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[54] **ANNULAR ROASTING MACHINE FOR LOOSE MATERIALS**

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[51] **Int. Cl.** **F27b 17/00**

[58] **Field of Search** 266/20, 21

[56] **References Cited**

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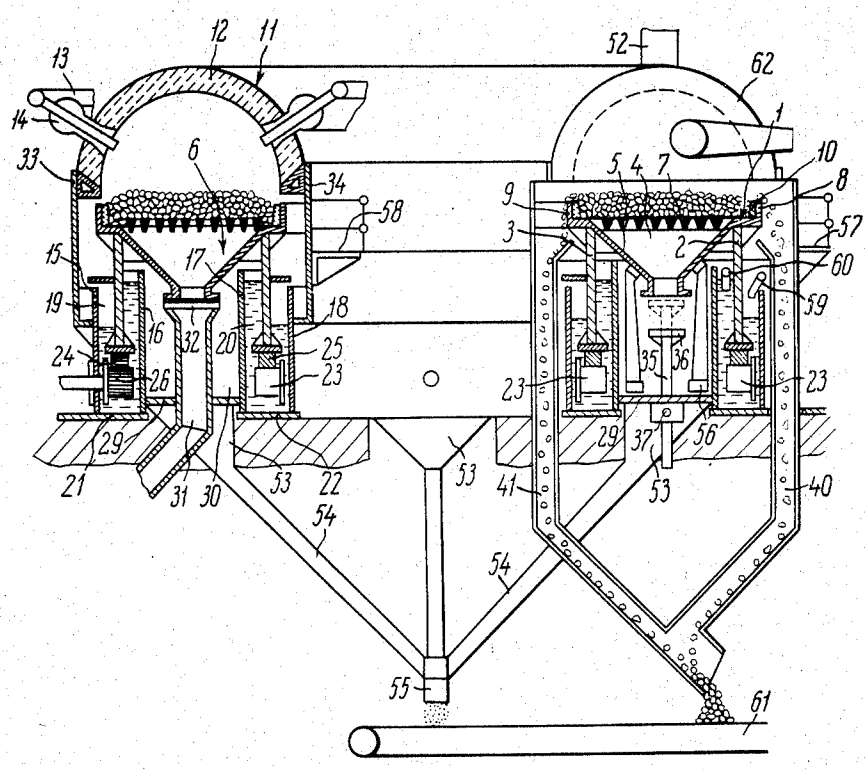
[57] **ABSTRACT**

A machine comprising a rotating housing in the form of two vertical coaxial cylinders whose bottom parts are disposed in annular spaces between two pairs of stationary cylinders closed from below and rest therein on rollers which form hydraulic seals for sealing lower portions of the cylinders and undergrate spaces. The housing cylinders are connected at the top by radial partitions between which are disposed respective windboxes, a common wind belt being formed under the windboxes between the hydraulic seals.

4 Claims, 2 Drawing Figures



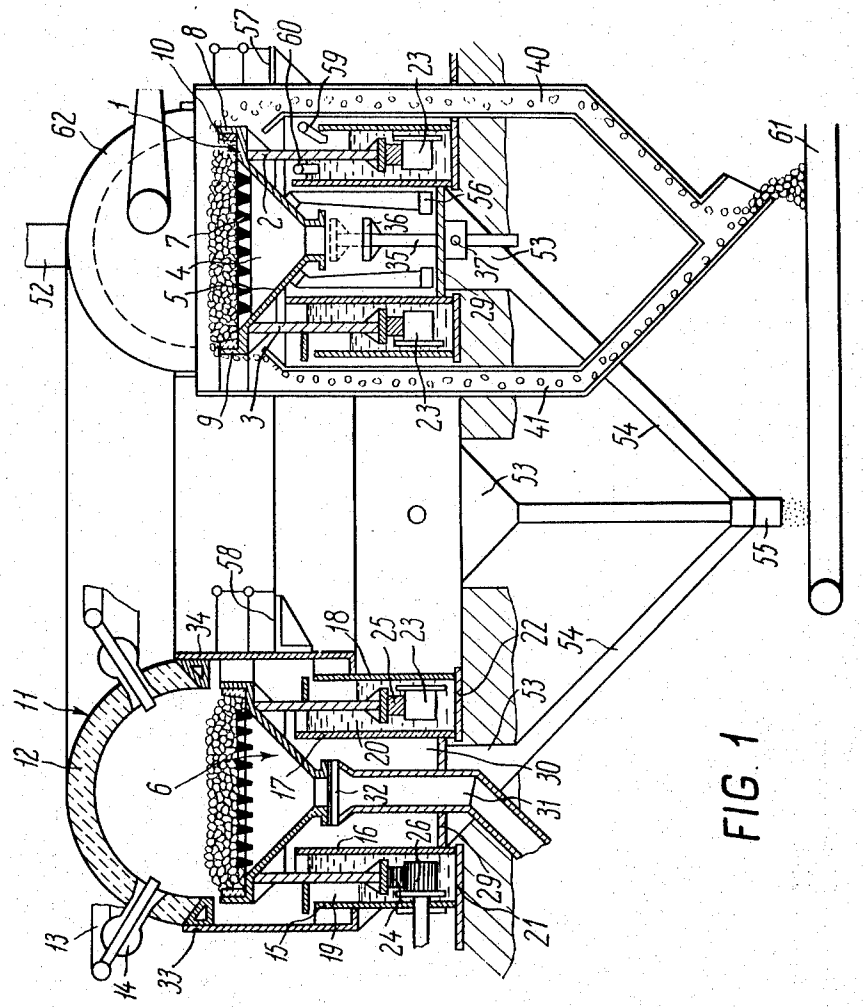


FIG. 1

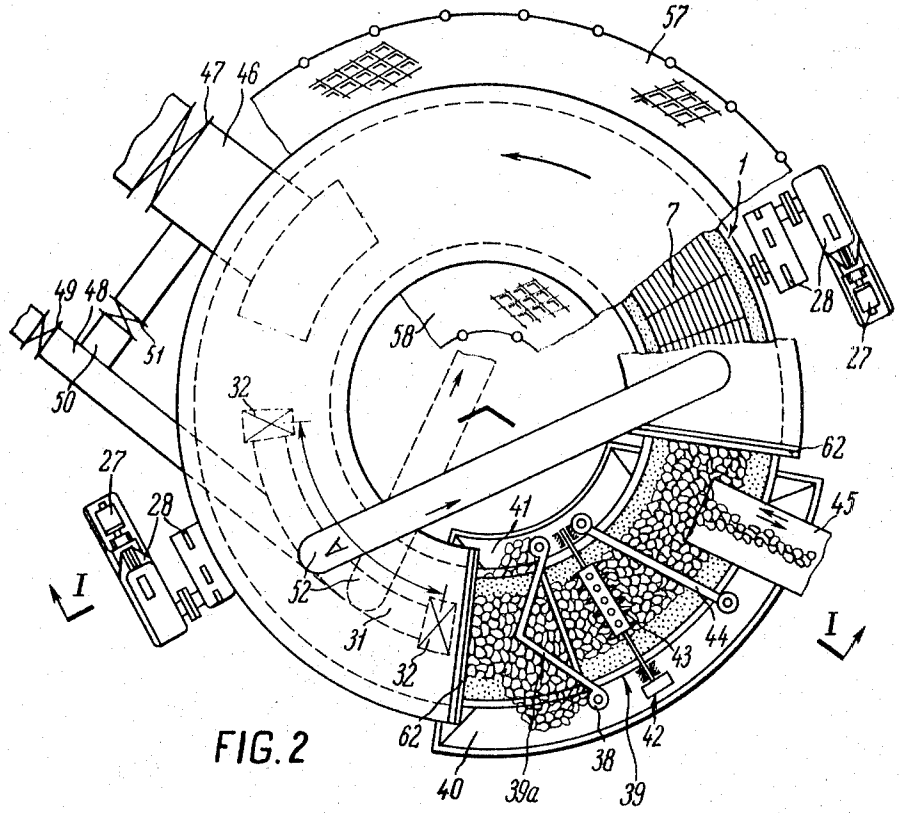

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FIG. 2

ANNULAR ROASTING MACHINE FOR LOOSE MATERIALS

The machine of the present invention is designed so as to simplify the construction of its main units, to improve sealing of the above- and undergrate spaces and to reduce machine weight per one square metre of its active grate area.

FIELD OF THE INVENTION

The present invention relates to annular roasting machines for loose materials, such as pellets. The machines can prove useful for firing limestone, porcelain clay, cement clinker, for the reducing roasting or sintering (agglomeration) of ores, etc.

BACKGROUND OF THE INVENTION

At the present time over 60% of the world production of iron ore pellets is roasted in conveyer belt roasting machines in which an active grate area constitutes only 40 percent of the total grate area.

Moreover, inherent in the machines is an extremely sophisticated construction, the machines being cumbersome (the weight of metal structures in them being equivalent to or in excess of 12 t. per one square metre of the active grate area); requiring much floor area feature large dimensions in terms of their height. In the above machines it is difficult to separate out a fraction of the total stream of roasted ready pellets being conveyed to produce a bed, to deliver them to a roasting machine bay and to effect bedding, the bed being composed of the pellets laid down over the fire grate and near the flanged edges of roasting pan cars; the factor which is of prime importance for stable and prolonged operation of the machines and for the quality of the pellets produced therein. Adequate sealing of the space above- and under the grate also poses a problem.

Known in the art is an annular roasting machine for loose materials, such as pellets comprising a revolving fire grate on which the material being processes is loaded, windboxes arranged under the fire grate and adapted for drawing off gaseous products of the roasting process, cooling the roasted material with air and heat recovery, hydraulic seals for sealing the undergrate space of the machine, furnaces mounted above the fire grate for producing a gaseous heat carrier which is sucked in the material layer being processed, a charging gear traversing over the fire grate, a discharging gear and a drive means for rotating the fire grate.

In the known annular roasting machine, the fire grate is built up of individual frames with water-cooled shafts and of the gears adapted to revolve the frames for discharging the roasted material. The fire grate travels over drive rollers. Back-up rollers serve to support the plates with fire-bars disposed between the drive rollers. Horizontal displacement of the fire grate is countered by side rollers.

The above design peculiarities of the travelling fire grate with a plurality of friction parts not only complicate its manufacture and operation but does not allow adequate sealing of the fuel combustion zone above the material layer being roasted. Besides, the system of laying a protective bed of the roasted pellets on the fire grate is also complicated. Numerous machine components and gears along with its heavy framework render it too cumbersome, the weight of metal per one square metre of the active grate area being also large (up to 10 t. and over).

SUMMARY OF THE INVENTION

It is an object of this invention to provide an annular roasting machine which is simpler in the manufacture and operation.

A further object of this invention is to provide an annular roasting machine which requires minimum material in its assembly.

Still another important feature of the present invention is to provide an annular roasting machine which would ensure the sealing of the spaces above the fire grate beneath the furnaces and under the fire grate and which simplifies the laying of a protective bed of roasted pellets on the grating. These and other objects are atteined in an annular roasting machine for loose materials, such as pellets, comprising a revolving fire grate on which the material being processed is loaded, windboxes for drawing off gaseous roasting products, cooling the roasted material with air and heat recovery, hydraulic seals for sealing the undergrate space of the machine, furnaces mounted above the fire grate to produce a gaseous heat carrier drawn in the material layer being roasted, a charging gear travelling over the fire grate, a discharging gear and a drive means for rotating the fire grate. According to the invention, the machine is provided with a rotary housing made in the form of two vertical coaxial cylinders coupled at the top with radial partitions separated by individual windboxes disposed therebetween. The bottom ends of the cylinders are disposed in annular spaces between two pairs of stationary cylinders closed from below, forming in conjunction with the cylinders two hydraulic seals, whereas the ringshaped space beneath the windboxes between the hydraulic seals form a common wind belt.

The gear for rotating the machine housing is preferably made in the form of a toothed ring fastened to a lower face end of one of the cylinders brought into rotation with the aid of gears operated from the drives operating in parallel, both cylinders resting on supporting (flanged) rollers located under the cylinders immersed in the hydraulic seals.

This permits adequate sealing of the spaces both above and under the fire grate inclusive of the rotating windboxes and stationary wind belt.

To adjust gas passage sections and accordingly the rarefaction and blasting conditions in the machine it would be expedient to provide at the bottom of the wind belt over its central circumference and under the apertures of the windboxes built-in vertically movable bars with damper plates mounted on top of the bars. This will rule out the need for independent gas vents with throttle valves to be arranged under the windboxes.

The discharging gear is to be equipped with the following appliances to be monted stationary; a wedge blade set up to be movable in a vertical direction and at an angle to the fire grate to ensure continuous formation of the bed of roasted pellets, a raking appliance adapted for stirring-up the bed and for cleaning both the bed and the fire grate from dust drawn thereafter in the wind belt, and a levelling-off knife adapted to adjust the bed height. This will keep the bed from being laden with dust and simplify the bedding-up process, the protective layer being composed of the roasted pellets laid over the fire grate, which enhances durability

of the machine, of its fire grate in particular, improves the quality of the pellets being produced and increases the production rate of the machine.

The present invention results in a provision of an annular roastng machine of a new type, adapted for processing loose materials and characterized by simplicity of construcion of its main units, dependability and stability in operation, a constant residual bed of the roasted pellets left on its fire grate in service, adequate sealing of the above- and undergrate spaces and more than a 2-fold reduction in machine weight per one metre of the active grate area.

A more complete understanding of the nature of the invention will be had from the description of an exemplary embodiment to be taken in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation of an a diagrammatic sectional annular roasting machine for loose materials, according to the invention taken substanially on line I—I of FIG. 2;

FIG. 2 is a top view with portions broken away.

DESCRIPTION OF A PREFERRED EMBODIMENT

An annular roasting machine for loose materials exemplified in FIGS. 1 and 2 comprises a rotating housing 1 made in the form of two vertical coaxial outer and inner cylinders 2 and 3, respectively interconnected at the top by radial partitions — undergrate beams 4 and oblique guide walls 5 separated by individual windboxes 6 disposed therebetween. The undergrate beams 4 disposed in the upper parts of the windboxes carry fire-bars which form an annular fire grate 7 restricted by two sides by flanged edges 8 and 9 bordering from the interior on a heat-insulating layer 10.

Mounted above the active grate area where the operations associated with the material processing occur are furnaces 11 with refractory lining 12 and fittings 13 for supplying burners with gas or liquid fuel and fittings 14 for air supply.

The bottom parts of the vertical cylinders 2 and 2 are lowered into ring-shaped annular spaces between cylinders 15, 16 and 17, 18, coaxial with the cylinders 2 and 3, forming two hydraulic seals 19 and 20 closed from below with bottoms 21 and 22.

The hydraulic seals 19 and 20 accommodate rollers 23 (with flanges) on which rest annular rims 24 and 25 (one of them - 24 - being toothed or pinned) of the housing 1, the rims being secured to the lower faces of the cylinders 2 and 3. The housing 1 is brought into rotation (the direction of rotation is indicated by arrows) through gears 26 by a drive means operating in parallel and comprising electric motors 27 and reducers 28.

Rotation of the machine housing 1 can be also effected with the aid of drive units which constitute the electric motors 27 and reducers 28 associated with the supporting rollers 23, i.e., by friction gearing.

The space between the cylinders 16 and 17, their bottom 29 and the windboxes 6 forms a wind belt 30 (whose internal stationary surface can be fitted with a refractory lining or with protective plates).

Set up at the centre of the wind belt 30 in zone A, adapted for cooling the roasted pellets, is a blast (air) box 31 incorporating damper plates 32 arranged in its upper part on either side of the box (in the direction of rotation of of the housing 1), each damper plate being adapted to cut off the gas flow in one of the windboxes 6 at the moment it is strictly above the plate. The box 31 is also fitted with a corresponding packing (not shown in the drawing).

The working space above the layer of material being processed and laid down on the fire grate 7 is sealed by metal annular casings 33 and 34 whose lower portions are connected with external walls of the cylinders 15 and 18 of the hydraulic seals 19 and 20 and the upper ones — with the furnaces 11.

To regulate rarefaction and blasting conditions in the windboxes 6 in various zones of the machine in the bottom 29 of the wind belt 30 are built-in bars 35 with damper plates 36 fastened on top of the bars 35 and shifting vertically by a mechanism 37, changing thereby the passage sections between the damper plates 36 and the lower edges — apertures of the windboxes 6.

Above the rotating housing 1 on fixed rests 38 is mounted a discharging appliance 39 with a wedge blade 39*a* fitted with special means (not shown in the drawing) to move it in a vertical direction and at an angle. The roasted and cooled pellets are discharged by the blade from the fire grate 7 into spouts 40 and 41.

The lower edge of the wedge blade 39*a* is disposed above the fire grate to provide the continuous formation of a bed composed of the roasted pellets and left on the grate, the hot pellets sliding off to the bed over the upper edge of the blade.

To rake-off the bed and to clean both the bed and the fire grate from dust, the discharging gear 39 is provided with a raking gear 42 whose pins 43 perform a rotary and translatory motion; for levelling-off the bed, its renewal and throwing-off the excess of the pellets into the spouts 40 and 41 provision is made for a knife 44 mounted to be movabile in a vertical direction.

A zone between the discharging gear 39 and levelling-off knife 44 serves also for checking the fire grate for proper condition, for erecting and replacing the fire-bars and for satisfying other process needs.

After thq levelling-off knife 44 (in the direction of rotation of the machine) a charging gear 45 is arranged operating in a shuttle mode to feed the greeen balls (the material being processed) onto the fire grate.

Connected to the portion of the wind belt 30 in which a rarefaction is maintained through the bottom 29 (or through side walls below the hydraulic seals) is a gas duct 46 with a throttle 47 which exhausts the gaseous products of the roasting process and regulates vacuum conditions within the machine. Further, the gas duct runs in succession to a dust collector, an induced-draft fan and a flue (not shown in the drawing).

Connected to the blast box 31 is an air duct 48 running from a forced-draft fan (not illustrated in the drawing), the duct being fitted with a throttle 49 to control air regime when cooling hot pellet discharge by blasting it with the air introduced from below. When the pellets are cooled by the air drawn through the pellet layer from above, the hot air being then directed (as a heat carrier) to the zones in the active grate area, the forced-draft fan is substituted by the induced-draft fan (not shown in the drawing).

The gas duct 46 and air duct 48 are coupled by a manifold 50 having a throttle 51 by which virtue the air and gas conditions can be regulated.

From the pellet cooling zone A the heated air (as the heat carrier) is admitted from below the furnaces and passed over the pellet layer being processed in a direc-

tion opposite to the direction of rotation of the machine. Next it flows along air lines **52** in the direction of rotation of the machine to assist in drying the green balls and in their roasting (the direction of air flow is indicated by arrows).

The undersize material from the ring-shaped wind belt **30** falls by gravity into hoppers **53** (dust collectors) built in the bottom **29** and provided with spouts **54** and gates **55** wherefrom it is raked out by scrapers **56** attached to the rotating housing **1**.

Provision is made for cooling certain machine members operating under high temperature conditions, such as furnace casings, etc., with water.

For servicing the machine special working platforms **57** and **58** are set up both on its external and internal side.

OPERATION

The annular roasting machine operates as follows.

Hydraulic seals **19** and **20** are filled with water from a water main **59** to the marks depending on the rarefaction values in a wind belt **30**. Next an electric motor **27** provided with a fine speed control is switched on and a housing **1** starts rotating the charging gear **45** operating in a shutle mode with green balls conveyed from a balling station. As soon as all the fire grate **7** is charged with the green balls, the machine is stopped.

Then an induced-draft fan is switched on and rarefaction in the wind belt **30** is regulated by a throttle **47** on a gas duct **46**, a throttle **49** on an air duct being covered and a throttle **51** on a manifold **50** — uncovered. Vacuum in windboxes **6** is controlled by shifting bars **35** with damper plates **36** in a vertical direction with the aid of a mechanism **37**.

As water commences to flow from the hydraulic seals via drain pipes **60**, the water main **59** is open to provide the continuous water supply to the hydraulic seals **19** and **20**.

Next, adhering strictly to the safety rules, a combustible gas fed to burners is ignited through furnace peep holes and using a reversed sequence as compared with the direction of rotation of the machine and with control of temperatures, heat, vacuum and air conditions, the balls are, in succession, subjected to drying, preheating and roasting to produce pellets.

With the above sequence in igniting the burners, the process of roasting the pellets will be completed in the same sequential oreder of operations, i.e., the process flow being opposite to the direction of rotation of the machine.

After the pellets have been subjected to holding in the machine at a pre-set roasting temperature but without overheating the fire grate, the throttle **51** is covered and the throttle **49** uncovered, whereupon the pellets are cooled with air blasted or drawn through the bed of roasted pellets.

Next, a machine rotating drive is cut on (at a speed of one to three revolutions per hour), the green balls are charged onto the fire grate and the machine starts operating continously.

Under steady-state machine operating conditions the roasted and cooled pellets are continuously discharged with the aid of a wedge blade **39***a* into spouts **40** and **41** wherefrom they are handled by a conveyer **61**, onto which the undersize from the wind belt **30** is also delivered, to a sifting station (not shown) where the fines to be recycled are picked up and directed to a balling station and the finished pellets are conveyed for further usage. (Hydraulic removal can be also employed for discharging the undersize from the wind belt).

A fraction of the finished pellets is always disposed on the travelling fire grate **7** beneath the slightly raised wedge blade **39***a* to form a constant residual bed.

Further the bed composed of the roasted pellets is stirred up by a raking gear **42** whereafter the bed and the fire grate **7** are cleaned from dust drawn through the windboxes **6** into the wind belt **30**.

Final adjustment of the optimum (most favorable) height of the bed is effected by a levelling-off knife **44**, the excess pellets being directed to the spouts **40** and **41**, i.e., into the stream of the finished pellets.

Hot air evolved from the layer of the pellets on being cooled is delivered via air lines **52** (there may be several of them) under the furnaces **11** to the green ball drying zones. It is also used for burning up combustible smoke constituents and is distributed over the layer being roasted to regulate the thermal conditions of the process.

If the hot pellets are cooled by the air drawn through the layer of pellets in a downward direction and passed through the blast box **31**, the hot air delivered by the induced-draft fan is admitted into the air lines **52** running under the furnaces **11** and closed from their face ends by walls **62**.

The design and principle of operation of the annular roasting machine afford the possibility of carrying out the roasting process by burning both gaseous or liquid fuel above the layer of the pellets as well as solid fuel which is applied to the surface of green balls. The above machine may prove useful for reducing roasting of ores, metallizing raw iron ores, firing limestone, kaoline, cement clinker, for ore sintering, etc.

With the above machine featuring large overall dimensions the active grate area can amount to 90 percent.

What we claim is:

1. An annular roasting machine for loose materials, such as pellets, comprising in combination: a rotating housing in the form of two vertical cylinders arranged coaxially and connected at the top and between which are disposed individual windboxes for drawing off gaseous products of the roasting process for cooling the roasted material with air and for heat recovery; a fire grate in the upper portions of said windboxes on which grate the material being processes is charged; furnaces above the fire grate for producing a gaseous heat carrier drawn in the material layer being processed; hydraulic seals for sealing undergrate spaces formed by two bottom ends of said cylinders disposed in annular spaces closed from below and arranged between two pairs of stationary cylinders; a wind belt in the form of an annular space located under said windboxes between the hydraulic seals; material charging means mounted to deposit material onto the fire grate; material discharging means; and a drive for rotating said housing of the machine.

2. A machine as of claim **1** in which a gear for rotating the housing is provided and including a ring-shaped toothed rim on the lower face of one of said housing cylinders and rotated by gears driven by drive units operating in parallel and supporting rollers being arranged under both said cylinders immersed in the hydraulic seals and resting on said rollers.

3. A machine, as of claim 1, in which said wind belt has along its central circumference under apertures of said windboxes vertically movable bars with damper plates mounted on their tops and adapted to control the gas passage section and respectively the vacuum and blasting conditions of the machine.

4. A machine, as of claim 1 in which said discharging gear comprises the following appliances fixed relative to the rotary housing; a wedge blade mounted for movement in a vertical direction and at an angle to the fire grate for forming a continuous bed composed of roasted pellets, a raking gear for stirring up the bed and cleaning both the bed and said fire grate from dust drawn thereafter into said wind belt; and a levelling-off knife adapted to regulate the bed height.

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