

## 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<sup>1</sup> 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 drive-shaft 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

<sup>1</sup>BrE: centre

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<sup>2</sup> 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.

<sup>2</sup>BrE: honoured

**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

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

**Word Families**

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

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

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

ESSENTIAL WORDS FOR THE IELTS

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

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

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

**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    |

## 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