March 31, 1970 L. J. BRUNELLE 3,503,549

MUZZLE BUSHING FOR PISTON-TYPE POWER-ACTUATED TOOL

Filed Sept. 29, 1967 2 Sheets-Sheet 1

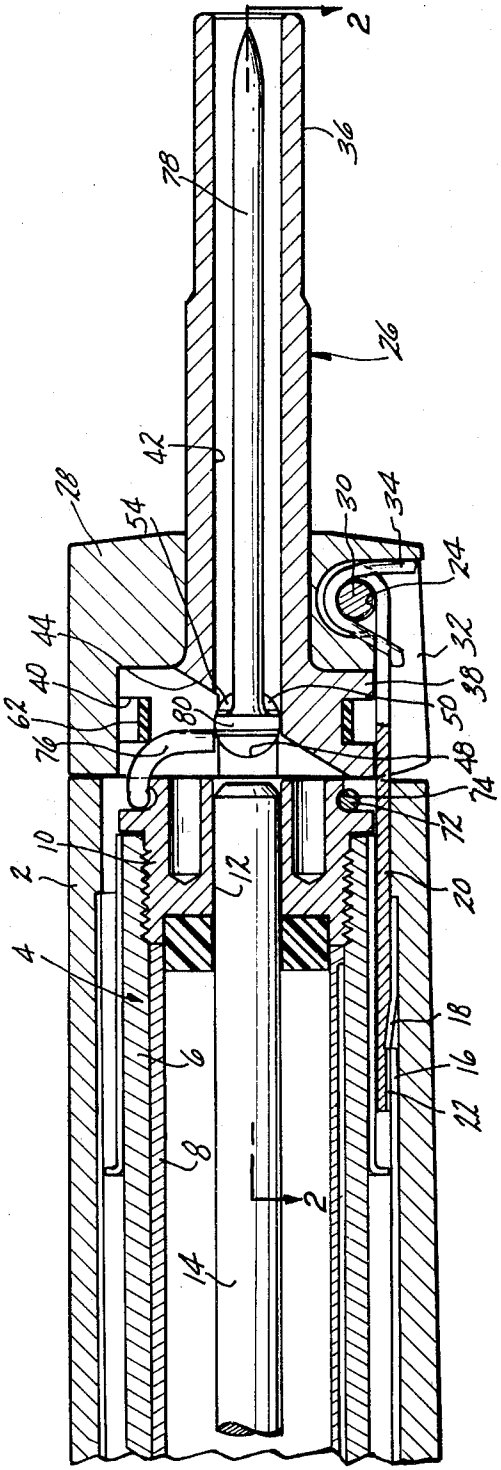


FIG - 1

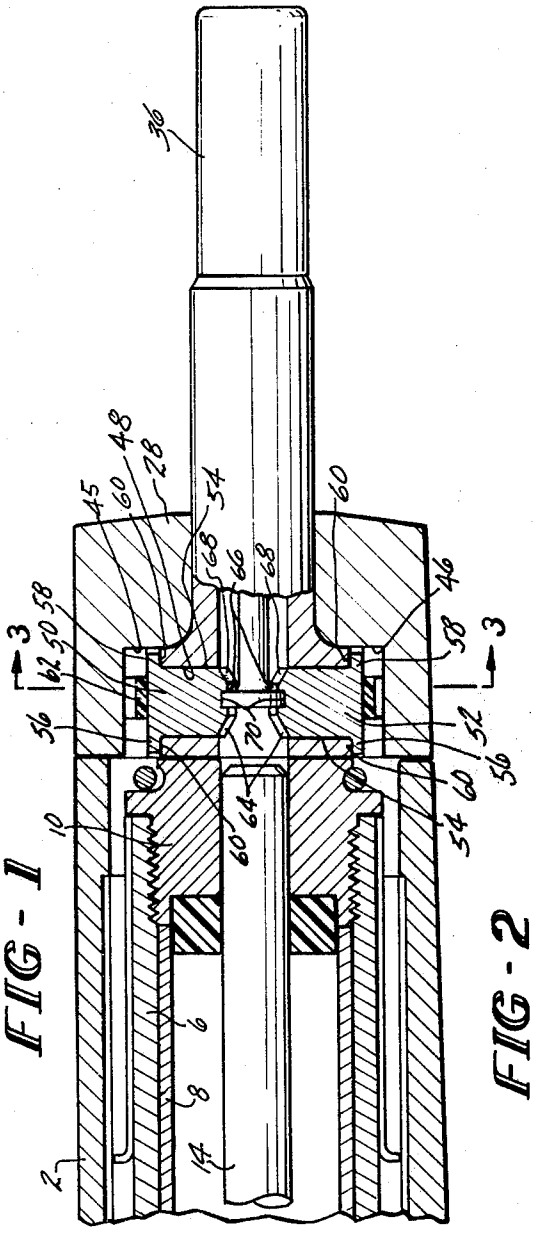


FIG - 2

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MUZZLE BUSHING FOR PISTON-TYPE POWER-ACTUATED TOOL

Filed Sept. 29, 1967 2 Sheets-Sheet 2

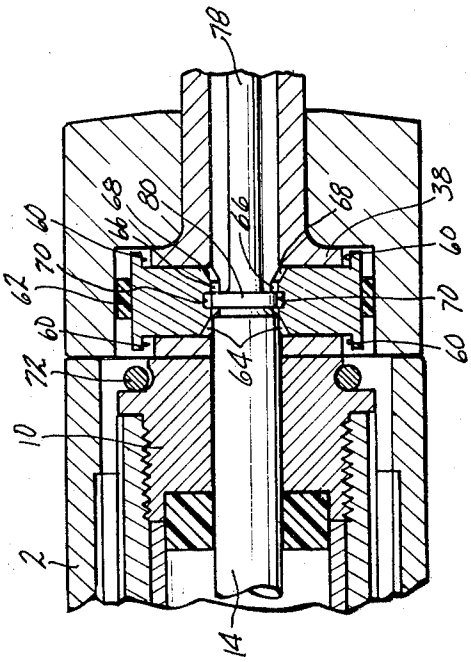


FIG - 5

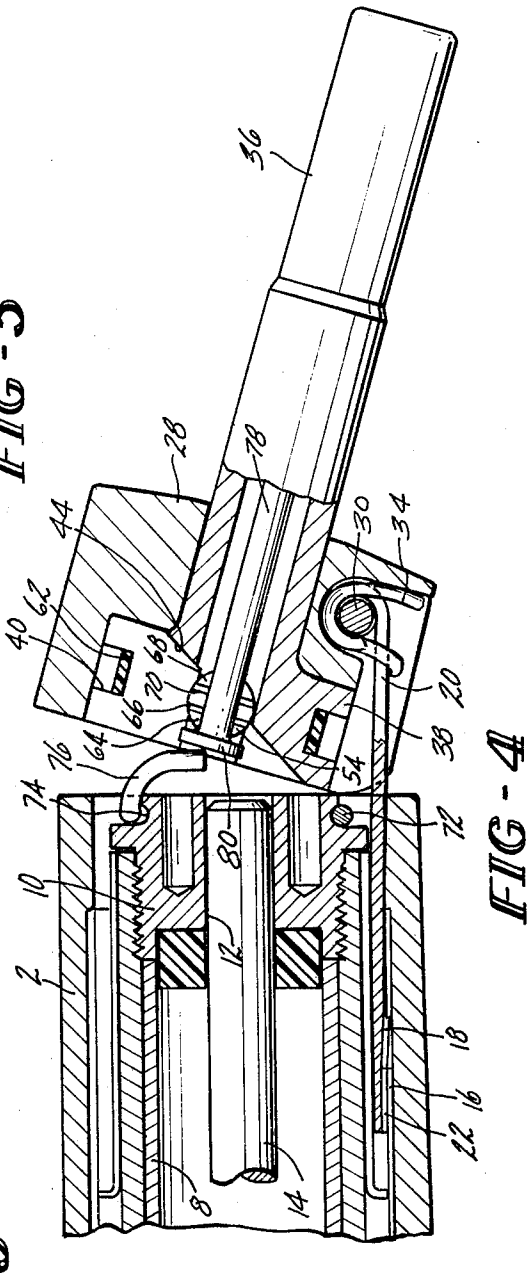


FIG - 4

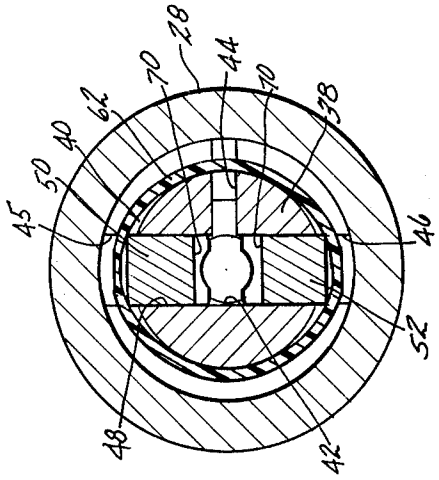


FIG - 3

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MUZZLE BUSHING FOR PISTON-TYPE POWER-ACTUATED TOOL

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Int. Cl. B25c 7/00
U.S. Cl. 227—149 8 Claims

ABSTRACT OF THE DISCLOSURE

A muzzle bushing having a longitudinal bore for a piston-type power-actuated tool. The muzzle bushing is provided with a plurality of key members which are peripherally spaced about the muzzle bushing and adapted to extend into the bore. The inner end faces of each of the key members are provided with a slot for the reception of the head of a fastener to hold the fastener in a position to be driven by the piston.

This invention relates generally to power-actuated tools of the piston type and more particularly to a muzzle bushing construction for use with such tools.

Prior to this invention, it was necessary to provide fasteners which were to be driven by a piston actuated power tool with some type of support to properly align the fastener in the muzzle bushing. Such support was usually in the form of a washer member positioned around the shank of the fastener or a tip positioned over the pointed end of the fastener and including a flange for engagement with a bore in the muzzle bushing. This was true whether the tool was of the type wherein the fastener was loaded through the breech end of the tool or of the type wherein the fastener was inserted into the muzzle end.

In view of the above it is the object of this invention to provide a muzzle bushing having means for holding a fastener in proper position for the driving operation.

It is another object of this invention to provide a muzzle bushing for a piston type power actuated tool which eliminates the need for fasteners being equipped with a special centering and holding device such as a washer or the like.

It is still another object of this invention to provide a power actuated tool wherein the closing of the muzzle bushing properly positions a fastener for driving by a piston.

Yet another object of this invention is to provide a fastener holding attachment for a power actuated tool which insures that the fastener will remain parallel to the axis of the piston during the driving operation.

These and other objects of the invention may be accomplished in accordance with a preferred embodiment of the invention through the provision of escapement keys mounted in the head of a muzzle bushing. The escapement keys are provided with slots to engage and hold the head of the fastener and are adapted to be moved out of the path of the head of the fastener by the piston immediately before the piston contacts the head.

The present invention also contemplates the provision of a tool having a muzzle pivotally attached to the remainder of the tool so that the tool can be broken open and the fastener inserted in the forward end of the muzzle bushing. Cam means are provided which upon closing of the muzzle bushing, urge the fastener into the slots in the escapement keys.

Additional objects and advantages of the present invention will become apparent by reference to the following description and to the accompanying drawings in which:

FIGURE 1 is a vertical sectional view of the muzzle end of a piston power actuated tool incorporating the features of the present invention;

FIGURE 2 is a sectional view taken along the lines 2—2 of FIGURE 1;

FIGURE 3 is a transverse sectional view taken along the lines 2—2 of FIGURE 3, but with the fastener omitted for the sake of clarity;

FIGURE 4 is a vertical sectional view of the forward end of a piston type power actuated tool taken during the operation of closing the muzzle bushing; and

FIGURE 5 is a view similar to FIGURE 2 showing the position of the escapement keys and piston during the driving operation.

In general, a piston actuated fastening tool incorporating the features of the present invention may include an outer housing **2** in which a barrel assembly **4** is mounted for relative reciprocal movement. The barrel assembly may include a barrel **6**, a liner member **8** positioned therein and a barrel plug **10** having a reduced bore **12** attached to the forward end of the barrel member **6**. A fastener driving member **14** in the form of a piston or the like is mounted for reciprocal movement within the barrel assembly with its shank end being supported in the bore **12** of the barrel plug **10**. The fastener driving member may be driven by explosive cartridge means mounted in a breech assembly such as shown in U.S. Patents Nos. 3,066, 302 and 3,172,118 or any other suitable breech assembly, or by any other suitable source of power such as liquid propellants, combustible mixtures of oxygen and a fuel, etc.

A housing insert **16** is mounted in the internal surface of the housing **2** and includes a plurality of circumferentially spaced lugs **18**. A retainer member **20** is mounted between the barrel assembly **4** and housing insert **16** and includes spaced lugs **22** which coact with lugs **18** on the housing insert **16** to prevent axial withdrawal of the retainer member **20**. The retainer member **20** further includes an eyelet **24** extending outwardly from the forward end of the housing **2**.

A muzzle bushing **26** is mounted within a muzzle bushing housing **28** which is attached to housing **2** by means of a pivot pin **30** passing through the eyelet **24** which is received within a slot **32** in the bottom of housing **28**. A suitable spring member **34** may be wrapped around the pivot pin **30** and have one end in engagement with the retainer member **20** and the other end in engagement with the forward end of slot **32** to bias the muzzle bushing housing into its closed position.

The muzzle bushing **26** includes a forward elongated portion **36** and a rearward enlarged head **38** having a circumferential groove **40** extending theerabout. The bore **42** of the muzzle bushing is slightly larger than the diameter of the shank portion of the driving member **14** to provide suitable clearance for movement.

The rearward face of the head **38** of the muzzle bushing **26** is provided with a vertically extending slot **44** which tapers to its greatest depth from bottom to top. As can be seen in FIGURE 1, the bottom end of the slot **44** intersects the rear face of the head portion at a point above the outer edge of the rear face. The top end of the slot **44** intersects the forward face at a point slightly above the outer surface of the forward elongated portion **36** of the muzzle bushing **26**.

The outer circumferential edge of head **38** of the muzzle bushing **26** is provided with two opposed axially extending slots **45** and **46**, the depth of each of said slots **45** and **46** being slightly greater than the depth of the circumferential groove **40**. The slots **45** and **46** are so positioned that a plane passing through the midpoint

between their sides is perpendicular to a plane passing through the midpoint between the sides of the slot **44**.

A cylindrical bore **48** extends radially through the head **38** of the muzzle bushing **26**. The ends of the bore **48** communicate with the slots **45** and **46** and the diameter of the bore **48** is substantially the same as the width of the slots **45** and **46** which in turn is substantially the same as the diameter of the axial bore **42** in the muzzle bushing **26**. The axis of the bore **48** lies in a plane passing through the axial midpoint of the head **38** of the muzzle bushing **26**.

A pair of escapement keys **50** and **52** are mounted on the bore **48** on opposite sides of the axial bore **42**. Each of the escapement keys **50** and **52** includes a cylindrical body portion **54** so dimensioned as to have a sliding fit within the bore **48**, and outer oppositely disposed flanges **56** and **58** extending in the direction of the axis of slots **45** and **46**, respectively. The flanges **56** and **58** form a pair of stop shoulders **60** which abut against the bottom of a respective slot **45** and **46** to limit the movement of the keys **50** and **52** toward the axis of the bore **42**.

The keys **50** and **52** are biased into their inner position wherein the shoulders **60** abut against the bottom of a respective slot **45** or **46** by spring means **62**. In the preferred embodiment, the spring means **62** comprises a band of elastomeric material extending about the head **38** of the muzzle bushing **26** in the circumferential groove **40** and engaging the outer surface of each of the keys **50** and **52**.

As shown in FIGURE 3, the inner surface of each of the keys **50** and **52** is generally arcuate, the radius of the arc being the same as or slightly larger than the radius of the bore **42** through the muzzle bushing **26**. As shown in FIGURE 2, the inner face of the escapement keys **50** and **52** includes, in cross section, a rear forwardly and inwardly tapering portion **64**, a straight portion **66** generally parallel to the axis of bore **42**, and a forward forwardly and outwardly tapering portion **68**. The straight portion **66** is provided with a slot **70** which is wide enough to receive the head of a fastener.

When the keys **50** and **52** are in their innermost position, both tapering portions **64** and **68** taper to a point substantially flush with the wall of the bore **42** in the muzzle bushing **26**. The slot **70** has a flat bottom. The depth of the slot **70** is such that when the keys **50** and **52** are in their innermost position, the bottom surface is substantially tangential with the wall of the bore **42** of the muzzle bushing **26**.

A snap ring **72** is mounted in a suitable groove **74** in the barrel plug **10** and includes a forwardly extending portion which terminates in a downwardly extending hook **76** which is normally positioned within the vertically extending slot **44** in the head **38** of the muzzle bushing **26**. When the muzzle bushing **26** is closed as shown in FIGURE 1, the hook terminates adjacent the bore **42** in the muzzle bushing **26**.

To load a fastener **78** in accordance with the described embodiment, the tool is broken open between the muzzle bushing **26** and housing **2** by pivoting the muzzle bushing **26** clockwise, as viewed in FIGURE 1, about pivot pin **30**. The fastener **78** may then be loaded from the rearward end of the muzzle bushing **26** into bore **42** wherein it will move forwardly until it is stopped by the tapered surfaces **64** of the escapement keys **50** and **52**. As the tool is closed by pivoting the muzzle bushing **26** counterclockwise, as viewed in FIGURE 4, the forward surface of the hook **76** contacts the head **80** of the fastener **78** and urges it forwardly within the bore **42** of the muzzle bushing **26**, against the tapered surface **64** of the keys **50** and **52**, moving the keys radially outwardly away from the bore **48**. The forward motion of the fastener **78** will continue until the tool is substantially closed and the head **80** of the fastener **78** becomes aligned with the slots **70** in the keys **50** and **52**, whereupon the keys **50** and **52** will move inwardly so that the head **80** of the fastener is contained within the slots **70**.

When the tool is actuated and the driving member **14** moves forwardly under the influence of the power source, it can be seen from FIGURE 5 that just as the driving member **14** is about to contact the head of the fastener, it has contacted the tapered surface **64** and the beginning of the straight portion **66** of the keys **50** and **52** and moved the keys **50** and **52** outwardly away from the bore **42**. Accordingly, at this point, the fastener is free to move forwardly in the muzzle bushing **26** under the propelling force of the driving member **14**.

The provision of the escapement keys **50** and **52** provides a positive retention means for a fastener. This eliminates the counterbore in the muzzle end of the muzzle bushing which is common in piston type tools for receiving an enlarged washer member attached to a fastener. The elimination of the counterbore ensures that the forward end of the shank of the driving member is supported throughout the entire driving stroke as well as providing support for the head of the fastener during the driving stroke thereby preventing bending of the upper portion of the fastener.

The escapement keys **50** and **52** also hold the fastener in proper alignment so that when the driving member contacts the fastener, the head of the fastener will be flat against the forward surface of the driving member ensuring that the axis of the fastener will remain substantially parallel to the axis of the bore so that the fastener enters the work surface perpendicular thereto.

Moreover, since the keys **50** and **52** eliminate the need for special attachments such as washers on the fastener, the cost of an individual fastening operation is greatly reduced.

It is to be understood that the use of the escapement keys, as described above, is not limited to tools wherein the fasteners are loaded by hand, but rather such keys may find use in those cases wherein a fastener magazine is used to automatically feed fasteners into position.

Although reference has been made above to a preferred embodiment of this invention, it will be obvious that various alterations and modifications will readily suggest themselves to those skilled in the art. Accordingly the scope of this invention should be ascertained from the following claims.

What is claimed is:

1. In a power-actuated tool, a barrel, fastener driving means mounted in said barrel, muzzle bushing means attached to the forward end of said barrel and having a bore normally co-axial with said barrel, a plurality of key mounting bores circumferentially spaced in said muzzle bushing means and communicating with said bore, a fastener holding member including a key member mounted in each of said key mounting bores for movement in a direction transverse to the axis of the bore of said muzzle bushing means, each of said key members having an inner end face movable into and out of said bore of said muzzle bushing means, means biasing said key members inwardly in a direction toward the axis of said muzzle bushing bore, means limiting the amount of inward movement of said key members, and a fastener receiving slot in the inner end face of each of said key members, the inner end face of each of said key members including a tapering portion rearward of said slot, said tapering portion tapering rearwardly of the tool and away from the axis of said bore of said muzzle bushing means so that when said keys are in their innermost position, the rearward edge of said tapering portion is tapered away from the axis of the bore to a point at least flush with the wall defining the bore of said muzzle bushing means.

2. The power-actuated tool of claim **1** wherein said inner end face of each of said keys includes a tapering portion forward of said slot, said tapering portion tapering forwardly and away from the axis of said bore so

that when said keys are in the innermost position, the forward edge of said forward tapering portion is tapered away from the axis of the bore to a point at least flush with the wall means defining the bore of the muzzle bushing.

3. The power-actuated tool of claim 1 wherein said muzzle bushing means includes a muzzle bushing housing attached to said barrel and a muzzle bushing mounted within said muzzle bushing housing and having an enlarged head portion and a reduced forwardly extending portion, a pair of axially extending, oppositely disposed grooves in the outer periphery of said head portion, a key mounting bore associated with each of said grooves, said key mounting bores extending in a direction perpendicular to the axis of said muzzle bushing bore with one end of each communicating with one of said grooves and the other end communicating with said muzzle bushing bore, a pair of said key members mounted in said bores, one said key member being positioned on the opposite side of said axis from the other, and said means for limiting the inward movement of each of said keys comprises at least one stop shoulder adjacent the outer end of each of said key members and extending in the direction of said groove so as to abut the bottom surface of said groove when the key member is in its innermost position.

4. The power-actuated tool of claim 3 wherein said biasing means comprises a peripheral groove extending about the head portion of said muzzle bushing, the axis of which lies in the same plane as the axis of the key mounting bore, and a band of resilient material positioned in said groove and abutting the outer end of each of said key members.

5. In a power-actuated tool, a barrel, fastener driving means mounted in said barrel, muzzle bushing means attached to the forward end of said barrel, said muzzle bushing means including a muzzle bushing housing pivotally attached to said housing and a muzzle bushing mounted in said muzzle bushing housing and including an enlarged head portion, a reduced forwardly extending portion, and a bore extending therethrough, said muzzle bushing means being pivotable between a closed position wherein said bore is axially aligned with said barrel and an open position wherein the rearward opening of said bore is exposed for the loading of a fastener, a slot in the rearward face of said muzzle bushing intersecting said muzzle bushing bore, fastener holding means mounted in said muzzle bushing, said fastener holding means including a plurality of key members peripherally spaced about said muzzle bushing means and mounted therein for movement in a direction transverse to the axis of the bore, each of said keys having an inner end face movable into and out of said bore, means biasing said key members inwardly, means limiting the amount of inward movement of said key members, a fastener receiving slot in the inner end face of each of said key members, the inner end face of each of said key members including a tapering portion rearward of said slot, said tapering portion tapering rearwardly relative to the tool and away from the axis of said bore so that when said keys are in their innermost position, the rearward edge of said tapering portion is tapered away from the axis of the bore to a point at least flush with the wall defining the bore, and fastener cam means attached to said barrel and extending in said muzzle bushing slot for urging the head of a fastener into the fastener receiving slots in said key members as the muzzle bushing means is moved into its closed position.

6. The power-actuated tool of claim 5 wherein said cam means includes a snap ring secured to the forward end of said barrel, said snap ring including a forward and inwardly projecting hook portion, the end of said hook portion terminating at a point flush with the wall means defining the bore in said muzzle bushing means and the forward edge thereof being substantially co-planar with the rearward wall of the fastener receiving slots in said key members when said muzzle bushing is in the closed position.

7. The power-actuated tool of claim 6 wherein said muzzle bushing includes a pair of axially extending, oppositely disposed grooves in the outer periphery of said head portion and a key mounting bore passing through the head portion of said muzzle bushing in a direction perpendicular to the axis of said muzzle bushing bore with the ends thereof communicating with said grooves, a pair of said key members mounted in said bore, one said key member being positioned on the opposite side of said axis from the other, and said means for limiting the inward movement of each of said keys comprises at least one stop shoulder adjacent the outer end of each of said key members and extending in the direction of said groove so as to abut the bottom surface of said groove when the key member is in its innermost position.

8. The power-actuated tool of claim 7 wherein said biasing means comprises a peripheral groove extending about the head portion of said muzzle bushing, the axis of which lies in the same plane as the axis of the key mounting bore, and a band of resilient material positioned in said groove and abutting the outer end of said key members.

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