



**PAN AM**

Some things you  
might be interested  
in knowing  
about the  
PRATT & WHITNEY AIRCRAFT  
TURBO WASP ENGINES  
on

**PAN AM**  
**JET**  
**CLIPPERS**

# **JET** AIR TRAVEL

*offers you*



## **SUPER SPEED**

Four engines developing the equivalent of more than 50,000 horsepower move your jet airliner at speeds up to 600 miles per hour, cutting your travel time almost 50% over regular piston travel.

## **PROVEN RELIABILITY**

The jet engine is a simple machine, readily maintained and easy to operate . . . and proven in millions of hours of service.



## **PAMPERING COMFORT**

Luxurious air-conditioned jet airliners fly quietly with no tiring vibration in the smooth air of high altitudes.



# *your* **JET** *flight*



You are in for a real thrill every time you take a trip on a jet airliner - - not the type that makes your heart pound and your spine tingle, but an inner excitement that brings with it a warm glow of satisfaction. It steals over you as you relax in air-conditioned, foam rubber, stretch-your-feet-out luxury. Suddenly you realize that you are traveling at a truly fabulous rate of speed.

Your good sense has to tell you this because your five senses cannot. The speed of your jet airliner is practically without sensation.



Inside the comfortable cabin no engine roar can be heard; no vibration can be felt. Since you fly "over the weather" there are no landmarks rushing by. Close your eyes and you could be sitting in your own living room.

But speed you have . . . . 600 mph of it . . . . speed which puts you at your destination in half the time it used to take.



## HOW A *JET*

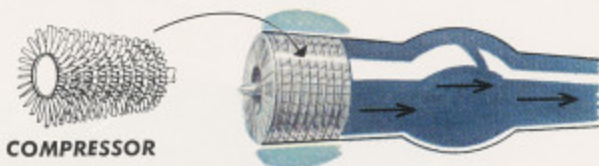
The jet turbine operates in much the same manner as a toy balloon. If you blow up a balloon, then hold it up and suddenly release the stem, it will travel at a fairly high speed for a few seconds.

It is not the escaping air pushing against the outside air that makes the balloon move. Releasing the stem removes a section of the skin on that side of the balloon against which air has been pushing. On the side directly opposite the stem, however, the air continues to push on an equal area of skin. It is the push on this area that causes the balloon to move in the direction away from the stem.



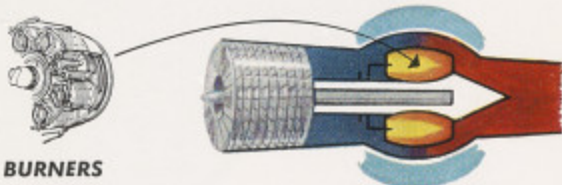
The balloon's flight is short because the pressure within the skin is lost quickly. This handicap could be overcome by pumping air into the balloon with a bicycle pump so that the pressure and air flow are maintained. This, in effect, is a complete jet engine using all of the principles of the power unit that propels an airplane.

# ENGINE WORKS



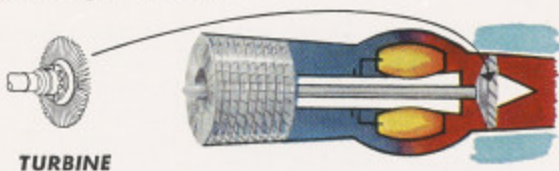
**COMPRESSOR**

To transform this apparatus into a self-contained jet engine, replace the hand-pump with a series of fans, called a compressor. If the compressor is turned at high speed, huge quantities of air are passed through the balloon while holding a high pressure inside.



**BURNERS**

For energy, place a burner in the airstream. Burning the fuel raises the air temperature rapidly and the volume of each air particle is greatly increased. Since the compressor pressure blocks forward flow of the air, the air can only move rearward on the less restricted path leading to the exit.

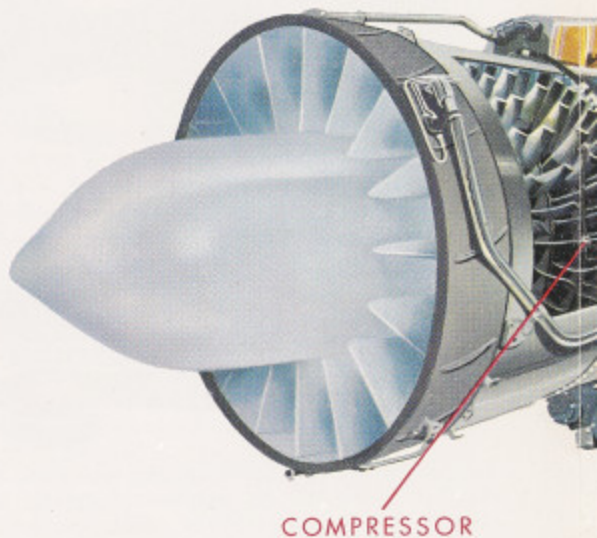


**TURBINE**

By placing a windmill (turbine) in the path of the heated air, some of this energy is used to spin the turbine which in turn spins the compressor by means of a connecting shaft. The remaining energy is expended in expelling the hot gases through the exhaust nozzle.

Now the transformation is complete and the balloon "jet engine" can operate as long as there is fuel to burn.

**Stripped of their outer cases the  
Pratt & Whitney Aircraft Turbo Wasp engines  
which power today's *JET LINE***



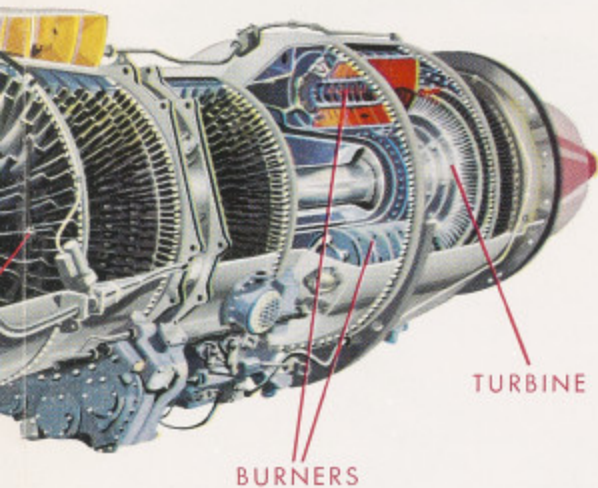
**WHAT'S INSIDE?**

As you can see, the compressor fans take up nearly half the length of the engine and, as this is a two-spool engine, there are two separate compressor fans. The fuel is burned in metal cans clustered around the engine and complete combustion takes place in the short distance of two feet. There are three turbine fans: the first drives the rearmost compressor and the other two drive the forward compressor by means of a shaft running through the hollow shaft of the first turbine. The exhaust, after passing through the turbines, retains enough energy to drive the engine (and airplane) forward at a high rate of speed.

This is known as a turbojet engine or, more simply, a jet engine. If another turbine were to be added to the engine just described, and this turbine used to turn a propeller at the front of the engine, it would be called a turboprop engine.

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o engines  
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*Look like this*



#### **WHAT ARE ITS ADVANTAGES?**

The simplicity of the jet engine is one of its strong points. There are only two moving parts in the engine proper, the front compressor-turbine unit and the rear compressor-turbine unit. These spin silently and smoothly without the explosive back-and-forth movement of the pistons in a piston engine. This difference is responsible for the vibrationless ride of a jet aircraft. The fewer moving parts means fewer trouble spots and the lack of vibration means less wear on the engine and longer periods between overhaul. A Pratt & Whitney Aircraft J-57 jet engine installed in a B-52 bomber has already completed the equivalent of twenty flights around the world and accumulated a flight time of 1,000 hours before overhaul. In commercial service, after a few years of experience, jet engines are expected to exceed greatly this figure.

## HOW THEY GO



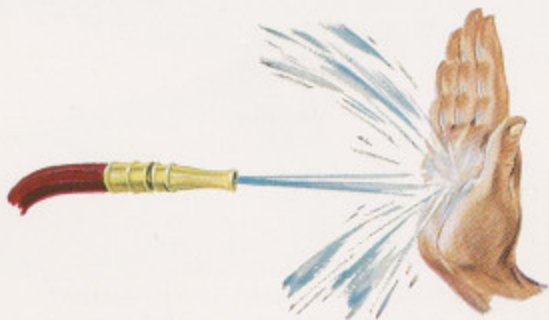
The four jet engines you see slung below and in front of the wing are installed there for a reason. Their location permits the construction of a thin, knife-like wing that can slice through the air at near-sonic speeds and at the same time allow an uninterrupted flow of air into the engines. Each of the engines in these "pods" produces more than 13,000 pounds of thrust, over twice the equivalent power of the biggest piston engines. More important, this power can be delivered at high speed and at high altitudes. Without the handicap of a propeller, which loses efficiency rapidly above 400 miles per hour, the jet airliner can cruise in the vicinity of 550 miles per hour. Jet airliners fly at around 30,000 feet, high enough to reap the advantages of high altitude flying in the lessened drag of the thin air on the airplane and the reduced fuel consumption of the jet engine.



## HOW THEY *STOP*



In landing, high speed was a drawback for the jet plane since the highly streamlined fuselage offered little resistance to the air. With no propeller to reverse, it tended to keep on rolling when it hit the runway. To solve this problem, all jet airliners are equipped with thrust reversers. These are devices for mechanically deflecting the exhaust gases forward in much the same manner as a garden hose nozzle can be made to squirt water backward by placing one's hand over the end. This deflection of the exhaust gases acts as a brake and slows the airplane down to a safe landing speed.



PRATT & WHITNEY AIRCRAFT  
TURBO WASP ENGINES ARE OF  
*proven* DEPENDABILITY

Pratt & Whitney Aircraft dual-rotor Turbo Wasp engines, which have been flying in military aircraft since 1951, are the most thoroughly tested engines ever to be installed in commercial aircraft. Approximately three million hours of flight time have been accumulated on the various models of the basic two-spool turbojet engine. This figure includes thousands of hours in huge, transport-type planes like the Air Force KC-135. Even under the rigorous conditions of military flying, this engine has proven to be exceptionally reliable and, since an airline runs an engine very conservatively, it is expected to be even more reliable in commercial service. With the knowledge gained from thirty years of building aircraft engines, Pratt & Whitney Aircraft has tailored its commercial jet engines to what an airline values most — dependability.



**The U. S. Air Force KC-135 Tanker-Transport**  
*One of the many military planes currently powered by  
Pratt & Whitney Aircraft jet engines.*

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# Glossary of **JET AGE**

## TERMINOLOGY

### MACH NUMBER

The designation of a jet airplane's speed. Mach 1 is the speed of sound, 760 miles per hour at sea level. The speed of sound varies according to temperature. Since temperature drops as altitude is increased, speed of sound is generally reduced as altitude is increased.

### JET STREAM

Powerful air currents miles high moving in a vast, irregular clockwise and counter-clockwise pattern.

### ZOMCOT

Abbreviation for zone of maximum change of temperature, the band between high-speed winds of the jet stream and winds outside of it.

### SONIC

Equal to the speed of sound.

### SUPERSONIC

Greater than the speed of sound.

### THRUST

The push of a jet engine measured in pounds.

### THIRD LAW OF MOTION

Newton's scientific definition, of which jet propulsion is an outstanding illustration. Every action produces a reaction equal in force and opposite in direction.

### TAIL CONE

The tail pipe, or nozzle, of a jet engine through which hot exhaust gases escape.

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**CREW COMPETENCE** comes from long experience and special training. Jet Clipper flight crew is composed of Captain, First Officer, Flight Engineer, Navigator. Following Pan Am's established policy in respect to skill in navigation, the Navigator is also a qualified Pilot.

## NO FINER FLIGHT CREWS FLY THE WORLD

Take a tried and tested jet airliner, man it with as fine a flight crew as the world has to offer, and you have a combination that spells safe dependability.

Jet Clipper flying crews are made up of Pan American's most experienced flight officers. Beyond flying experience running into millions of miles, all jet flight personnel undergo lengthy training in jet operation. To qualify for jet flying, Pan American's strict standards must be met; in all the world, there are none higher.