Nov. 5, 1957 J. M. F. CONRAD 2,811,941

DEVICE FOR FORMING ANNULAR ENLARGEMENTS ON HOLLOW MEMBERS

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Fig. 1



Fig. 2

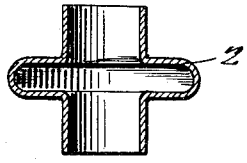


Fig. 5

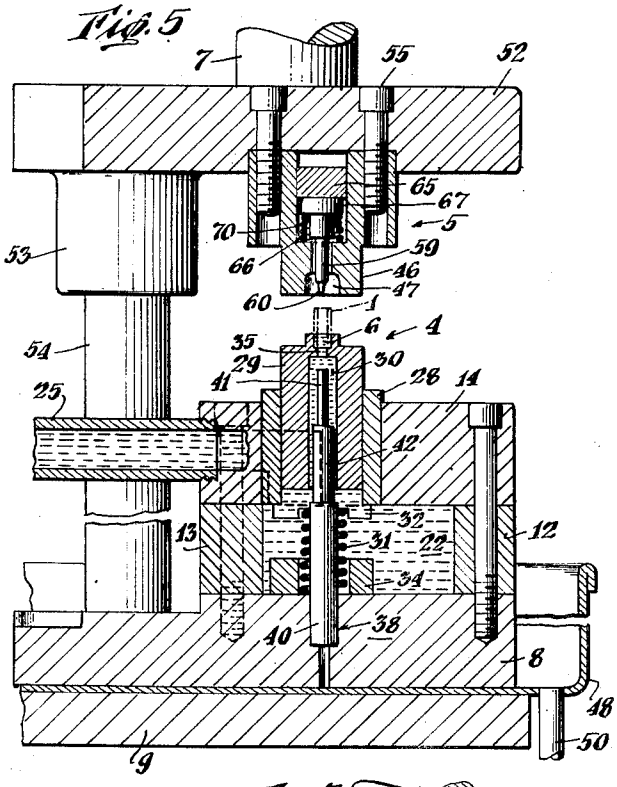


Fig. 6

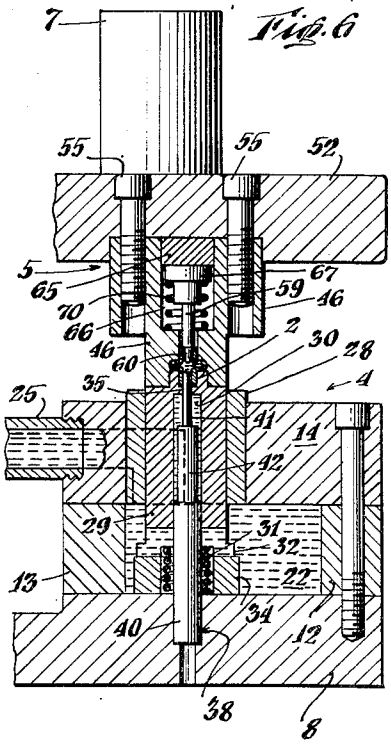
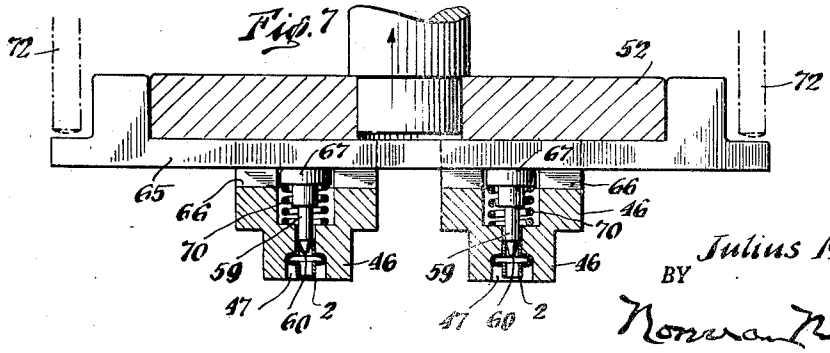


Fig. 7



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Fig. 3

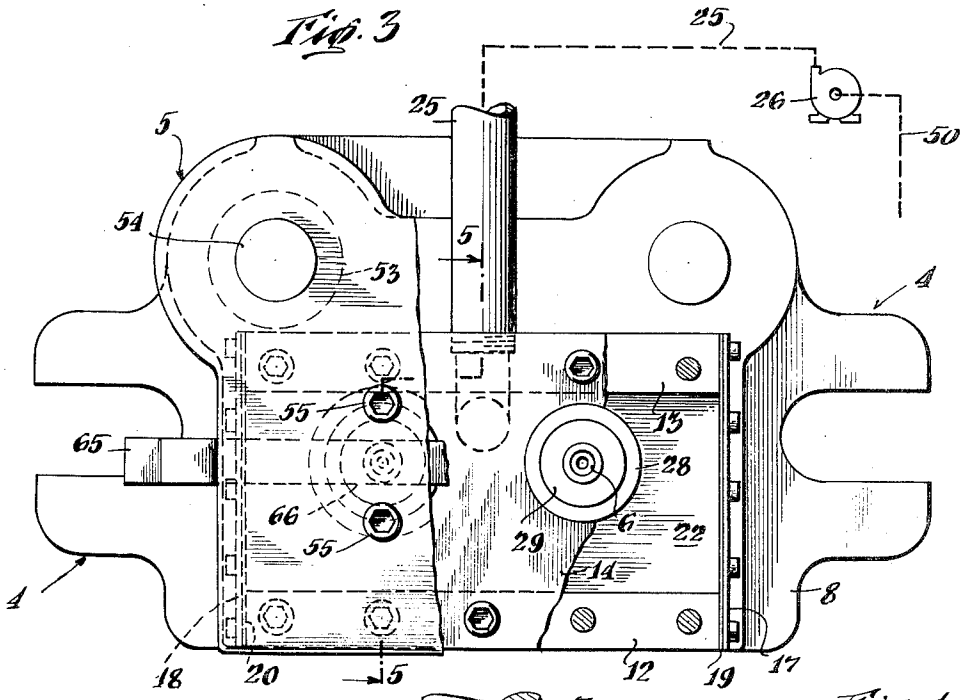
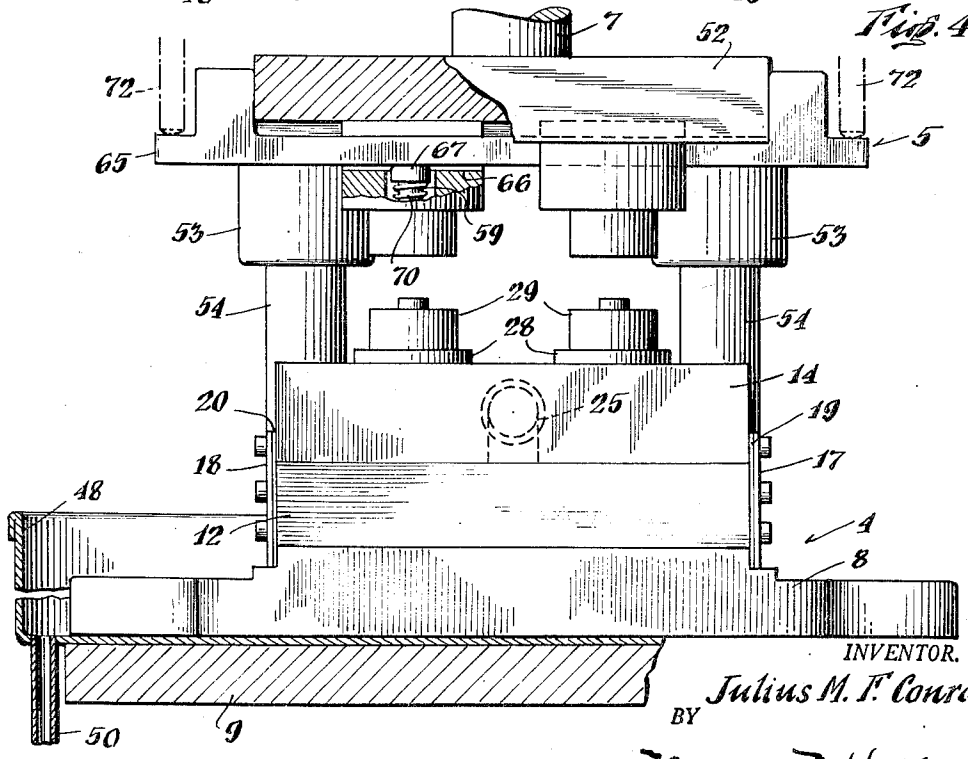


Fig. 4



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DEVICE FOR FORMING ANNULAR ENLARGEMENTS ON HOLLOW MEMBERS

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4 Claims. (Cl. 113—44)

The present invention relates to a device for shaping a length of tubing so as to provide it with an integral annular enlargement.

It has been found that, with certain types of electrical equipment, highly improved results are obtained by utilizing electric terminals which embody a tubular metal member having an integral outwardly projecting enlargement or flange. The metal article with annular enlargement, frequently referred to as an "eyelet," cooperates with other portions of the terminal to form a superior hermetic seal. The device or machine of the present invention is for use in making flanged members to be used in such terminals, as well as elsewhere.

An object of the present invention is to provide a new and improved device for forming an annular enlargement or flange on a hollow member.

Another object of the invention is to provide an improved device for producing substantially identical flanged hollow members at each operating stroke.

Another object of the invention is to provide an improved device of relatively simple construction and operation for forming flanged hollow members.

Another object of the invention is to provide an improved device for forming hollow flanged articles which embodies means for accurately controlling a liquid used in connection with forming the flange.

A further object of the invention is to provide an improved flange-forming device which embodies means for automatically ejecting a completed article.

A still further object of the invention is to provide an improved device for producing identical flanged members at relatively high rates of speed.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

Fig. 1 is an enlarged sectional view showing a tubular or hollow member prior to shaping it so as to provide it with a flange;

Fig. 2 is a sectional view showing the member of Fig. 1 after being provided with an annular projecting flange;

Fig. 3 is a top plan view, partly broken away, showing one form of the present device for transforming the hollow member of Fig. 1 to the shape illustrated in Fig. 2;

Fig. 4 is a front elevational view, partly broken away, of the device illustrated in Fig. 3;

Fig. 5 is a sectional view taken along line 5—5 of Fig. 3;

Fig. 6 is a sectional view showing the device of Fig. 5 in fully closed relationship; and

Fig. 7 is a sectional view showing the reciprocable head of Figs. 4, 5 and 6 in elevated position shortly prior to ejection of a completed flanged member.

Described generally the present device comprises (Figs. 4–6) lower means 4 adapted to support in on-end position in socket 6 a tubular member 1 such as that shown in Fig. 1, and upper means 5 reciprocable toward and away from the lower means 4. As the upper means 5 moves downwardly the intermediate tubular member is subjected to endwise pressure and fluid is forced into it from the lower means 4, so that hydraulic shaping pressure is applied at the inside of the tubular member. The combination of endwise pressure and internal hydraulic pressure causes the wall of the hollow member 1 to bulge outwardly and form a hollow flange 2. The shaped member provided with a projecting flange is shown in Fig. 6 clamped between the upper and lower shaping or forming means 4 and 5.

When the reciprocable head 5 is lifted from the position shown in Fig. 6 it carries with it the shaped member and the latter is automatically ejected shortly before the reciprocable head 5 reaches its uppermost position. The lower means 4 may be bolted or otherwise secured to any suitable and known type of press and the upper reciprocable head 5 may be secured in any suitable manner, for example through boss or extension 7, with a crosshead or crank of the press. The details of such presses are well known in the art and hence are not shown herein.

The present device and its operation will now be described in detail. As shown, the lower means 4 comprises a base member 8 which may be bolted or otherwise secured to the table 9 of a press. To the base 8 are bolted or otherwise secured supporting members 12 and 13 and a cover member 14. Opposite ends of the opening formed by the side members 12 and 13 and the base and cover members 8 and 14 are closed by end plates 17 and 18 and gaskets 19 and 20, to form a liquid reservoir 22 to which oil or other liquid may be supplied through an inlet pipe 25. The reservoir 22 contains the oil or other liquid which is used to apply hydraulic pressure at the interior of a hollow member that is to be provided with an annular enlargement or flange.

The cover member 14 is preferably provided with a plurality of spaced openings, herein shown as two, into each of which is fitted a bushing 28. Each bushing fits closely against and guides an apertured piston 29, which is normally urged upwardly by a spring 31 so that an enlargement 32 at its lower portion rests against the lower end of the bushing 28. Downward movement of the apertured piston 29 is limited by a stop member 34 secured to the upper surface of the base member 8. The recess or socket 6 provided at the upper part of each piston 29 and an inwardly projecting shoulder portion 35 form a seat for the lower end of a hollow member that is to be provided with an annular flange.

In operation the piston 29 is moved down by the reciprocable upper head 5 and liquid moves up through the aperture 30 into a tubular member supported in the piston recess 6. As will be brought out hereinafter, the upper end of the tubular member is closed by a portion of the reciprocable head 5, so that the liquid is confined at the interior of the tubular member. Very accurate control of liquid flow through the apertured piston 29 and accurate control of the quantity of liquid forced into a tubular member is obtained by an upwardly projecting plunger 38 which rests in a socket of the base member 8 and cooperates with the piston aperture.

As shown more particularly in Figs. 5 and 6, the plunger has a lower portion 40 of diameter about equal to the diameter of the piston aperture 30 at its lower portion, and has a reduced upper portion 41 of a diameter

about equal to the diameter of the aperture through the piston shoulder 35. The enlarged and reduced diameter portions 40 and 41 of the plunger are connected by an intermediate portion 42 which has its walls spaced from the walls of the piston aperture 30. When the piston 29 is forced downwardly, by downward movement of the reciprocable head 5, the enlarged diameter portion 40 of the plunger enters the piston aperture 30 and liquid is forced upwardly through the piston aperture into the open lower end of a tubular member that is to be shaped. As the piston 29 continues its downward movement, the reduced upper portion 41 of the plunger enters the small diameter shoulder at the upper part of the piston and traps liquid inside the tubular member carried in the recess 6.

As the piston continues its downward movement for a short interval longer, the relative upward movement of the reduced plunger portion 41 subjects the trapped liquid to high pressure, which combined with the endwise pressure against the length of tubing, forces the tubing walls outwardly to the relationship shown in Fig. 6. The reduced end of the plunger preferably moves up into the length of tubing to about the position illustrated in Fig. 6 and liquid pressure expands the tubing side walls until the upper head 5 seats against the upper end of the piston 29, at which time the side walls of the tubing are expanded outwardly into contact with the inwardly facing walls of a cavity 47 in the upper die 46.

Liquid is supplied to the reservoir 22 from an inlet pipe 25 connected with a supply pump 26. When the present device is in use, oil is delivered continuously through the pipe 25 to the reservoir 22 and flows up through the piston apertures 30 and out the upper ends thereof. Overflowing liquid runs into a catch pan 48, from which it is removed through an outlet conduit 50 and returned to the pump 26. In this manner a continual supply of liquid is delivered to and removed from the reservoir 22.

The reciprocable upper head 5 comprises a base member 52 having aperture bosses 53 fitted about generally upright guide pins 54. Each upper die 46 is secured by bolts 55 to the base member 52 and has extending therethrough a pin 59 which is adapted to fit into and seal off the upper end of a tubular member as the head 5 moves downwardly. As shown, a tapered lower end 60 is provided on the pin 59 for fitting into the open upper end of a tubular member.

The upper head 5 also carries means for ejecting a completed flanged member such as that shown in Fig. 6. This ejecting means comprises a knockout bar 65 which extends through a slot 66 in the upper part of the die member 46 and bears against an enlarged head 67 on the pin members 59. Springs 70 extending around the upper portion of the pin members 59 normally urges the pin members upwardly and the knockout bar into contact with a portion of the upper base member 52.

As the upper head 5 raises away from the lower die 4 it carries with it the completed flanged members. As the upper die approaches its uppermost position the knockout bar 65 comes into contact with stop pins 72 (Fig. 7) that hold the bar down as the base member 52 and upper dies 46 continue to raise. Since the knockout bar is in contact with the enlarged upper ends 67 of the pins 59 it moves them downwardly in opposition to their supporting springs 70, and the pins force the completed flanged members out of the die recesses 47 so that they may be collected in any suitable manner. The upper head 5 and its parts are shown in fully lowered position in Fig. 6, in partly raised position in Fig. 7, and in fully raised position in Fig. 5.

In operation a hollow member 1, preferably a length of brass tubing which is held to close tolerance as to length, diameter and wall thickness and which is preferably in fully annealed or soft state, is inserted into the piston recess 6 and pressed down therein until it rests against the inwardly extending shoulder 35. The punch press is now actuated and the upper head 5 moves downwardly.

As the upper head moves down the tapered end 60 of pin member 59 enters the upwardly facing open end of the hollow member seated in the piston recess 6. Pressure of the pin member 59 against the hollow member forces the piston 29 downwardly into oil reservoir 22 and along the plunger 38 which projects up into the piston aperture 30. Oil from the reservoir 22 passes up through the piston aperture 30 into the hollow member.

During this downward movement of the piston 29 the enlarged plunger portion 40 enters the lower end of the piston aperture 30 and forces oil upwardly therethrough. Just before the piston comes into contact with the stop member 34 at the bottom of the liquid reservoir, the reduced portion 41 of the plunger enters the small diameter opening in the piston shoulder 35 and subjects liquid trapped in the hollow member to high pressure; as the piston continues its downward movement the reduced plunger portion 41 moves up inside the hollow member and applies continuing pressure. When the piston 29 strikes the stop member 35 it becomes stationary and all pressure applied by the downwardly moving upper head 5 is applied against the intermediate length of tubing; as this endwise pressure is applied against the hollow member the liquid confined therein is highly compressed, not being able to escape back into the piston aperture 30 or reservoir 22 due to the fact that it is sealed off by the reduced portion 41 of the plunger. The oil pressure expands the side walls of the tubing until the upper die 46 comes into contact with the upper end of the piston 29 (Fig. 6). At this time the formerly straight length of tubing (Fig. 1) has been transformed to the shape illustrated in Fig. 2.

When the upper head 5 raises the flanged member is held within the cavity 47 of upper die 46 and carried upwardly therewith. Piston return spring 31 elevates the piston to the original position shown in Fig. 5. Knockout bar 65 comes into contact with the stop pins 72 and forces pin members 59 downwardly and the flanged member out of the die recess 47, so that they may be suitably removed from the machine.

It will be seen that the present invention provides a new and improved device or mechanism for shaping straight lengths of tubing so as to provide them with laterally projecting annular enlargements or flanges. The device produces identical flanged members at each stroke, which is of utmost importance as any substantial variation would cause the members to be commercially useless. Accurate control of hydraulic forming pressure is provided by the plunger which cooperates with the piston. The enlarged diameter lower portion of the plunger has a fairly close fit with the surrounding walls of the piston aperture, but not so close as to prevent some backflow of liquid; in operation the device acts so quickly that suitable pressures and liquid control are maintained within the hollow member even though there may be some backflow of liquid from the piston aperture into the reservoir. The reduced diameter upper end of the plunger has a close fit with the piston wall through which it projects and objectionable escape of liquid out of a length of tubing to be shaped is prevented. Completed flanged members are automatically ejected upon the upward stroke of the reciprocable head. The present device is of relatively simple and rugged construction and may be operated at high speeds to produce identical eyelets at each stroke.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. A device for shaping a hollow article to form a projecting flange thereon comprising a fluid reservoir adapted for connection to a source of fluid under pres-

sure, a piston having a socket to engage one end of the hollow article and slidably mounted on said reservoir, said piston having a passageway connecting the interior of the reservoir and the article socket, a plunger fixedly mounted in the reservoir and aligned with said passageway and having a cross section generally corresponding to but slightly smaller than the cross section of the passageway to provide clearance between the plunger and passageway, a pin having a tapered end for closing off the other end of the hollow article and a shoulder surrounding said tapered end, a reciprocal mounting means for the pin adapted to move the said pin toward and away from the piston, said piston being positioned on said reservoir whereby said shoulder on said pin contacts the hollow article when moved toward said piston to apply mechanical force to the hollow article and whereby said tapered end seals off said other end of the hollow article, said contact between said pin and the hollow article moving the slidably mounted piston into the reservoir thereby effecting relative movement of the plunger and the passageway to displace fluid into the hollow article from the passageway to create fluid pressure therein, the clearance between said reduced cross section portion of said plunger and said passageway controlling the fluid pressure within said hollow article by providing a controlled leakage of fluid from the passageway as the combined mechanical force and fluid pressure on the hollow article cause its sides to bulge outwardly.

2. The device as claimed in claim 1 in which a die member having a cavity therein is mounted in surrounding relationship to said pin with said pin having its tapered end and shoulder portions in said cavity whereby the walls of the cavity and said socket confine the walls of the hollow article to limit the exterior dimensions of the projecting flange formed thereon as fluid under pressure is displaced thereinto.

3. A device for shaping a hollow article to form a projecting flange thereon comprising a fluid reservoir adapted for connection to a source of fluid under pressure, a piston having a socket to engage one end of the hollow article and slidably mounted on said reservoir, said piston having a passageway connecting the interior of the reservoir and the article socket having a portion of reduced cross section adjacent to said socket corresponding to the cross section of the interior of the hollow article, a plunger having one end fixedly mounted in the reservoir and aligned with said passageway and having a reduced cross section at its other end generally corresponding to but slightly smaller than the cross section of the interior of the hollow article to provide clearance between the plunger and the hollow article when the plunger enters the hollow article, a pin having a tapered end for closing off the other end of the hollow article and a shoulder surrounding said tapered end, a reciprocal mounting means for the pin adapted to move the said pin toward and away from the piston, said piston being positioned on said reservoir whereby said shoulder on said pin contacts the hollow article when the pin is moved toward said piston to apply mechanical force to the hollow article and whereby said tapered end seals off said other end of the hollow article, said contact between said pin and the hollow article moving the slidably mounted piston into the reservoir thereby effecting relative movement of the plunger and the passageway to displace fluid into the hollow article from the passageway to create fluid pressure therein, the clearance between said reduced cross section portion of said plunger and the reduced cross section portion of said passageway controlling the fluid pressure within said hollow article by providing a controlled leakage of fluid from the hollow article as the combined mechanical force and fluid pressure on the hollow article cause its sides to bulge outwardly.

4. A device for shaping a hollow article to form a projecting flange thereon comprising a fluid reservoir adapted for connection to a source of fluid under pressure, a piston having a socket to engage one end of the hollow article and slidably mounted on said reservoir, said piston having a passageway connecting the interior of the reservoir and the article socket having a portion of reduced cross section adjacent to said socket corresponding to the cross section of the interior of the hollow article, a vertical plunger fixedly mounted at its lower end in the reservoir and aligned with said passageway and having a cross section at its upper end corresponding to but slightly smaller than the cross section of the interior of the hollow article and having a lower portion with a cross section generally corresponding to but slightly smaller than the cross section of the passageway to provide clearance between the plunger and passageway, a pin having a tapered end for closing off the other end of the hollow article and a shoulder surrounding said tapered end, a reciprocal mounting means for the pin adapted to move the said pin toward and away from the piston, said piston being positioned on said reservoir whereby said shoulder on said pin contacts the hollow article when moved toward said piston to apply mechanical force to the hollow article and whereby said tapered end seals off said other end of the hollow article, said contact between said pin and the hollow article moving the slidably mounted piston into the reservoir thereby effecting relative movement of the plunger and said passageway and said hollow article to displace fluid into the hollow article from the passageway to create fluid pressure therein, the clearance between said upper portion of said plunger and the reduced cross section portion of said passageway and between the lower portion of said plunger and said passageway controlling the fluid pressure within said hollow article by providing a controlled leakage of fluid from the hollow article and the passageway as the combined mechanical force and fluid pressure on the hollow article cause its sides to bulge outwardly.

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