Reading

The Invention of Variable Pitch Propellers

Until the late 1920s, airplane propellers were made of a single piece of wood attached at the center[1] to the driveshaft of the engine. The tilt of the propeller, that is, how flatly it faced the wind, was fixed, which meant planes flew as if they had only one gear. If the plane had a fine propeller, it traveled the entire time as if in first gear, working well on takeoff and landing but working inefficiently during sustained flight. If the plane had a thick, coarse propeller, it traveled the entire time as if in high gear, working efficiently during sustained flight, but making takeoffs and landings dangerous and prolonged. This inflexibility meant that commercial uses of such aircraft were limited because the planes could not carry heavy loads either safely or efficiently.

In 1922, Wallace Rupert Turnbull patented his latest invention, the Variable-Pitch propeller. His propeller in effect gave airplanes gears. The propeller's blades were separate from each other, attached at the driveshaft in the center, and could be moved independently or together to chop the air at different angles. The propellers could be tilted at takeoff and landing to act as if in first gear, chopping less air with each rotation, and could be tilted when cruising to act as if in high gear, chopping more air with each rotation. With this Variable-Pitch propeller, planes could now take off and land more safely and reliably, carry varying weights, and handle greater variations in wind speed and turbulence.

Turnbull was born in New Brunswick in eastern Canada in 1876. He studied mechanical engineering at Cornell, then continued his post-graduate studies in Europe, and returned to work at the Edison labs in New Jersey. In 1902, just one year before the Wright brothers made their historic flight, Turnbull went back home, set up his own lab in a barn, and started running his own aviation experiments.

To begin, Turnbull needed a wind tunnel. He built a wind tunnel, the first in the world, out of packing materials. In it, he tested different designs for propellers and wings; his research is the basis for many of the successful designs still in use today. Alone in his barn, Turnbull designed and tested his Variable-Pitch propeller. It was tested successfully in flight in Borden, Ontario, on June 6, 1927.

Turnbull spent his life experimenting and designing for the new science of aviation in his barn in Rothesay. He sometimes conferred with fellow aviation enthusiast Alexander Graham Bell in Nova Scotia, but for the most part, he worked in isolation. Unlike most engineers, he chose not to work in a university laboratory or in a lab such as Edison's, where

[1]BrE: centre

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he would have been supported by like-minded engineers and physicists. Instead, he spent his adult life in a barn he equipped himself. Depending only on his intelligence, curiosity, and work ethic, he revolutionized flight. He is honored[2] in Canada as a pioneer in aviation and a genius in the study of aerodynamics.

Answer the questions about **The Invention of Variable-Pitch Propellers.**

Questions 1–5

Do the following statements agree with the information in the reading passage?

Write

TRUE *if the statement agrees with the information.*
FALSE *if the statement contradicts the information.*
NOT GIVEN *if there is no information on this in the passage.*

_____ 1. A coarse propeller worked better during sustained flight than during landing.

_____ 2. Variable-Pitch propellers caused problems because of their inflexibility.

_____ 3. The blades of a Variable-Pitch propeller could be moved to different angles.

_____ 4. A plane with a Variable-Pitch propeller was easier to handle in turbulence.

_____ 5. Variable-Pitch propellers were expensive to manufacture.

[2]BrE: honoured

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Questions 6–7

Choose the correct letter, ***A, B, C,*** *or* ***D.***

6. Wallace Rupert Turnbull designed his Variable-Pitch propeller
   - **A** at Cornell University.
   - **B** in Canada.
   - **C** at the home of Alexander Graham Bell.
   - **D** in Edison's lab.

7. Turnbull preferred to work
   - **A** with other inventors.
   - **B** in a university lab.
   - **C** with like-minded engineers.
   - **D** in isolation.

My Words

Write the words that are new to you. Look them up in the dictionary and write their definitions.

Words	Definitions

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Word Families

noun	enthusiast	Aviation enthusiasts are very interested in flying.
noun	enthusiasm	Turnbull's enthusiasm for aviation kept him searching for a better propeller design.
adjective	enthusiastic	Turnbull was enthusiastic about aviation.
adverb	enthusiastically	The inventor worked enthusiastically to turn his idea into reality.

noun	inflexibility	The inflexibility of early propellers made planes difficult to fly.
adjective	inflexible	The successful inventor cannot be inflexible.
adverb	inflexibly	An inventor should not work inflexibly.

noun	isolation	Inventors often prefer to work in isolation.
verb	isolate	An inventor may need to isolate herself to do her best work.
adjective	isolated	Turnbull set up his lab in an isolated location.

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noun	reliance	His reliance on others' work caused some to question his research.
verb	rely	Early pilots could not rely on their planes to carry heavy loads.
adjective	reliable	The Variable-Pitch propeller made planes more reliable.
adverb	reliably	A plane with a Variable-Pitch propeller flew more reliably than earlier planes.

noun	revolution	The invention of the Variable-Pitch propeller led to a revolution in flight.
verb	revolutionize	New inventions revolutionize the way we do things.
adjective	revolutionary	Turnbull's propeller was a revolutionary invention.

noun	variable	Researchers look at different variables in their studies.
verb	vary	Planes carry different kinds of loads, and the size of the load will vary.
adjective	variable	It might be more difficult to fly if the winds are variable.
adverb	variably	Planes carry variably heavy loads.

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Word Family Practice

Choose the correct word family member from the list below to complete each blank.

Like most inventors, Wallace Rupert Turnbull was filled with curiosity about many things. He became **1**..... about designing a propeller that would fly more efficiently, during takeoff and landing as well as while cruising. Propellers on early planes were **2**..... , that is, the angle could not be changed, so they did not fly efficiently under certain conditions. Because of this, pilots could not always **3**..... on their planes to perform well. Turnbull worked in an **4**..... barn in New Brunswick to develop a new kind of propeller. He could **5**..... the angle, or pitch, of this propeller, which made it efficient under different conditions. Turnbull's invention led to a **6**..... in flight.

1. enthusiast	enthusiastic	enthusiastically
2. inflexibility	inflexible	inflexibly
3. rely	reliable	reliably
4. isolation	isolate	isolated
5. vary	variable	variably
6. revolution	revolutionize	revolutionary

Unit 10

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Word Skill

Prefix *in–*
The prefix *in–* can make the meaning of a word negative.

Read the sentences. Write a definition for each underlined word.

1. Inventing involves trying out different ways of doing things, so it is important for an inventor to be flexible.

flexible: _____

2. Because the position of the propeller on early airplanes was inflexible, it was always set at the same angle.

inflexible: _____

Listening

CD 1 Track 30

*Listen to the conversation. Choose **FOUR** letters, **A–G**.*

Which **FOUR** facts about the flight demonstration will the students include in their report?

A the name of the plane's designer

B the names of the passengers

C the number of passengers

D the size of the propeller

E the speed of rotation

F the length of the flight

G the weather conditions

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