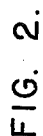


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3,103,034

2 Sheets-Sheet 1



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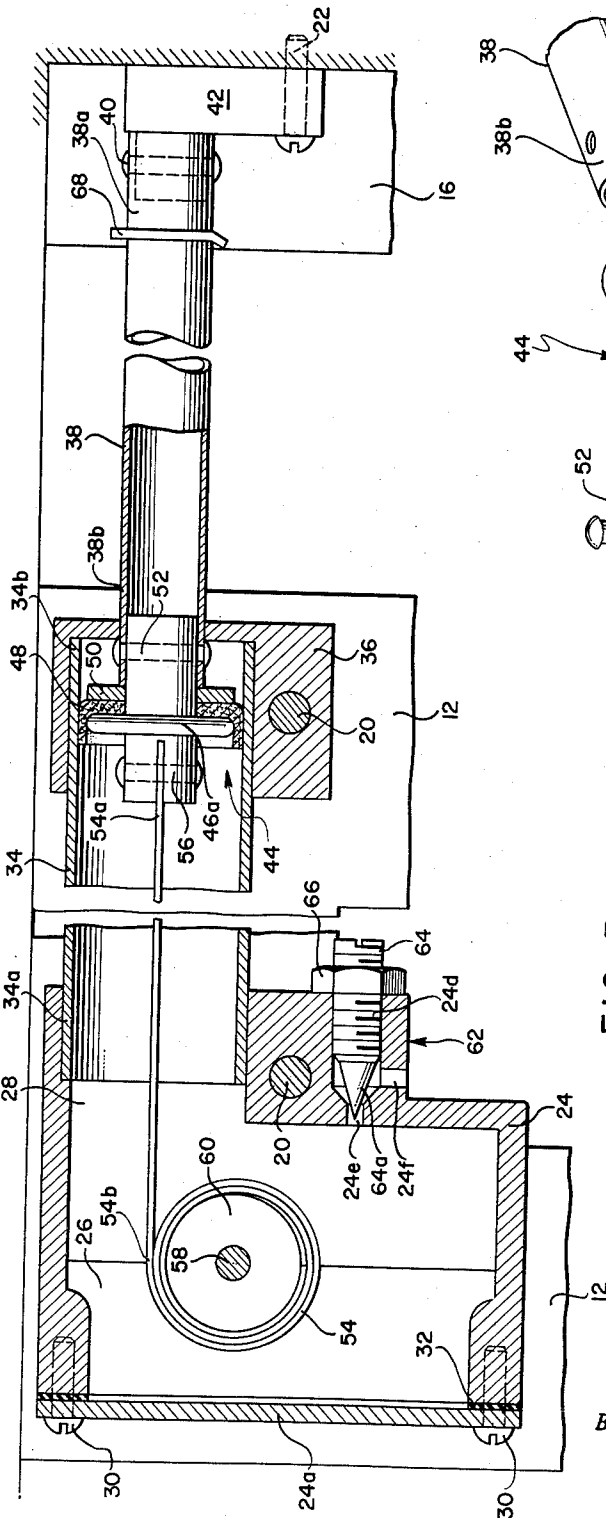
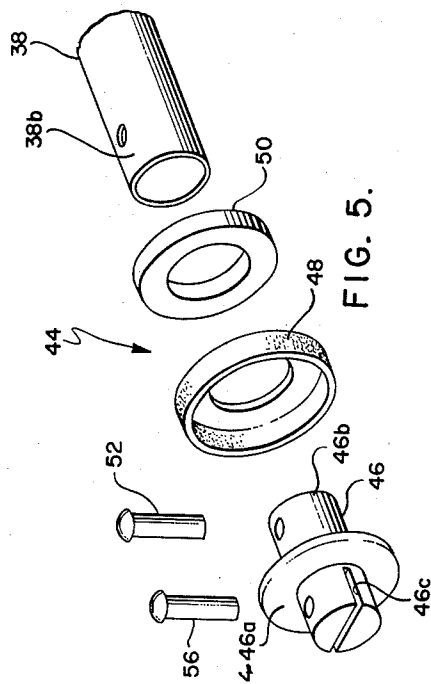
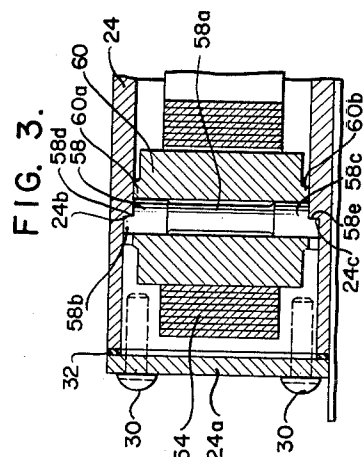
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DOOR CLOSURE APPARATUS

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2 Sheets-Sheet 2



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1

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DOOR CLOSURE APPARATUS

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The present invention relates to door closure apparatus, but more particularly to means for controlling the rate of closure of a sliding door.

Although many satisfactory types of door closing apparatuses have been devised for controlling the rate of closure of hinged doors, such has not been true with respect to sliding doors wherein the problems are considerably different. Mechanisms heretofore employed for returning sliding doors to their initial closed positions have been either ineffective in returning the door the entire distance or have returned the door at a variable rate of speed. Either of these conditions is likely to pose a serious threat of injury to persons using the door, particularly small children. Also, devices heretofore prevalent in the art have been very bulky and cumbersome in construction, and have left much to be desired regarding satisfactory operation over a reasonable period of time.

In view of the above shortcomings, the present invention has as one of its objects the provision of a door closure apparatus which is simple and compact in construction, and rugged and dependable in operation.

Another object of this invention is to provide a door closure apparatus which is capable of returning a sliding door to its closed position at a substantially constant rate of speed.

Another object of this invention is to provide such a door closure apparatus which is capable of returning a sliding door from its fully open to its fully closed position.

Another object of this invention is to provide a door closure apparatus as characterized above which employs both spring means and pneumatic means.

Another object is to provide apparatus as characterized above which is adaptable for use on sliding doors which are required to move a considerable distance from their open to their closed position.

Another object is to provide a door closure mechanism as characterized above wherein is employed a pre-formed spiral spring which is very compact and diminutive in construction as compared to the overall length thereof when fully extended.

Another object of this invention is to provide apparatus as characterized above wherein the spring means is a coil spring which is pre-wound to thereby be self-biased toward its wound position and wherein each successive increment or unit of length of the spring is provided with substantially the same bending force.

Another object is to provide door closure apparatus as characterized above wherein the coil spring is so utilized that at any given moment throughout the opening or closing movement of the door only one increment or unit of length of the spring is effective to bias the door toward its closed position whereby such door is urged toward its closed position with the same amount of force regardless of the instantaneous position thereof.

Another object is to provide apparatus as characterized above wherein is included manual means for adjusting the rate of return of the door from its open to its closed position.

Another object of this invention is to provide door closure means comprising the above spring means and also including a hermetically sealed chamber having a movable wall portion which is so associated with the

2

door closure means that the rate of closure of the door is governed by the action of such wall portion against the fluid pressure within the hermetically sealed chamber, there being adjustable bleed means provided for controlling the rate of fluid flow to and from such chamber.

The novel features which I consider characteristic of my invention are set forth with particularity in the appended claims. The device itself, however, both as to its organization and mode of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings, in which

FIGURE 1 is a side elevational view of a sliding screen door having the subject door closure apparatus attached thereto;

FIGURE 2 is a longitudinal sectional view of the door closure apparatus of FIGURE 1, showing the door in its closed position;

FIGURE 3 is a sectional view taken substantially along line 3—3 of FIGURE 2;

FIGURE 4 is a longitudinal sectional view of the subject apparatus, showing various of its component parts in their extended positions following movement of the door to its fully position; and

FIGURE 5 is an exploded perspective view of the parts which comprise the plunger mechanism employed in the subject invention.

Like reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to FIGURE 1 of the drawings, it shows a screen door 10 which is provided with appropriate metal or plastic rollers (not shown) for enabling door 10 to be slid back and forth between its open and closed positions. Door 10 comprises a door casing or frame 12 and screen material 14 attached to said frame in any well known manner. As will be readily apparent from a further understanding of the present invention, door frame 12 may be made in any desired configuration and of any appropriate material, and the screening material 14 may be replaced with glass, wood, or any other desired material without departing in any respect from the pertinency of the instant invention. Door 10 is shown in FIGURE 1 in its closed position whereby a portion of frame 12 abuts against a door jamb 16.

Door closure apparatus 18 is secured to door frame 12 by means of several screws 20, 20, and a portion of the apparatus 18 is secured to the door jamb 16 or the wall immediately adjacent thereto by means of a screw 22, which is more clearly shown in FIGURES 2 and 4.

As shown in FIGURE 2, door closure apparatus 18 comprises a housing 24 formed with a central cavity or chamber 26, there being an opening 28 communicating with chamber 26. Housing 24 is provided with a removable end wall 24a which is held in its assembled position by screws 30. To assist in hermetically sealing chamber 26 for purposes hereinafter to be explained in detail, a sealing gasket 32 is interposed between end wall 24a and the main portion of housing 24.

Firmly fastened to housing 24 within opening 28 is a hollow or tubular member 34. In the interest of hermetically sealing chamber 26 it has been found preferable to secure end portion 34a of tube 34 within opening 28 of housing 24 by means of bonding material such as epoxy resins. Slidably engaging the other end 34b of tube 34 is a mounting bracket 36 which has a suitably formed opening 36a for receiving end 34b and a centrally located through opening 36b for slidably receiving a body member 38 which may be tubular in form as shown in the drawings. Bracket 36 is secured to frame 12 of door 10 by a screw 20. External end 38a of tube 38 is fastened as by

means of rivet 40 to a mounting bracket 42 which is connected to door jamb 16, or to the adjoining wall portion, by means of screw 22. Fixed to end 33b of tube 38 is a plunger mechanism or subassembly 44. Plunger mechanism 44 comprises a plug 46 formed with an annular shoulder 46a and provided with an end portion 46b suitably shaped for insertion within end portion 38b of tube 38. Interposed between annular shoulder 46a and end portion 38b of tube 38 when assembled on end portion 46b is a cup-shaped leather washer 48 and a retaining ring 50. While so assembled, a rivet or screw 52 is inserted within appropriate openings in end portion 38b of tube 38 and end portion 46b of plug 46 for retaining such members in their assembled positions.

Referring to FIGURE 5 of the drawings, it will be seen that each of washer 48 and retaining ring 50 is provided with a through opening whereby they may be slipped over end portion 46b of plug 46 prior to insertion of such plug into the end 38b of tube 38. It will also be noted that the peripheral portion of annular shoulder 46a of plug 46 is rounded for better cooperation with leather washer 48 in hermetically sealing against the inner surface of hollow tube 34.

Positioned within chamber 25 of housing 24 is pre-formed spirally wound spring member 54 having an end 54a attached to plug 46 by insertion thereof within a slot 46c formed in the latter, there being a rivet or screw 56 for retaining spring end portion 54a in such position. Spring 54 comprises flat spring steel or other spring material which has been wound about a mandrel or other tool having a fixed axis to thereby provide a spirally wound coil spring which is self-biased toward its wound position. In forming such spirally wound spring 54, each successive increment or unit of length of spring material is formed with substantially the same radius of curvature and hence is provided with substantially the same bending force. As will be readily appreciated from an understanding of the operation of the instant invention, it is this bending force which biases the spring toward its wound position, and it is this force which is used in returning sliding door 10 to its closed position as will hereinafter appear.

As most clearly shown in FIGURE 3, unique mounting means is provided for positioning spring 54 within chamber 26. Such mounting means comprises a pin 58 formed of relatively hard stainless steel or other suitable material and provided with a reduced central portion 58a. Pin 58 is further provided with cylindrical end portions 58b and 58c each of which is formed with a shoulder 58d and 58e respectively for engagement with elongated abutments 24b and 24c formed in the opposite side walls of housing 24. Rotatably mounted on pin 58 is a roller 60 the opposite ends of which are provided with bosses 60a and 60b which engage the opposite side walls of chamber 26. The reduced central portion 58a of pin 58 enables roller 60 to rotate on and about pin 58 in a substantially frictionless manner, the bosses 60a and 60b also minimizing frictional forces during rotation of roller 60. Spring member 54 may be pre-formed about roller 60, or it may be pre-formed about a mandrel and subsequently mounted on roller 60. Once this has been accomplished, pin 58 is inserted within the through opening of roller 60 and such subassembly is then inserted into chamber 26 while end wall 24a of housing 24 is removed.

It should be noted that once the spring assembly is properly mounted within cavity 26, it is free to move in a vertical direction while being prevented from moving in a horizontal plane. This arrangement is very desirable if not mandatory to insure satisfactory operation of the device. As the spring material is unwound from coil 54, the outer diameter thereof decreases appreciably. If the axis of rotation of coil spring 54 is stationary during this period, several undesirable effects will result.

Firstly, as the coil diameter decreases there is a greater tendency for the spring material within hollow member 34 to rub against or engage the side walls of member 34

since the point at which the spring material leaves the coil has been shifted downwardly with respect to member 34. This creates very undesirable extraneous frictional forces which hinder satisfactory operation of the door closure apparatus. Also, if after the door is opened the remaining coil 54 is so positioned that the center-line of movement of member 38 is not tangent with such coil 54, then the entire biasing force of spring 54 is not available for moving door 10 to its closed position. To state it another way, if such tangential relationship does not exist then the biasing force of spring 54 has both a vertical and a horizontal component, only the latter of which is effective for moving door 10 to its closed position. It is this vertical force component which automatically moves the spring 54 up or down, as the case may be, to insure that the center-line of member 38 is tangent to the coil 54. Such movement of spring 54 is accomplished by the sliding of pin 58 along shoulders 24b and 24c in the side walls of housing 24. As will hereinafter appear in greater detail, the above feature insures that all of the biasing force of spring means 54 is applied to returning door 10 to its closed position and since said spring is formed with a constant spring rate, a constant force is thereby applied to door 10 regardless of its position.

An adjustable bleed control 62 is provided in housing 24 for cooperation with plunger mechanism 44. Bleed control 62 can take virtually any desired form, but is shown in the instant embodiment as comprising a threaded needle valve 64 fastened within a threaded opening 24d in housing 24. The pointed end 64a of needle valve 64 cooperates with a bleed port 24e and an exhaust port 24f formed in housing 24 as shown in FIGURES 2 and 4. A lock nut 66 is provided on needle valve 64 for retaining said needle valve in any selected position.

Loosely engaging body member or tube 38 is a crimped lock washer 68 which, when the door 10 is in an open position, may be manually moved into engagement with mounting bracket 36 merely by sliding said washer 68 along tube 38. While in this position, any force tending to move door 10 to its closed position will, due to the bent nature of washer 68 cause such washer to bind with tubular member 38. As such washer 68 overcomes the force tending to close door 10 whereby the latter is retained in its pre-selected open position.

The embodiment chosen for illustration of the instant invention generally operates as follows:

With spring means 54 pre-formed such that each successive increment or unit of length of the spring material is formed with the same bending force, it will be seen that as door 10 is moved from its closed position, shown in FIGURE 2, to an open position as illustrated in FIGURE 4, spring 54 creates a constant force opposing such movement. Such movement of door 10 causes relative movement between telescoping tubular members 34 and 38 whereby spring member 54 is unwound to an extent corresponding to such relative movement.

Also opposing movement of door 10 to its open position is the pneumatic means comprising the hermetically sealed chamber 26, bleed means 62 and the plunger mechanism 44, the latter of which employs leather washer 48 in sealing engagement with the through opening of tubular member 34. As plunger mechanism 44 is moved away from housing 24, a partial vacuum is created within chamber 26 in accordance with the setting of needle valve 64.

Upon release of door 10 while in its open position, spring means 54 in attempting to return to its pre-formed coiled position urges such door to its closed position. It should be particularly noted however that the only segment or increment of the spring material which is, at any given moment, exerting a force in the proper direction for closing door 10 is that segment immediately adjacent the coil as shown at 54b. That is, although energy is stored in each and every increment of spring material which has been straightened during open movement of the door, only the segment of spring material

5

which is already partially wrapped around the coil is able to create a force which is in the direction of relative movement of tubular members 34 and 38. The energy which has been stored in the straight portion of the spring material within tubular member 34 creates a force trying to return such spring portion to its pre-formed arcuate condition, but such force acts in a direction perpendicular or lateral with respect to the direction of telescoping movement of members 34 and 38. Thus, such force has no effect whatever on tending to close door 10. It is because of this phenomenon that it has been found that if each successive increment or unit of length of spring material is pre-formed with the same bending force, a constant force will be exerted by spring 54 in urging door 10 towards its closed position throughout the entire movement of the latter from its fully opened position to its closed position. This will be so regardless of the length of spring 54 and regardless of the movement of the sliding door.

As will be readily apparent to those persons skilled in the art, the biasing force of the portion 54b of spring material will always be present during opening and closing of the door and it is this force which raises and lowers the spring member 54 as hereinbefore explained, to keep the unwound portion of the spring material in direct alignment with the direction of telescoping of members 34 and 38. This obtains by virtue of the fact that the force created by the increment of spring material at 54b acts directly toward the end 54a of spring member 54. As such, this force will tend to maintain the distance between point 54b and the end portion 54a of spring material 54 as short as possible, thereby causing the unwound portion of the spring material to align itself perpendicularly with respect to the bosses or shoulders 24b and 24c of housing 24. Thus, as the spring material is being unwound from roller 60, pin 53 will move upwardly and while the spring material is being returned to the spool or roller 60 the entire coil will move downwardly.

It will be noted that this arrangement further insures that only that portion of the spring material at point 54b is capable of urging the door to its closed position, the other energy stored in the unwound portion of the spring material being truly at right angles with respect to the direction of telescoping relative movement of the tubular members 34 and 38. If such arrangement was not provided for permitting the coil to move up and down in accordance with the movement of door 10, the forces created by the unwound spring material within tubular member 34 would have a component in line with the direction of telescoping movement of members 34 and 38, which components would add to or subtract from the spring force in increment 54b acting on door 10.

During closure of door 10, the fluid pressure within chamber 26 increases in accordance with the adjustment of bleed means 62. As will be readily realized, this increase in pressure within chamber 26 is due to the closing movement of sealing washer 48 within tubular member 34. Thus the rate of return of door 10 to its closed position will be determined by the setting of needle valve 64 of bleed means 62. Lock nut 66 is provided to maintain needle valve 64 in its preselected position.

It is contemplated within the scope of this invention that the entire door closure apparatus could be installed within the frame 12 of door 10. Under these conditions some of the various parts, particularly housing 24 and hollow member 34, could be eliminated and portions of the frame 12 substituted therefor.

It is thus seen that the present invention provides door closure apparatus which is simple in construction, and rugged and dependable in operation. Such apparatus provides a constant rate of return of the sliding door to its closed position which, together with the feature of being able to control the rate of return, materially de-

6

creases the likelihood of anyone being injured due to fast or erratic return movement of the door.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim:

1. Door closure apparatus comprising, a housing formed with a cavity, a coil spring within said cavity comprising a strip of spring material pre-formed such that each successive increment of spring material possesses substantially the same bending force, a body member fixed to said spring and movable relative to said housing to thereby unwind a portion of said spring material into a single plane for biasing said body member toward a given position relative to said housing, and means mounting said spring within said cavity including means permitting said coil spring to move transversely of said plane to retain said coil spring tangent to said plane regardless of the amount of spring material unwound therefrom to thereby insure that the bending force of only one increment of said spring material is effective at a given moment for biasing said body member toward said given relative position.

2. Door closure apparatus comprising, a housing formed with a cavity, a coil spring within said cavity comprising a strip of spring material pre-formed such that each successive increment of spring material possesses substantially the same bending force, a body member fixed to said spring and movable relative to said housing to thereby unwind a portion of said spring material into a single plane for biasing said body member toward a given position relative to said housing, and means mounting said spring within said cavity including means operable under the biasing force of said coil spring to move the latter in a direction transverse to said plane to cause said coil spring to retain itself tangent to said plane regardless of the amount of spring material unwound therefrom to thereby insure that the bending force of only one increment of said spring material is effective at a given moment for biasing said body member toward said given relative position.

3. Door closure apparatus comprising, a housing formed with a cavity, a coil spring within said cavity comprising a strip of spring material pre-formed such that each successive increment of spring material possesses substantially the same bending force, a body member fixed to said spring and movable relative to said housing to thereby unwind a portion of said spring material into a single plane for biasing said body member toward a given position relative to said housing, and means mounting said spring within said cavity comprising a pin on which said coil spring is rotatably mounted and which is free to move in a plane transverse to the plane of said unwound spring material whereby said coil spring is retained tangent to the plane of said unwound spring material regardless of the amount of material unwound to thereby insure that the bending force of only one increment of said spring material is effective at a given moment for biasing said body member toward said given relative position.

4. Door closure apparatus for returning a sliding door from an open to its closed position comprising, a housing fixed to said door and formed with an hermetically sealed chamber and an opening communicating therewith, an elongated hollow member having one end fixed to said housing within said opening, an elongated body member partially within said hollow member having one end fixed to a door jamb associated with said door for rectilinear movement relative to said hollow member upon movement of said door relative to said door jamb, a sealing washer for preventing fluid flow through said hollow member fixed to the other end of said body member for

movement therewith relative to said hollow member, adjustable bleed means in said housing for controlling the rate of fluid flow to and from said chamber, a coil spring self-biased to its wound position having one end fixed relative to said body member, and means for mounting said spring member within said chamber comprising a pin rotatably carrying said coil spring and abutment means in the opposite side walls of said chamber for engagement by said pin to retain said spring within said chamber while permitting movement thereof laterally of the direction of movement of said sliding door whereby as said door is moved from its closed to its open position said coil spring is unwound a corresponding amount to thereby store in said spring member sufficient energy for returning said door to its closed position at a substantially constant rate in accordance with the adjustment of said bleed means.

5. Door closure apparatus for returning a sliding door from an open to its closed position comprising, a housing fixed to said door and formed with an hermetically sealed chamber and an opening communicating therewith, an elongated hollow member having one end fixed to said housing within said opening, an elongated body member partially within said hollow member having one end fixed to a door jamb associated with said door for telescoping movement relative to said hollow member upon movement of said door relative to said door jamb, a sealing gland for preventing fluid flow through said hollow member fixed to the other end of said body member for movement therewith relative to said hollow member, adjustable bleed means in said housing for controlling the rate of fluid flow to and from said chamber, a coil spring self-biased to its wound position having one end fixed relative to said body member, and means for mounting said spring member within said chamber comprising a pin rotatably carrying said coil spring and abutment means in opposite side walls of said chamber for engagement by said pin to retain said spring within said chamber while permitting the biasing force of said spring to move said spring in a direction normal to the direction of movement of said sliding door whereby as said door is moved from its closed to an

open position said coil spring is unwound a corresponding amount to thereby store in said spring member sufficient energy for returning said door to its closed position at a substantially constant rate in accordance with the adjustment of said bleed means.

6. Door closure apparatus comprising, a housing, a coil spring within said housing formed of overlapping successive convolutions of resilient material, a member fixed relative to said spring and rectilinearly movable relative to said housing, and mounting means for said spring comprising means providing a track within said housing extending transversely of the direction of movement of said member and support means for said coil spring operable in said track to permit of movement of said spring normal to the direction of movement of said member to insure alignment of unwound resilient material with the direction of movement of said member.

7. Door closure apparatus comprising, a housing formed with a cavity, a spring member within said cavity comprising a coil of spring material, means rotatably mounting said spring member within said cavity, a body member fixed to said spring member and movable relative to said housing to thereby unwind said spring and store in each successive increment of unwound spring material substantially the same amount of energy for return movement of said body member relative to said housing, and means for insuring that at any given moment only one of said increments of spring material is effective for return movement of said body member relative to said housing.

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