ГОСУДАРСТВЕННЫЙ КОМИТЕТ РСФСР
ПО ДЕЛАМ НАУКИ И ВЫСШЕЙ ШКОЛЫ

КУЙБЫШЕВСКИЙ ордена ТРУДОВОГО КРАСНОГО ЗНАМЕНИ
АВИАЦИОННЫЙ ИНСТИТУТ имени АКАДЕМИКА С.П.КОРОЛЁВА

ИЗ ИСТОРИИ ДВИГАТЕЛЕСТРОЕНИЯ

Учебные задания по английскому языку

САМАРА 1992

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ББК Ш 143.21.923

Из истории двигателестроения: Уч. .задания по англ.яз./ Куйбышев. авиац.ин-т; Сост. С.И. Ермишина. Самара, 1992. 28 с.

Данные учебные задания составлены в соответствии с требованиями программы по английскому языку для неязыковых специальностей вузов (1986г.) с целью совершенствования навыков чтения и понимания прочитанного по вышеназванной тематике, а также с целью контроля за формированием лексико-грамматических навыков студентов. Выполнены на кафедре "Иностранные языки".

Печатается по решению редакционно-издательского совета Куйбышевского ордена Трудового Красного Знамени авиационного института имени академика С.П.Королёва

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S T E P I.

I. Просмотрите следующие слова, они помогут вам понять текст "A Page of History":

flyable – готовый (пригодный) к выполнению полётов
skilled – квалифицированный
run – налёт/наработка (в часах)
ratio – отношение (степень)
arrange – размещать, компоновать
crankshaft – коленчатый вал (двигателя)
set up – обеспечивать
liquid – жидкий (жидкость)
cool – охлаждать

II. Прочтите текст и укажите вопрос, на который нельзя найти ответ в содержании текста:

1) What was the biggest difficulty in developing power for aircraft in the 19th century? 2) When did Charles Manly develop his really efficient engine? 3) How many cylinders had Manly's engine? 4) Why was the Wrights' engine considered the 1st successful aircraft power plant? 5) In what way was cooling of the Wrights' engine done?

A Page of History.

1. A flyable airplane begins with a practical aerodynamic design. But there must be a power source capable of lifting. In developing power for airplanes, the biggest difficulty was the weight of the engine. All these engines weighed too much to lift the airplanes for which they were designed.

2. For the first really efficient engine was not the Wrights', but that built by Charles Manly. Manly was an engineer and a skilled machinist and the engine he developed in 1901 was far better than the Wrights' in the power to support flight in a flyable airplane. Manly's five-cylinder engine produced 52 horsepower during a 10-hour run. The engine weighed only 125 pounds and delivered one horsepower for every 24 pounds of its

own weight and a power-to-weight ratio that was not bettered until 1918.

3. The Wrights' engine must be considered the 1st successful aircraft power plant, because it made possible the first powered, man-carrying flight. The Wrights' calculated that they needed an engine which would produce at least eight horsepower, at a ratio of not more than 20 pounds of engine weight per horsepower. It was a four-cylinder engine which developed 13 horsepower - five more than the Flyer needed. Within five years the brothers were able to modify the basic engine so that it developed 30 horsepower, or one horsepower for every six pounds of engine weight. The Wrights' engine was basically a modified automobile engine with the cylinders one behind the other.

4. Manly's engine was a liquid-cooled one, with the cylinders arranged in a circle and the pistons driving a crankshaft in the center. Each design had its advantages and each its disadvantages. Because its cylinders are arranged in the form of a wheel, this engine sets up more air resistance than the Wrights' engine. On the other hand, Manly's engine provided more horsepower for its weight.

III. Прочтите предложения и поставьте их номера в последовательности, соответствующей содержанию текста:

- Manly was an engineer and a skilled machinist.
- The Wrights' engine was basically a modified automobile engine with the cylinders one behind the other.
- In developing power for airplanes, the biggest difficulty was the weight of the engine.
- Manly's engine was a liquid-cooled one, with the cylinders arranged in a circle and the pistons driving a crankshaft in the center.
- A flyable airplane begins with a practical aerodynamic design.
- Each design had its advantages and each its disadvantages.

IV. Замените подчёркнутые слова близкими по значению:

1. A flyable airplane <u>begins</u> with a practical aerodynamic

design. 2. Manly was an engineer and a skilled machinist. 3. Manly's five-cylinder engine produced 52 horsepower during a 10-hour run. 4. The engine weighed only 125 pounds and delivered one horsepower for every 24 pounds of its own weight and a power-to-weight ratio that was not bettered until 1918. 5. The Wrights' engine made possible the first powered, man-carrying flight. 6. It was a four-cylinder engine which developed 13 horsepower - five more than the Flyer needed. 7. Within five years the brothers were able to modify the basic engine so that it developed 30 horsepower.

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can, to generate, manned, to start, main, coefficient, experienced, to improve, to require, thrust.

S T E P 2.

I. Просмотрите следующие слова, они помогут вам понять текст "Aircraft Engines".

single-engined - одномоторный; deliver- подавать; overcome - преодолеть; due to - вследствие; reciprocating engine - поршневой двигатель; displace - перемещать; a column of air - поток(столб) воздуха.

II. Прочтите текст, поставьте вопросы в правильной последовательности, соответствующей содержанию теста:

- What are the main types of jet engines? 6
- How can the cylinders of the internal combustion engines be placed? 2
- Where may the engines be located in a biplane? 1
- In what vehicles are reciprocating engines used? 4
- What is the function of the engine? 3
- At what velocity does a jet engine push a column of air to the rear? 5

Aircraft Engines

1. In the single-engined aircraft, one engine is usually located in the nose of the machine. In multiple-engined machines general engines may be located either in the wing or above it. This location of engines we observe in a monoplane. In a biplane the engines may be between the wings. The fuction of the engine is to develop the necessary power and to deliver it in the form of thrust. The thrust in its turn must overcome the resistance of the airplane due to its motion through the air, and accelerate the aircraft.

2. The aircraft engine may be of the internal combustion type. The cylinders may be placed radially or vertically, in a line or in two lines to form a V.

3. Cooling of the engine is done either by air or by liquid. There are two broad categories of aircraft engines: reciprocating and jet ones. The principle of the aircraft propulsion is the same for both types of engines. It is done by displacing a mass of air to the rear. Any engine must be able to develop the necessary power and to propel the aircraft in the opposite or forward direction.

4. Reciprocating engines are used in subsonic airplanes and helicopters. A jet engine pushes a column of air to the rear at a very high velocity. This velocity may be greater than the speed of sound. The main types of jet engines are turbojet, propjet and turbofan engines.

III. Закончите данные предложения в соответствии с содержанием текста:

1. The thrust in its turn must overcome the resistance of the airplane due to its motion through the air, and ... (compress the air; expand the energy; accelerate the aircraft; turn the crankshaft).

2. Any engine must be able to develop the necessary power and to propel the aircraft in the opposite or ... (landing direction; orbit direction; approach direction; forward direction).

3. The function of the engine is to develop the necessary power and to deliver it in ... (2 hours; in the form of thrust; the street; due time).
4. In the single-engined aircraft, one engine is usually located in ... ... (one of the wings; the tail; the nose of the machine; the rear of the machine).

IV. Подберите слово, противоположное подчёркнутому по значению:

1. In the single-engined aircraft, one engine is usually located in the nose of the machine. 2. This location of engines we observe in a monoplane. 3. The thrust in its turn must overcome the resistance of the airplane and accelerate the aircraft. 4. The cylinders may be placed radially or vertically. 5. Cooling of the engine is done either by air or by liquid. 6. Any engine must be able to propel the aircraft in the opposite or forward direction. 7. There are two broad categories of aircraft engines: reciprocating and jet ones.

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heating; multi-engined; solid; backward; horisontally; rear; dislocation; decelearte; narrow.

S T E P 3.

I. Просмотрите следующие слова, они помогут вам понять текст "Basic Principles of Diesel Engines":

common - общий; gear - шестерня (привод); connecting rod - шатун; rapid - быстрый; compression - ignition engines - двигатели с воспламенением от сжатия; self-contained - автономный; admit - подавать/впускать (о воздухе); considerable - значительный; highly atomised spray - сильно распылённая струя; fuel injection - впрыск горючего; live steam - острый пар; exhaust steam - отработанный пар; sliding valve - золотник; spring valve - пружинный клапан.

II. Прочтите текст, найдите и переведите предложения, в которых содержатся ответы на вопросы:

1. How is the piston of the steam engine forced along the cy-

linder?

2. In what way does the diesel engine differ from the steam one? 3. What process takes place in a diesel engine at the moment of maximum compression? 4. What can you say about the fuel injection? 5. Is the live and exaust steam controlled in a steam engine and how?

Basic Principles of Diesel Engines.

1. The diesel engine has certain characteristics in common with the steam engine. Both are designed to convert the force applied to their pistons into rotary motion for driving electric generators, gears and wheels and, therefore, have connecting rods and crankshafts.
2. The piston of the steam engine is forced along the cylinder by expanding steam under pressure; the pistons of the diesel engine are moved by the rapid burning of oil mixed with air and highly compressed. From this process all diesel engines are known as compression-ignition engines.
3. Unlike the steam engine, the diesel engine is a self-contained unit in which power is generated within the engine itself. Advantage is taken of the physical law that air, when compressed, generates heat. Air is admitted into the cylinder of a diesel engine and is highly compressed between the top of the piston and the cylinder head, generating considerable heat. At the moment of maximum compression, or when the piston reaches the top of its stroke, oil fuel in the form of a highly atomised spray is forced into the space occupied by the compressed air. The heat generated by the compressed air immediately ignites the oil which rapidly expands with great energy, forcing the piston along the cylinder and turning the crankshaft by means of the connecting rod to which the piston is attached. The process of admitting atomised oil fuel into the cylinder of a diesel engine is known as the fuel injection.
4. Means must be provided for air to be admitted to the cylinder, and for the spent gases to be discharged. In a steam engine cylinder the live and exhaust steam is controlled by a sliding valve, in a four-stroke engine cylinder, air is admit-

ted and the exhaust gases are expelled through spring-loaded valves.

III. Назовите английские и русские термины, соответствующие следующим определениям:

1. A unit in which power is generated within the engine itself. 2. Engines in which pistons are moved by the rapid burning of oil mixed with air and highly compressed. 3. A process of admitting atomised oil fuel into the cylinder of a diesel engine. 4. Means of controlling the live and exhaust steam. 5. A valve through which the exhaust gases are expelled.

IV. Найдите в 3 абзаце неличные формы глагола и переведите их.

S T E P 4.

I. Просмотрите следующие слова, они помогут вам понять текст "Internal Combustion Engines":

accomplish - выполнять; common - общий; vapor - пар; rapidity - быстрота; complete - полный; revolution - оборот; a boiler - паровой котёл; suction - всасывание

II. Прочтите текст и выберите правильные ответы на следующие вопросы:

1. How does the fuel burn in an internal combustion engine?
2. What common characteristic have various types of engines?
3. When does the force of the pressure decrease?
4. By what means is the reciprocating motion of the piston changed to the rotary motion?
5. How many strokes must the piston make in the cylinder? What are they?

1a. In an internal combustion engine the fuel burns in a crankshaft connected to the piston.

1b. The fuel burns directly under the piston in the cylinder of an internal combustion engine.

2a. Motion is obtained as a result of the pressure of gases generated by the rapid combustion of the fuel mixture in the cylinder itself.

2b. Motion is obtained as a result of the pressure decrease.

3a. The force of the pressure decreases when the piston operates the crankshaft of the engine.

3b. The force of the pressure decreases as the piston travels downward.

4a. The reciprocating motion of the piston is changed to the rotary motion by means of a fuel mixture.

4b. The reciprocating motion of the piston is changed to the rotary motion by means of a crankshaft.

5a. The piston in the cylinder must make the four strokes (suction, compression, power, and exhaust).

5b. The piston during two revolutions of the crankshaft must make two strokes only: compression and exhaust.

Internal Combustion Engines
(Part I)

1. An internal combustion engine is an engine in which the fuel burns directly under the piston in the cylinder. The gases are produced by combustion, these gases push against the piston to accomplish their work. That's why, it is not necessary for an internal combustion engine to have a boiler.

2. Various types of engines have one common characteristic: motion is obtained as a result of the pressure of gases generated by the rapid combustion of the fuel mixture in the cylinder itself.

3. When a compressed mixture or charge of gasoline vapour and air is ignited, it burns with great rapidity. During its combustion it produces intense heat. This heat causes the gases to expand and thus generate pressure against the head of the piston. This piston operates the crankshaft of the engine. The force of the pressure decreases as the piston travels downward. This decrease of pressure is due to the expansion of the gases. The pressure causes the piston go along the cy-

linder from the head toward the open end.

4. The piston is connected to the crankshaft by a connecting rod. The back-and-forth motion of the piston in the cylinder is called reciprocating motion. The reciprocating motion of the piston is changed to the rotary motion by means of a crankshaft.

5. One complete turn of the crankshaft from one end of the cylinder to the other and back again is called a revolution. One half of a revolution of the crankshaft moves the piston from one end of the cylinder to the other. This is called a stroke.

6. The four-stroke cycle is almost universally used on automobile gasoline engines. This principle is used on most of the aircraft reciprocating engines too. The piston in the cylinder must make the four strokes (suction, compression, power, and exhaust) during two revolutions of the crankshaft.

III. Сгруппируйте слова, близкие по значению:

1) revolution 3	1) because of
2) to use 5	2) top
3) by means of 8	3) rotation
4) to produce 10	4) quickness
5) due to 1	5) to utilize
6) to accomplish	6) general
7) various 9	7) to do
8) rapidity 4	8) with the help of
9) head 2	9) different
10) common 6	10) to generate

IV. Соответствуют ли данные высказывания содержанию текста:

1. Возвратно-поступательное движение поршня превращается во вращательное движение с помощью коленчатого вала.
2. Уменьшение давления происходит вследствие расширения газов.
3. Нет необходимости двигателю внутреннего сгорания иметь корёл.
4. Давление заставляет поршень двигаться вдоль цилиндра сверху вниз.
5. Принцип четырёхтактного двигателя используется только в автомобилях.

S T E P 5

I. Просмотрите следующие слова, они помогут вам понять текст "Internal Combustion Engine" (Part II):

flywheel - маховик; exert - оказывать влияние; valve - клапан; admit - впускать; escape - выходить; inlet valve - входной клапан; camshaft - кулачковый вал; gear - шестерня; bank - (зд.) сторона; engage - зацеплять(ся); lever - рычаг/рукоятка; precise - точный (определённый); spring - пружина; supply - снабжать (подавать).

II. Прочтите текст и укажите вопрос, на который нельзя найти ответ в содержании текста:

1. How is the camshaft connected to the crankshaft? 2. What is the function of a flywheel? 3. How many eccentric projections has a camshaft per cylinder? 4. Where is atomised oil fuel under high pressure forced through? 5. When must the pump supplying the fuel through the injector deliver the right quantity of fuel? 6. Why is it necessary for the camshaft to rotate at a speed equal to half the speed of the crankshaft?

Internal Combustion Engine (Part II)

1. The internal combustion engine converts heat into mechanical energy by burning a mixture of oil fuel and air within its cylinder or cylinders.
2. Such engine consists of the following units:
   a - a cylinder (there may be several)
   b - a piston which moves up and down inside the cylinder
   c - a crankshaft connected to the piston by a rod known as a connecting rod. It turns the up-and-down motion of the piston into a rotary motion of the crankshaft
   d - a flywheel to keep the crankshaft moving when no pressure is exerted upon the top of the piston
   e - two valves, one to admit the mixture of air and fuel into the cylinder and the other to allow the exhaust gas to escape, the first being known as the inlet valve,

and the other as the exhaust valve

f - a camshaft which is used to open and close the valves, driven by gears from the engine crankshaft

3. The movement of the valves of the four-stroke internal combustion engine cylinder is controlled by a camshaft which is located parallel to the crankshaft and has two eccentric projections per cylinder, called cams, one for the inlet and one for the exhaust valves. In practice there is generally one camshaft for each bank of cylinders.

4. The camshaft is rotated by the crankshaft to which it is connected by gears. As the camshaft rotates, the cams engage with the ends of rods and a system of levers, known as the valve gear, which cause the valves to open at the precise moment required.

5. The valves are closed by strong springs. In order to open and to close the valves at the correct moment in relation to the position of the piston, it is necessary for the camshaft to rotate at a speed equal to half the speed of the crankshaft.

6. Similarly, the pump supplying the fuel through the injector must deliver the right quantity of fuel at the right moment. This is done by an arrangement of cams which, like those operating the valves, are driven by the crankshaft and at half its speed.

III. Подберите определения к существительным:

3 1. valve	2 1. mechanical
1 2. energy	4 2. connecting
5 3. motion	3 3. exhaust
2 4. rod	6 4. eccentric
7 5. pump	5 5. up-and-down
4 6. projection	7 6. valve
6 7. gear	5 7. supplying
8 8. moment	8 8. precise

IV. Укажите номер абзаца, в котором находится предложение с независимым причастным оборотом, предложение переведите.

S T E P 6

I. Просмотрите следующие слова, они помогут вам понять текст "A Page of History":

supercharger - нагнетатель; air-breathing - воздушно-реактивный; intake - воздухозаборник; loss - потеря; thin out - становиться разряженным; safety - безопасность; owner - владелец; heyday - расцвет; overhaul - ремонт; trouble - неисправность; tear - вырывать (отрывать); destructive - разрушительный (вредный).

II. Прочтите текст и закончите предложения в соответствии с содержанием текста:

1. A major innovation in the engines of the 20s was the ... . (overhaul, intake, supercharger, propeller).
2. As altitude increases and the air begins to thin out, the engine loses ... (reliability, efficiency, cost, vibration).
3. Until the 1920's, all propellers were made of ... (steel, composite materials, glass, wood).
4. Propellers sometimes flew apart in the air and the imbalance could tear the engine out of the ... (blade, intake, compressor, plane).
5. The more powerful that engine became, the faster the propellers had to ... (lose, improve, turn, develop).

A Page of History

1. In 1927 Pratt and Whitney Aircraft developed the aircooled, 425-horse-power engine that became the primary type of airplane power plant. A major innovation in the engines of the '20s was the supercharger, which did much to improve high-altitude performance. Since the piston engine is an air-breathing machine, any reduction in the intake of air results in a loss of power.
2. As altitude increases and the air begins to thin out, the engine loses efficiency. The supercharger maintains an engine's power at higher altitudes by precompressing air. It does this by means of a compressor that provides the cylinders with low-

-altitude air at great heights. The designers and builders concentrated on reliability. Reliability means safety, first of all to the airman it may mean life itself. To the airplane owner, it also means lower maintenance costs. In the early days of aviation, an engine required constant turning up; in the post-World War II heyday of the piston engine, large and complex power plants were able to run more than 2,500 hours between overhauls. As engine performance advanced, it became necessary also to improve the thrusting device, the propeller, which had been a major source of trouble since the pioneer era of aviation. Until the 1920s, all propellers were made of wood. In wet weather they were likely to absorb water and if one blade absorbed more than the other the propeller became unbalanced, setting up a tremendous vibration in the airplane. Propellers sometimes flew apart in the air and the imbalance could tear the engine out of the plane. The more powerful that engine became, the faster the propellers had to turn. This produced very high tip speeds which brought on potentially destructive vibrations.

III. Подберите дополнения к глаголам:

1. to maintain	1. a supercharger
2. to develop	2. an engine power
3. to set up	3. performance
4. to improve	4. a vibration
5. to absorb	5. a loss
6. to result in	6. reliability
7. to run	7. water
8. to concentrate on	8. 2,500 hours

IV. Поставьте вопросы в правильной последовательности, соответствующей содержанию текста:

6 - The more powerful that engines became, the faster the propellers had to turn, hadn't they? Yes, they had.

5 - Why did it become necessary also to improve the propeller?

1 - When did Pratt and Whitney Aircraft develop the air-cooled, 425-horsepower engine?

4 - How many hours were large and complex power plants able to run between overhauls?

2- In what way does the supercharger maintain an engine's power at higher altitudes?

3- What does reliability mean first of all?

S T E P 7

I. Просмотрите следующие слова, они помогут вам понять текст "Ramjets".

ramjet - прямоточный ВРД; ram pressure - давление скоростного напора; hybrid - комбинированная (установка, работающая на твёрдо-жидком топливе); turboramjet - турбопрямоточный двигатель; bypass - обходить; shock wave - ударная волна; cause - вызывать (служить причиной).

II. Прочтите текст, найдите и переведите предложения со словосочетаниями:

1. rearward ramjet section
2. to block off mechanically
3. mode of combustion
4. ram pressure
5. to propose as a solution
6. to increase by the shock wave

III. Замените подчёркнутые слова близкими по значению:

1. The ram effect occurs only when great speed has been achieved.
2. Any airplane must be able to operate at both low and high speeds.
3. Fuel is then injected and burned, and the products of combustion are exhausted through a nozzle to produce thrust.
4. Stable, efficient supersonic combustion in a ramjet can be produced by using a shock wave to cause ignition.
5. Fuel is injected upstream of the combustion chamber and mixed with the air inlet flow.

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to utilize, stream, to take place, burner, to initiate, power, to mix, to discharge, to ally, to generate

Ramjets

A ramjet engine is like a turbojet engine without any com-

ressor or turbine. Instead , a ramjet is a specially shaped open tube containing a combustion chamber and a fuel injection system. Compression is achieved by ram pressure.

2. Since the ram effect occurs only when great speed has been achieved, ramjet engines cannot start from rest or function (operate) well at low speeds. Since any airplane must be able to operate at both low and high speeds, a hybrid power plant, called the turboramjet, has been proposed as a solution. For low speeds it will function as a normal turbojet. When the airplane reaches the range of ramjet efficiency, airflow to the compressor would be blocked off mechanically; bypassing the compressors, the air would be burned in the rearward ramjet section of the engine.

3. According to the mode of combustion there are three basic types of ramjet engines. The classical ramjet has an inlet that diffuses the free-stream flow down to a low subsonic velocity in the combustion chamber. Fuel is then injected and burned, and the products of combustion are exhausted through a nozzle to produce thrust.

4. Stable, efficient supersonic combustion in a ramjet can be produced by using a shock, or detonation, wave to cause ignition. Fuel is injected upstream of the combustion chamber and mixed with the air inlet flow. The temperature and pressure of the mixture are then increased by the shock wave to a level sufficient to cause rapid ignition and combustion under supersonic conditions.

IV. Содержится ли в тексте информация о том ...

1) как происходит сжатие в прямоточных ВРД-х?
2) какой двигатель был предложен в качестве решения вопроса полёта как на малых, так и больших скоростях?
3) какова функция входного устройства?
4) для какой цели производится повышение температуры и давления смеси в камере сгорания?

Подтвердите ваши соображения по этому поводу предложениями из текста.

Т Е К С Т 8

I. Просмотрите следующие слова, они помогут вам понять текст "Turbofans":

pure - чистый ; expel - выбрасывать (зд.); amount - количество; suck - всасывать ; the remainder - остаток; duct - распределение (потока) по трубам ; endanger - подвергать опасности.

II. Прочтите текст и, используя имеющиеся в тексте сведения, ответьте на вопросы:

1.О чём гласит второй закон Ньютона? 2. Какое ещё название турбовентиляторного двигателя вы знаете? 3. Какая часть всасываемого воздуха подается (нагнетается) в камеру сгорания? 4. Что произойдёт, если нагретый воздух продолжать сжимать? 5. В каком случае наблюдается потеря тяги (мощности) двигателя?

III. Найдите в тексте и переведите предложения, в которых содержатся ответ на вопросы:

1. How can a larger force be achieved in the turbofan? 2. At what velocity are the exhaust gases expelled from the rear nozzles? 3. What creates a "ram" pressure? 4. Will any further heating of the air endanger the metal turbine driving the compressors? 5. What engine is needed at speeds in the range of Mach 3 to 4?

Turbofans

In the turbojet, or so-called "pure jet", the turbofan engine is the most significant innovation. The force or thrust produced by both turbojet and turbofan engine is not only an example of Newton's third law of motion, it is also controlled by Newton's second law, which states that a given acceleration of a given mass (in this case, air) produces necessary force. A larger force can be achieved either by increasing the acceleration of the air, or by moving a larger amount of it.

In the turbofan, also called the bypass engine, the exhaust gases are expelled from the rear nozzles at a slower

velocity than in a turbojet engine. This decreased velocity would provide less thrust. But the amount of air passing through a turbofan engine is much larger than that passing through a turbojet, and results in a much greater push. Only about half of the sucked air is pumped into the combustion chamber, the remainder is ducted around it. Thus, the turbofan engine achieves greater thrust, actually with a lower fuel consumption, than the turbojet engine.

As a jet plane begins to travel at increasingly high speeds, the great amount of air creates a ram pressure. This compression of the air being rammed into the intake develops an increase in the temperature of the air. If this heated air is further compressed by the engine's compressors, the temperature of the air is raised even higher. By the time it reaches the combustion chamber, the air may be so hot that any further heating will endanger the metal turbine which drives the compressors. This upper limit on exhaust temperature can mean a loss of power. So at speeds in the range of Mach 3 to 4, with present-day fuels and engine materials, a new type of power plant and design is needed. This most modern of designs is the simplest kind of aircraft engine known, for it has no moving parts. It is called the ramjet.

IV. Подберите английские эквиваленты:

I. ускорение	1. moving parts
2. уменьшать	2. intake
3. выхлопные газы	3. acceleration
4. камера сгорания	4. loss of power
5. расход топлива	5. exhaust gases
6. воздухозаборник	6. decrease
7. потеря тяги (дв.)	7. fuel consumption
8. нагретый воздух	8. combustion chamber
9. подвижные части (узлы)	9. present-day
10. современный	10. heated air

S T E P 9

I. Просмотрите следующие слова, они помогут вам понять текст "Turbojets":

beer keg - пивной бочонок; spray - струя; feed (fed, fed) - - подводить (подавать); spin - вращать; magnitude - величина; recent - новый (современный); file - регистрировать (патент); rather than - а не... ; short-haul flight - полёт малой протяжённости.

II. Прочтите текст и укажите вопрос, на который нельзя найти ответ в содержании текста:

1. What is a turbojet engine like? 2. What is the function of a turbine? 3. How is the ignition system of a jet engine function? 4. How old is the theory of jet propulsion? 5. Who was the first to do turbine research? 6. When did the W-1 engine first power an airplane in flight? 7. Are turboprop airliners still in service now?

III. Замените подчёркнутые слова близкими по значению:

1. As the mixture burns, its temperature and pressure rise greatly. 2. Part of its energy is used to spin a turbine that powers the compressor. 3. Jet propulsion for airplanes is generally considered a recent development. 4. From these beginnings, the jet engine progressed rapidly. 5. The turboprop engine is finding application in vertical-take off airplanes.

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use, increase, quickly, rotate, advance, new

Turbojets

A turbojet engine is a very simple mechanism: it is like a beer keg with both ends open. Great quantities of air are sucked into the leading end and mechanically compressed. In the center of the keg is a combustion chamber into which the compressed air and a constant spray of fuel are fed. As the mixture burns, its temperature and pressure rise greatly. Part

of its energy is used to spin a turbine that powers the compressor. Since, according to Newton's law of motion, for every action there must be an equal and opposite reaction, the reaction to the rearward thrust created by the hot gases is a forward thrust of the same magnitude.

Jet propulsion for airplanes is generally considered a recent development, but its theory is almost as old as powered flight having been proposed as early as 1908. But the real start of the jet engine dates from 1930, the year a 23-year-old flying officer named Frank Whittle filed a patent for a turbojet power plant. But he could not get financial support. During the next 2 years Whittle did additional turbine research and studied the latest advances in aviation.

Whittle had his first engine ready for laboratory testing in April, 1937. The engine developed less than its 1,400-pound design thrust. On May 15, 1941 the W-1 engine first powered an airplane in flight. From these beginnings, the jet engine progressed rapidly. As a major power plant for commercial aircraft, the turboprop engine was in production only about a decade (in which a propeller is driven by a turbine rather than a piston engine). Turboprop airliners are still in service on short-haul flights, and the turboprop engine is finding application in vertical-take off airplanes and some advance helicopter designs.

IV. Закончите предложения в соответствии с содержанием текста:

1. Great quantities of air ... ... into the leading end and mechanically compressed. (are mixed, are burnt, are created, are sucked)
2. But the real start of the jet engine ... from 1930. (does, makes, dates, becomes)
3. Whittle had his first engine ready for laboratory ... in April, 1937. (research, testing, flight, start)
4. Turboprop airliners are still in ... on short-haul flights. (time, power, production, service)
5. From these ... the jet engine progressed rapidly.(turbines flights, beginnings, developments)

S T E P 10

I. Просмотрите следующие слова, они помогут вам понять текст "Jet Propulsion":

ram temperature - температура набегающего потока воздуха; compatible - совместимый; integrity - целостность; circulate - циркулировать; hydrocarbon - углеводород; flammability - воспламеняемость; eliminate - ликвидировать; fan flow - поток в вентиляторном контуре; split - разделять (зд.); former - первый (из вышеупомянутых); intercooler - промежуточный радиатор.

II. Прочтите текст, найдите и переведите предложения со словосочетаниями:

1. fan discharge flow
2. short flame lengths
3. fuel-rich turbofan cycle
4. allowable turbine inlet temperature
5. conventional hydrocarbon fuels
6. easy ignition
7. fuel-rich turbine exhaust
8. high specific heat

III. Подберите слово, противоположное подчёркнутому по значению:

1. As aircraft flight speeds increase beyond Mach 3, two major problems begin to limit the usefulness of conventional jet engines. 2. There are hydrogen's well-known advantages for the combustion process. 3. Large portions of the engine must be cooled by circulating the fuel through them before injection into the combustion chamber. 4. The allowable turbine inlet temperature can be raised to the level of 4,000 deg R.

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to lower, disadvantage, to uncool, uselessness, to decrease, unknown.

Jet Propulsion (Turbojets)

1. As aircraft flight speeds increase beyond Mach 3, two major problems begin to limit the usefulness of conventional jet engines: Cycle efficiency tends to change for the worse because of the increase in the free-stream total temperature, and the

ram temperature at the engine inlet tends to approach the maximum compatible with structural integrity of uncooled engine components. Large portions of the engine, therefore, must be cooled by circulating the fuel through them before injection into the combustion chamber. With conventional hydrocarbon fuels, unfortunately, even this complicated arrangement extends the turbojet only into the lower part of the hypersonic region.

2. All this explains why cryogenic hydrogen has become a practical jet engine fuel. There are, of course, hydrogen's well-known advantages for the combustion process: easy ignition, wide limits of flammability, and short flame lengths. In addition, high specific heat and elemental molecular structure make hydrogen an ideal high temperature coolant.

3. Hydrogen fuel can be used in an otherwise "conventional" turbojet engine. Because of the improved cooling capability of the hydrogen, the allowable turbine inlet temperature then can be raised to the level of 4,000 deg R. The result is improved turbine efficiency, which makes it possible to eliminate the afterburner to come up with a shorter, lighter and more efficient engine.

4. The molecular stability of hydrogen at high temperatures can also be used in the "fuel-rich turbofan cycle". In this design, the fan discharge flow is split into two parts, one passing through the power-generating section and the other ducted around this section to the rear of the engine. The former portion flows through an intercooler cooled by the hydrogen fuel, a compressor, a fuel-rich combustion chamber, and a turbine. Finally, the fuel-rich turbine exhaust is mixed and burned with the by-passed portion of the fan discharge.

IV. Укажите, какое из высказываний даёт правильный ответ на вопрос:

Why has cryogenic hydrogen become a practical jet engine fuel?

1. Криогенный углеводород улучшает (эффективность) к.п.д. турбины.
2. Криогенный углеводород обладает способностью быстро охлаждать форсажную камеру.

3. Криогенный углеводород характеризуется легкостью воспламенения, широкими границами (пределами) воспламеняемости, небольшой длиной пламени.
4. Криогенный углеводород стремится расширить диапазон сверхзвуковых областей (полёта).

Тексты для письменного перевода (без словаря) на 30 мин

I. Four-Stroke Cycle
II. The Jet Engine
III. Rocket Engines
IV. Engine Health

T E X T I

Four-Stroke Cycle

1. The diesel cylinder is equipped with two valves and a fuel injector located in the cylinder head. The four-stroke cycle operates as follows:

a) Induction or Suction Stroke.- The piston is moving away from the cylinder head and is drawing in filtered air through the air inlet valve which is open.

b) Compression Stroke. - The piston has reached the end of its stroke and is now returning toward the cylinder head. The air valve has closed and the air is being compressed within the cylinder between the top of the piston and the cylinder head.

c) Working or Power Stroke.[1]- The piston has now reached the limit of its motion toward the cylinder head: both valves are closed, and the air within the cylinder is highly compressed in a small area called the combustion space. Simultaneously,[2] atomised oil fuel under high pressure is forced through the injector into the combustion space where it immediately[3] ignites. The resulting mixture of atomised oil and air burns and expands and the energy thus created forces the piston along the cylinder, turning the crankshaft by means of the connecting rod.

d) Exhaust or Scavenging[4] Stroke.- The piston has reached the end of the power stroke and is once more about to travel toward the cylinder head, the cylinder now being full of spent gases. The exhaust valve now opens and the piston, connecting its motion, forces the burnt gases out through the exhaust valve to the atmosphere.

This cycle is continued in each of the cylinders of the engine, the working strokes being so arranged that the crankshaft turns evenly[5].

N o t e s:

1. Power Stroke - рабочий ход
2. simultaneously - одновременно
3. immediately - немедленно
4. scavenge - удалять (отработавшие) газы
5. evenly - ровно

T E X T II

The Jet Engine

1. The turbojet engine works on the principle of Newton's Third Law of Motion. A good example of this law is the toy balloon. When its outlet[1] is closed, equal pressure is spread throughout the balloon.

2. If the outlet is opened, some of the air will immediately escape at high velocity, causing the balloon to move forward. This forward motion is a result of thrust (reaction).

3. The gas turbine jet engine (or turbojet engine) functions by taking air, compressing it, injecting fuel into the compressed air and igniting the mixture which then expands through a turbine which drives the compressor.

4. The standard fuel for jet engines is a kerosene-type fuel. Kerosene burns at a hotter temperature than gasoline and it has a higher viscosity.[2]

5. A typical jet fuel system consists of: fuel pump, fuel filter, fuel regulators, shut-off valve[3], fuel manifold[4] and discharge nozzles.

6. The ignition system of a jet engine functions only during the starting operations. Electrical power is supplied to the two spark plugs[5], to make a hot spark and fire the combustible[6] fuel-air mixture in the combustion chambers of the engine.
7. Upon initial ignition of the mixture, the combustion becomes continuous within the engine. In engines with an annular (or singl) combustion chamber, the flame spreads around the engine inside the single can (= combustion chamber). Those engines with multiple chambers have their cans connected internally. The flame from the two cans with igniters will travel through the interconnectors[7] and light the remaining chambers.

N o t e s:

1. outlet - насадок, штуцер
2. viscosity - вязкость
3. shut-off valve - отсечный клапан
4. fuel manifold - топливный коллектор
5. spark plug - запальная свеча
6. combustible - горючий
7. interconnector - кольцеванная система

T E X T III

Rocket Engines

Another type of power plant is the rocket engine, to be used in airplanes rather than missiles. Like the turbojet and ramjet, the rocket produces thrust by means of the expansion of exhaust gases resulting from the combustion of fuel.

However, the rocket does not depend on oxygen in the atmosphere to burn its fuel. It must therefore carry its own oxidizer to mix with the fuel in order to get combustion. The rocket engine is capable to produce extremely high thrust and expand its propellants at an enormous[1] rate. The amount of propellants which can be carried on board the airplane sharply[2] limit the operating engine time, and 10 minutes is the maximum any rocket-powered airplane has achieved to date.

The rocket engine consists of a propellant injector, combustion chamber surrounded by a cooling jacket[3], and a nozzle

to allow the natural expansion of the combustion gases.

The rocket engines all operate on the same principle whether they are solid-fuel or liquid-fuel types. Fuel is fed or pumped to a combustion chamber where it is ignited. This gives a fast stream of exhaust gases through the exhaust tubes. Exhaust thrust is rapid. The power duration is short, being from 12 to 45 sec, but pressures are high during this time.

N o t e s:

1. enormous - громадный, огромный
2. sharply - резко
3. jacket - кожух

T E X T IV

Engine Health[1]

Engine components have to be designed to achieve the best possible compromise between high reliability (which means high engine life), low initial cost, high efficiency and minimum weight. This optimization process is particularly important in the case of HP[2] turbine. Attempts to maximize operating efficiency, which in turn demand very complex and expensive components with lifetimes often below 10,000 hours. Usually, it is the turbine which regulates the total engine materials cost per engine operating hour, and the lifetime of the engine.

The lifetime of turbine blades rises very much if the maximum temperature to which they exposed[3] can be reduced by even a small amount. Strict[4] control of temperature peaks is of great importance in the operation and maintenance of aircraft engines. Maintenance procedures are designed to keep the compressor, combustor and turbine in such a condition that the turbine inlet temperature stays at the lowest possible level. The flight crew on the other hand, try to reduce the frequency of maximum thermal loads by limiting the use of maximum thrust to those situations when full power is necessary.

N o t e s:

1. health - (эд.) исправность; 2. HP turbine = high pressure turbine; 3. to ex[illegible] подвергаться (чему-либо); 4. strict - строгий