Е.В.Семчук

Английский язык

Учебно-методическое пособие

для студентов второго курса факультета «Промышленная теплоэнергетика »

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ПРЕДИСЛОВИЕ

Настоящее пособие предназначено для студентов второго курса факультета теплоэнергетики.

Пособие составлено в соответствии с требованиями программы по иностранным языкам для технических вузов.

Цель пособия – развитие навыков чтения научной и технической литературы по специальности и некоторых навыков устной речи в пределах тем, предусмотренных программой.

Текстовый материал предназначен для развития навыков просмотрового, ознакомительного и изучающего чтения, а также для развития навыков устной речи и перевода. Упражнения к текстам предусматривают следующие виды работы: активизация языковых навыков, определение главного содержания, запоминание основных лексических единиц.

Краткий грамматический справочник имеет целью помочь студентам обобщить и систематизировать полученные знания по отдельным вопросам грамматики.

THE STEAM POWER PLANT

The function of a steam power plant is to convert the energy in nuclear reactions or in coal, oil or gas into mechanical or electric energy through the expansion of steam from a high pressure to a low pressure in a suitable prime mover such as a turbine or engine. A noncondensing plant discharges the steam from the prime mover at an exhaust pressure equal to or greater than atmospheric pressure. A condensing plant exhausts from the prime mover into a condenser at a pressure less than atmospheric pressure.

In general, central-station plants are condensing plants since their sole output is electric energy and a reduction in the exhaust pressure at the prime mover decrease the amount of steam required to produce a given quantity of electric energy. Industrial plants are frequently noncondensing plants because large quantities of low-pressure steam are required for manufacturing operations. The power required for operation of a manufacturing plant may often be obtained as a by-product by generating steam at high pressure and expanding this steam in a prime mover to the back pressure at which the steam is needed for manufacturing processes.

The steam-generating unit consists of a furnace in which the fuel is burned, a boiler, superheater, and economizer, in which high-pressure steam is generated, and an air heater in which the loss of the energy due to combustion of the fuel is reduced to a minimum. The boiler is composed of a drum, in which a water level is maintained at about the mid-point so as to permit separation of the steam from the water, and bank of inclined tubes, connected to the drum in such a manner as to permit water to circulate from the drum through the tubes and back to the drum The hot products of combustion from the furnace flow across the boiler tubes and evaporate part of the water in the tubes. The furnace walls are composed of tubes which are also connected to the boiler drum to form very effective steam-generating surfaces. The steam which is separated from the water in the boiler drum then flows through a superheater which is in effect a coil of tubing surrounded by the hot products of combustion. The temperature of the steam is increased in the superheater to perhaps 800° to 1100° F, at which temperature the high-pressure superheated steam flows through suitable piping to the turbine.

Since the gaseous products of combustion leaving the boiler tube bank are at a relatively high temperature and their discharge to the chimney would result in a large loss in energy, an economizer may be used to recover part of the energy in these gases. The economizer is a bank of tubes through which the boiler feedwater is pumped on its way to the boiler drum.

A reduction in gas temperature may be made by passing the products of combustion through an air heater which is a heat exchanger cooled by the air required for combustion. This air is supplied to the air heater at normal room temperature and may leave the air heater at 400° to 600° F, thus returning to the furnace energy that would otherwise be wasted up the chimney. The products of combustion are usually cooled in an air heater to an exit temperature of 275° to 400° F, after which they may be passed through a dust collector which will remove objectionable dust and thence through an induced-draft fan to the chimney. The function of the induced-draft fan is to pull the gases through the heat transfer surfaces of the boiler, superheater, economizer and air heater and to maintain a pressure in the furnace that is slightly less than atmospheric pressure. A forced-draft fan forces the combustion air to flow through the air heater, duct work, and burner into the furnace.

Coal is delivered to the plant in railroad cars or barges which are unloaded by machinery. The coal may be placed in storage or may be crushed and elevated to the overhead raw-coal bunker in the boiler room.

The coal flows by gravity from the overhead bunker to the pulverizer or mill through a feeder which automatically maintains the correct amount of coal in the mill. In the mill the coal is ground to a fine dust. Some of the hot air from the air heater is forced through the mill to dry the coal and to pick up the finely pulverized particles and carry them in suspension to the burner where they are mixed with the air required for their combustion and discharged into the furnace at high velocity to promote good combustion.

The high-pressure, high-temperature steam is expanded in a steam turbine which is generally connected to an electric generator. From 3 to 5 per cent of the output of the generator is needed to light the plant and to operate the many motors required for fans, pumps, etc., in the plant. The rest of the generator output is available for distribution outside the plant.

The condensed steam, which is normally at a temperature of 70° to 100° F, is pumped out of the condenser by means of a hot-well pump and

is discharged through several feed-water heaters to a boiler feed pump that delivers the water to the economizer.

Most steam power plants of large size are now being built for operation at steam pressures of 1500 to 2400 psi, and in some plants pressures up to 5000 psi are being used. Steam temperatures of 1000° to 1100° F are in general use. Turbine-generator capacities of 250,000 kw (1 kilowatt = 1.34 horsepower) are common, and units of 500,000 kw are in operation. Steam-generating units capable of delivering 3,000,000 lb of steam per hr are now in operation. Overall efficiency of the plant from raw coal supplied to electric energy delivered to the transmission line depends upon size, steam pressure, temperature, and other factors, and 40 per cent is now being realized on the basis of a full year of operation.

1.Read and `translate the following word-combination

steam power plant [ˈsti:m ˈpauə ˈplænt]
manufacturing process [mænju'fæktʃəriŋ] [ˈprəuses]
separation [ˌsepəˈreiʃən]
superheated steam ['sju:pə,hitɔ 'sti:m]
chimney ['tʃimni]
induced-draft fan [inˈdju:st ˈdraft ˈfæn]
forced-draft fan [fɔ:st dra:ft ˈfæn]
condensed steam [kə'hdenst 'sti:m]

2. Put the following words into the gaps :

Exhausts, noncondensing, operation,is burned, combustion, are composed, gaseous, the boiler feedwater

1. A condensing plant ( ) from the prime mover into a condenser at a pressure less than atmospheric pressure.

2. Industrial plants are frequently ( ) plants because large quantities of low-pressure steam are required for manufacturing operations.

3. The power required for ( ) of a manufacturing plant may often be obtained as a by-product by generating steam in a prime mover …

4. The steam-generation unit consists of a furnace in which the fuel ( ), a boiler, superheater, and economizer, in which high-pressure is generated…

5. The hot products of ( ) from the furnace flow across the boiler tubes and evaporate part of the water in the tubes.

6. The furnace walls ( ) of tubes which are also connected to the boiler drum to form very effective steam-generating surfaces.

7. Since the ( ) products of combustion leaving the boiler tube bank are at a relatively high temperature and their discharge to the chimney would result in a large loss in energy…

8. The economizer is a bank of tubes through which ( ) is pumped on its way to the boiler drum.

3.Translate from Russian into English:

…в механическую или электрическую энергию, низкое давление,в основном, уменьшать, требуемый для производства, состоит из, котельный барабан, отделён от воды, через супернагреватель

4.Make up 3 forms of the following verbs:

Burn, begin, flow, show, feed, supply, do, form, run, remove, use

5. Put the necessary prepositions:

1. The hot products ( ) combustion ( ) the furnace flow across the boiler tubes and evaporate part ( ) the ( ) the tube.

2.The coal may be placed ( ) storage or may be crushed and elevated ( ) the overhead raw-coal bunker ( ) the boiler room.

3. Some ( ) the hot air ( ) the air heater is forced through the mill ( ) dry the coal and to pick up the finely pulverized particles…

4. Coal is delivered ( ) the plant ( ) railroad cars or barges which are unloaded ( ) machinery.

5. ( ) 3 ( ) 5 per cent ( ) the output ( ) the generator is needed ( ) light the plant and ( ) operate the many motors required ( ) fans ,pumps, etc.,( ) the plant.

6. Steam temperatures ( ) 1000° ( ) 1100°F are ( ) general use.

6.Translate correct:

Is delivered
Is expanded
Is connected
Is required

THE INTERNAL-COMBUSTIQN-ENGINE POWER PLANT

The internal-combustion-engine power plant including essential auxiliaries is shown diagrammatically in Fig. 2. The fuel is burned directly in the cylinder of the engine or prime mover, and the high pressure thus generated drives the piston downward and rotates a crankshaft.

Air is supplied to the engine silencer and cleaner, the function of which is to reduce noise and remove dust which would accelerate cylinder and piston wear if allowed to enter the cylinder.

A supercharger is installed in the air-intake system. The function of the supercharger is to increase the amount of air supplied to the cylinder by acting as an air pump. This in turn permits burning more fuel and obtaining more power from a given size of cylinder. An intake manifold is used to distribute the air equally from the supercharger to the various cylinders of multicylinder engine.

The exhaust system consists of an exhaust manifold for collecting the discharge gases from each of the cylinders into a common exhaust line, an exhaust silencer or muffler for reducing noise, and the exhaust stack for disposing of the exhaust gases to the atmosphere without creating a public nuisance.

The cooling system includes a pump for circulating water through the cylinder jackets and heads of each cylinder and a heat exchanger to remove the energy absorbed in the engine by the cooling water. The heat exchanger may be air-cooled as in the automobile radiator, or it may be

water-cooled. Seldom is raw water fit to circulate directly through the jackets of an internal-combustion engine.

The lubricating oil may be passed through a cooler, filter, and reservoir and is supplied to the engine under pressure by means of an oil pump, usually to a hollow crankshaft. The oil serves as a lubricant, for the rubbing surfaces of the engine and also as a coolant.

The fuel system consists of a storage tank from which the fuel may be supplied to a small day tank or reservoir. The oil is filtered and pumped as needed to the fuel-injection system which is an integral part of the engine.

Since the fuel is burned directly in the cylinder of the prime mover, the internal-combustion-engine power plant is simpler and more

compact than the steam power plant. It is seldom built in engine sizes of more than 4000 hp, whereas a 300,000-hp steam turbine is common. It is more efficient than a steam power plant of comparable size but not so efficient as large steam central-station plants, which moreover can burn a cheaper grade of fuel. Consequently, the internal-combustion engine is used primarily in the transportation field for driving automobiles, buses, trucks, tractors, locomotives, ships, and airplanes where a compact, light-weight, efficient power plant of relatively small size is necessary.

1.Read and translate the following words:

Internal-combustion engine, high pressure, to distribute, multicylinder engine, exhaust system, muffler, heat exchanger, lubricating oil, hollow crankshaft, coolant, fuel-injection system, comparable size, light-weight, rubbing surfaces.

2.Remember the following words and word-combinations.

High pressure, ['haɪ, 'prɛʃə]
Silencer,['saɪlənsə]
Cleaner, ['klɪ:nə]
Air supply,['ɛə, sʌplaɪ]
Supercharger, ['sju:pə'tʃa:dʒə]
Fuel injector, ['fjuəl, 'indʒektə]
Air cleaner, ['ɛə, 'klɪ:nə]
Heat exchanger, ['hɪ:t, ɪks'tʃendʒə]

3.Put the following words into the gaps:

Internal-combustions-engine;shown, engine, cleaner, silencer, supercharger, burning, fuel, obtaining, cylinder, exhaust, cooling, lubricating, storage.

1.The ( ) power plant including essential auxiliaries is ( )…
2.Air is supplied to the ( ) through a ( ) and ( ), the function of which is…
3.A ( ) is installed in the air-intake system.
4.This is turn permits ( ) more ( ) and more power from a given size ( ).

5.The ( ) system consists of an ( ) manifold for collecting …
6.The ( ) system includes a pump for circulating water…
7.The ( ) oil may be passed through a cooler.
8.The fuel system consists of a ( ) tank from which…

4.Translate the following word-combinations from Russian into English :

Количество, очиститель, горение, охладитель(охлаждающий агент);коленчатый вал, рубашка цилиндра, разгружать, пыль, действительный, двигатель, двигатель внутреннего сгорания, поршень, существенный, выхлоп(выхлопная труба), топливо, теплообменник, устанавливать, смазывать, всасывание, смазочный материал, коллектор(сборник); масло(нефть);паровая электростанция, уменьшать, удалять, насос, давление на выхлопе.

5.Make up 3 forms of the following verbs:

To be, to supply, to burn, to become, to feed, to five, to take, to include, to remove, to build, to use, to show.

6 .Put the necessary prepositions :
1.The fuel is burned directly ( ) the cylinder ( ) the engine or prime mover…

2.Air is supplied ( ) the engine ( ) a silencer and clean, the functions ( ) which is to reduce noise and remove dust…

3.The functions ( ) the super charger is to increase the amount ( ) air supplied ( ) the cylinder ( ) acting as an air pump.

4.The exhaust system consists ( ) an exhaust manifold ( ) collecting the discharge gases ( ) each ( ) the cylinders ( ) a common exhaust line…

5.The lubricating oil may be passed ( ) a cooler, filter, and reservoir and is supplied ( ) the engine ( ) pressure ( ) means ( ) an oil pump…

6.Since the fuel is burned directly ( ) the cylinder ( ) the prime mover…

BURNING EQUIPMENT

There are two general methods of firing fuel commonly employed: 1) on stationary grates, or 2) on stokers. Also coal may be pulverized to the consistancy of 70 per cent through a 200-mesh screen and burned in suspension. The types of solid fuel encountered in various parts of the world and the general conditions under which they must be burned are so variable that it is impossible to-design one type of grate or stoker that is exactly suited to all fuels. The problem becomes one rather of suiting the equipment to the type of fuel to be handled.

To a certain extent, the design of the furnace must be considered coincidentally with the selection of fuel-burning equipment, so that satisfactory ignition and heat release may be ensured. The choice of equipment for a given set of conditions is limited, and, although any stoker will burn any fuel only one design as a rule will give satisfactory results. Coals may be broadly classified as follows:

Group 1. This group includes the anthracites and semi-anthracites which should be burned without agitation of the fuel bed.

A fuel of this class is satisfactorily burned on travelling grate or chain-grate stokers, on which the coal is fed in a comparatively thin, uniform layer. As combustion progresses, the ash covers the surface of the stoker and acts as a protective blanket, the fuel being supplied with combustion air as it travels toward the ashpit.

Croup 2. This group includes the bituminous coals of the caking type which require agitation of the fuel bed to break up the mass of coke as it forms as well as to resist the tendency of this fuel to fuse into a mat, or cake, that resists the passage of air and retards the process of combustion. Underfeed stokers of the multiple-retort type are designed to burn coals of this class, for the plungers have a characteristic forward and upward motion. By breaking up the surface of the fuel bed, more air passages are created, with a tendency to increase combustion rate. A few coals of this class have a low ash-fusion temperature with a resulting tendency to fuse and jam the operating parts of the stoker. These coals, particularly if high in sulphur, should be avoided as stoker fuels.

Group 3. This group includes midwestern coals and most of the western bituminous coals. These do not tend to soften but form masses of coke, they require no agitation of the fuel bed and are burned to best advantage on chain-grate stokers.

Group 4. This group consists of most of subbituminous coals and lignites which do not fuse when heated and do not require agitation. They have a tendency to disintegrate or slack on the grate as well as drift and sift through if disturbed. They have a tendency to avalanche on inclined grates and are most satisfactorily burned on chain- or traveling-grate stokers.

1. Read the following words:

Stationary grates, stokers, pulverize, consistency, suspension, solid oil, encountered, equipment, furnace, ignition, anthracite, semi anthracite, surface, combustion, ash, bituminous coals, resist, tendency, multiple-retort, plunger, increase, sulphur, sub bituminous, avalanche, inclined.

2.Remember the following words and word-combinations:

Stoking-burning-equipment: ['staukiŋ, 'baniŋ, i'kwipmənt]
Solid fuel ['sɔlid, 'fjuəl]
Selection ['seleкʃn]
Ignition ['igniʃn]
Ensure ['in ʃuə]
Chain-grate stoker ['ʧein, 'greit, 'stɔkə]
Surface ['səf is]

Ash ['æʃ]
Include [ɪn'kLu:d]
Bituminous coal [bɪ'tju:mɪnəs]
Plunger ['pLʌndʒə]
Fuse [fju:z]
Slack ['sLæk]
Drift ['drift]
Sift ['sift]

3.Put the words into the gapes:
FIRING, SOLID, EXTENT, CHOICE, COVERS,
BITUMINOUS, PLUNGERS, ASH-FUSION

1.There are two general methods of ( ) fuel commonly employed…
2.The types of( )fuel encountered in various parts of the world…
3.To a certain( ), the design of the furnace must be considered coincidentally with the selection of fuel-burning equipment…
4.The( )of equipment for a given set of conditions is limited…
5.As combustion progresses, the ash( )the surface of the stoker and acts as a protective blanket..
6.This group includes the( )coals of caking type which require agitation of the fuel bed to break up the mass of coke…
7.Underfeed stokers of this class, for the( )have a characteristic forward and upward motion.
8.A few coals of this class have a low( )temperature with a resulting tendency to fuse and jam the operating parts of the stokers.

4.Translate the following words-combinations from Russian into English:

Главные методы, сгорающее топливо, неподвижная решетка, твердое топливо, различные части мира, точно подходил ко всем топливам, до некоторой степени, выделение тепла, выбор оборудования, механический загрузчик топлива, механическая топка с цепной решеткой, механическая топка с движущимися колосниками, однородный слой, зола покрывает поверхность топки, зола двигается в сторону золовой воронки, битуминозный уголь, тенденция к разлаганию.

5. Make up 3 forms of the following verbs:

To be, to have, to supply, to burn, to suit, to become, to limit, to give, to include, to feed, to cover, to protect, to require, to break, to resist, to fuse, to design, to soften, to consist, to avalanche, drift, sift.

6. Put the necessary prepositions:

1.Also coal may be pulverized ( ) the consistency ( ) 70 per cent ( ) a 200-mesh screen and burned ( ) suspension.

2.The types ( ) solid fuel encountered ( ) various parts ( ) the world and the general conditions ( ) which they must be burned are so variable that it is impossible to design one type ( ) grate or stoker that is exactly suited ( ) all fuels.

3.( ) a certain extent, the design ( ) the furnace must be considered coincidentally ( ) the equipment…

4.The choice ( ) equipment ( ) a given set ( ) is limited…

5.A fuel ( ) this class is satisfactory burned ( ) traveling -grate or chain-grate stokers, ( ) comparatively thin…

6.This group includes the bituminous coals ( ) the caking type which requires agitation ( ) the fuel bed…

7.( ) breaking ( ) surface ( ) the fuel bed…

8.This group consists ( ) most ( ) sub bituminous coals and lignites do not fuse when…

FURNACES

A furnace is a fairly gas-tight and well-insulated space in which gas, oil, pulverized coal, or the combustible gases from solid-fuel beds may be burned with a minimum amount of excess air and with reasonably complete combustion. Near the exit from the furnace at which place most of the fuel has been burned, the furnace gases will consist of inert gases such as CO_2, N_2 and H_2O vapor, together with some O_2, and some combustible gases such as CO, H_2, hydrocarbons, and particles of free carbon (soot). If combustion is to be complete, the combustible gases must be brought into intimate contact with the residual oxygen in a furnace

atmosphere composed principally of inert gases. Also, the oxygen must be kept to a minimum if the loss due to heating the excess air from room temperature to chimney-gas temperature is to be low. Consequently, the major function of the furnace is to provide space in which the fuel may be burned with a minimum amount of excess air and with a minimum loss due to the escape of unburned fuel.

The design of a satisfactory furnace is based upon the "three T's of combustion": temperature, turbulence, and time.

For each particular fossil fuel, there is a minimum temperature, known as the ignition temperature, below which the combustion of that fuel in the correct amount of air will not take place.

The ignition temperature of a fuel in air as reported by various investigators depends somewhat upon the methods used to determine it and, for some common gases, is as follows:

Hydrogen (H_2)1075–1095°F

Carbon monoxide (CO)1190–1215°F

Methane (CH_4)1200–1380°F

Ethane (C_2H_6) 970–1165°F

If the combustible gases are cooled below the ignition temperature, they will not burn, regardless of the amount of oxygen

present. A furnace must therefore be large enough and be maintained at a high enough temperature to permit the combustible gases to burn before they are cooled below the ignition temperature. In other words, the relatively cool heat-transfer surfaces must be so located that they do not cool the furnace gases below the ignition temperature until after combustion is reasonably complete.

Turbulence is essential if combustion is to be complete in a furnace of economical size. Violent mixing of oxygen with the combustible gases in a furnace increases the rate of combustion, shortens the flame, reduces the required furnace volume, and decreases the chance that combustible gases will escape from the furnace without coming into contact with the oxygen necessary for their combustion. The amount of excess oxygen or air required for combustion is decreased by effective mixing. Turbulence is obtained, in the case of oil, gas, and powdered coal, by using burners which introduce the fuel-air mixture into the furnace with a violent whirling action. High-velocity steam or air jets and mixing arches may be used to increase the turbulence in furnaces fired with coal on stokers.

Since combustion is not instantaneous, time must be provided for the oxygen to find and react with the combustible gases in the furnace. In

burning fuels such as gas, oil, or pulverized coal, the incoming fuel-air mixture must be heated above the ignition temperature by radiation

from the flame or hot walls of the furnace. Since gaseous fuels are composed of molecules, they burn very rapidly when thoroughly mixed with oxygen at a temperature above the ignition temperature. However, the individual particles of pulverized coal or atomized oil are very large in comparison with the size of molecules, and many molecules of oxygen are necessary to burn one particle of coal or droplet of oil. Time

is required for the oxygen molecules to diffuse through the blanket of inert products of combustion which surround a partially burned particle of fuel and to react with the unburned fuel. Consequently, oil and pulverized coal burn with a longer flame than gaseous fuels.

The required furnace volume is dependent, therefore upon the kind of fuel burned, the method of burning the fuel, the quantity of

excess air in the furnace, and the effectiveness of furnace turbulence. The shape of the furnace depends upon the kind of fuel burned, the equipment employed to burn the fuel, and the type of boiler used to absorb the energy if the fuel is burned for steam generation.

Industrial furnaces in which the objective is to create and maintain a region at a high temperature and the furnaces of small steam boilers are constructed of fire brick, a brick that has been developed to withstand high temperatures without softening, to resist the erosive effects of furnace atmospheres and particles of ash, and to resist spalling when subjected to fluctuating temperatures. Low vertical walls may be constructed of fire brick in the conventional manner. High walls which are subject to considerable expansion may be tied to and sectionally supported by an external steel frame.

When a boiler furnace is operated at high capacity, the temperature may be high enough to melt or fuse the ash which is carried in suspension by the furnace gases. Molten ash will chemically attack and erode the fire brick with which it comes into contact. Also, if the ash particles are not cooled below the temperature at which they are plastic or sticky before they are carried into the convection tube banks of the boiler, they will adhere to these surfaces, obstruct the gas passages, and force a shutdown of the unit. Moreover, the function of a boiler is to generate steam, and the most effective heat-transfer surface is that which can "see" the high-temperature flame and absorb radiant energy. The rate of heat absorption expressed in Btu per hour per square foot of projected wall area may be from 1000 to 10,000 times as great as the heat-transfer rate in the boiler

surface with which the products of combustion are in contact last before being discharged up the chimney. Consequently, the walls of furnaces for large steam boilers are constructed of boiler tubes.

1.Read and translate following words and word-combinations:

Furnace, fairly-gas-tight and well-insulated space, pulverize, oil, combustion, solid-fuel beds, complete combustion, residual oxygen, inert gases, temperature, chimney-gas, major functions, to provide, due to, escape, unburned fuel, design, particular fossil fuel, ignition temperature, regardless, maintain, permit, heat-transfer, reasonable, turbulence, violent, reduce, excess, require, decrease, mixture, high-velocity steam, instantaneous, gaseous fuels, particles, molecules of oxygen, generation, withstand, vertical walls, considerable expansion, frame, capacity, ash, convection, adhere, absorb, energy, boiler tubes.

2.Remember the following words and word-combinations:

Fairly gas-tight ['fɛəlɪ ˌgæs ˌtaɪt]
Solid-fuel beds ['sɔlɪd ˌfjuəl ˌbedz]
Inert gases [ɪ'nət ˌ 'gæsɪz]
Hydrocarbon ['haɪdrəu'kɑ:bən]
Chimney-gas temperature ['tʃɪmnɪ ˌgæs ˌ 'temprɪtʃə]
Turbulence ['tə:bjʊlənsɪ]
Ignition temperature [ɪg'nɪʃn ˌ 'temprɪtʃə]
Common gases ['kɔmən ˌ 'gæsɪz]
Locate [ləu'keɪt]
Powdered coal ['paudə ˌ 'kəul]
Air jet ['ɛə ˌ 'dʒet]
Mixing archers ['mɪksɪŋ ˌ 'ɑ:tʃəz]

3. Put the following words into the gapes:

Combustion, residual oxygen, atmosphere, satisfactory furnace, turbulence, fossil, ignition, combustible, be maintained, turbulence, excess

oxygen, gaseous fuels, pulverized coal, shape, considerable expansion, boiler furnace

1.If ( ) is to be complete, the combustible gases must be brought into intimate contact with the ( ) in a furnace ( )…

2.The design of a ( ) is based upon the "three T's of combustions temperature", ( ) and time.

3 .For each particular ( ) fuel, there is a minimum temperature, known as the ( ) temperature…

4.If the ( ) gases are cooled below the ignition temperature…

5.A furnace must there fore be large enough and ( ) at a high enough temperature to permit gases…

6. ( ) is essential if combustion is to be complete in a furnace of economical size.

7 .The amount of ( ) or air required for combustion is decreased by effective mixing. Since ( ) are composed of molecules…

8.Consequently, oil and ( ) burning with a longer frame than gaseous fuels. The( ) of the furnace depends upon the kind of fuel burned… High walls which are subject to ( ) may be tied to… When a ( ) is operated at high capacity…

4.Translate the following word-combinations from Russian into English:

Котел, горение, температура воспламенения, зависит от, пылевидный уголь, дымовая труба, углерод, вместимость, увеличить, уменьшить, разгружать, действенный, охлаждать, двигатель, следовательно, кислород, пламя, образование,

воздушная струя, струя пара, ограничивать, распыленная нефть, снабжать, качество, невзирая на, ниже, выше

5.Make up 3 forms of the following verbs:

To burn, to take, to feed, to give, to snow, to bring, to provide, to know, to increase, to find, to operate.

6.Put the necessary prepositions:

1.Near the exit ( ) the furnace ( ) which place most ( ) the fuel has been burned.

2.Also, the oxygen most be kept ( ) a minimum if the loss due ( ) heating the excess air ( ) room temperature.

3.The design ( ) a satisfactory furnace is based ( )...

4.The ignition temperature ( ) a fuel ( ) air as reported ( ) various investigators depend somewhat ( ) the methods...

5.Violent mixing ( ) oxygen ( ) the combustible gases ( ) a furnace increases the rate ( ) combustion...

6.The amount ( ) excess oxygen or required ( ) combustion is decreased ( ) effective mixing.

7.However, the individual particles ( ) pulverized coal or atomized oil are very large ( ) comparison ( ) the size ( ) molecules...

8.The shape ( ) the furnace depends ( ) the kind ( ) fuel burned...

GAS BURNER

Gas is burned in many industrial furnaces because of its cleanliness, ease of control of furnace atmosphere, ability to produce a long slow burning flame with uniform and gradual energy liberation, and ease of temperature regulation. Natural gas is used for steam generation in gas-producing areas and in areas served by natural-gas

transmission lines where coal is not available at a competitive price. It is also burned extensively in coal- or oil-fired units during the summer months in districts served by natural-gas pipe lines, at which time the absence of the domestic heating load creates a temporary, surplus of natural gas. By-product gas such as blast-furnace gas may be available at the steel mills for steam generation. Because of. the variable or, season al supply of gaseous fuels, combination burners have been developed to permit the simultaneous burning of the available gas together with pulverized coal or oil in an amount sufficient to produce the required steam. When a molecule of combustible gas is mixed with the oxygen necessary for its combustion at a temperature above the ignition temperature, combustion is practically instantaneous. For steam generation, where a short flame is desired in order to reduce the required furnace volume, the burner should provide for rapid and thorough mixing of the fuel and air in the correct proportions for good ombustion. For such applications, a good burner is primarily a proportioner and mixing device.

In industrial furnaces where long "lazy" flames are desired, slow and gradual mixing of the air and fuel in the furnace is necessary.

In the burner the gas, under pressure in the supply line, enters the furnace through a burner port and induces a flow of air through the port. Mixing is poor, and a fairy long flame results. The flame can be shortened by use of the ring burner, in which the gas flows through an annular ring and induces air flow both around and within the annulus of gas.

1.Read and translate the following words:

Gas burner, atmosphere, ability, liberation, regulation, area, natural-gas,transmission, available, extensively, oil-fired units, temporary, blast-furnace gas, variable, gaseous fuels, permit, simultaneous, together, combustible gas, instantaneous, generation, proportioner, desire, through, induce.

2.Remember the following words and word-combinations:

Gas burner ['gæs, 'bə:nə]
Cleanliness ['klenlinis]
Pipe lines ['paip, 'lainz]
Domestic heating [də'mestik, 'hi:tiŋ]
By-product ['bai,prɔdʌkt]
Steam generation ['sti:m, ʤenə'reiʃən]
Induce [in'dju:s]

3 . Put the following words into the gapes:

Natural, extensively, blast-furnace, combustible, furnaces, pressure, mixing, ring burner.

1. ( ) gas is used for steam generation in gas-producing areas…
2. It is also burned ( ) in coal-or oil-fired units…
3.By-product gas such as ( ) gas may be available…
4.When a molecule of ( ) gas is mixed with the oxygen necessary for its combustion…
5.In industrial ( ) where long "lazy" flames are desired…

6.In the burner the gas, under ( ) in the supply line…
7.( ) is poor, and a fairly long flame results.
8. The flame can be shortened by use of the ( ) …

4. Translate the following word-combinations form Russian into English:

Промышленные печи, требовать, магистральные газопроводы природного газа, агрегаты использующие
угольное или жидкое топливо, доступный,
площадка(поверхность), кольцевое пространство, круговое кольцо, побочный продукт, газовая горелка, каменный уголь, пламя, горючий газ, колосниковый газ(доменный), требуемый пар.

5. Make up 3 forms of the following verbs:

To be, to show, to have, to take, to burn, to permit, to develop, to use, to break, to design.

6. Put the necessary prepositions:

1. Natural gas is used ( ) steam generation ( ) gas-producing areas and ( ) areas served ( ) natural-gas transmission lines…
2.Became ( ) the variable or seasonal supply ( ) gaseous fuels…
3.When a molecule ( ) combustible gas is mixed ( ) the oxygen necessary ( ) its combustions ( ) a temperature ( ) the ignition temperature…
4.( ) industrial furnaces where long "lazy" flames are desired, slow and gradual mixing ( ) the air…
5.( ) the burner the gas ( ) pressure ( ) a burner port…
6.The flame can be shortened ( ) use ( ) the ring burner, ( ) which th gas floes ( ) annular ring…

STOKERS

A stoker should not only be designed from the combustion poir

of view, but it must be mechanically strong to withstand all working stresses due to high temperature, etc. A simple design will ensure low first cost minimum maintenance and operation for long periods without failure. Some of the factors to be aimed at in stoker design are:

maximum rates of burning, highest continuous efficiency and the unlimited choice of fuels.

Any study of the use of stokers must begin with an analysis of the four principal constituents of coal, namely, moisture, volatiles, mixed carbon and ash, or, more generally, water, tar, coke and dirt. These determine the features which should be embodied in the stoker and furnace equipments so that the proper treatment of the coal at the correct time is effected on its passage through the furnace. Whichever of the two types be used the coal has to be taken from the bunkers to the feeding hoppers on the boilers. The coal falls by gravity from the bunkers through a valve into feeding chutes. In some installations automatic weighers are included in the downspouts between the cut-off valves and the boiler feed hoppers. The cut-off valves may be operated from the firing floor by means of chains. The chutes are one ore two types namely, traversing and fixed.

There are usually two or three chutes for large boilers. The travelling chutes travel the full width of the feeding hopper, the motion being affected by means of a continuously rotating screwed shaft which engages with a special nut attached to the chute. The operating shaft has right- and left-hand helical grooves and the nut is designed so that at the end of its travel it reverses automatically.

The chutes are operated from the stoker drive, there being two or four chutes for large boiler units. Coal chutes are of welded mild steel plates, wearing plates also being included.

1. Read the following words:

Stoker, point of view, mechanically strong, stress, maintenance, periods, aimed, efficiency, highest, unlimited, principal constituents, moisture, volatile, mixed carbon, ash, tar, coke, dirt, features, embodied, equipment, proper treatment, bunkers, feeding hoppers, boiler, valve, chutes, installation, downspout, cut-off valve, firing floor, traversing, motion, reveres, welded mild steel plate, include.

2.Remember the following words and word-combinations:

Maintenance ['meintənəns]
Moisture ['mɔistʃə]
Volatile ['vɔlətaiL]
Proper treatment ['prɔpə, 'tri:tmənt]
Bunker ['bʌŋkə]
Feeding chute ['fi:diŋ, 'ʃu:t]
Firing floor ['faiəriŋ, 'flɔ:]
Mixed chutes ['miKSt, 'ʃu:tS]
Include [in'kLu:d]

3.Put the following words into the gaps:

Stoker, determine, falls, bunkers, valve, installations, wingers, cut-off valuing, chutes, traversing, fixed, shaft, helical grooves, welded mild steel plates.

1.Some of the factors to be aimed at in ( ) designs are…
2.These ( ) the features which showed be embodied in the stoker…
3.The coal ( ) by gravity from the ( ) through a ( ) into feeding chutes.
4.In some ( ) automatic ( ) are included in the downspouts between the cut-off valves…
5.The ( ) may be operated from the firing floor by means of chains.
6.The ( ) are one of two types namely, ( ) and ( ).
7.The operating ( ) has right-and left-hand ( ) and the nut is designed so that at the end of its travel…
8.Coal chutes are of ( ) , wearing plates also being included.

4.Translate the following word-combinations from Russian into English:

Зола, горение, точка зрения, лоток, котел, проект, уменьшать, включатель, осуществлять, бункер(воронка загрузочная), пластина, установка, механический загрузчик топлива, выбор, потеря, летучий, клапан, отсечной клапан, вращающийся.

5.Make up 3 forms of the following verbs:
To be, to study, to determine, to give, to show, to drive, to bring, to burn, to operate, to feed, to begin.

6.Put the necessary prepositions.

1.Some ( ) the factors to be aimed ( ) ( ) stokers design is...
2.Any study ( ) the use ( ) stokers must begin ( ) an analysis ( ) the four principal constituents ( ) coal...
3 . The coal falls ( ) gravity ( ) the bunkers ( ) a valve ( ) feeding chutes
4.The cut-off valves may be operated ( ) the firing floor ( ) means ( ) chains.
5.There are usually two or three chutes ( ) large boilers.
6 .The chutes are operated ( ) the stokers drive, there being two or four chutes ( ) large boiler units.

SPREADER STOKERS

The spreader stoker is designed to throw coal continuously onto a stationary or moving grate. A spreader stoker is equipped with a mo-ving grate which travels toward the feeder mechanism and ischarges the refuse continuously. Coal is fed from the hopper by means of a reciprocating feeder plate having a variable-speed drive which for bestperformance should be regulated automatically to feed coal in accordance with the demand for energy.

The coal is delivered by the feeder to a rapidly revolving drum or rotor on which are fastened specially shaped blades which throw the fuel into the furnace and distribute it uniformly over the grate. Coal can be distributed thus for a total distance of about 22 ft.The feeder mechanism is built in standardized widths, and several units may be installed across the front of the larger furnaces. Air is supplied by means of a blower to the space under the moving grate through an adjustable damper. The active fuel bed is normally not over 1,5 in.deep so that an adequate supply of air can penetrate the fuel bed and enter the furnace. Active fuel beds much thicker than 1,5 in will produce excessive amounts of smoke.

Much of the volatile matter is distilled from the coal before it strikes the fuel bed,and the caking properties of the fuel are thus destroyed, thereby making it possible to burn even the strongly caking bituminous coals.

Since the fuel bed is thin and undisturbed and the ash is cooled by the flow of air through it, trouble with clinkering or fusing of the ash is uncommon, and this stoker can burn almost any kind of bituminous coal.

Since the finer sizes of coal are burned in suspension, large furnaces are required, and objectionable quantities of dust may be discharged from the installation if it is not designed correctly and if dust collectors are not installed to clean the gases leaving the steam-generating unit. Also it is standard practice to promote turbulence, improve combustion, and reduce smoke.

Large units provided with continuous ash-discharge grates are capable of burning 12 to 15 tons of coal per hr. Small units may have stationary grates with clean-out doors trough which the ashes may be removed manually with a hoe, or they may have dump grates operated by a power cylinder in which grate sections may be tilted periodically to dump the ashes.

The spreader stoker is simple in construction and reliable in operation .It can burn a wider variety of coal successfully than any other type of stoker. Maximum continuous combustion rates of 45 to 60 psf of grate area per hr are normally used. When provided with automatic regulation of fuel and air in accordance with the demand for energy, this stoker is very responsive to rapidly fluctuating loads.

However, it is not so adaptable to light-load operation as other types of stokers because of the difficulty of maintaining ignition and combustion in the very thin fuel bed and with a cold furnace. It is because of the thin fuel bed and the continuous,uniform firing of coal that the spreader stoker overcomes the smoke-producing problem associated with the thick intermittently hand-fired fuel bed.

1.Read the following words:

Spreader, stoker, stationary, mechanism, refuse,Variable-speed, performance, automatically, damper, adequate, excessive, distill, property, bituminous, clinkering, quantity-turbulence, ash-discharge, periodically, construction, reliable, area, ignition, maintaining, intermittently.

2.Read and translate the following word-combinations:

Spreader ['spreda],
Specially shaped blades [spe∫aLi, 'se1pt, 'bLeidz]
Adjustable damper [ə'dʒʌstəbL, 'dæmpə]
Active fuel bed ['æktiv, 'fjueL, 'bed]
Excessive amount of smoke [ik'sesiv, 'əmaunt, 'ɔf, 'smauk]
Strongly caking bituminous coals ['strɔŋli, 'keikiŋ, bitjumnəs, 'kəuL]
High-velocity steam jets ['hai, vi'LɔSiti, 'sti:m, 'dʒets]
Automatic regulation [,ɔ:tə'mætik, regju'lei∫ən]
Rapidly fluctuating loads ['ræpidli, 'flʌktjueitiŋ, 'LəudZ]

3.Put the following words into the gapes: Spread stoker, moving, hoper, reciprocating, feeder mechanism, blower, volatile, matter, finer, ash-discharge, adaptable, high-load.

1.The ( ) is designed to throw coal continuously onto a stationary or ( ) grate.
2.Coal is fed from the ( ) by means of a ( ) feeder plate…
3.The ( ) is built in standardized widths…
4.Air is supplied by beans of a ( ) to the space under the moving grate trough an adjustable damper.
5.Much of the ( ) is distilled from the coal before it strikes the fuel bed…
6.Silence the ( ) sizes of coal or burned in suspension…
7.Large units provided with continuous ( ) grates are capable of burning 12 to 15 tons of coal per hr.
8.However, it is not so ( ) to ( ) operation as other types of stokers because of the difficulty of maintaining ignition…

4.Translate into Russian, Pay attention to the predicates :

Coal can be distributed this for a total distance of about 22 ft.
Several units may be installed across the front of the larger furnaces.
This stoker can burn almost any kind of bituminous coal.
It can burn a wider variety of coal successfully than any other type of stoker.

5.Translate the following word-combinations from Russian into English :

Топка с разравнивающей решеткой и непрерывными удалениями золы, улучшать, уменьшать, пластина, разгружать, бункер(воронка),решетка, решетка с непрерывным удалением золы, заслонка(регулярной тяги), двигатель(приводить в движение), питающий(питательный) механизм.

6.Make up 3 forms of the following verbs:

To have, to promote, to build, to show, to put

7.Put the necessary prepositions:

1.The spread stokers is designed to throw coal continiously ( ) a stationary or moving grate.

2.Coil is fed ( ) the hopper ( ) means ( ) a reciprocating feeder plate having a variable-speed drive…

3.Coal can be distributed this ( ) a total distance ( ) ( ) 22 ft.

4.Air is supplied ( ) means ( ) a blower ( ) the space ( ) the moving grate ( ) an adjustable damper.

5.Much ( ) the volatile matter is distilled ( ) the coal ( ) it strikes the fuel bed…

6.Large units provided ( ) continuous ash-discharge grates are capable ( ) burning 12 ( ) 15 tons ( ) coal per hr.

7.It can burn a wider variety ( ) coal successfully than any other type ( ) stoker.

8.When provided ( ) automatic regulation ( ) fuel and air ( ) accordance ( ) the demand ( ) energy, this stoker is very responsive ( ) rapidly fluctuating loads.

CHAIN-AND TRAVELLING-GRATE STOKERS

A chain-grate stoker has a moving grate in the form of a continuous chain. The upper and lower runs of the chain are supported on a structural steel frame. The chain is driven from the stoker front by means of sprockets mounted on a rotating shaft which is actuated by a ratchet

mechanism and hydraulic cylinder. The grate bars are made of heat-resistant cast iron, are cooled by the air supplied for combustion, and form a flat undisturbed surface for the fuel bed.

Coal from the stoker hopper is placed on the moving grate in a uniform layer, the depth of which is controlled by the vertical movement of an adjustable fuel gate. The depth of the fuel bed is usually between 3 and 8 in. depending upon the kind of fuel being burned. The speed of the grate may be adjusted, usually between the limits of 4 and 20 in. per min., so that the combustible material is burned before the ash is discharged from the rear end into the ashpit.

The shearing action of adjacent grate bars as they pass around the curved supporting member at the rear of the stoker provides a self-cleaning action for the grate bars. Air is supplied under adjustable pressure to several compartments under the grate. Thus the supply of air to various sections of the fuel bed may be adjusted to suit the combustion requirements.

When bituminous and other high-volatile coals are burned, high-velocity air jets are installed in the front furnace wall. The volatile matter that is released from the incoming green coal is mixed with swirling turbulent air that is introduced above the distillation zone. Two important results are thereby accomplished: 1) the volatile matter is burned smokelessly, and 2) a high-temperature zone is formed which provides for stable ignition of the incoming coal. The existence of this highly incandescent zone of turbulent combustion over the front end of the stoker makes mixing arches in the furnace unnecessary, and an open furnace with vertical walls similar to the spreader-stoker furnace may be used.

The small sizes of anthracite which cannot be sold for a domestic fuel and the small sizes of coke which are too small to charge into the blast furnace, called coke breeze, are important stoker fuels in certain localities. These fuels contain practically no volatile matter. Because of the fine size and large total surface of the incandescent carbon in the fuel bed, all the oxygen combines with carbon a short distance above the grate unless fuel-bed air velocities are so high as to almost lift the fuel from the grate. Under these conditions, large amounts of fine particles of carbon are blown upward into the furnace.

It is necessary to maintain a hot zone above the entering fuel to ignite the fuel on the grate. Accordingly, furnaces for burning anthracite and coke breeze are constructed with a long rear arch and over-fire air injection through the rear arch.

The net effect is to maintain a hot zone over the incoming fuel and to blow the fine particles of carbon onto the front of the stoker so as to assist ignition and retain them in the combustion zone until they are burned. Over-fire air injection and a high furnace are necessary to burn the CO that is formed in the fuel bed.

The traveling-grate stoker is similar in general appearance and operation to the chain-grate stoker except that individual grate bars or keys are mounted on carrier bars which extend across the width of the stoker and are attached to and driven by several parallel chains. Since adjacent grate bars have no relative motion with respect to each other, this stoker is particularly applicable to the burning of the fine sizes of anthracite and coke breeze in which all the fuel may pass through a screen having 3/16-in. round openings.

1.Read the following words:

Chain-grate stoker, continuous chain, structural steel frame, sprockets, hydraulic cylinder, uniform layer, death, adjustable, combustible, compartment, bituminous, high-volatile, high-velocity, release, turbulent, smokeless, incandescent, anthracite, oxygen, injection, screen.

2.Remember the following words and-combinations:

Chain-grate stoker,['tʃeɪn, 'greɪt, 'stəʊkə]
Continuous chain [kən'tɪnjʊəs, 'tʃeɪn]
Structural steel frame ['strʌktʃərəl, 'stiːl, 'freɪm]
Sprockets ['sprɔkets]
Ratchet cylinder ['rætʃɪt, 'sɪlɪndə]
Grate bars ['greɪt, 'bɑːz]
Discharge [dɪs'tʃɑːdʒ]
Rear of the stoker [rɪə, ɔf, ðɪ, stɔkə]
Stable ignition ['steɪbl, ɪgnɪʃən]
Coke breeze ['kəʊk, 'briːz]
Traveling-grate stoker ['trævlɪŋ, 'greɪt, 'stɔkə]

3.Put the following words into the gaps:

Sprockets, heat-resistant, hopper ,adjustable, bituminous, high-volatile, incandescent, volatile, to maintain

1.These fuels contain practically no ( ) matter…
2.It is necessary ( ) a hot zone above the entering fuel to ignite.
3.The grate bars are made of ( ) cast iron, are cooled by the air supplied
4.for combustion, and form a flat undisturbed surface for the fuel bed.
5.Coal from the stoker ( ) is placed on the moving grate in a uniform layer, the depth of which is controlled by the vertical movement of an ( ) fuel gate.
6.When ( ) and other ( ) coals are burned, coals are burned, high-velocity air jets are installed in the front furnace wall.
7.The existence of this highly ( ) zone of turbulent combustion over the front end of the stoker makes mixing arches in the furnace unnecessary…
8.These fuels contain practically no ( ) matter.
9.It is necessary ( ) a hot zone above the entering fuel to ignite the fuel on the grate.

4.Translate the following word combinations from Russian into English:

Механическая топка с цепной решеткой, механическая топка с движущимися колосниками, битуминозный уголь, зона высокой температуры, воздушная струя, зона накапливания.

5.Make up 3 form of the following verbs:

To have, to run, to make, to sell, to burn, to know, to bring, to charge, to blow

6.Put the necessary prepositions into the gapes:

1.The grate bars are supplied ( ) combustions…
2.Coal ( ) the stoker hopper is placed ( ) the moving grate ( ) a uniform layer…
3.The speed ( ) the grate may be adjusted…

4.Air is supplied ( ) adjustable pressure several compartments ( ) the grate.

5.The existence ( ) this highly incandescent zone is formed which provides ( ) stable ignition ( ) the incoming coal…

6.Because ( ) the fine size and large total surface ( ) the incandescent carbon ( ) the fuel bed…

7.( ) these conditions, large amount ( ) fine particles ( ) carbon are blown upward ( ) the furnace.

8.The net effect is to maintain a lot zone ( ) the incoming fuel and to blow the fine particles ( ) carbon ( ) the ( ) the stoker to assist ignition…

STEAM GENERATION

Steam is used for space heating, in manufacturing processes, and for power generation. Except for hydroelectric power plants, practically all the central-station generating capacity is in the form of steam turbines. Because of the magnitude of the load and the economies that are effected through the use of the smallest possible number of largest machines, most central-station turbines now being built are in the size range of 1000,000 to 600,000 kw. It is standard practice to install one steam-generating unit per turbine. Consequently, these turbines require steam-generating units in the capacity range of 750,000 to over 3,000,000 lb of steam per hr.

The steam boiler is a pressure vessel in which feedwater can be converted into saturated steam of high quality at some desired pressure. When other heat-transfer surfaces such as superheater, air heater, or economizer surfaces are combined with boiler surface into a unified installation, the name steam-generating unit is applied to the complete unit.

Boilers in which the water is inside the tubes are called water-tube boilers, whereas boilers that have the hot products of combustion in the tubes and the water outside the tubes are called fire-tube boilers. Boiler heating surface is defined as that surface which receives heat from the flame or hot gases and is in contact with water. The area is based on the surface receiving the heat, that is, the outside area of water tubes and the inside area of fire tubes.

1.Read the following words:

Hydroelectric ['haidrəuilektrik]
Magnitude ['mægnitjud]
Consequently ['kɔnsikwəntli]
Capacity [kə'pæsiti]
Economizer [i:'kɔnəmaizə]
Installation [,instə'leiʃən]

2. Put the following words into the gaps:

Hydroelectric, magnitude, vessel, economizer, whereas, heating, Receiving

1. Except for ( ) power plants, practically all the central-station generating capacity is in the form of steam turbines.
2. Because of the ( ) of the load and the economies that are effected through the use of the smallest possible number of largest machines.
3. The steam boiler is a pressure ( ) in which feedwater can be converted into saturated steam of high quality at some desired pressure.
4. When other heat-transfer surfaces such as superheater, air heater, or ( ) surfaces are combined with boiler surface into a unified installation…
5. Boilers in which the water is inside the tubes are called water-tube boilers, ( ) boilers that have the hot products of combustion in the tubes and the water outside the tubes are called fire-tube boilers.
6. Boiler ( ) surface is defined as that surface which receives heat from the flame or hot gases and is in contact with water.
7. The area is based on the surface ( ) the heat, that is, the outside area of the water tubes and the inside area of fire tubes.

3.Translate from Russian into English

Производственный процесс, практически, следовательно, питательная вода, установка, тогда как, внешний, внутренний

4. Make up three forms of the verbs:

Forget, give, say, tell, know, mean, write, fall, feel, sleep

5. Put the necessary prepositions:

1. Steam is used ( ) space heating, ( ) manufacturing processes, and ( ) power generation.
2. The steam boiler is a pressure vessel ( ) which feedwater can be converted ( ) saturated steam ( ) high quality ( ) some desired pressure.
3. Boiler ( ) which the water is inside the tubes are called water-tube boilers, whereas boilers that have the hot products ( ) combustion ( ) the tubes and the water outside the tubes are called fire-tube boilers.
4. Boiler heating surface is defined as that surface which receives heat ( ) the flame or hot gases and is ( ) contact ( ) water.
5. The area is based ( ) the surface receiving the heat, that is, the outside area ( ) water tubes and the inside area ( ) fire tubes.

6.State to what part the following words belong and translate them

Extract-extraction-extractive
Expand-expansion-expensive
Exist-existence-existent
mix-mixture
present-presence-presentable
use-useful-useless

BOILERS

Fire-tube boilers. These are boilers with straight tubes that are surrounded by water and through which the products of combustion pass. The tubes are usually installed within the lower portion of a single drum or shell below the water-line.

Water-tube boilers. These are boilers in which the tubes themselves contain steam or water, the heat being applied to the outside surface. The tubes are usually connected to two or more drums set parallel to, or across, the center line. The drums are usually set horizontally.

Tube shape and position. The tubular heating surface may be classified: 1) by form — either straight, bent, or sinuous or 2) by inclination — horisontal, inclined or vertical.

Firing. The boiler may be either a fired or an unfired pressure vessel. In fired boilers the heat applied is a product of fuel combustion. A nonfired boiler has a heat source other than combustion.

Circulation. The majority of boilers operate with natural circulation. Some utilize positive circulation in which the operative fluid may be forced "once through" or controlled with partial recirculation.

Furnace position. The boiler is an external combustion device in that the combustion takes place outside the region of boiling water. All heat must be transferred through the heating surface to reach the water. The relative location of the furnace to the boiler is indicated by the description of the furnace as being internally or externally fired: 1) the furnace is internally fired if the furnace region is completely surrounded by water-cooled surfaces; 2) the furnace is externally fired if the furnace is auxiliary to the boiler or built under the boiler.

General shape. During the evolution of the boiler as a heat producer many new shapes and designs have appeared. Some of these boilers have become popular and are widely recognized in the trade, including the following:

1. Fire-tube boilers — horizontal return tubular, short firebox, compact, locomotive, vertical tube (steam jenny), Scotch type, and residential units.

2. Water-tube boilers — both horizontal straight tube and bent tube units. The horizontal straight tube boiler may have a box type header made of steel plate, or a sectional header each section of which connects the tubes in a single vertical row. The bent tube boiler may have one to four drums. If the drum is parallel to the tubes, the boiler is long — longitudinal drum; if across the tubes, it is a cross drum. If the furnace is enclosed with water-cooled surfaces, it is a waterwall (water-cooled) furnace.

1. Read the following words:

Centerline ['sentərlaɪn]
Horizontal [ˌhɔrɪ'zɔntl]
Inclination [ˌɪnklɪ'neɪʃən]
Vertical ['vətɪkəl]

Circulation [ˌsəːkjuˈleɪʃən]
Utilize [ˈjuːtɪlaɪz]
Auxiliary [ɔːgˈzɪljərɪ]

2. Put the following words into the gaps:
The centerline, heating, vessel, majority, utilize, location

1. The tubes are usually connected to two or more drums set parallel to, or across, ( ).
2. The tubular ( ) surface may be classified…
3. The boiler may be either a fired or an unfired pressure ( ).
4. The ( ) of boilers operate with natural circulation.
5. Some ( ) positive circulation in which the operative fluid may be forced"once through" or controlled with partial recirculation.
6. The relative ( ) of the furnace to the boiler is indicated by the description of the furnace…

3. Translate from Russian into English:

Продукты сгорания, ниже линии воды, горизонтально, большинство, формы и проекты, добавочный, жаротрубный котёл, ,водотрубный котёл, огневая коробка, огнеупорный кирпич

4.Make up three forms of the verb:

Fight, rise, leave, sell, become, win, shake, see, lose, stand

5. Put the necessary prepositions:

1. The tubes are usually installed ( ) the lower portion ( ) a single drum or shell ( ) the waterline.
2. The tubes are usually connected to two or more drums set parallel ( ), or ( ), the centerline.
3. All heat must be transferred ( ) the heating surface ( ) reach the water.
4. The horizontal straight tube boiler may have a box type header made ( ) steel plate, or a sectional header each section ( ) which connects the tubes ( ) a single vertical row.

THE TWO-DRUM WATER-TUBE BOILER

A typical small two-drum water-tube boiler is fired by a spreader stoker equipped with a dump grate. By means of baffles, the gases are forced to follow a path from the furnace to the boiler exit. This arrangement of gas flow is known as a "three-pass" design. A water level is maintained slightly below the midpoint in the steam drum. Water circulates from the steam drum to the lower or mud drum through the six rows of tubes in the rear of the boiler-tube bank where the comparatively low gas temperature results in a low heat-transfer rate. Circulation is from the mud drum to the steam drum through the front boiler tubes and the side-wall furnace tubes. The side-wall furnace tubes are supplied with water from the mud drum by means of circulators connected to rectangular water boxes located in the side walls at the level of the grate. Water for the front-wall tubes is supplied to a round front-wall header by downcomer tubes connected to the steam drum and insulated from the furnaces by a row of insulating brick. Most of the steam is generated in the furnace-wall tubes and in the first and second rows of boiler tubes which can "see" the flame in the furnace and absorb energy by radiation. Boilers of this type have been standardized in a range of sizes capable of generating 8,000 to 50,000 lb of steam per hr.

The position of the drums and the shape of the tubes result in a compact unit having a well-shaped and economically constructed furnace. By simple changes in the arrangement of furnace-wall tubes, the design can be adopted to almost any kind of firing equipment and fuel.

1. Read the following words

Spreader [ˈspredə]

Maintained [meɪnˈteɪnd]

Comparatively [kəmˈpærətɪvlɪ]

Circulation [ˌsɜːkjʊˈleɪʃən]

Rectangular [rekˈtæŋgjʊlə]

Insulate [ˈɪnsjʊleɪt]

2.Put the following words into the gaps:

A dump, maintained, circulation, insulated, constructed, equipment

1. A typical small two-drum water-tube boiler is fired by a spreader stoker equipped with a ( ) grate. 2. A water level is ( ) slightly below the midpoint in the steam drum. 3. ( ) is from the mud drum to the steam drum through the front boiler tubes and the side-wall furnace tubes. 4. Water for the front-wall tubes is supplied to a round front-wall header by downcomer tubes connected to the steam drum and ( ) from the furnaces by a row of insulating brick. 5. The position of the drums and the shape of the tubes result in a compact unit having a wall-shaped and economically ( ) furnace. 6. By simple changes in the arrangement of furnace-wall tubes, the design can be adopted to almost any kind of firing ( ) and fuel.

3. Translate from Russian into English:

Водотрубный котел, двухбарабанный водотрубный котел, изолировать, водяная камера, поддерживать(сохранять, обслуживать), оборудование, положение, производить, расположение

4.Make up three forms of the verb:

To hurt, to throw, to spend, to rise, to lose, to shak

5.Put the necessary prepositions:

1. By means ( ) baffles the gases are forced to follow a path ( ) the Furnace ( ) the boiler exit. 2. A water level is maintained slightly ( ) the midpoint ( ) the steam drum. 3. Curculation is ( ) the mud drum ( ) the steam drum ( ) the front boiler tubes and the side-wall furnace tubes.4. Water ( ) the front-wall tubes is supplied ( ) a round front-wall header ( ) downcomer tubes connected ( ) the steam drum and insulated ( ) the furnaces ( ) a row ( ) insulating brick. 5. ( ) simple changes ( ) the arrangement ( ) furnace-wall tubes, the design can be adopted ( ) almost any kind ( ) firing equipment and fuel.

6.Find the predicates in the Passive Voice in the text

THE HORISONTAL STRAIGHT TUBE BOILER

The horizontal straight tube boiler covers a range of capacity and pressure between that of the fire-tube boiler and the large

central steam generator. It is used in industrial applications primarily for process steam, occasionally for hearting, and sometimes for power generation. The horizontal straight tube boiler is limited to an hourly production of about 10 000 lb steam per ft of boiler width. It is simple in operation and has low draft loss.

The straight tube boiler is made up of banks of tubes that are usually staggered, the tubes are inclined at an angle (5 to 15 deg.) to promote circulation and expanded at the ends into headers.

The header (either a box header or a sectional header) provides flat surfaces for tube connections. It may be connected to the drum by means of circulation tubes (downcomers or downtakes for supplying water to the tubes, uptakes or risers for discharging water and steam from the tubes) or by sheet steel saddles. The drum may be either longitudinal (long) or across (cross) with reference to the axis of the boiler tubes. Some boilers have a portable firebox with wrapper and furnace sheets instead of a drum. The high end is usually the firing end. The area of the heating surface (and the capacity) is varied by changing the tube length and the number of tube row in both height and width. The tubes, 3 to 4 in. in diameter, are spaced 7 to 8 in. on centers horizontally and 6 in. on centers vertically (except slag screen tubes, which are on about 12 in. centers). The tubes are all of the same diameter and length, never over 18 to 20 ft.

As the pressure increases, the header design changes. Greater tube spacing is required, and the tubes must be smaller in diameter.

Internal fireside baffles may be horizontal (parallel with and between the tubes) or vertical (across the tubes). The baffling is arranged for two or three gas passes across the tubes. In the headers opposite the tube end, there is a handhole of sufficient size to permit removal or renewal of the tubes and the inspection of tubing and cleaning of the tube interior. Handholes are elliptical in shape, machined to form a smooth gasket seat and fitted with forged steel handhole plates.

Superheaters with a maximum temperature rise of about 100F may be installed. They are termed overdeck and interdeck depending upon their location in the boiler.

Circulation. The steam and water rises along the inclined tubes to the front headers, then through the headers and circulation tubes to the drum. The water then circulates through the downcomers to the rear header and finally to the tubes to complete the cycle. In the long drum boiler, the water is diverted by a baffle plate back through the steam drum. In the cross drum boiler, steam separators (drum internals), are often used to eliminate entrained moisture and precipitates, thereby purifying the steam. If the tubes discharge to the steam drum at or above the waterline, the boiler is known as an exposed-tube boiler, otherwise it is a submerged-tube boiler.

Fuels and fuel firing. The horizontal straight tube boiler is suitable for operation with oil, gas, coal, bagasse, or wood.

Burning methods include oil and gas burners with hand or stoker firing. Pulverized coal firing is rarely used. The firing is usually manually controlled.

1.Read the following words

Horizontal [ˌhɔrɪzˈɔntl]
Primarily [praɪˈmərɪlɪ]
Staggered [ˈstægərd]
Saddles [ˈsædlz]
Longitudinal [ˌlɔndʒɪˈtjuːdɪnl]
Gasket [ˈgæskɪt]

2.Put the following words into the gaps

Straight, draft, sectional, wrapper, increases, elliptical, downcomers, stoker

1. The horizontal ( ) tube boiler is limited to an hourly production of about 10 000 lb steam per ft of boiler width.
2. It is simple in operation and has low ( ) loss.
3. The header (either a box header or a ( ) header) provides flat surfaces for the tube connections.

4. Some boilers have a portable firebox with ( ) and furnace sheets instead of a drum.
5. As he pressure ( ), the header design changes.
6. Handholes are ( ) in shape, machined to form a smooth gasket seat and fitted with forged steel handhole plates.
7. The water then circulates through the ( ) to the rear header and finally to the tubes to complete the cycle.
8. Burning methods include oil and gas burners with hand or ( ) firing.

3.Translate from Russian into English:

Горизонтальный прямотрубный котёл, разгрузка, спускная труба, прокладка, водяной коллектор, котёл с погружением, длина, ширина, очищение, влажность

4.Make up 3 forms of the following verbs:

To grow, to think, to shut, to set, to drive

5.Put the necessary prepositions:

1.It is used ( ) industrial applications primarily ( ) process steam, occasionally ( ) heating, and sometimes ( ) power generation.
2. It may be connected ( ) the drum ( ) means ( ) circulation tubes...
3. Some boilers have a portable firebox ( ) wrapper and furnace sheets instead ( ) a drum.
4. Handholes are elliptical ( ) shape, machined ( ) form a smooth gasket seat and fitted ( ) forged steel handhole plates.
5. ( ) the long drum boiler, the water is diverted ( ) a baffle plate back ( ) the steam drum.
6. The horizontal straight tube boiler is suitable ( ) operation ( ) oil, gas, coal, bagasse or wood.

6 .Give the synonyms:

Large, small, many, sad, high, inside

SUPERHEATERS

Superheated steam is produced by causing saturated steam from a boiler to flow through a heated tube or superheater, thereby increasing the temperature, enthalpy, the specific volume of the steam.

It should be noted that in an actual superheater there will be a decrease in steam pressure due to fluid friction in the superheater tubing.

Maximum work is obtained when a fluid expands at constant entropy, that is, without friction and without heat transfer to the surroundings. By calculations it will be found that the constant-entropy expansion of 1 lb of dry saturated steam at 1000 psia to a final pressure of 1.0 psia will result in the conversion into work of 417 Btu, whereas the expansion of superheated steam at the same initial pressure, 1000 psia but at 1000° F, to the same final pressure of 1.0 psia will result in the conversion into work of 581 Btu, an increase of 39.3 per cent.

In addition to the theoretical gain in output due to the increased temperature of superheated steam as compared to saturated steam, there are additional advantages to the use of superheated steam in turbines. The first law of thermodynamics states that all the work done by the turbine comes from the energy in the steam flowing through the turbine.

Thus, if steam enters the turbine with an enthalpy of 1300 Btu per lb and the work done in the turbine is equivalent to 300 Btu per lb of steam, the enthalpy of the exhaust steam will be 1300 − 300 = 1000 Btu per lb, neglecting heat transfer to the surroundings. If sufficient energy is converted into work to reduce the quality of the steam below about 88 per cent, serious blade erosion results because of the sandblasting effect of the droplets of water on the turbine blades.

Also, each 1 per cent of moisture in the steam reduces the efficiency of that part of the turbine in which the wet steam is expanding by 1 to ½ percent. It is necessary, therefore, that high-efficiency steam turbines be supplied with superheated steam. The minimum recommended steam temperature at the

turbine throttle of condensing turbines for various initial steam pressures is as follows:

Throttle Steam	*Minimum Steam*
Pressure, psig	Temperature, ° F
400	725°
600	825°
850	900°
1250	950°
1450	1000°
1800	1050°

Large power plants currently being built in regions of high fuel cost are designed for operation at pressures of more than 1500 psig. At these high pressures a reduction in the annual fuel cost of 4 to 5 per cent can be made by expanding the steam in the turbine from the initial pressure and 1000 to 1100° F to an intermediate pressure of about 30 per cent of the initial pressure, returning the steam to the steam-generating unit, and passing it through a second superheater, known as a reheater, where it is superheated to 1000 to1100° F, and then completing the expansion of the steam in the turbine. For initial steam pressures above the critical pressure (3206 psia), a second stage of reheating is employed.

The decreased strength of steel at high temperature makes it necessary to use alloy steels for superheater tubing where steam temperatures exceed 800° F. Alloy steels containing 0.5 per cent of molybdenum and 1 to 5 per cent of chromium are used for the hot end of high-temperature superheaters at steam temperatures up to 1050° F, and austenitic steels such as those containing 18 per cent chromium and 8 per cent nickel are used for higher temperatures.

Superheaters may be classified as convection or radiant superheaters. Convection superheaters are those that receive heat by direct contact with the hot products of combustion which flow around the tubes. Radiant superheaters are located in

furnace walls where they "see" the flame and absorb heat by radiation with a minimum of contact with the hot gases.

In a typical superheater of the convection type saturated steam from the boiler is supplied to the upper or inlet header of the superheater by a single pipe or by a group of circulator tubes. Steam flows at high velocity from the inlet to the outlet header through a large number of parallel tubes or elements of small diameter. Nipples are welded to the headers at the factory, and the tube elements are welded to the nipples in the field, thus protecting the headers from temperature stresses due to uneven heating during final welding.

The amount of surface required in the superheater depends upon the final temperature to which the steam is to be superheated, the amount of steam to be superheated, the quantity of hot gas flowing around the superheater, and the temperature of the gas. In order to keep the surface to a minimum and thus reduce the cost of the superheater, it should be located where high-temperature gases will flow around the tubes. On the other hand, the products of combustion must be cooled sufficiently before they enter the superheater tubes so that any ash that may be present has been cooled to a temperature at which it is no longer sticky or plastic and will not adhere to the superheater tubes. In a modern two-drum steam generating unit fired by a continuous-ash-discharge spreader stoker, the superheater is located ahead of the boiler convection surface and at the gas exit from the furnace. In installations burning coal having a high content of low-fusing-temperature ash, it may be necessary to place a few boiler tubes ahead of the superheater.

1. Read the following words:

Superheater ['sju:pə,hitə]
Volume ['vɔljum]
Expansion [iks'pæhʃən]
Conversion [kən'və:ʃən]
Droplet ['drɔplit]
Erosion [i'rəuʒən]
Throttle ['θrɔtl]
Austenitic ['ɔstenitik]
Nipple ['nipl]

...e ...

...nodynamics,

...there will be a decrease i...
...n in the superheater tubing.
...al gain in output due to the
...o ( ) steam, there are additional
...rheated steam in turbines.
...states that all the work done by the
...nergy in the steam flowing through th...

...nmended steam temperature at the turb...
...turbines for various initial steam pres...

...aters are those that receive heat by dir...
products of combustion which flow...

...ows at high ( )from the inlet to th...
a large number of parallel tubes or...
...er.

...) are welded to the headers at the...
...ments are welded to the ( ) in the fi...
...eaders from temperature stresses due...
final welding.

3. Translate from Ru...

...асыщенный, через, капельк...
...ектировать, получать...
...ок, сварка

Make ...

Put the necessary prepositions:

1. Maximum work is obtained when a fluid expands ( ) constant entropy, that is, ( ) friction and ( ) heat transfer ( ) the surroundings.
2. ( ) addition ( ) the theoretical gain ( ) output due ( ) the increased temperature ( ) superheated steam as compared ( )saturated steam, there are additional advantages ( ) the use ( ) superheated steam ( ) turbines.
3. Also, each 1 per cent ( ) the moisture ( ) the steam reduces the efficiency ( ) that part ( ) the turbine ( ) which the wet steam is expanding ( ) 1 ( ) 5 per cent.
4. Large power plants currently being build ( ) regions ( ) high fuel cost are designed ( ) operation ( ) pressures ( ) more than 1500 psig.
5. ( ) initial steam pressures ( ) the critical pressure (3206 psia), a second stage ( ) reheating is employed.
6. Radiant superheaters are located ( ) furnace walls where they "see" the flame and absorb heat ( ) radiation ( ) a minimum
( ) contact ( ) the hot gases.
7. Nipples are welded ( ) the headers ( ) the factory, and the tube elements are welded ( ) the nipples ( ) the field, thus protecting the headers ( ) temperature stresses due ( ) uneven heating ( ) final welding.

6.Find the predicates with the model verbs
7.Arrange synonyms in pairs and translate them

1) to choose 2) to finish 3) to construct 4) to leave 5) to fight

6) to enter 7) famous 8) main 9) to attend

a) chief b) to come in c) to select d) to build e) to complete

f) to go away g) to visit h) well-known i) to struggle

ECONOMIZERS AHD AIR HEATERS

The largest loss that occurs when fuel is burned for steam

5. Put the necessary prepositions:

1. Maximum work is obtained when a fluid expands ( ) constant entropy, that is, ( ) friction and ( ) heat transfer ( ) the surroundings.
2. ( ) addition ( ) the theoretical gain ( ) output due ( ) the increased temperature ( ) superheated steam as compared ( )saturated steam, there are additional advantages ( ) the use ( ) superheated steam ( ) turbines.
3. Also, each 1 per cent ( ) the moisture ( ) the steam reduces the efficiency ( ) that part ( ) the turbine ( ) which the wet steam is expanding ( ) 1 ( ) ½ per cent.
4. Large power plants currently being build ( ) regions ( ) high fuel cost are designed ( ) operation ( ) pressures ( ) more than 1500 psig.
5. ( ) initial steam pressures ( ) the critical pressure (3206 psia), a second stage ( ) reheating is employed.
6. Radiant superheaters are located ( ) furnace walls where they "see" the flame and absorb heat ( ) radiation ( ) a minimum ( ) contact ( ) the hot gases.
7. Nipples are welded ( ) the headers ( ) the factory, and the tube elements are welded ( ) the nipples ( ) the field, thus protecting the headers ( ) temperature stresses due ( ) uneven heating ( ) final welding.

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ECONOMIZERS AHD AIR HEATERS

The largest loss that occurs when fuel is burned for steam

header. If the inlet header is at the bottom so that so that the water rises as it flows from tube to tube, the hot gas normally enters at the top and flows downward. Thus the coldest gas will be in contact with the coldest tubes, and it is possible to cool the gas to within 125 to 150F of the temperature of the inlet water if sufficient surface is installed.

Since the economizer has water in the tube and a dry gas around the tube, the major resistance to heat transfer is on the gas side. In order to increase the surface exposed to the gas around per linear foot of tube and thus increase the effectiveness of the tubular surface, the economizer has fine welded to the top and bottom of each tube. This increases the surface available for heat transfer from the gas without substantially increasing the pressure drop of the gas as it flows across the surface. The gas flows at right angles to the tubes, and the 2-in. finned tubes are staggered to promote effective scrubbing of the outside surface by the gas so as to improve the overall heat-transfer coefficient.

Where scale-free feedwater is available or acid cleaning of heat transfer surfaces is used to remove scale, the flanged return bends may be eliminated. The flow circuits then consist of continuous welded tubing between inlet and outlet headers.

1. Read the following words:

Efficiency [ɪ'fɪʃənsɪ]
Conventional [kən'venʃənL]
Increment ['ɪnkrɪmənt]
Sufficient [səfɪʃənt]
Exchangers [ɪks'tʃeɪndʒz]
Economizer [ɪ(:)'kɔnəmaɪzə]
Considerable [kən'sɪdərəbl]
Substantially [səb'stænʃəlɪ]
scrubbing ['skrʌbɪŋ]

2.Put the following words into the gaps

Conventional, decreases, increment, sufficient, installations, inlet, downward, economizer, transfer, linear, angles

1.In the ( ) boiler the theoretical minimum flue-gas temperature would be the saturation temperature of the water in the boiler tubes.
2.It will be noted that, as the temperature difference ( ), each ( ) of added surface becomes less effective and that the amount of surface required to cool the gases from 700 to F is about 60 per cent ...
3.In general, it is not economical to install ( ) boiler surface to cool the gases to within less than ...
4.In many ( ), it is economical to install a small boiler and a large economizer and air heater and to deliver the gases to the economizer...
5.If the ( ) header is at the bottom so that the water rises as it flows from tube to tube, the hot gas normally enters at the top and flows ( ).
6.Since the ( ) has water in the tube and a dry gas around the tube, the major resistance to heat ( ) is on the gas side.
7.In order to increase the surface exposed to the gas per ( ) foot of tube and thus increase the effectiveness of the tubular surface...
8.The gas flows at right ( ) to the tubes...

3. Translate from Russian into English
4.

Подогреватель,стандартный,сопротивление,увеличение,свободная от накипи питательная вода,значительный

4.Make up 3 forms of the worb:
Throw, shut, lose, draw, let, light, read

5.Put the necessary prepositions:

1. The efficiency ( ) a steam-generating unit provided ( ) good fuel-burning equipment is a function ( ) the flue-gas temperature.
2. The gases must be cooled ( ) the boiler exit-gas temperature ( ) the flu-gas temperature required ( ) high efficiency ( ) means ( ) heat exchangers supplied ( ) fluids ( ) temperatures less than the saturation temperature

( ) the boiler pressure.
3. Since the economizer has water ( ) the tube and a dry gas ( ) the tube, the major resistance ( ) heat transfer is ( ) the gas side.
4. The gas flows ( ) right angles ( ) the tubes, and the 2-in. finned tubes are staggered ( ) promote effective scrubbing ( ) the outside3 surface ( ) the gas so as to improve the overall heat-transfer coefficient.
5. The flow circuits then consist ( ) continuous welded tubing ( ) inlet and outlet headers

.

6. Arrange antonyms in pairs.

1) active, 2) to find, 3) rich, 4) the first, 5) correct, 6) high, 7) to disappear, 8) to weaken, 9) peace, 10) to decrease, 11) to appear, 12) to lengthen, 13) wrong, 14) low, 15) poor, 16) to lose, 17) the last, 18) to shorten, 19) war, 20) passive, 21) to strengthen, 22) to increase

THE AIR HEATER

The tubular air heater is constructed by expanding vertical tubes into parallel tube sheets which form the top and bottom surfaces, respectively, of the gas inlet and outlet boxes. The tube bank is enclosed in an insulated casing so constructed that the inlet air at room temperature can be admitted to the heating surfaces at the upper end from a fan or blower. The air passes downward around the tubes in a direction opposite to the flow of the hot gases and leaves the air heater at the lower end of the tube bank. Deflecting baffles are installed to guide the air and reduce frictional resistance at the turns. A by-pass damper and baffle permit by-passing the air around the upper half of the tube surface on light load when there is danger of corrosion due to low flue-gas temperatures. Long tubes closely spaced to maintain high air and gas velocities and countercurrent flow of gases and air make it possible in many installations to cool the gases to a temperature 100° to 200° F below the temperature at which the hot air is discharged.

Let us consider another type of air heater which operates on the regenerative principle. A drum filled with corrugated sheet-steel plates is

rotated about a vertical shaft at about 3 rpm by means of a small motor. Hot flue gas passes downward through the right side of the rotor from a duct connected to the economizer or boiler. An induced-draft fan may be connected by a duct to the lower side of the air-heater casing. This fan induces a flow of the gases through the boiler, economizer, and air-heater surfaces, and discharges them to waste up the chimney. The cold air from a forced-draft fan flows upward through the left side of the rotor, where the air is heated, after which it is delivered through suitable duct work to the stoker or burner in the furnace. Any point on the corrugated sheet-metal surface of the rotor is rotated alternately into the hot descending gas stream and the cold ascending air stream, thus transferring energy from the hot gas to the cold air.

Radial seals with rubbing surfaces on them are mounted on the rotor and make contact with a flat section of the casing between the hot-gas and cold-air ducts, thus minimizing leakage between the two streams of fluid. The depth of the rotor is normally between 3 and 4 ft. The unit is also made for operation about a horizontal shaft with horizontal flow of gas and air where building space makes such an arrangement desirable.

The maximum air temperature that can be used in stoker-fired installations without increasing grate maintenance is about 300° F, since the grate surface which supports the hot fuel bed must be cooled by the air to a temperature below which the iron grates will not be damaged. Air temperatures of 600° F are often used with pulverized coal. Since the stoker limits the heat-recovery possibilities of the air heater, both economizers and air heaters are usually installed in stoker-fired high-pressure steam-generating units. Where oil, gas, or pulverized coal is burned, an air heater is often installed without an economizer, although in many high-pressure units it may be more economical to reduce the boiler surface and use an economizer. The air heater is necessary in modern pulverized-coal plants since the coal is dried in the pulverizer by hot air to reduce power consumption and increase the capacity of the mill.

1. Read the following words:

Tubular ['tju:bjulə]
Deflecting [di'flektiŋ]
Countercurrent 'kauntə, 'kʌrənt]
Regenerative [ri'dʒenərətiv]

Corrugated ['kɔrugeitid]
Induced-draft [in'dju:st ,dra:ft]
Duct work [dʌkt ,wə:k]

2. Put the following words into the gaps:
Insulated, deflecting, corrugated, induced-draft, discharges, rotated, descending, pulverized, although, economizer

1.The tube bank is enclosed in an ( ) casing so constructed that the inlet air at room temperature can be admitted to the heating surfaces at the upper end from a fan or blower.
2. ( ) baffles are installed to guide the air and reduce frictional resistance at the turns.
3. A drum filled with ( ) sheet-steel plates is rotated about a vertical shall at about 3 rpm by means of a small motor.
4. An ( ) fan may be connected by a duct to the gases through the boiler, economizer, and air-heater surfaces, and ( ) them to waste up the chimney.
5. Any point on the ( ) sheet-metal surface of the rotor is ( ) alternately into the hot ( ) gas steam and the cold ascending air stream, thus transferring energy from the hot gas to the cold air.
6. Air temperatures of 600 F are often used with ( ) coal.
7. Where oil, gas or pulverized coil is burned, an air heater is often installed without an ( ), although in many high-pressure units it may be more economical to reduce the boiler surface and use an ( ).

3. Translate from Russian into English:
Изолировать, искусственная тяга, сопротивление, топочный газ, установка, выпускать, гофрированный лист, уменьшать, дымовая труба, принудительная тяга, перепускная задвижка

4.Translate from English into Russian:

Since, depending on, essentially, consequently, thus

5. Put the necessary prepositions:
1. The air passes downward ( ) the tubes ( ) a direction opposite ( ) the flow ( ) the hot gases and leaves the air heater ( ) the lower end ( ) the tube bank.

2. Let us consider another type ( ) air heater which operates ( ) the generative principle.
3. A drum filled ( ) corrugated sheet-steel plates is rotated ( ) a vertical shaft ( ) ( ) 3 rpm ( ) means ( ) a small motor.
4. This fan induces a flow ( ) the gases ( ) the boiler, economizer, and air-heater surfaces, and discharges them ( ) waste ( ) the chimney.
5. Radial seals ( ) rubbing surfaces ( ) them are mounted ( ) the rotor and make contact ( ) a flat section ( ) the casing ( ) the hot-gas and cold-air ducts, thus minimizing leakage ( ) the two streams ( ) fluid.
6. The air heater is necessary ( ) modern pulverized-coal plants since the coal is dried ( ) the pulverizer ( ) hot air to reduce power consumption and increase the capacity ( ) the mill.

6. Arrange synonyms in pairs:

1) to occur, 2) rapidly, 3) spot, 4) to encounter, 5) to offer, 6) to finish, 7) quickly, 8) place, 9) to happen, 10) to supply, 11) to meet, 12) to provide, 13) aim, 14) to suggest, 15) to indicate, 16) to construct, 17) till, 18) to denote, 19) up to, 20) to build, 21) to complete, 22) purpose

THE STEAM-GENERATING UNIT

For operation at pressures below the critical pressure, a steam-generating unit consists of a boiler, superheater, air heater, and (or) economizer. The furnace walls are either partially or fully covered with boiler tubes. In general, moct of the steam is generated in the furnace-wall tubes since they can absorb radiant energy from the high-temperature flame.

A typical stoker-fired steam-generating unit in the smaller size range*, has a capacity of 72,500 lb of steam per hr. The gases as they leave the completely water-cooled furnace pass across the superheater surface,then the convection tubes of the boiler, then upward through a small aconomizer, downward through a tubular air heater, dust collector, and fan, to the chimney. The boiler is of the two-drum type without gas baffles; that is, it is a single-pass boiler. The internal baffles in the steam drum are so arranged that the last four rows of boiler tubes in which the heat-transfer rate is quite low are downcomers. Since a major item in the

cost of a boiler is the drums, as many boiler tubes as possible are placed between the drums. A large amount of surface is required to cool the gases from the temperature at which they leave the superheater to the final temperature.

Depending upon the steam pressure, the feedwater is heated in regenerative feed-water heaters to 275F to over 600F, depending on pressure, before being admitted to the economizer. Essentially, the economizer raises the feed-water temperarure almost to the saturation temperature, the boiler supplies the latent heat, and the superheater supplies the superheat. It will be noted that, as the pressure increases, a decreasing portion of the total energy absorption occurs in the boiler and that, for pressures above the critical, there is no boiler. Supercritical-pressure steam generators essentially are economizers connected to superheaters. There is no steam drum since there is no boiling and no steam to be separated from water at a constant temperature.

At the higher pressures at which natural circulation boilers may be used, the boiler becomes a smaller part of the installation and the superheater and reheater become a larger portion of the total heat-transfer surface.

Modern high-capacity steam-generating units have been developed to the point that they can be depended upon to carry heavy loads continuously for months at a time. Their reliability is approximately equal to that of modern steam turbines. Consequently, most new central-station power plants are built on the unit system: that is, with each turbine generator supplied with steam from its own steam-generating unit. Thus, turbine-generator units in capacities up to 500000 kw are being supplied with steam from a single stem-generating unit. One of the major reasons for this arrangement is the decreased cost per unit of capacity which results from increased size.

1. Read the following words:

Baffles ['bæfl z]
Single-pass ['sɪŋgl, pɑ:s]
Superheater ['sju:pə,hi:tə]
Essentially [ɪ'senʃəlɪ]
Latent ['leɪtənt]
Supercritical-pressure [sju:pəkritikəl,'preʃə]
Approximately [ə'prɔksɪmɪtlɪ]
Consequently ['kɔnsɪ'kwentlɪ]

2.Put the following words into the gaps:
Partially, baffles, between, almost, connected, approximately, reasons

1. The furnace walls are either ( ) or fully covered with boiler tubes.
2. The boiler is of the two-drum type without gas ( ); that is a single-pass boiler.
3. Since a major item in the cost of a boiler is the drums, as many boiler tubes as possible are placed ( ) the drums.
4. Essentially, the economizer raises the feed-water temperature ( ) to the saturation temperature, the boiler supplies the latent heat, and the superheater supplies the superheat.
5. Supercritical-pressure steam generators essentially are economizers ( ) to superheaters.
6. Their reliability is ( ) equal to that of modern steam turbines.
7. One of the major ( ) for this arrangement is the decreased cost per unit of capacity which results from increased size.

3.Translate from Russian into English:

Парогенератор, одноходовой котел, оставлять, питательная вода, существенно, газовая направляющая перегородка, одноходовой котел,двухбарабанный водотрубный котел, дымоход, приблизительно

4.Find the Participle 2 and translate:

5. Translate the following words taking into consideration the meaning of their antonyms given in brackets:

to connect (to disconnect-разъединять); to heat (to cool-охлаждать), positive (negative-отрицательный); to charge (to discharge-эл. Разряжать); simple (complicated-сложный); to give (to take-брать); to melt (to solidify-застывать); equal (unequal-неравный); absence (presence-присутствие); remarkable (usual-обычный); to increase(to reduce-уменьшать); previous (future-будущий); military (civil-гражданский); capable (incapable-неспособный); rapid (slow-медленный); fault (advantage-преимущество)

6. Put the necessary prepositions:

1. The furnace walls are either partially or fully covered ( ) boiler tubes.
2. the boiler is ( ) the two-rum type ( ) gas baffles; that is, it is a single-pass boiler.
3. A large amount ( ) surface is required to cool the gases ( ) the temperature at which they leave the superheater ( ) the final temperature.
4. ( ) the higher pressures ( ) which natural circulation boilers may be used, the boiler becomes a smaller part ( ) the installation and the superheater and reheater become a lager portion ( ) the total heat-transfer surface.
5. One ( ) the major reasons ( ) this arrangement is the decreased cost per unit ( ) capacity which results ( ) increased size.

List of expressions

Above – вышеупомянутый
According to – согласно, в соответствии с
Accordingly – в соответствии с этим
A great dial of – много, большое количество
Along with – наряду, вместе с
A number of – ряд, много
As a general rule – как правило
As follows – следующим образом
As pointed out above – как указывалось выше
Because of – из-за, вследствие
By gravity – под действием силы тяжести
By means of – посредством, при помощи
Compared with – по сравнению, в сравнении с
Concerning – касающийся, относительно, в отношении
Due to – из-за, вследствие, обусловленный
Depending on – в зависимости от
For instance – например
For this reason – по этой причине
From the standpoint of – с точки зрения
Furthermore – кроме того, к тому же, более того
In a steady flow – непрерывно
In as much as – ввиду того, что; поскольку
In balance – в равновесии
In fact – фактически, на самом деле
In general – обычно
In series – последовательно
In the case of –в случае
In the range of – в пределах
In turn – в свою очередь
It is advisable – рекомендуется, целесообразно
It is common knowledge – общеизвестно
It is customary – обычно принято
It is likely – вероятно, по-видимому
It should be kept in mind – следует помнить
It should be mentioned – следует упомянуть
It should be noted – следует заметить

No longer – больше не, уже не
On a weight basis – по весу
On a worldwide scale – в мировом масштабе
On the other hand – с другой стороны
Presumably – по-видимому, предположительно
Rather…than – скорее…чем
Refer to as – называть, именовать
Roughly – приблизительно
Seemingly – по-видимому
Similarly – так же, подобным образом
To a certain extent – до некоторой степени
To a limited extend – в ограниченной степени
To an appreciable extent – в значительной степени
To a small extend – в незначительной степени
To the extent of – до
To take into consideration -принимать во внимание, учитывать
Unfortunately – к сожалению
Unlikely – в отличие от
Up to – до
Vice versa – (лат.) наоборот
With regard to – относительно, по отношению к

List of Abbreviations

BOD (Biochemical Oxygen Demand) – биохимическое потребление кислорода (БПК)
C (Centigrade) – температурная шкала Цельсия
Cd (cord) – складская мера древесины
DP (degree of polymerization) – степень полимеризации
rpm (revolutions per minute) – оборотов в минуту
F (Fahrenheit) – температурная шкала Фаренгейта
fsp (fibre saturation point) – точка насыщения волокна
ft (foot) – фут
g.p.m. (gallons per minute) – галлонов в минуту
hp (horsepower) – лошадиная сила, мощность
hr (Hour) – час
i.e. –то есть
in (inch) – дюйм
psi (pounds per square inch) – футов на кв. метр

СОДЕРЖАНИЕ