and intimate friends and gives unexpected and highly entertaining insight into the characters of the men and women biographed. To the serious student or casual follower of prominent figures in aviation this book will bring much that is inspirational as well as amusing.

Horizons Unlimited. By S. Paul Johnson. (Duell, Sloan & Pearce, Inc., \$3.75.) Friend Johnson, formerly editor of *Aviation*, and now co-ordinator of research for the N. A. C. A., must have had a lot of fun as well as headaches in digging up the material for this "graphic history of aviation"—to judge by some of the illustrations. This highly entertaining and enlightening story of man's conquest of the air consists of over 350 pages of text and illustrations gathered from all over. It recounts the progress of aviation from the first feeble attempts by man's imagination to visualize "flying machines" up to the stratoliners of today. A book recommended for aviation followers of all ages.

(Turn to page 32)

FLYING BOX CARS

Will national defense needs hasten big-scale air freight haulage in this country?

OUT of New York for Chicago every day wing seventy-six regularly scheduled transport planes. Seventy-five of them are laden to the de-icers with passengers, mail and express. The seventy-sixth, a sort of aerial ugly duckling, carries no passengers at all—but it totes plenty of express, and bigger packages than the other planes. It is the nation's only all-cargo craft, a DC-3 United Air Lines Mainliner which gets away from LaGuardia Field nightly at eleven p. m. for its 740-mile nonstop hop. It is always stuffed from nose to tail with a 5,000-pound load, ranging from pins to pianos.

Operating since January, this unique flying box car is quietly blazing the trail of what many far-seeing aviation and shipping men think will be a vast national network of heavy-duty freight planes after World War II ends. They remember well what the auto truck did to freightage after World War I, and are laying plans accordingly to cash in on this expected new phase of air transportation. There are some among them who are clamoring for the establishment of this system now as a national defense measure, and it would not be surprising, therefore, if steps in this direction were taken in the coming months, at least preliminary ones.

The fact is, air cargo carrying has been one of the most backward phases in the development of American aviation. In 1939, for example, the nation's air lines did \$28,000,000 in passenger business and only \$1,500,000 in express, whereas eighty percent of the railroads' revenues came from freight cartage. United's all-cargo ship consequently is unique not as a milestone of progress, but rather as some ghostly, belated flight from a 1930 schedule. The rest of the world carries much more air cargo than the United States, has had all-freight ships for years. In the year before the present war started, Canada lugged 12,500 tons; Russia, 10,000 tons; Air France, 1,368 tons; the Dutch K. L. M., 2,371 tons, and TACA, in Central America, 7,500 tons. In 1940 the total U. S. air tonnage was only 3,850.

Lumber and coal are hauled by air in Alaska, livestock and heavy machinery weighing several tons in Guatemala, household goods and wheat in Canada, autos in New Guinea. From London, a British freight plane used to fly nightly to the continent with 3,000 pounds of mail. K. L. M. even boasted a "sky-tramp" service.

It isn't that America didn't start early enough. Indeed, the first shipment by air express in this country—and probably the first anywhere—took place thirty years ago. The shipment was



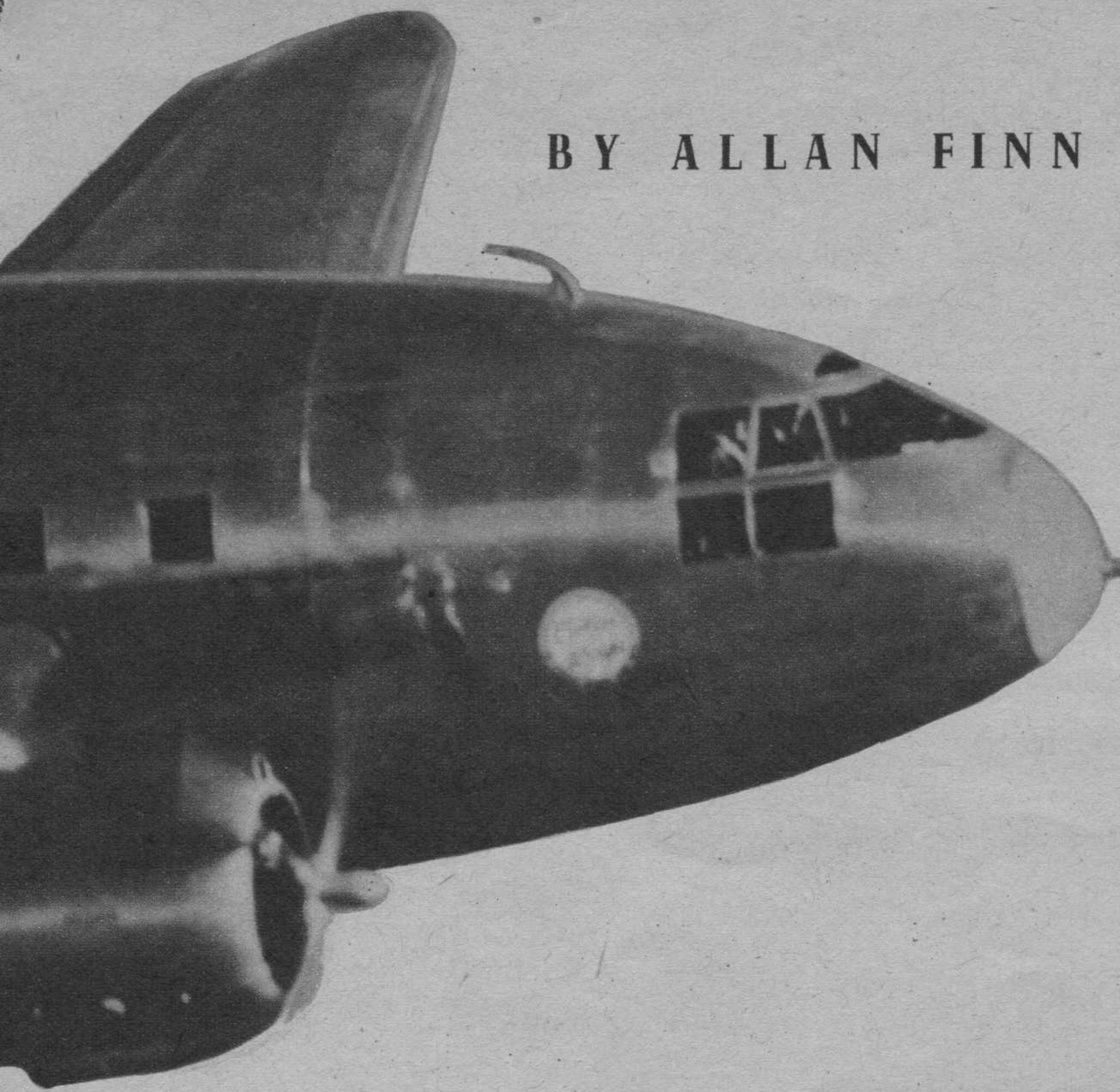
The Curtiss-Wright cargo airliner in flight above has special baggage door in the belly for easy loading.



This 750-pound crankshaft is being loaded in Chicago for a 6,825-mile flight to Wake Island in the Pacific.



Pump to Chile. Emergency met by flying boiler pump to South America in time to save long plant shutdown in Santiago. More and more heavy stuff goes by air.



BY ALLAN FINN

five bolts of silk worth \$1,000 flown to Columbus, Ohio, from nearby Dayton, whence it had been dispatched by rail from New York. In 1915 a load of hams was carted by air from St. Petersburg to Tampa, Florida. And in 1919 Railway Express began experimenting with planes as carriers, sending out from Mitchel Field a heavily laden Handley Page which, unfortunately, was forced down at Mount Jewett, Pennsylvania. U. S. commercial air transportation did not come into being, however, until 1925, with the award of the first air-mail contracts. Regular express service opened with inauguration of regular air-line flights in September, 1927. Slow to get started, air express took in a mere \$200,000 in 1929, year of the crash.

After a period of irregular operations, American air express reached its present stage in 1935 after the mail cancellations and passage of the Black-McKellar bill prohibiting air lines from engaging in any other business except transportation on their own systems. Hard up at the time, the lines found it necessary to sign up with their greatest competitor, REA. Owned by seventy railroads, REA today has contracts with seventeen lines, gets for its work thirty-two percent of air-express revenues.

Reason for tie-up: REA effects an air-rail co-ordination pick-up and delivery system covering 44,399 miles of airways and 230,000 miles of railways, manned by 59,000 employees in 23,000 offices and on 12,500 vehicles. REA services 250 planes daily in 269 airport cities.

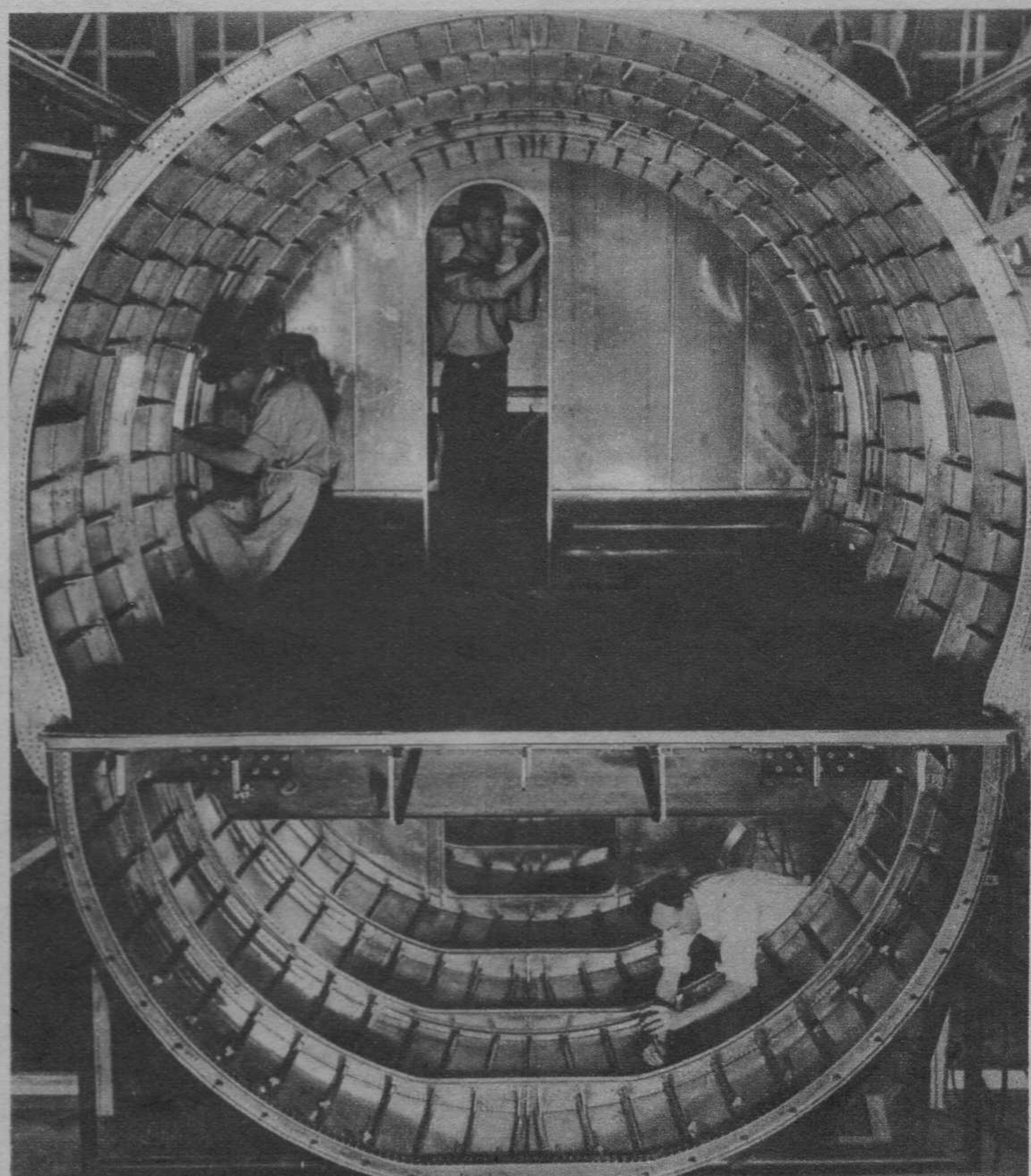
The notion that air express is necessarily limited to light shipments is one of the illusions of aviation, one of the stumbling blocks to the public's acceptance of real freight transportation via the clouds. The average person conceives of air express as de luxe delivery of baby chicks, perishable table delicacies and millionaires' playthings. Of course, the bulk of even today's haulage consists of light goods, such as radio transcriptions, printed matter, newsreels, wearing apparel, medical supplies, jewelry, et cetera. But America's big transports are daily engaged in heavy traffic operations, too. Not long ago when a huge motor generator broke down in a factory in Emeryville, California, armature windings weighing 2,657 pounds were rushed west by air from Pittsburgh, saving (Turn to page 38)



Lockheed aluminum also flies. Special aluminum bars and strips travel by air across the country to meet shortage in bomber plant in California.



Boeing box car. The Stratoliner interior will hold 33 passengers and has cargo room below. Future freight planes, would use entire space for cargo.



Double-decker. This gives excellent view of passenger and cargo holds of the Curtiss-Wright CW-20. Passengers number 40, cargo over three tons.

Gliders Fill A Need

(Continued from page 21)

suggest teaching gliding to youngsters between the ages of fourteen and eighteen, especially model builders, who usually have the all-consuming urge to fly, and thus create a pool of future pilots from which all the inept have been eliminated and only good pilot material remains. Germany, Russia and Poland used both of these methods with a great deal of success. In Germany commercial and military pilots are required to take a refresher course in soaring once a year. All their air-line pilots prior to the war had to have a "C" license in order to get a job.

Practical knowledge of meteorology and air currents enables the pilot to avoid situations which otherwise might lead to disaster. A number of fatal accidents in private, commercial and military flying can be traced directly to the pilot's lack of understanding of meteorological conditions. On the other hand, men with soaring experience have taken advantage of such conditions to pull themselves out of a tight spot. Not so long ago we were witness to an occurrence where glider training came in handy. A young pilot with certain amount of glider time was told by his employer to fly a Cub from a small airport to another one situated three miles away for a check-up of the engine, which was not functioning right. Soon after take-off the motor of the Cub revved down quite a bit and the pilot was about to land back on the field when

he hit a strong thermal. Immediately he circled in the lift, rose to 5,000 feet, and glided into the bigger airport, where the engine was repaired. His knowledge of soaring saved his boss the expense and delay of having the Cub's motor taken out and trucked to the repair station for overhaul.

The pilot who flew us to Elmira to see the triple-tow demonstration was Emil Lehecka, one of the ablest soaring men in the country. During the trip the air was rough and the sky dotted with cumulus clouds. We noticed that just before we hit exceptionally strong bumps he would throttle down, slowing the ship. We were flying in a fast Beechcraft and all ships possessing high speeds must be flown slower in rough air or great strains are imposed on their structure. Emil, because of his vast soaring experience, knew when these strong bumps would occur by watching the clouds and was able to take precautionary measures before we hit them. We could quote a number of similar examples, but they would all lead to the same thing: A power-plane pilot who has a knowledge of soaring will make a better and safer flier.

NEWS AND EVENTS

Twenty-six sailplanes and thirty-one soaring pilots gathered at the Kern Mesa gliderport at Arvin, Calif., for the Fourth Annual Western Soar-

ing Championship held from April 12th to the 27th. New records and notable performances included an out and return flight by Allan Essery with passenger in his two-place Baby Bomber sailplane, from Arvin to Maricopa. This flight established a new goal and return distance record, as well as a new American record for two-place ships in this event. Dick Johnson, seventeen-year-old soaring pilot, became the first one to ever cross the Ridge Route, soaring over the 8,000 to 10,000-foot-high Tehachapi Mountains which separate central and southern California. He landed at Saugus, having flown a distance of 55 miles. The present altitude record was considerably topped by Henry Stiglmeier in his Bowlus Baby Albatross when he rode a thunderhead to an altitude of more than 20,000 feet. Unfortunately his barograph needle had been set too high and ran off the paper just 200 feet short of 17,000 feet, so this flight cannot be credited as an official record.

Best duration during the meet was made by Dick Johnson, when he remained aloft for 5½ hours. A new sailplane made its first appearance during the meet, a two-place ship built by Volmer Jensen. It finished high in the point totals, although it did not participate in the contest for the full time. Several ships were equipped with thermal locators and a motion-picture camera was installed

on Frank Wolcott's craft from which some sensational aërobatic shots were taken, later to appear in the newsreels. The Stiglmeier brothers, Herman and Henry, had their sailplanes equipped with two-way radio sets and talked with each other and their ground crews as well as the assembled crowd while in flight. A total of 2,574 miles of cross-country distance which took 246 hours and 51 minutes of flying time were flown in these two weeks. First prize and the title of Western Soaring Champion went to Allan R. Essery. Second place was taken by Howard Morrison and third by Harold Huber.

The Tennessee Bureau of Aeronautics inaugurated recently the first State-sponsored glider school in the country. A two-place Schweizer sailplane has been ordered and Hawley Bowlus will supervise the program. State-supported schools will be established in Tennessee for boys between the age of fifteen and eighteen.

Lewin Barringer, Golden "C" pilot and ace record breaker, has accepted a position as head of public relations and manager of mechanics school with the South-West Airways at Phoenix, Ariz. This school trains pilots for the army air corps. Barringer has also been made director of the Briegleb Aircraft Co., Van Nuys, Calif.

Guns Win Battles

(Continued from page 20)

in the black in the granted fraction of a second is what keeps the medal-makers busy. Whether the man behind the trigger peers through a reflector sight and pours his spearhead of lead from fixed guns or spins his power turret to defend his bomber's blind spot, the mastery of aërial marksmanship is paramount.

When I first entered aviation in 1916 I'd been using machine guns since 1909, when I mixed up with a revolution in Nicaragua. Afterward through Honduras, Guatemala, Venezuela, Brazil and Mexico I had perfected myself in the art of machine gunning and I finished off with a post-graduate course with the Princess Pats of the Canadian Expeditionary forces in Europe. Wounded and invalided out of the infantry, I joined the British Royal Naval Air Service and learned to fly. My groundwork with machine guns was as near perfect as experience could make it, but I had to learn the science of aërial sights and it was a tough job. Later, after my transfer to American aviation, I was in charge of aërial gunnery schools.

The first and greatest trouble I ever encountered was to convince a gunner of the importance of the sights. The most important adjunct to this was the development of the aërial camera gun which photographed the target against a background of sights and gave proof to

the student of his inaccurate holding.

The common aërial gun sight and the type in universal use is known as the ring sight. This is a ring, varying in diameter according to the distance between the front and rear sights. Usually the ring sight consists of three concentric circles. The inner ring and the smallest is the peep sight for dead-on shooting. The other two are designed to give the gunner an automatic and instantaneous gauge, or lead, on another plane, taking into consideration its speed and direction of flight in relation to the attacking plane.

One of the most important elements in the training of an aërial gunner is to teach him to know every plane with which he may come in contact, and their speeds while flying at any angle, from climbing to diving. A plane in a dive must necessarily be given a greater lead than one flying level or climbing. Likewise allowances must be made for a ship flying at right angles or quartering.

The most common front sight is a straight steel peg topped with a round ball, sometimes red but often of a luminous material for better visibility in darkness or dull weather. Some front sights—especially those on movable gun mounts—are fitted with a double vane sight that at first glance resembles a miniature airplane. This movable gun sight is

supposed automatically to take care of the windage and drift of the plane. With the average gunner it causes more misses than hits. Likewise tracer bullets can cause poor marksmanship.

Tracer bullets are bullets filled with magnesium instead of the regular lead core. The magnesium is ignited by the flash of the gun and as it travels through the air toward the target it leaves a trail of smoke behind. In theory this is supposed to give the gunner a line on where his bullets are going. Actually the bullet becomes lighter as the powder burns out and it is subject to the vagaries of the wind, and at a distance of two hundred yards may be as much as a hundred feet off the course taken by the regulation bullets. The latest tracers are being made with an explosive content in their point. This tends to keep the bullet on its course with greater accuracy and it is so constructed as to explode at a given range, usually one hundred yards. This not only gives the gunner a better gauge on his sighting but the explosion helps him check his distance. All in all, with the present great speed of combat airplanes, tracer bullets are not much additional aid, for the speed is too great to allow for corrections.

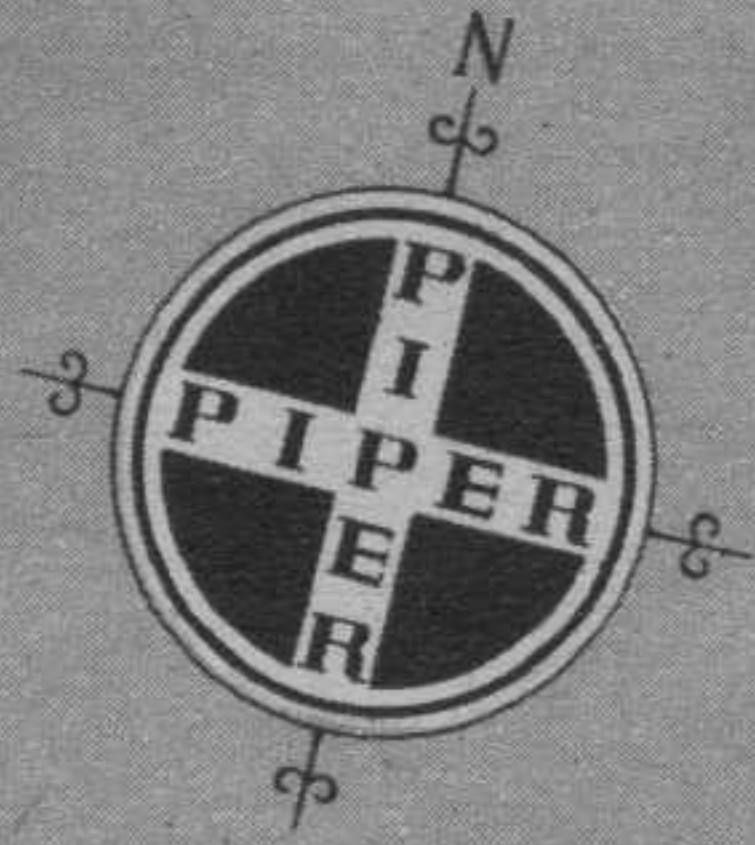
The interrupter gear and the aërial sights as developed during World War I have not been changed in

principle. They have been smoothed down and made more mechanically accurate. Today if a gunner knows his sights and his reactions are swift enough, he may be sure of a percentage of hits on the enemy target, but no single branch of the service requires more study or quicker reactions.

In 1919 a good pilot could hold his ship in a firing position long enough to get in a hundred or more shots as most fighting planes had a top speed of a hundred miles per hour. Today with speeds of three hundred or more miles per hour the firing time is cut to split seconds, and to get in a volume of fire larger numbers of guns are needed.

At the end of the World War I the best machine guns were rated around four hundred shots per minute. Let me explain one thing, probably the most misunderstood thing about machine guns. They speak of a machine gun as firing a thousand rounds per minute, or fifteen hundred. The correct statement should be "firing at the rate of one thousand rounds per minute." Few guns could stand up to throwing a thousand bullets a minute. Barrels would overheat, springs would give way and feed belts would whip through the gun at such speed they'd jerk themselves to pieces. In actual combat a machine gun—both on the

(Turn to page 32)



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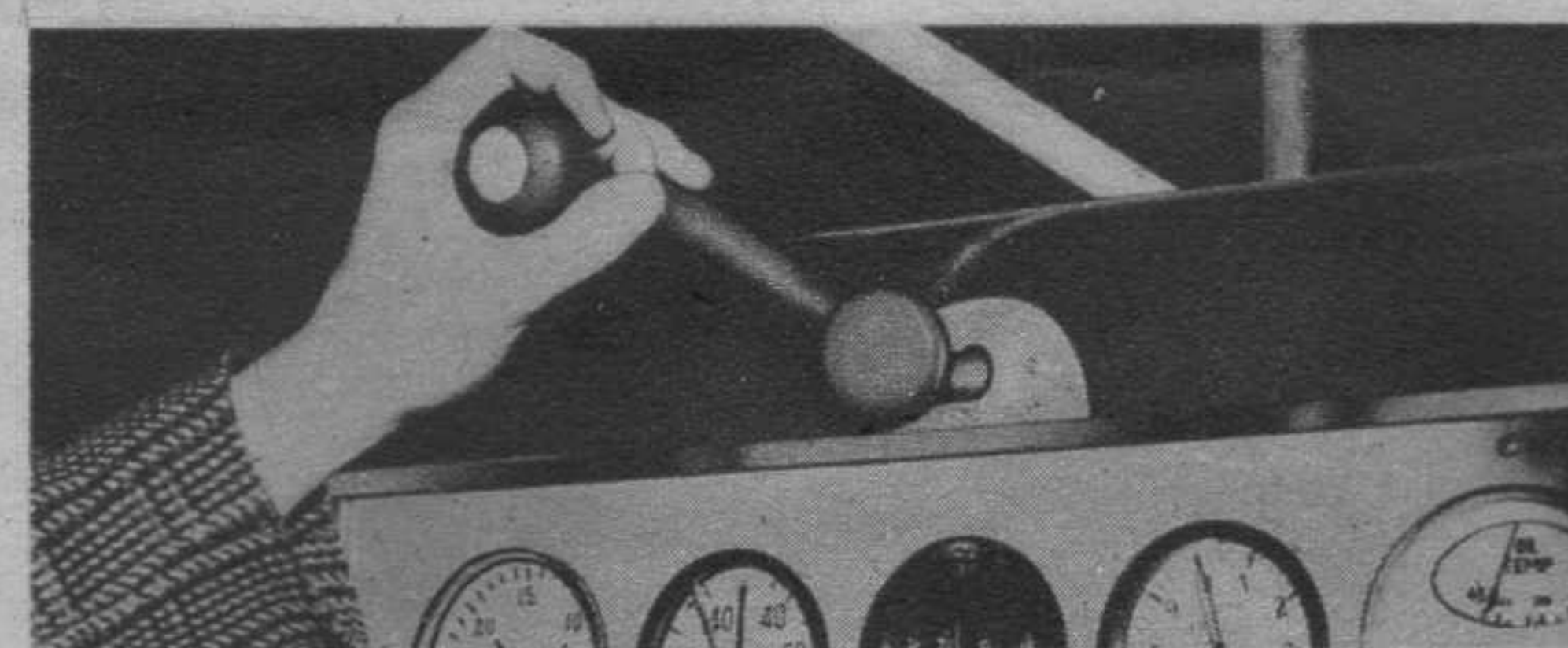
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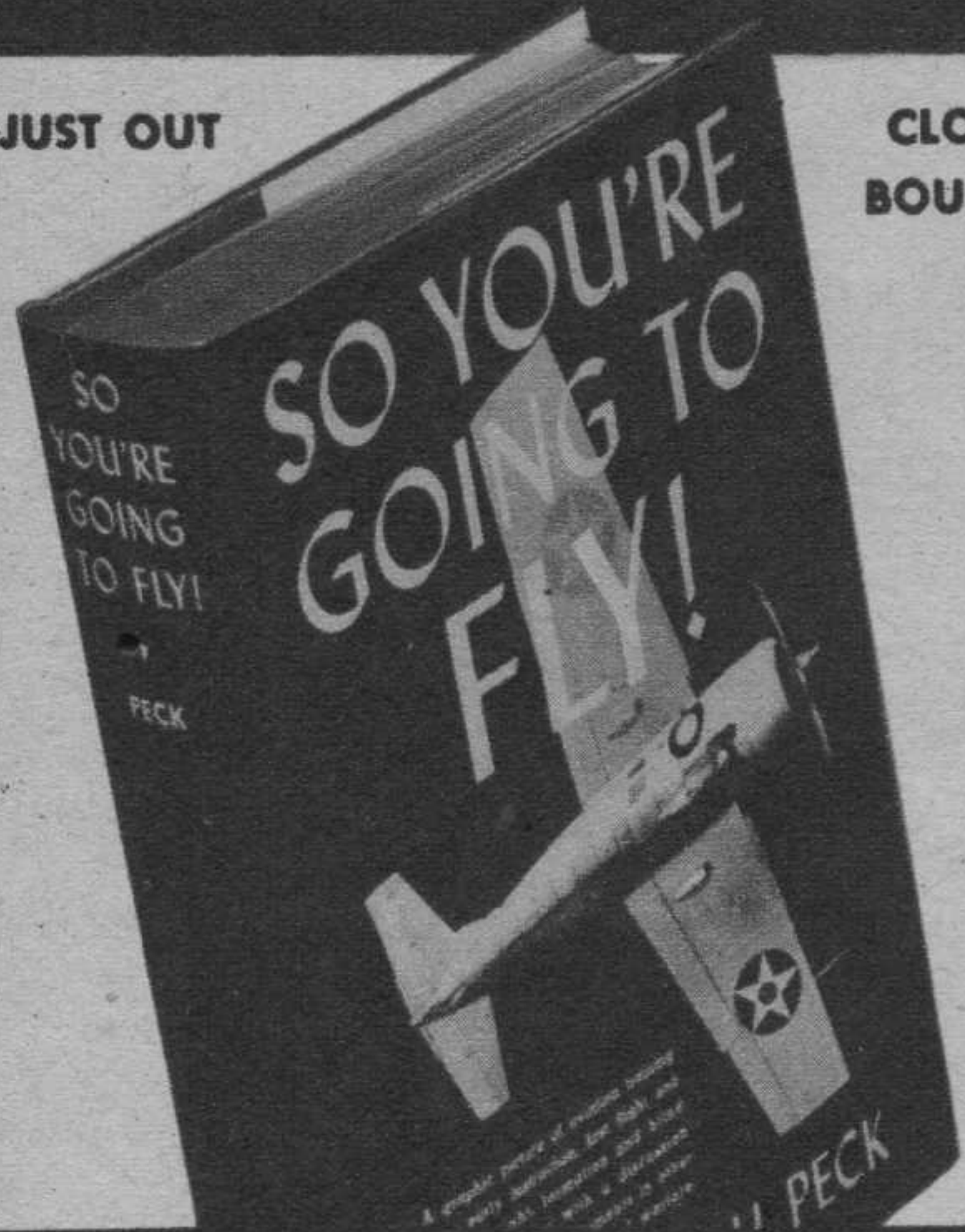
(Continued from page 30)

FOR YOU WHO WANT WINGS

This Book Tells How
To Get Them!

JUST OUT

CLOTH
BOUND



SO YOU'RE GOING TO FLY!

By JAMES L. H. PECK

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His book begins with the very first step, the doctor's examination. Next it tells you how to get your Student Pilot's license. Then come the lessons. It explains all the phases of the ground course in mechanics, navigation and instruments. All your hours in the air with the instructor and on your solo flight are described. The latter half of the book discusses both military aviation—with the fleet, the Army Air Corps, combat, observation, bombing, etc.—and commercial aviation, including Atlantic and Pacific flights. Only a chosen few can ever be fliers! YOUR chances of being chosen will be doubled if you get this book and really use it.

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ground and in the air—is fired in short bursts, very short, almost as quickly as the button can be depressed and released. So it is that eight machine guns firing forward from an airplane would deliver, during the second the pilot was actually on the target, somewhere around a thousand bullets, depending on the caliber of his guns. The larger the caliber the slower the rate of fire. Machine guns of .30 have been stepped up to the point where they can fire at the rate of fifteen hundred rounds per minute. The 20-mm. guns—just short of three quarters of an inch—fire at the rate of one hundred and twenty rounds per minute. Some of the 37-mm. guns are stepped that high for anti-aircraft fire, but not for firing from planes. These larger guns have the decided advantage in that one of their explosive shells will do more damage than a hundred of the smaller machine-gun bullets.

Undoubtedly the most valuable adjunct to practicing aerial gunnery is the camera gun. This, too, was developed during the last World War, but has since been perfected to the point where it is almost as good, if properly used, as the real machine gun. The latest type camera guns are movie cameras mounted exactly as a machine gun. The regular sights are used and the same firing mechanism. The pilot aims his ship as though in combat, fires his burst and the target is photographed on the film over an imposed image of the sights. In some cameras a clock is inserted in the camera and the

exact time of firing is also recorded on the film.

Several pilots go up for combat practice and when they return to the ground the films from the camera guns are developed and the results analyzed. They show first the exact time the shots were fired, thus establishing which of two planes might have got in the first fatal burst. They show the target ship, its exact position in relation to the firing plane when the picture was made. By this simple process of photographing the target against the ring sights and knowing the exact speed, the percentage of hits and misses can be figured and corrections made. There was never a better lie detector than the aerial camera gun; it furnishes proof in black and white. The British have realized this to the extent that many of their fighting planes are equipped with camera guns in addition to their regular quota of machine guns and cannon. Every time the fighter pilot fires a burst at an enemy plane the camera operates and the pilot comes back with an indisputable record of his accomplishments. If he comes back with his ammunition expended and no enemy plane recorded on his film he is packed off to an aerial gunnery school for more practice.

There is one element of aerial gunnery that has not changed since its inception, and that is the necessity for study and much practice. The principle is simple, but it takes a lot of experience to make a first-rate aerial gunner.

Reviewing Stand

(Continued from page 27)

Book of Modern Airplanes. By Harold H. Booth. (Garden City Publishing Co.) The author-illustrator presents in this aviation "picture book" twenty-three excellent pencil drawings in color of various foreign and American planes of well-known types. The end pages contain fourteen silhouette drawings showing various types of wing placement and type details. While in no sense a technical work, much information is contained in these drawings and the younger aviation fan will enjoy the various types presented. A foreword by Colonel Roscoe Turner gets it off to a good start.

A. B. C. of Aviation. By Victor W. Pagé. (Norman W. Henley Pub. Co., \$2.50.) This work, an old stand-by for many years, has been revised and enlarged with many added pages and chapters. Its hundreds of photos and diagrams, some of which will be familiar to readers of Air Trails, make this work interesting reading. The statement that this is an "elementary introduction to the study of aviation for students, mechanics and non-technical people wishing a ground-work in basic aviation fundamentals" seems well backed up by the contents.

Aircraft Electricity. By Norman J. Clark and Howard E. Corbitt. (The

Ronald Press, \$2.50.) Good reference books, while never "best sellers," should find a ready market in the trade if they give real information in well-arranged form. Such a trade book is "Aircraft Electricity." The coauthors of this book have aimed its contents at electricians and designers of modern aircraft. The many charts, tables, scales and photos of wiring diagrams should be of great practical value to this book's many potential buyers.

Navigation of Aircraft with Air Pilots' Dead Reckoning Tables. By Logan C. Ramsey. (The Ronald Press Co., \$4.50.) These two books are to be used together for the study of air navigation by the serious student, advanced pilot, or air navigator. Commander Ramsey has certainly covered the subject completely and, through his vast knowledge of the subject, in a comprehensive way. The first of the two books covers all phases of navigation and the instruments used in this exacting science, while the second volume consists of the important data and tables necessary for the practical use of navigation knowledge and instruments. While not for the novice, these volumes should be invaluable to the men making a serious study of aerial navigation.

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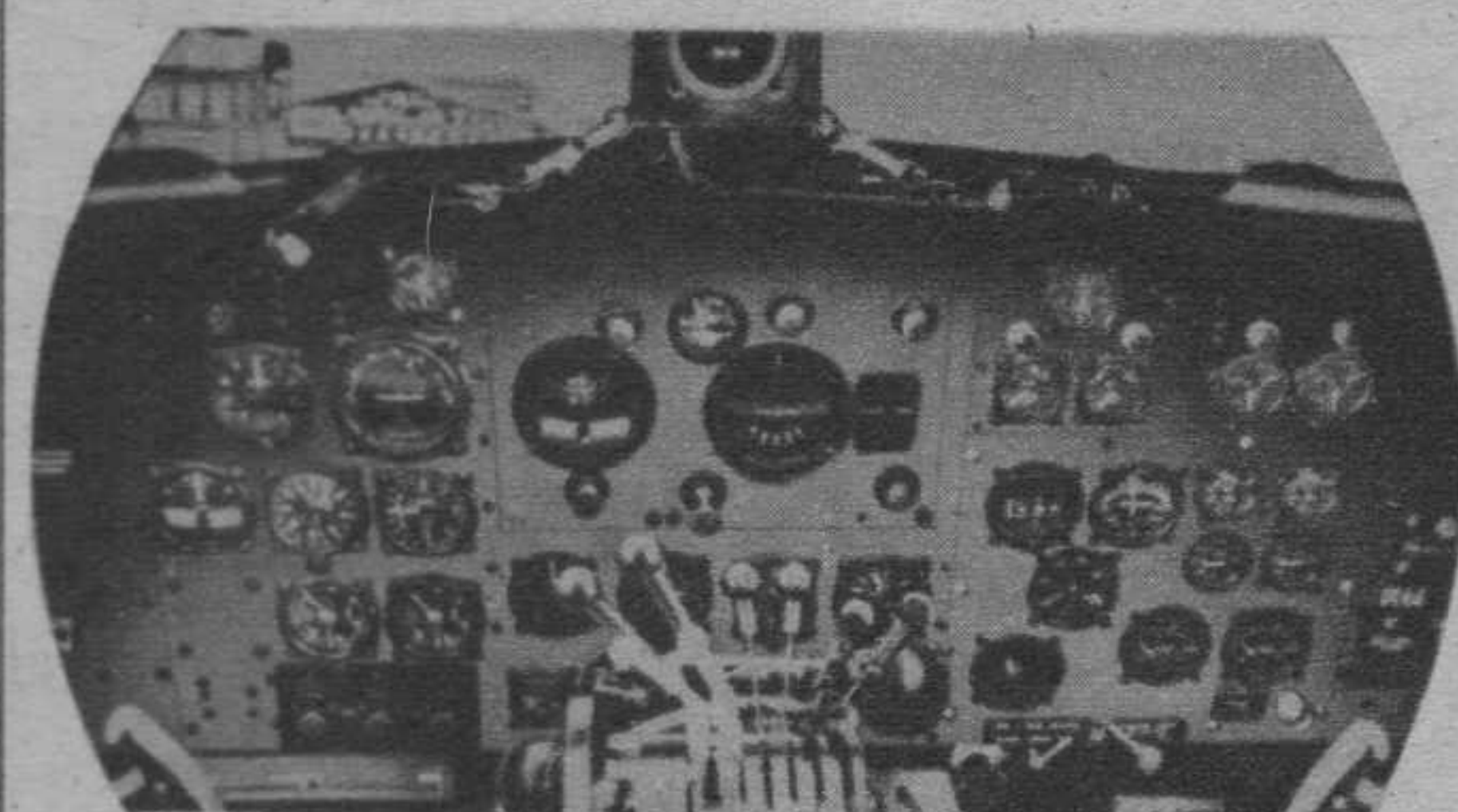


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Service Test—Rush!

(Continued from page 17)

Around the cockpit and the motor, which rests underneath the pilot in the center of the plane's fuselage, is three-quarter-inch armor plating. In Europe the armor used is never more than one-half inch.

The light caliber .30-caliber guns used in the foreign turrets are not capable of penetrating the three-quarter-inch armor on the Airacobra, which could safely approach very near to any of the European bombers and blast it from the skies with its heavy fire power without endangering its own pilot.

Tests run with the new guns at Patterson Field on the ground show that at 200 yards the .30-caliber bullets are stopped cold when they meet with one-third-inch armor plating. The .50-caliber bullet "cuts through it like butter," at the same range. American planes are all being equipped with .50-caliber guns and 37-mm. cannon. In one test, an attempt to prove the fire power of .50-caliber guns, the bullet pierced the outer skin of an airplane, tore through three bulkheads, a one-third-inch plate of armor and smashed through the other side of the ship's skin after the bullet had flattened itself out. This is fire power unexcelled.

Our planes are also being equipped with the electrically controlled revolving gun turrets that you've heard so much about. There are three companies in America today producing the turrets for our bombers as fast as they can be turned out. One of the newest planes under test is equipped with three of these gun turrets, one in its tail, another on top of its fuselage and still a third beneath. The plane has no blind spot.

New methods of testing have been developed that help to speed up the program. When pilots take a pursuit plane up to "give it the works," usually a magic camera goes along as a third pilot. Mounted in the airplane so that its wide-angle lens films a set of instruments that tell speed, altitude, oil pressures, gas consumption, r. p. m.'s, et cetera, the camera

takes pictures that record the plane's actual performance by recording the readings on its instruments. The film is studied closely on the ground by engineers and experts.

On the big bombers, crew members stationed at the different posts have small movie cameras that they use to film instruments at the various test boards inside the ship. Sometimes a camera is mounted on engine nacelles to record bullets as they pass through the whirling propeller blades, color cameras film exhaust stacks to show how the metal is holding up. And oftentimes the camera eye reveals deficiencies that the human eye cannot see.

Landings and take-offs are also filmed on motion-picture film. A course is marked off and from the sidelines movie camera crews follow the airplane from a fifty-foot altitude down to earth until it rolls to a complete stop. In this way the engineers and test experts learn how long runways must be for their big ships. Pilots are told what size fields to pick for operations. The same procedure is applied to the take-offs.

The spin test is one that is required of every airplane, especially the pursuits and fighters. Special safety devices have been developed to eliminate the hazards for pilot and machine. A small parachute is attached to the rudder of the airplane and when the plane is in a spin the pilot releases the 'chute which snaps the rudder into a normal position and straightens the ship out into a dive. A dive is a simple maneuver for any pilot to pull out of, but spins are dangerous. Thus, when ships are proving too difficult to bring out of tailspins the spin 'chute is used and it has saved many lives.

The story could go on forever—the story of wings under test. Planes in the sky, dipping, soaring, night and day. It is an impressive picture. One that leaves you with a feeling of security—that Uncle Sam's wings are being made safer than any in the skies.

Supercharged Pilots

(Continued from page 15)

loses consciousness so quickly and so easily that there isn't time to realize it. Nor is there time to take steps to prevent it. In such high altitudes and low pressures, the amount of oxygen in the lungs (the alveolar oxygen) is very small. This means that it is impossible to hold one's breath for a minute, as one might while diving. In fact, ten seconds will mean that a pilot may pass completely out. And also, the carbon dioxide in the lungs is very small, which means that one may forget to breathe! Moreover, removing the pipe from the mouth and then replacing it does not signify that recovery is possible, because oxygen itself is not a respiratory stimulant—oxygen alone will not start a pilot breathing.

What is the lesson from this near-accident? Simply that our pilots are now learning that they must be "supercharged" before quick ascents to the stratosphere. By going into a chamber containing pure oxygen and no nitrogen (our air at sea level contains one-fifth oxygen, four-fifths nitrogen) and breathing this oxygen, say for half an hour, a large part of the nitrogen in the blood is eliminated. By exercising mildly during this period, nearly all of it is expelled.

That's the first step.

After the supercharging or pre-decompression period is over, the pilot takes his oxygen mask with him, leaves the chamber, and steps into his interceptor fighter. *Without*

(Turn to page 36)

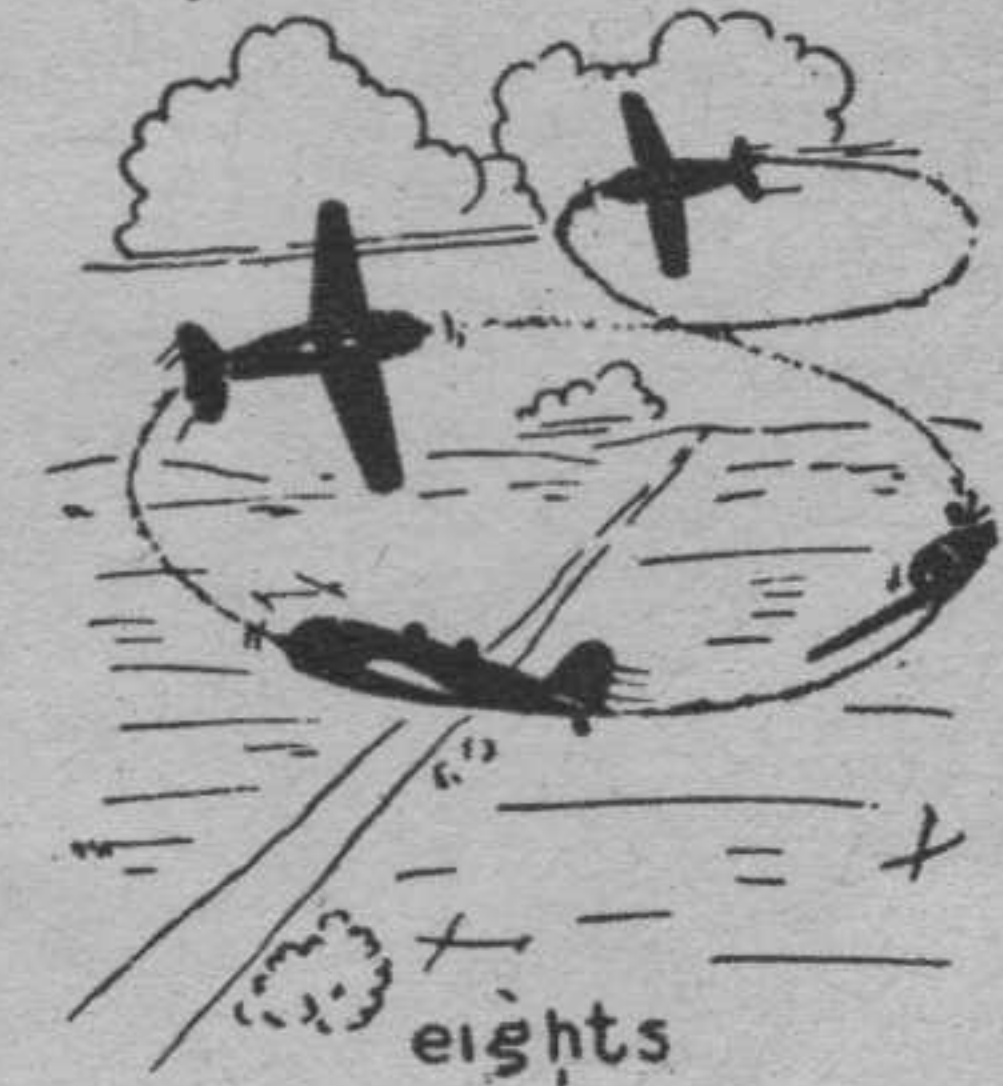
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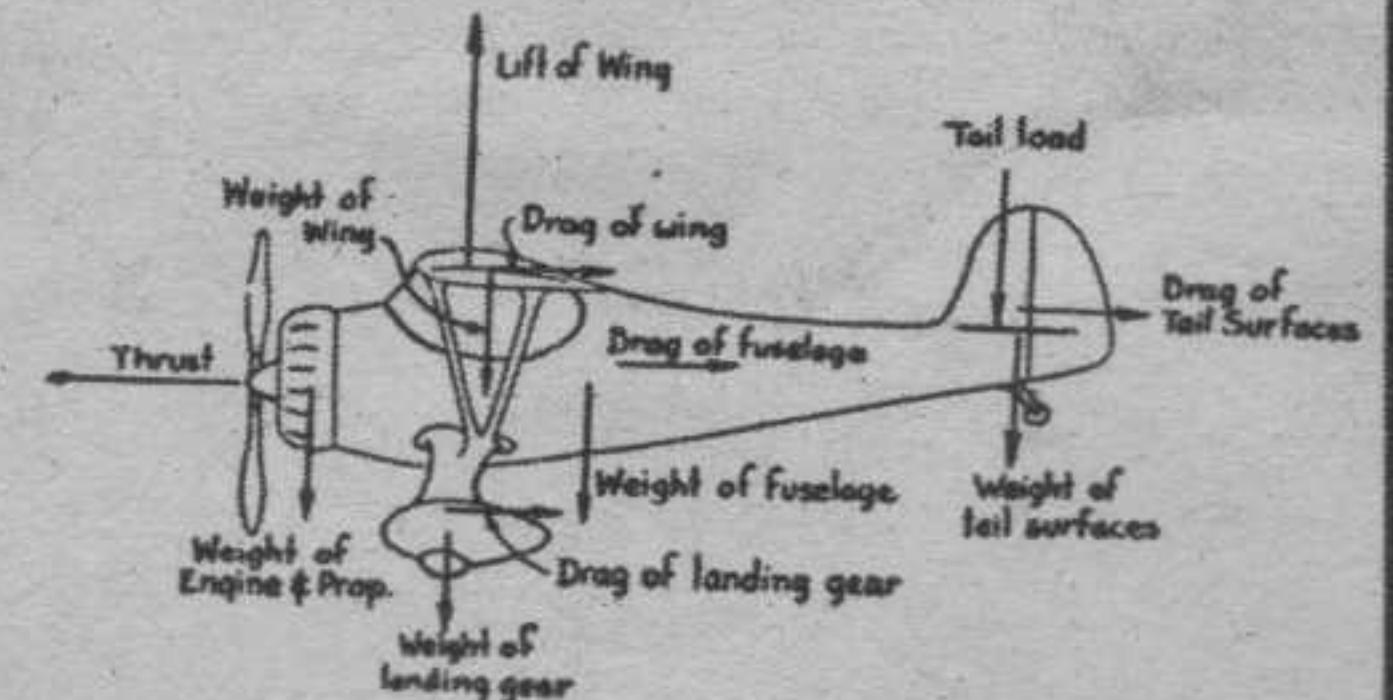


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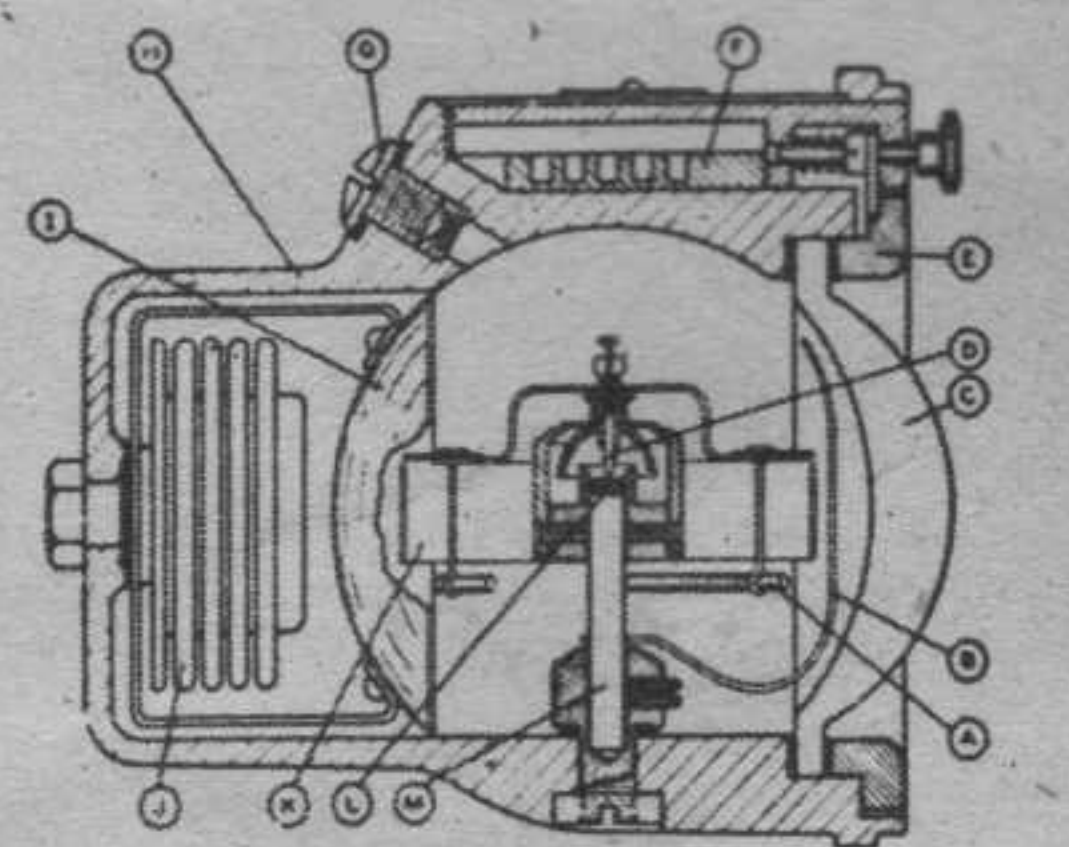
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AIRCRAFT INSTRUMENTS Their Theory Function and Use

By ORION EDWARD PATTON

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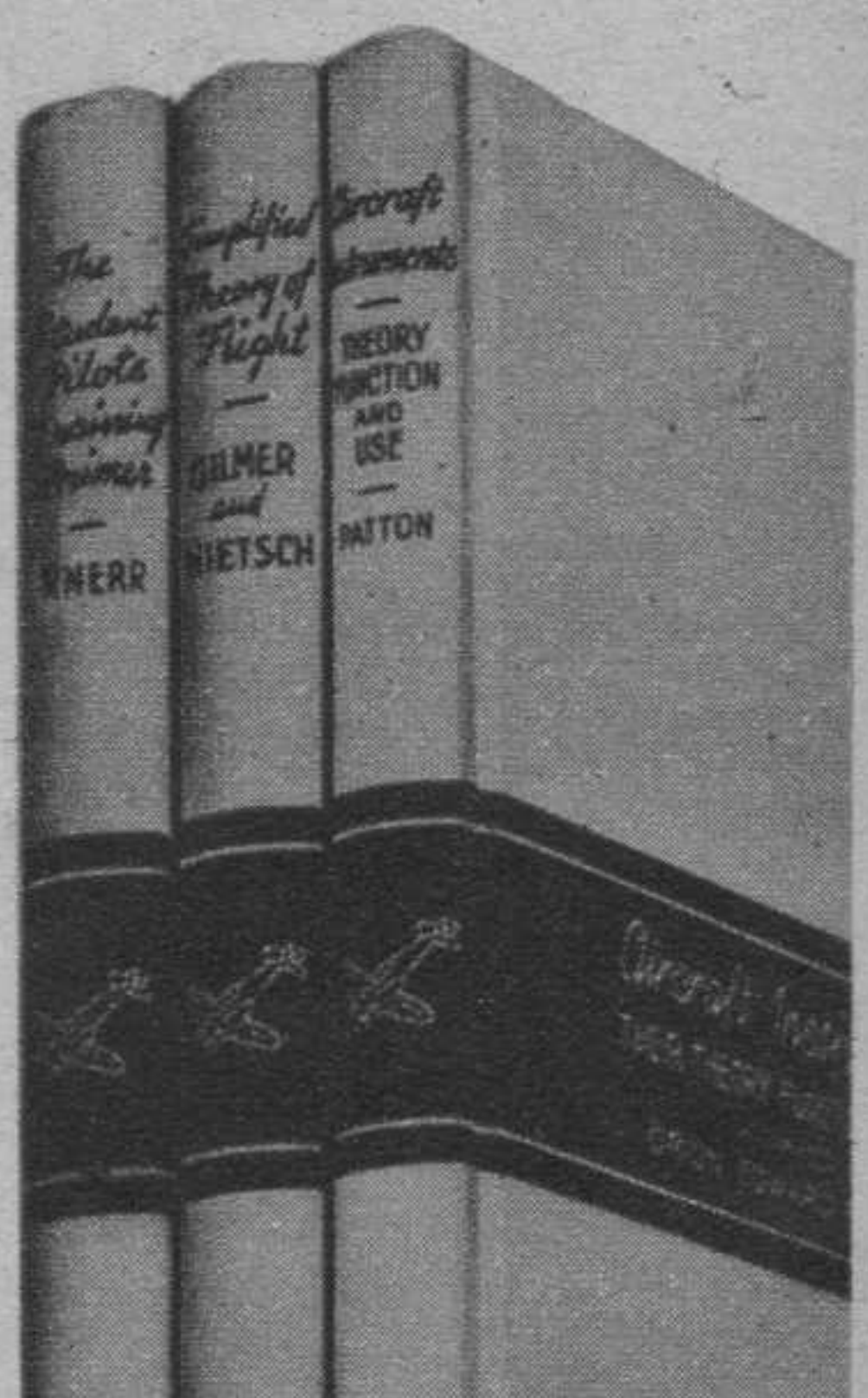
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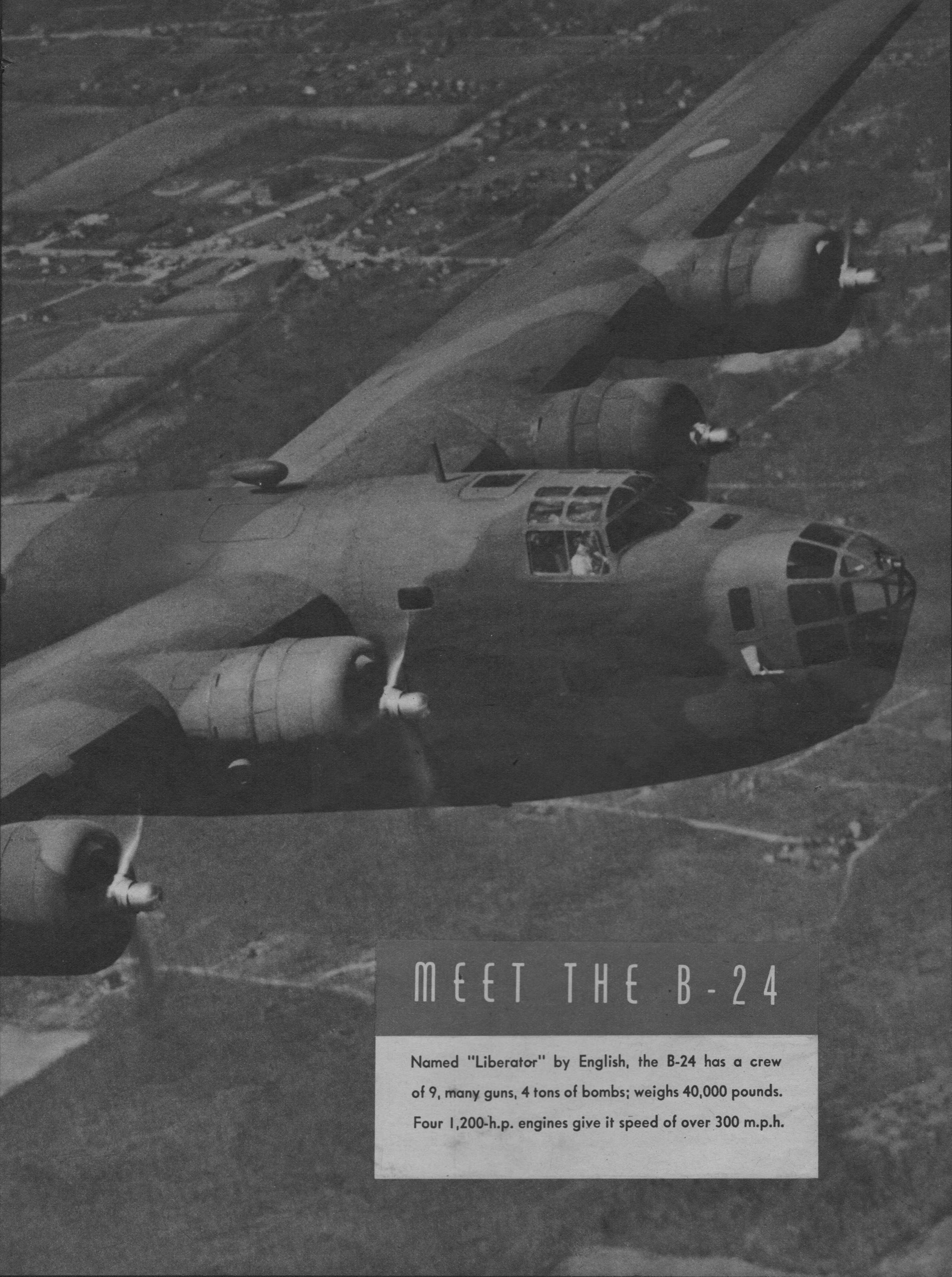
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