April 10, 1951 C. FRANKENSTEIN 2,548,299

SPEED CONTROL DEVICE FOR CENTRIFUGES

Filed Sept. 20, 1946 2 Sheets-Sheet 1

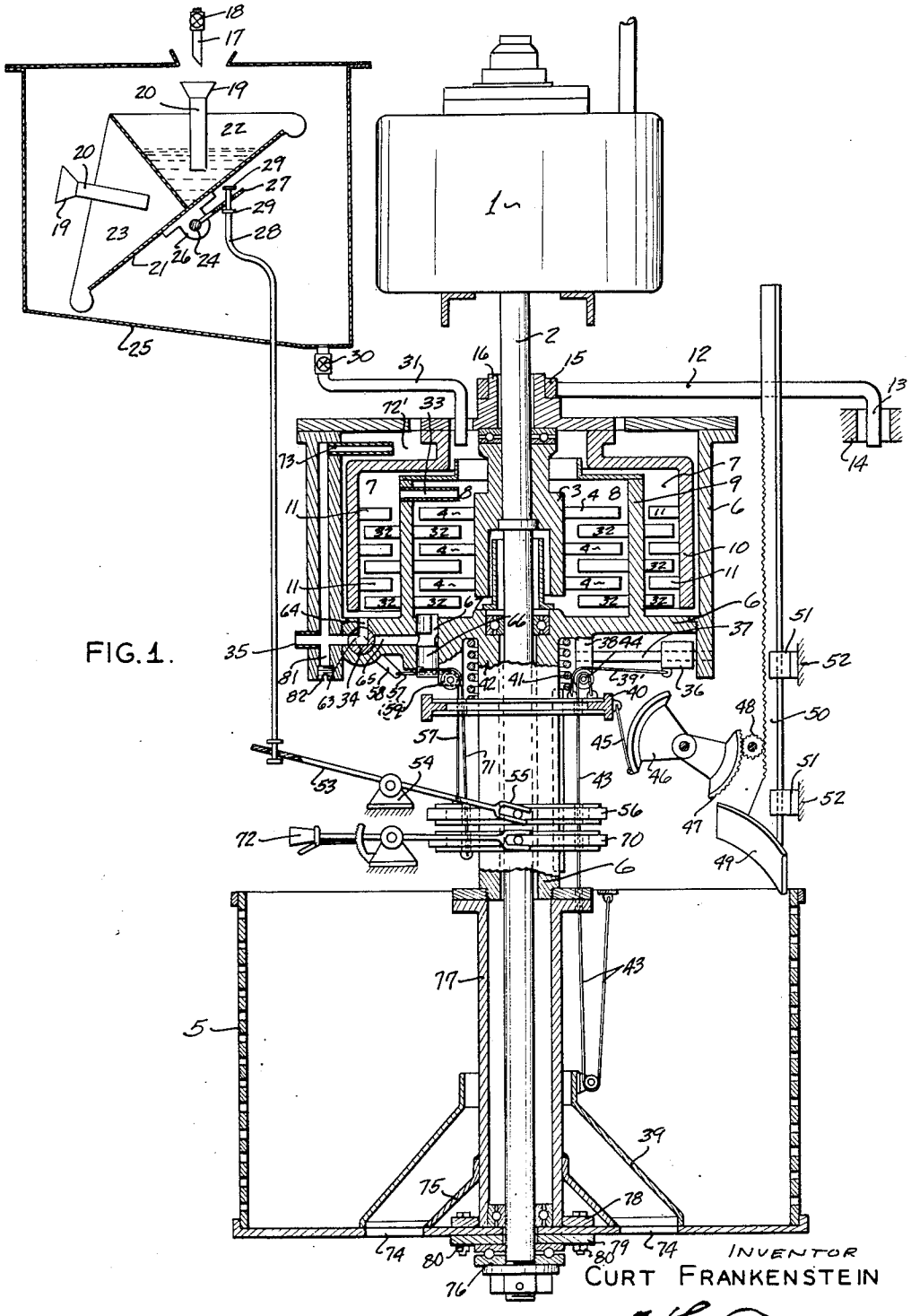

FIG. 1.

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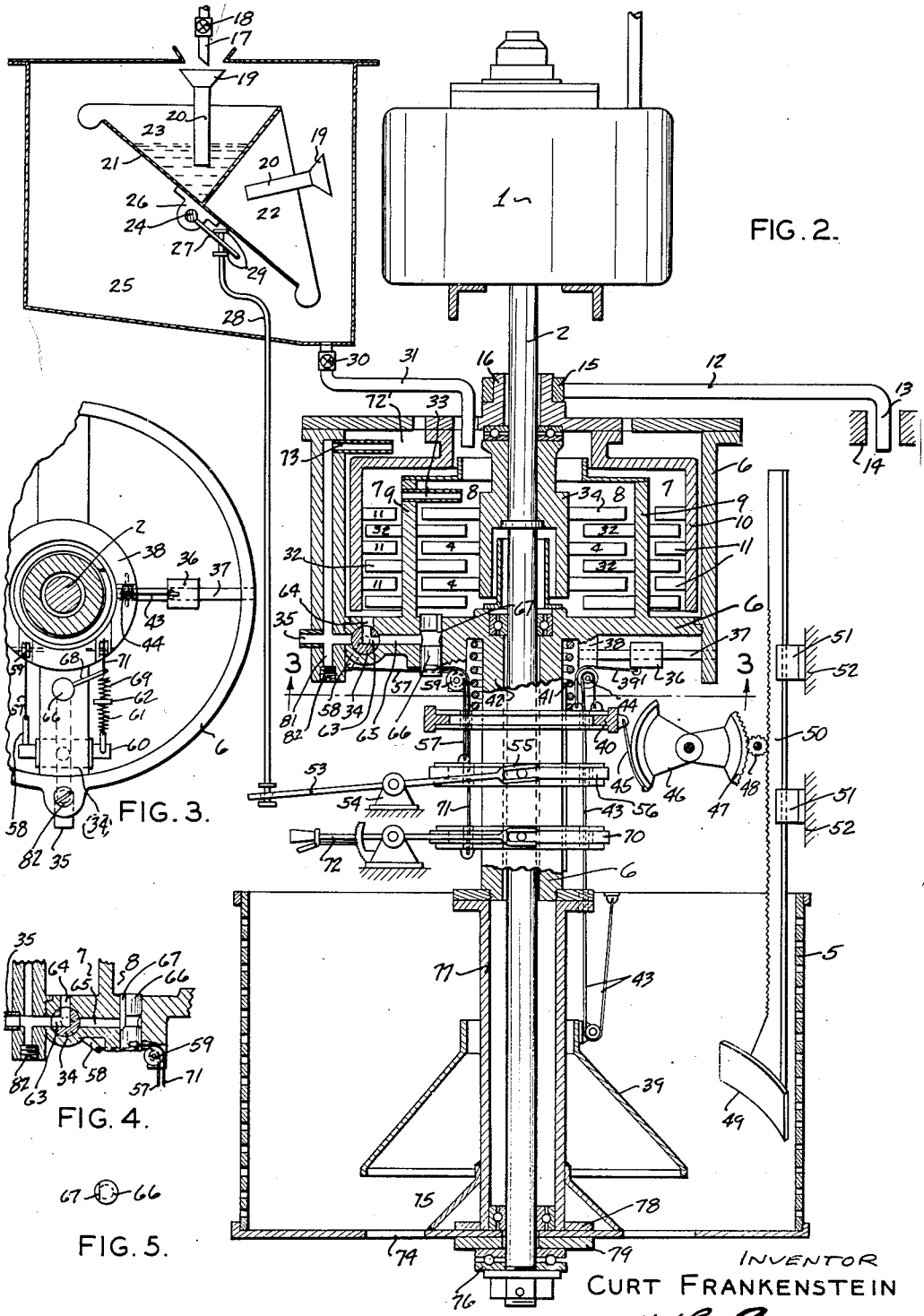

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

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SPEED CONTROL DEVICE FOR CENTRIFUGES

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6 Claims. (Cl. 210—71)

1

This invention relates to speed control devices for centrifuges, and more particularly to centrifuges used in sugar mills in separating sugar crystals from the liquid. The centrifuges are driven by belt drive, steam, or water turbines, or electric motors. The centrifuge runs a few minutes at top speed (about 1500 R. P. M.) and then is stopped in order to empty the contents, or goes on running at a low speed. The revolutions of the centrifuge are checked by shoe brakes, frequently air or water cooled.

My invention provides an automatic speed control device for centrifuges for sugar mills which requires no operator to manipulate. Also, I provide centrifuges with a fluid coupling and brakes which are not subject to wear. By my invention I also avoid disconnection of the driving power and the corresponding waste of starting energy. Also, through the use of my invention it is possible to rebuild the many existing centrifuges, of any drive whatever, into automatic ones.

In the drawings—

Fig. 1 is a vertical sectional view of a centrifuge with my automatic liquid speed control device applied thereto.

Fig. 2 is a view similar to Fig. 1, except the liquid speed control is operating to slow down the revolutions of the centrifuge.

Fig. 3 is a view taken on line 3—3, Fig. 2.

Fig. 4 is a detail view of the valves or cocks for controlling the liquid in my device.

Fig. 5 is a top view of the valve or cock for controlling the flow of liquid from an inner section of my device to an outer section.

The centrifuge consists of the motor 1, which is directly connected to shaft 2 and drum 3, said drum being provided with blades 4 on its circumference.

On shaft 2, but not directly connected thereto, is centrifugal drum 5, which is arranged in such a way that it can revolve. This drum 5 is securely connected with a casing 6, which surrounds shaft 2 but is not directly connected to said shaft 2.

The casing 6 is divided into an outer section 7 and an inner section 8 by a separation wall 9, such casing and separation wall being similar to the well known water brake for calculating the efficiency of machines.

In the outer section 7 of the casing 6 there is a drum 10, the inside circumference of which is also provided with blades 11. An arm 12, having a downturned end portion 13 fitted into an opening in a stationary member 14, is secured at 15 to the bearing 16 and prevents the drum 10 from turning round but permits the centrifuge to adjust itself to its natural center of gravity.

2

A source of water supply (not shown) is made available through pipe 17, controlled by valve 18, discharging into a funnel-shaped member 19 at the upper end of pipe 20, so that the water empties into a tiltable structure 21, which has two compartments 22 and 23, each having a pipe 20 with funnel-shaped mouth 19 so as to alternately permit water to enter first one compartment and then the other compartment to tilt the structure 21 in alternate directions when a quantity of water sufficient to tilt said structure 21 collects in either compartment 22 or 23. As shown in Fig. 1, compartment 22 is in the uppermost position and is receiving water through pipe 20.

The tiltable structure 21 is pivotally supported on shaft 24 mounted in a water-receiving tank 25. To a bracket 26 is secured an arm 27 which receives at its outer end a rod 28, which has any appropriate devices such as 29 to retain the end of rod 28 in operative engagement with arm 27.

A certain quantity of water flows in a certain time into compartment 22 and thereafter into compartment 23 through the pipe 17 and pipes 20. The time is set in accordance with the time necessary to free the sugar crystals in centrifugal drum 5 from the liquid. When sufficient water has collected in compartment 22 the structure 21 rocks or tilts on shaft 24 downwardly so as to discharge its accumulation of water into tank 25. Such measured quantity of water so emptied into tank 25 flows through a valve 30 and pipe 31 in to the inside section 8 of casing 6. Such water when received in section 8 will serve to couple together the casing 6 and the constantly revolving drum 3 through the blades 4 and 32, said blades 32 being mounted on the separating wall 9, thus the casing 6 and centrifugal drum 5 will quickly acquire speed to approximately 1500 R. P. M. This will make the water, the static level of which is horizontal, take a vertical position by action of centrifugal force. The surplus and at the same time friction heated water flows through pipe 33, valve or cock 34, and pipe 35 into an escape line (not shown on the drawings).

At the lower part of casing 6 two weights 36 are arranged on opposite sides in such a way that they can slide on the rod 37, which is secured in the lower portion of casing 6 and circular member 38 surrounding the shaft 2 to the inner periphery of casing 6, and said weights 36 are connected with discharge valve 39 in centrifugal drum 5 by rope or cable 39'. These weights 36 are also connected to slip ring 40 which is pressed against by spring 41 surrounding the sleeve 42 integral with and depending from the

casing 6. As these weights 36 are connected by a thin wire rope or thin chain 43 over rolls 44 to discharge valve 39, said valve is closed when the highest number of revolutions is reached.

Slip ring 40 is also connected by a chain or thin wire rope 45 with segment 46, so that gear segment 47 and pinion 48 will operate the sugar scraper 49, which is connected with a toothed bar 50 and is slidably supported by the brackets 51 mounted on any stationary abutment as 52.

As shown in Fig. 1, the centrifuge is rotatable at its maximum capacity (approximately 1500 R. P. M.), no braking action being exerted in this view.

Now when a predetermined quantity of water has accumulated in compartment 22, that is, for a given amount of elapsed time of the full speed of the centrifugal action, the tiltable structure 21 will tilt to the right (Fig. 1) and discharge the water in compartment 22 into tank 25 and through valve 30 and pipe 31 into the inner section 8 of casing 6, which will cause the braking action exerted by the water between movable blades 4 and 32 and stationary blades 11 to be automatically applied to slow down the centrifuge, so that the sugar crystals accumulated in centrifugal drum 5 may be discharged. This is illustrated in Fig. 2.

The tiltable member 21 is connected to the rod 28, which rod is connected at its lower end to another rod 53, pivotally mounted on a support 54, the said rod 53 having a forked end 55 to connect said rod 53 to a slip ring 56. As shown in Fig. 2, slip ring 56 has moved to its upward position on the sleeve 42 and the hydraulic braking action is operative. This action will now be described.

Slip ring 56 is connected by a thin rope or chain 57 to the cock or valve 34 through arm 58, said rope or chain 57 passing over roller 59. On the valve or cock 34 is another arm 60 to which is attached a spring 61 secured at one end to a member 62, and which spring normally tends to rotate cock 34 into the position shown in Fig. 2 to retain water in the sections 7 and 8 of casing 6, so that as slip ring 56 moves upwardly the chain or rope 57 slackens and the spring 61 rotates cock 34 so that the angular shaped opening 63 in said cock is in registration with a vertical opening 64 in the lower wall of the casing 6 and also with a horizontal passageway 65 also in the lower wall of the casing 6.

At the inner end of the horizontal passageway 65 is a valve 66 mounted in a vertical opening in the lower wall of the casing 6, and has an opening 67 therein which is so formed as to provide a connection between sections 7 and 8. This valve 66 has an arm 68 to which is fastened a spring 69, also mounted on the member 62, and the position of said valve is controlled by slip ring 70 through rope or chain 71, operable manually by lever 72 which is set in a predetermined position by an operator and remains in such position, permitting a predetermined flow of water from inner section 8 to outer section 7.

Now there exists a controlled connection between the outer section 7 and the inner section 8 of casing 6.

Because of the fact that drum 10 with its blades 11 does not rotate, but drum 3 with its blades 4 and casing 6 with its blades 32 (that is wall 9) continues to revolve, the drum 3 is checked by hydraulic braking action and consequently the revolutions of centrifugal drum 5 are slowed down, as no more water is added through pipe 31 and a large part of the water has escaped to the outer section 7 of casing 6 by centrifugal action.

In order that centrifugal drum 5 will not be stopped completely and so that it can be emptied of its sugar, part of the water will remain in the inside casing 8 of casing 6. For adjustment of the quantity of water for maintaining the slow revolutions which are necessary to remove the sugar by means of the scraper 49, the regulating cock or valve 66 with its spring 69 (Fig. 3) is provided, which is manually adjustable by means of the lever 72, slip ring 70, and the wire or chain 71.

By the decrease in revolutions the weights 36 lose centrifugal force, slip ring 40 goes down, scraper 49 moves slowly to its lowest position, and discharge valve 39 rises to its highest position, so that the sugar will be removed from centrifugal drum 5.

Superfluous water can freely escape from section 72' through pipes 73 and 35.

While the sugar is being emptied from centrifugal drum 5 through discharge opening 74, compartment 23 of tiltable structure 21 is filling with water coming in through pipe 20, and as soon as the necessary quantity of water is in said compartment to cause the structure 21 to tilt it will do so and empty its accumulated volume of water into tank 25, and this causes the tiltable structure 21 to tip over into the position shown in Fig. 1. This raises rod 28 which lifts the outer end of rod 53 and lowers its inner end which lowers slip ring 56 and the wire or chain 57, which causes valve 34 to partly rotate to bring passageway 63 into registration with opening 64 in outer section 7, so that water in said section can escape through pipe 35. Thus the braking effect is interrupted and the water anew entering through pipe 31 is again used as a coupling between the always revolving drum 3 and casing 6, with centrifugal drum 5 still running at low speed, in order to increase the number of revolutions to the normal rate (1500 R. P. M.). Discharge valve 39 is lowered again to the bottom of centrifugal drum 5 and scraper 49 returns to its highest position by centrifugal force of the weights 36. A conical shaped member 75 on the bottom of centrifugal drum 5 tends to direct sugar crystals to the discharge opening 74.

A bearing for the lower end of shaft 2 is indicated at 76, generally. Such bearing permits the centrifugal drum 5 to rotate at speeds different from the speed of shaft 2, as will be apparent from both Figs. 1 and 2. A cylindrical inner wall 77 is secured to the centrifugal drum 5 and surrounds the shaft 2. Circular plates 78 and 79 are secured by bolts 80 to the inner and outer central bottom portions of said drum 5 (Fig. 1).

Water may be drained from the hydraulic braking drums when desired through opening 81 by removal of plug 82.

Slip rings 40, 56, and 70 are mounted in three slidable members surrounding the sleeve 42 and keyed thereto, so that they may move upwardly and downwardly on said sleeve 42 and be rotatable therewith.

I claim:

1. An automatically controlled centrifuge comprising a centrifugal drum, driving means for rotating said centrifugal drum, said means including a motor driven shaft and a casing concentric therewith but not directly connected thereto, said centrifugal drum and said casing being located vertically with said centrifugal

drum beneath and separated from said casing, said casing being provided with a wall member to form an inner and outer chamber therein, a non-rotatable drum located between said wall member and said casing, said shaft having a portion thereof disposed within said inner chamber, interdigitating blade means on said shaft and the inner wall of said wall member to effect rotation thereof in unison in the presence of a fluid medium, blade means on the outer surface of the wall member and the inner surface of the non-rotatable drum, means for supplying the inner chamber of said drum with a fluid effective on said means, and fluid flow control means comprising a fluid outlet pipe between the upper ends of said inner and outer chambers, and a rotatable valve for periodically discharging fluid only when said valve is rotated to connect it with a fluid discharge pipe for removal of said fluid from said centrifuge.

2. An automatically controlled centrifuge comprising a centrifugal drum, driving means for rotating said centrifugal drum, said means including a motor driven shaft extending within said drum and a casing concentric therewith, means for coupling said shaft with said casing to effect rotation of said drum, said means including support means on said shaft, laterally projecting interdigitating blades on said shaft and casing, means for admitting fluid to said casing operable on said blades, said casing being divided by a wall structure into an inner coupling chamber and an outer braking chamber having braking means therein, fluid flow passage means carried by said inner chamber wall and operable to pass fluid from the inner chamber into the outer chamber whereby the braking means retards the rotation of said casing and drum, and a non-rotatable scraper mounted for vertical movement within said drum by a horizontally slidable member secured to said scraper and operable by said centrifuge for lowering and raising said scraper as the speed of rotation of said centrifuge diminishes and increases.

3. An automatically controlled centrifuge comprising a centrifugal drum, driving means for rotating said centrifugal drum, said means including a motor driven shaft and a casing associated therewith, said casing being provided with a wall member to form an inner coupling chamber and an outer braking chamber having braking means therein, said shaft having a portion thereof disposed within said inner casing, a supporting member on said shaft within said casing, means for supplying a predetermined amount of fluid to said inner chamber, conduit and valve means in said casing whereby fluid can flow periodically from the inner section into the outer section to cause a braking action on the rotating casing and centrifugal drum, a series of radially extending vertically disposed blades on said supporting member and the inner surface of said wall member, said blades being arranged in interdigitating relation to serve, when fluid is present in the inner chamber, as a coupling for rotating said casing and centrifugal drum at maximum speed, a second drum non-rotatably mounted in said casing and adjacent the inner periphery thereof, a series of radially extending vertically disposed blades on said second drum, radially extending vertically disposed blades on the outer surface of said wall member, said blades being arranged in interdigitating relation to reduce the speed of rotation of said centrifugal drum when fluid passes from the inner coupling chamber to the outer braking chamber, mounting means adjacent said casing, and a vertically operable scraper supported by said mounting means and movable within said centrifugal drum to periodically remove material from the inner periphery of said drum.

4. The structure as set forth in claim 3 and, a regulating valve adjustably mounted in said wall member adapted to maintain a certain quantity of fluid in the inner coupling chamber of said casing to provide a coupling capable of driving the centrifuge at a reduced rate of speed, and a valve within said centrifugal drum operable by slidable means mounted on said outer braking chamber to open and close a discharge port in the bottom wall of said centrifugal drum.

5. In a combination clutch and brake assembly, a casing rotatably supported, a wall member in said casing providing inner and outer coupling and braking chambers respectively, a drive shaft extending axially into the casing, support means on said shaft, radially extending vertically disposed blades on said support means and the inner wall of said wall member, a fixed wall member extending into said casing between said wall member and the inner peripheral surface of said casing and radially arranged vertically disposed blades arranged in interdigitating relation on the outer peripheral surface of the wall member and the inner peripheral surface of the fixed member, valve means located at the lower portion of said chambers whereby fluid within said coupling chamber can escape to the outer chamber and create a braking action when said liquid reaches a level through centrifugal action.

6. An automatically controlled centrifuge comprising a centrifugal drum, driving means for rotating said centrifugal drum, said means including a motor-driven shaft and a casing concentric therewith not directly connected to said shaft, said casing being divided by a wall structure to provide an inner coupling chamber and an outer braking chamber, said shaft having a portion thereof disposed within said inner casing, coupling elements mounted on said shaft and the inner surface of said wall, respectively, to effect rotation thereof in unity, conduit means for supplying the inner chamber of said casing with a fluid, valve means connecting the inner and outer chambers for the periodical discharge of fluid from the inner chamber to the outer chamber, said outer chamber having inwardly projecting arms on the interior wall thereof, and outwardly projecting arms on the exterior of the inner chamber which cooperate to cause braking action on the centrifugal drum.

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