Excerpts from

The Modern Wonder Book of the Air

(Published in 1945)

In 2009, and totally by chance, an Internet search revealed that the name “Kirt Hine” appeared somewhere in a book titled “The Modern Wonder Book of the Air”. I was able to purchase an old and very used copy of the book and identify where Kirt was mentioned.

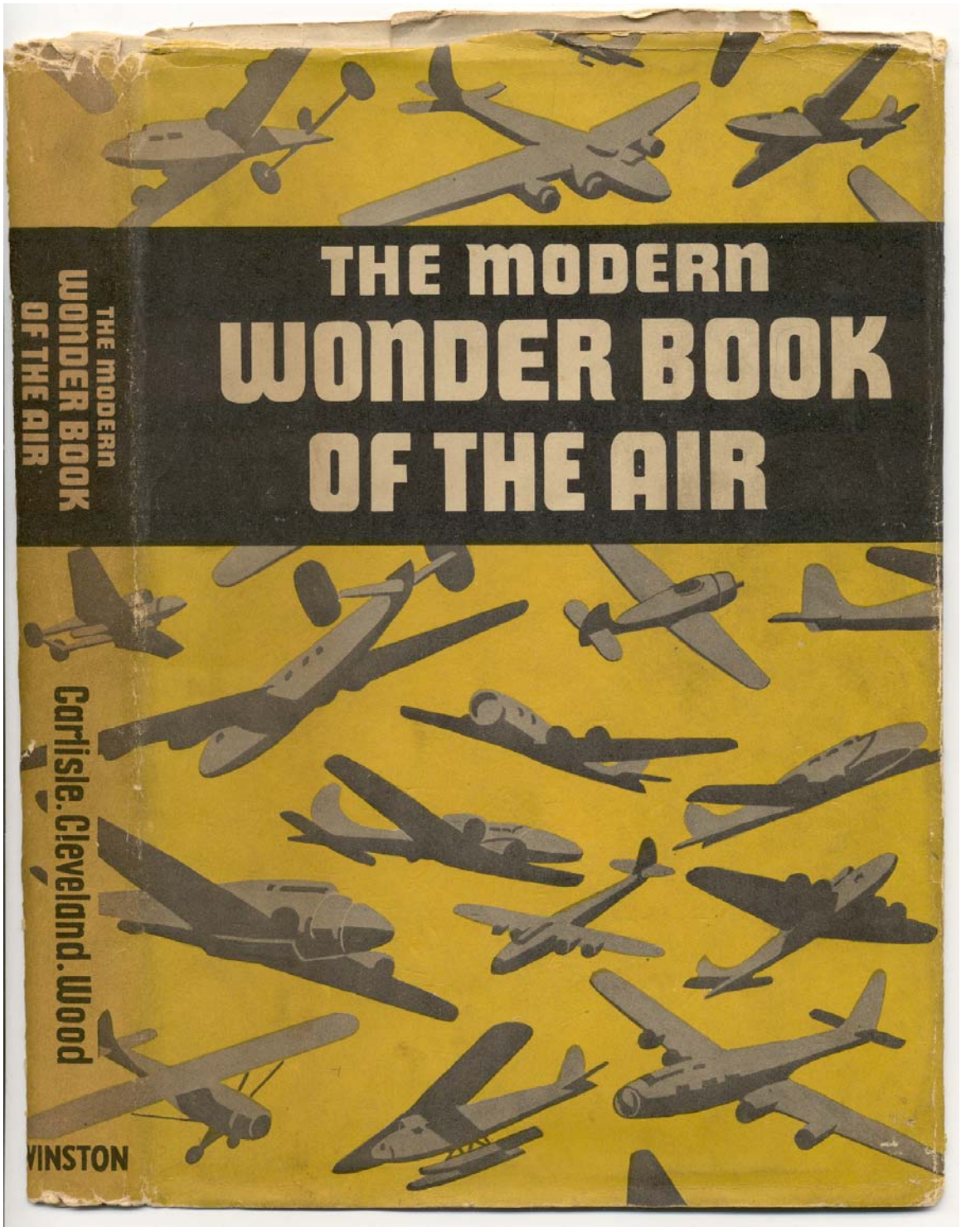
I suspect that Kirt probably never know that he was mentioned by name in a book but it’s clear that the authors interviewed him during the World War II years regarding propeller de-icing tests when Kirt was running Curtiss-Wright’s Propeller Division’s Flight Test program. I have no idea why Kirt was mentioned by name as there are almost no other specific names referred to in the book. (I note that on page 83 Kirt is referred to as “engineer in charge of the Propeller Division” which makes it sound like he ran the entire division. He was in fact the engineer in charge of the division’s flight test program.)

The 316 page hard cover book published in 1945 appears to me as if it was written as perhaps a text book for high school or college level students with the intent of giving them an overview of the history and current state of aviation. It isn’t terribly technical, is easy to read, and covers a wide variety of aviation subjects.

For the purposes of this document I’ve only scanned a few of the book’s pages including the dust jacket front cover and inside front flap, the copyright page, the index page, the photo credit page, and finally pages 78 through 84 as this is where Kirt is mentioned (page 83) and these pages contain a pretty good description of what a propeller does and how one works (obviously written before the top secret reverse pitch propellers were public knowledge.)

Page 79 contains a photo of Kirt’s flight test B-25 bomber with it’s boom designed to spray water on propellers in flight to allow testing of propeller de-icing technologies.

Ted Hine
February 2010
Louisville, CO


THE MODERN
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THE MODERN WONDER BOOK OF THE AIR
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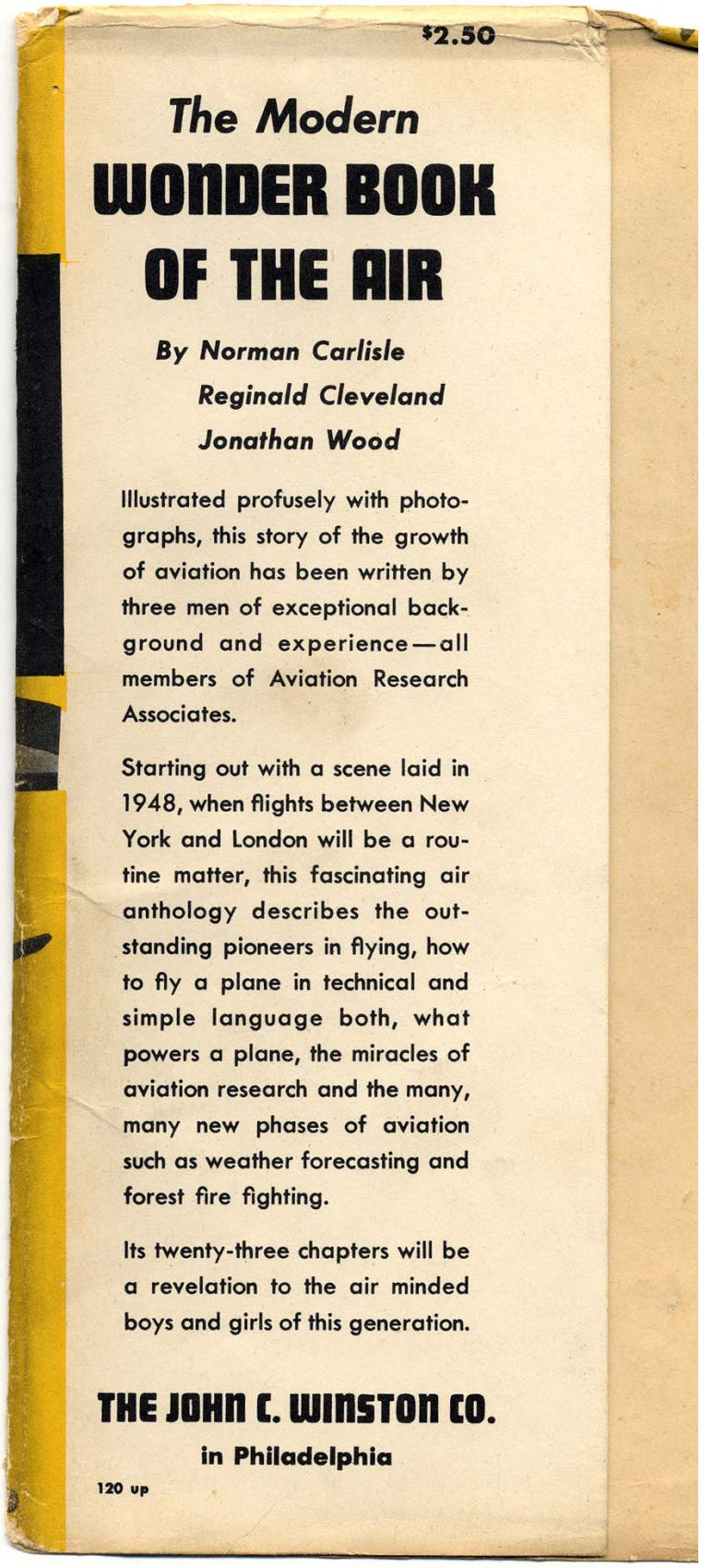

$2.50

The Modern WONDER BOOK OF THE AIR

By Norman Carlisle
Reginald Cleveland
Jonathan Wood

Illustrated profusely with photographs, this story of the growth of aviation has been written by three men of exceptional background and experience—all members of Aviation Research Associates.

Starting out with a scene laid in 1948, when flights between New York and London will be a routine matter, this fascinating air anthology describes the outstanding pioneers in flying, how to fly a plane in technical and simple language both, what powers a plane, the miracles of aviation research and the many, many new phases of aviation such as weather forecasting and forest fire fighting.

Its twenty-three chapters will be a revelation to the air minded boys and girls of this generation.

THE JOHN C. WINSTON CO.
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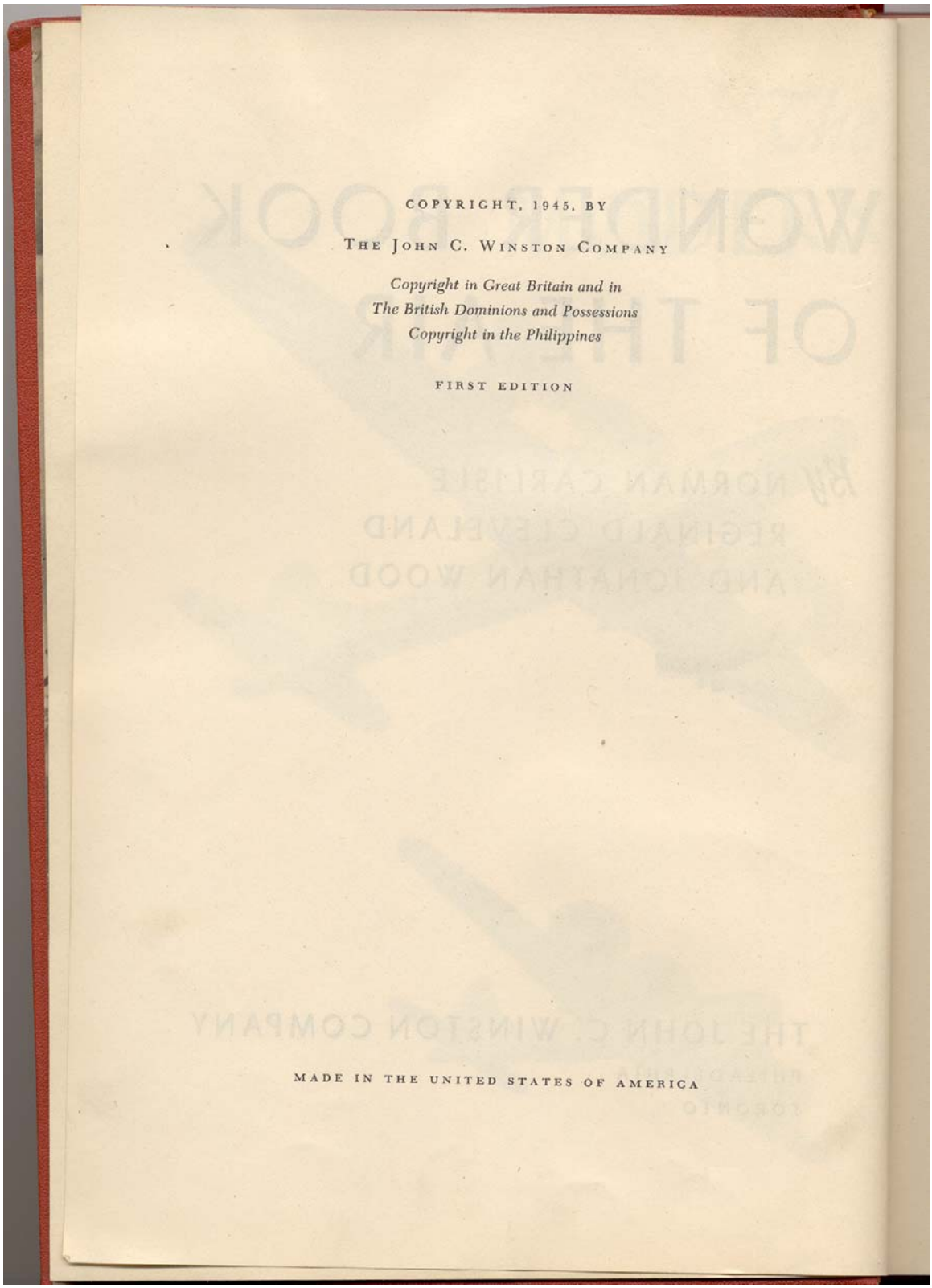

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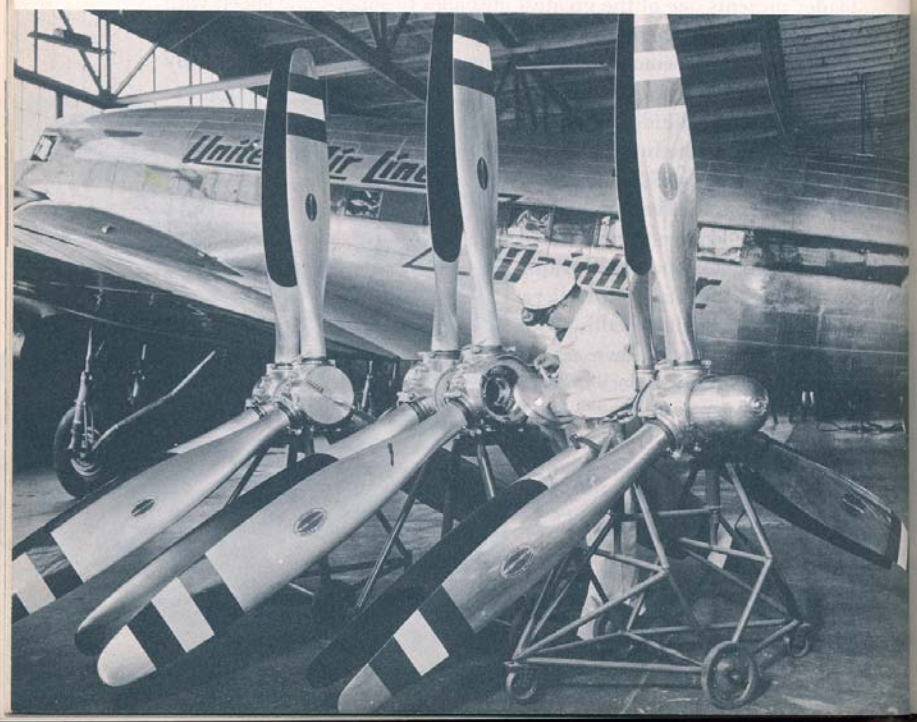
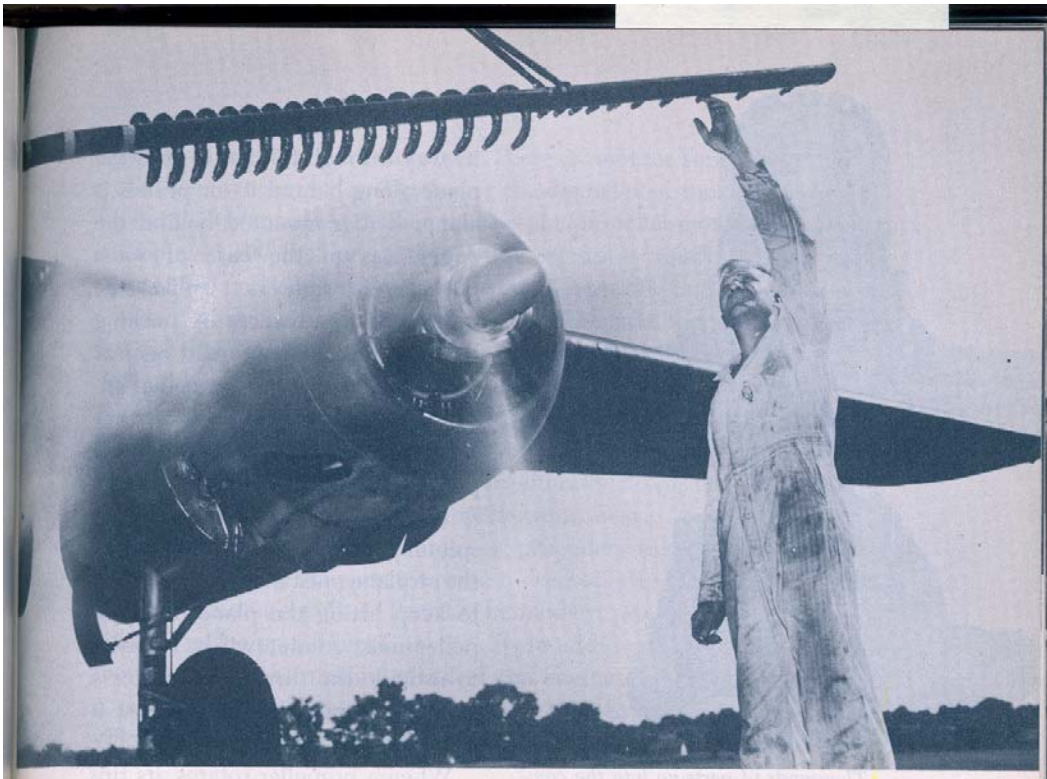
propellers more or less for granted. But the spectacular airplane performance that has become accepted today is due in large measure to the miracle of the modern, automatically controlled propeller, composed of hundreds of precision parts.

It is a far cry from the old, wooden, fixed pitch propeller to the electrically controlled, constant-speed, metal propeller such as that developed by the Curtiss Propeller Division for modern powerful, high altitude, long-range fighter bomber and troop transport planes. However, during aviation's span of life the function of the propeller has remained unchanged—to propel the plane through the air. The propeller, which converts engine power into thrust that actually flies the plane, is as much a part of the plane's power plant as is the engine. This fact is seldom appreciated by those outside the fields of aviation engineering and aerodynamics because most of us do not even see the propeller very often. When a propeller is doing its best work, the whirling blades are virtually invisible.

The propeller is a primary factor in determining the speed at which the plane can cut through the air. Its job can be compared to that of

These gleaming propellers have just been overhauled, and are ready to go back to their jobs aloft.





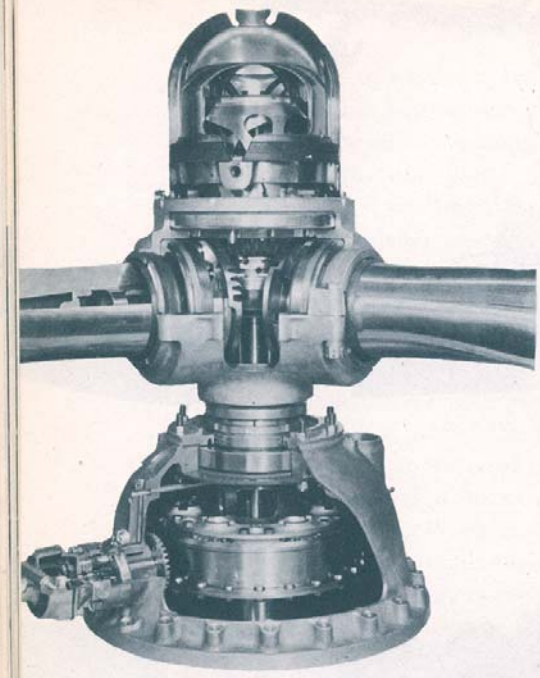
The nozzles in this testing device spray the propellers with water. At 20,000 feet ice forms, to permit engineers to test the value of de-icing equipment.

the transmission and rear wheels of an automobile—to absorb engine power and to convert this power into forward motion.

For instance, if the angles of the blades of a full-feathering propeller are likened to the various gear settings of an automobile, we can draw a direct comparison. Low gear on a car is utilized for starting; low blade angle is used when the plane is taking off. Medium blade angle corresponds to second gear, and the greatest blade angle to the automobile's high gear.

The new electrically controlled propellers differ from the transmission in a car in that it is not necessary to shift gears for the various conditions of flight. Such shifting or blade angle-changing, which enables the airplane engine to maintain constant speed whether climbing, cruising, or diving, is handled by a governor which automatically operates the blade pitch-changing mechanism.

Perhaps the best way to think of a propeller is as a screw that works its way through the air in much the same manner that an ordinary screw works its way into a piece of wood. When the propeller screws



Thousands of parts go into the complicated mechanism of a modern propeller.

its way through the air, it pulls the plane along behind it—or pushes it along, if it is mounted behind the engine, as in the case of some pusher-type fighters. Unlike the screw, which advances by pushing the rear face of its thread against the wood fibers, the propeller advances by creating in front of itself an area of suction into which the propeller is then drawn.

The propeller is really a set of spinning airfoils. Just as the wing of the airplane must move forward fast to keep lifting the plane, the propeller must rotate swiftly in order to provide the thrust. The faster a propeller turns, the more thrust it provides.

When a propeller rotates, its tips must travel a greater distance than that part of the propeller closest to the hub. Yet they must cover that greater distance in the same length of time. Therefore they must travel much faster than the center of the propeller. For that reason, the blades are twisted so that the blades can meet the air at their best "angle of attack" along their entire leading edge.

The work of the propeller is not easy. The propeller must struggle constantly with drag, which acts on the propeller more than it does on the wing because of the propeller's speed of rotation. Many of the principles that are used by designers to minimize wing drag are also used by propeller manufacturers.

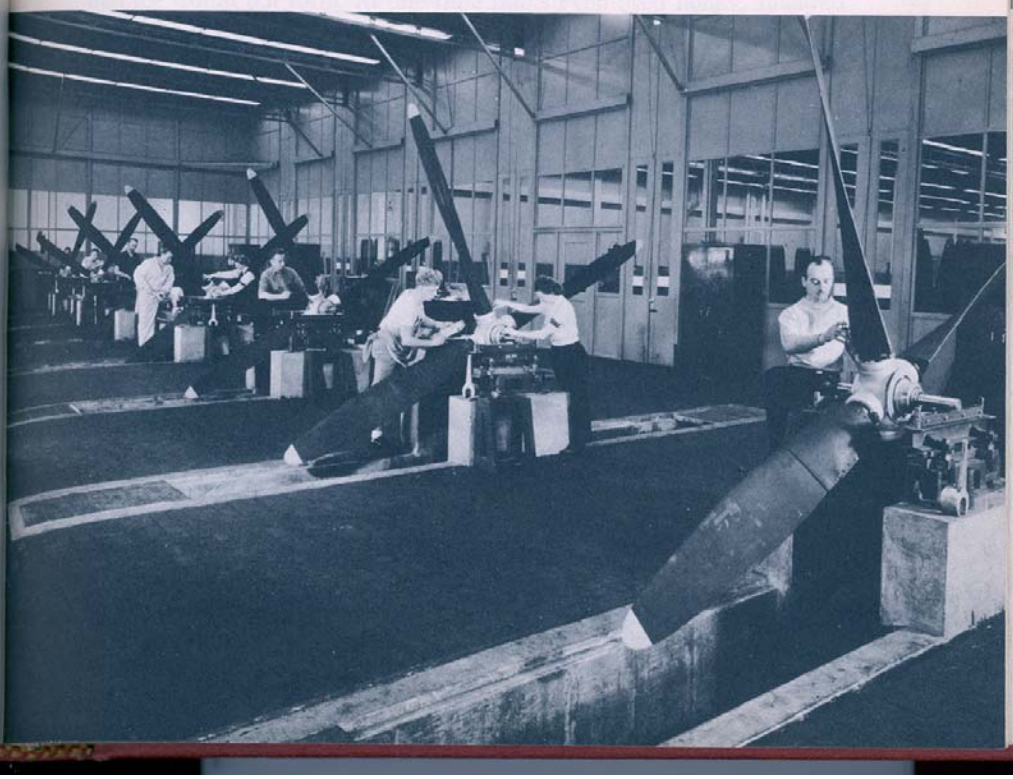
Increasing the area of the blades is one way of increasing a propeller's efficiency. But here engineers meet problems. The diameters of propellers are limited by various factors. Single-engined airplanes must have short propellers that allow clearance when the plane is on the ground. Multi-engined planes sit higher off the ground, so the propellers do not have to be short for that reason. But putting bigger propellers on multi-engined planes means moving the engines farther

apart to give them room to rotate. There is another serious limitation to the size of a propeller. The larger the diameter of the propeller, the higher the tip speed. And when the tips of a propeller move at the speed of sound—1,100 feet per second—they set up a "shock wave" which creates an exaggerated drag condition. There are limitations on the width of propeller blades also. The wider the blade, the heavier it must be, and this results in greater drag and weight for the plane.

Hamilton Standard engineers found one solution to the problem of increased blade area. They extended the diameter by making the blade paddle-shaped from the shank outward. The paddle blade is wider, has a more rounded tip, yet is still structurally strong enough to withstand the many stresses that a propeller must bear.

There have been many changes in propellers since the early fixed-pitch type. Those propellers were required only to convert the power of the engine into pull, or thrust. The modern propeller plays a versatile role in the operation of its aircraft. In addition to providing thrust, it now maintains constant speed of the engines. It even regulates, to a certain extent, gasoline consumption, thereby providing maximum efficiency with minimum fuel consumption.

Propellers must be perfectly balanced before they leave the factory to be installed in airplanes.



Modern propellers are adjustable over a wide range of angles to meet all operating conditions. The high pitch settings provide for high speed at sub-stratosphere altitudes and limit engine speed during dives. The range of these electrically operated propellers is unlimited. Control may be maintained through any position from reverse to feather, and easily adapted to any operating requirement.

Whenever propeller engineers get together, the term "full-feathering" is bound to come up. Full-feathering a propeller means changing the angle of the propeller blades so that the edges lead into the wind. There are definite reasons for full-feathering and it has many advantages. In the case of multi-engine planes, if a motor stops, the job of the remaining motor or motors is to pull or maintain the forward motion of the plane, thus carrying the burden of the inoperative engine. This naturally throws an additional load on the propeller of the working engine and tends to decrease the r.p.m.s of that engine. But with the full-feathering constant speed propeller, a governor unit overcomes this tendency of the engine to decrease in r.p.m.s by automatically changing the pitch of the working propeller to hold the motor at its proper power output. With this full-feathering control the pilot is also able to keep the "dead" prop from turning, or windmilling, so that drag is eliminated.

Gases emerging from the nozzles of the jet engines drive this plane through the air at tremendous speeds.

There is power in those whirling blades!

Ice is one of the worst enemies of the propeller, and scientists are doing their best to fight it. The search for a solution to the threat of ice on propeller blades is one of aviation's oldest puzzles. At first, the answer was sought in *anti*-icing—that is, preparing the blades in such fashion that ice would not form. At one time pilots even used honey, smeared on the blades, and since then every substance from road tar to ski wax has been tried—and is still being tried.

Then came *de*-icing—getting rid of propeller ice after it has formed. It had become apparent that even the most effective forms of anti-icing solutions found have lost effectiveness after a relatively short time in the air.

Because of the valuable information gained through de-icing and many other propeller tests, the Army made a medium bomber available to the Propeller Division of Curtiss Wright for use in such tests. The job of Kirt Hine, engineer in charge of the Propeller Division, was to make the bomber a "flying refrigerator."

First—how to carry enough water aloft to make the ice? Into the bomb bay of the plane went a 400-gallon tank.

Next—how to spray this water to the propellers? A seven-foot hollow strut was obtained. To this was fitted forty-four atomizer nozzles. The device was rigged from the fuselage outward, parallel to the port propeller disc and about three feet in front.

Then—how to govern this device so that all atmospheric conditions could be simulated and ice made to form at any season? Electric pumping solved that, at the rate of six gallons of water each minute. Electric heating coils around each nozzle kept the water from freezing before it was sprayed on the blades.

Weather conditions under which propellers "ice up" vary, of course, in intensity, and these variations are simulated on the test plane by regulating the water pump or by previously changing the nozzles to vary the density of the spray.

The de-icing solution itself is released by another ingenious arrangement. Electrically pumped from a tank in the fuselage, through a slinger device, the solution pours out at the shank of the blade, into a grooved rubber shoe to the blade tip. There, through a slit in the rubber, it spills out over the entire surface of the blade.

At 20,000 feet, the testing pilot will level off and fly evenly, and the flight test engineer with him presses a button on the instrument panel. Immediately, from the forty-four nozzles jets of water forcefully strike the whirling blades of the portside propellers. A twin-engine plane is used so that the danger of deliberately icing a propeller in the air is minimized.

Ice forms at once. Great chunks of it fly off to beat a fierce tattoo on the fuselage. But most of it remains on the blades.

The test plane falters; loses speed. Tail and wings begin to vibrate. The starboard propeller continues to run smoothly, but the portside blades, now thoroughly iced up, begin to vibrate. The portside engine fights to regain control over the enemy ice.

This is what happens to a plane when ice forms on the propeller blades. Although this flight test ice is artificially produced, it is the same kind of ice—and just as dangerous—as that which imperils pilots at freezing altitudes and in Arctic and sub-Arctic areas.

The flight test engineer, intently watching the iced propeller, presses still another button on the panel. A de-icing solution, being tested on this current flight, is released to spill over the surface of the blades. A color camera is aimed at the now feathered blades of the iced propeller. Later, these pictures will be used to compare the results of this with past and future de-icing tests. This is de-icing in action—one of the most constant of a propeller division's activities.

The propeller may yet find new ways to overcome its problems and compete with its rival, jet propulsion.