

Nov. 10, 1931.

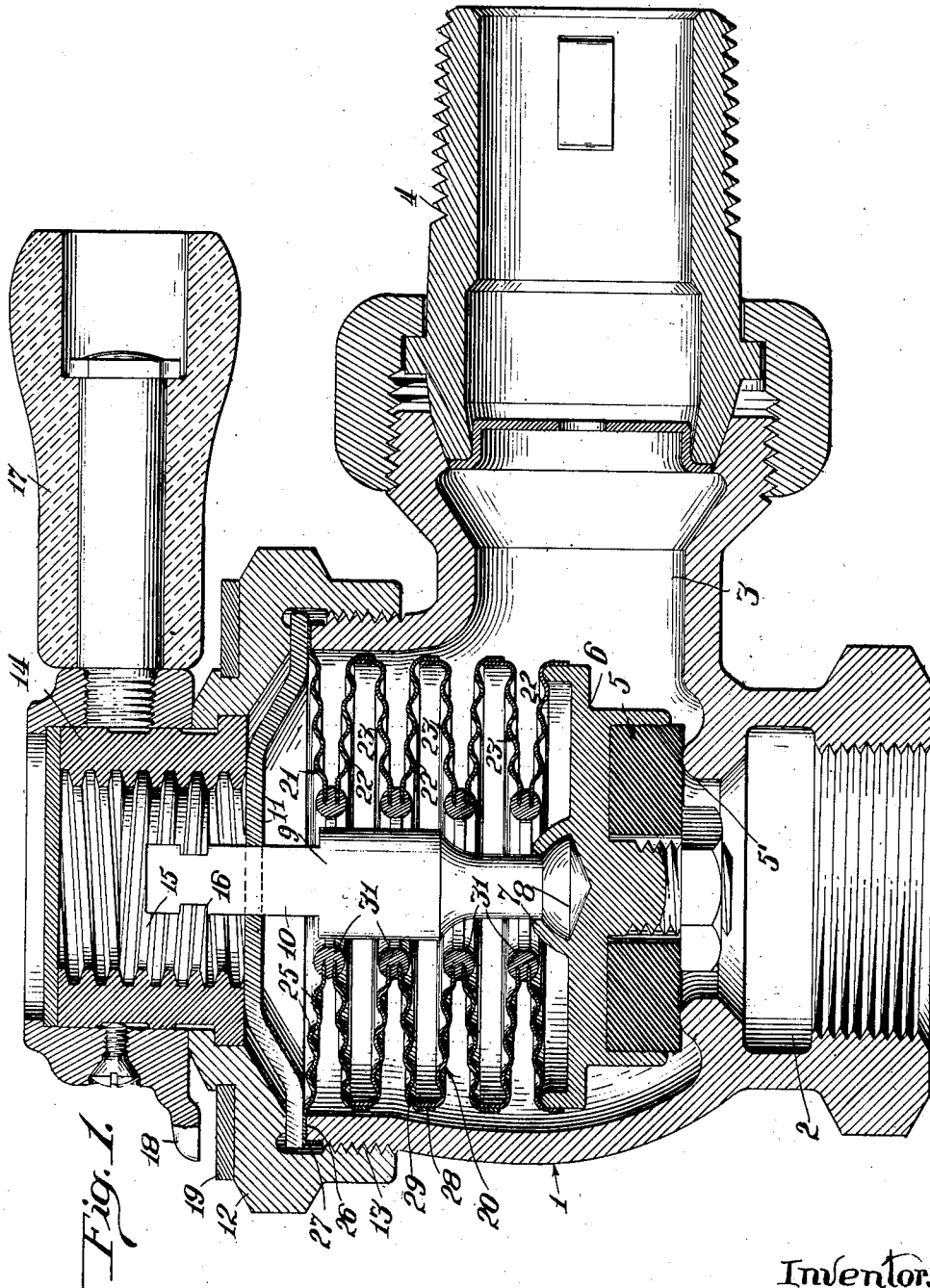
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1,830,780

PACKINGLESS EXPANSION MEMBER

Filed Dec. 9, 1929

3 Sheets-Sheet 1



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Fig. 2.



Fig. 3.

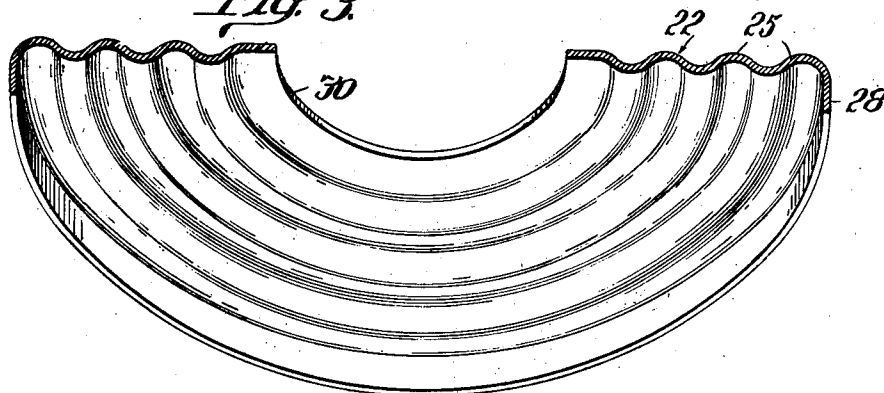
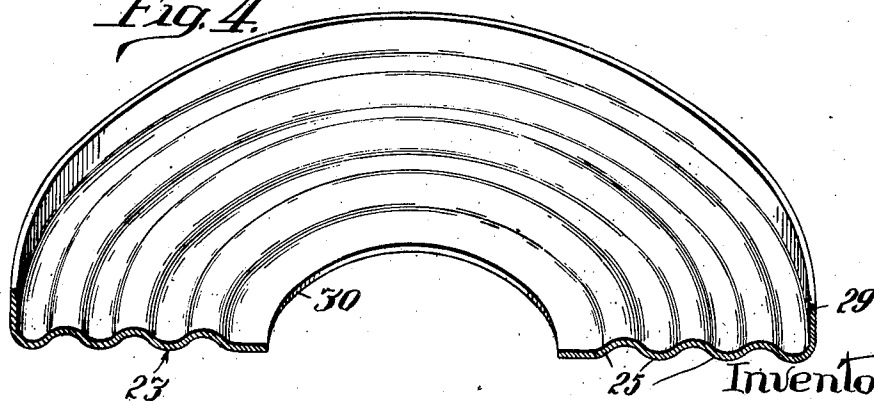


Fig. 4.



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Fig. 5.

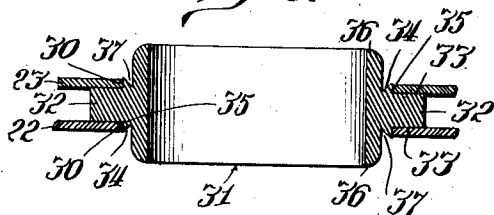


Fig. 6.

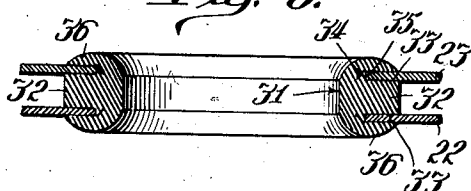


Fig. 8.

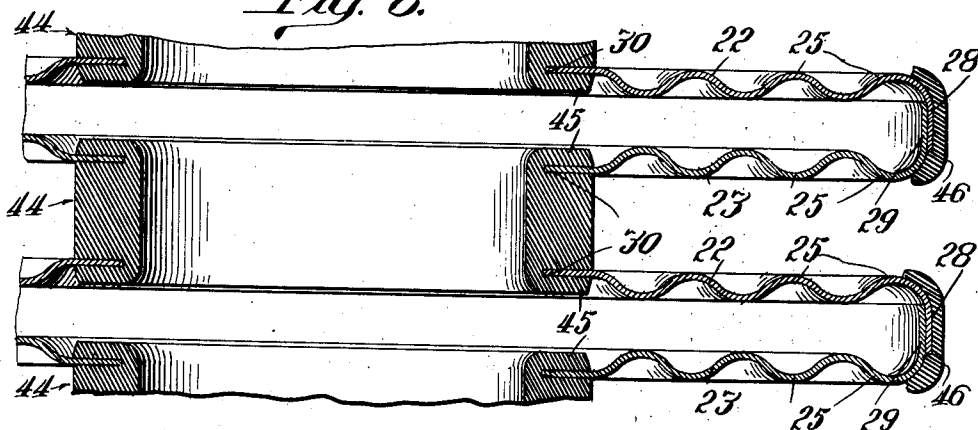
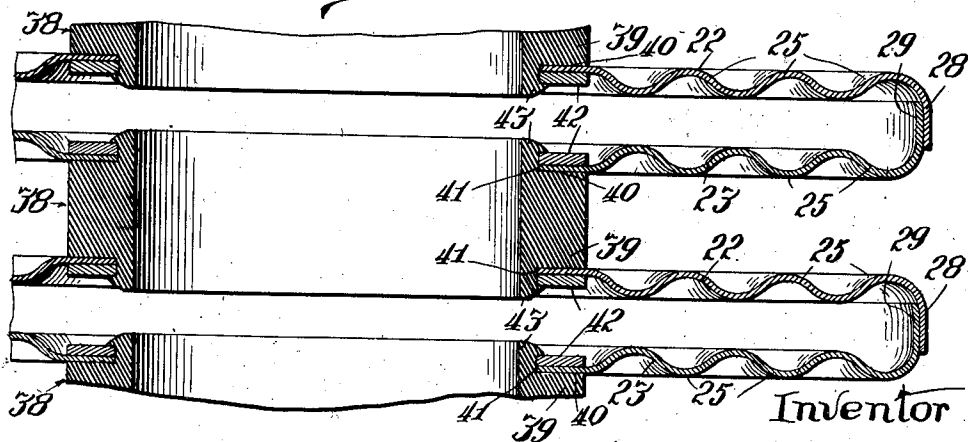


Fig. 7.



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UNITED STATES PATENT OFFICE

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PACKINGLESS EXPANSION MEMBER

Application filed December 9, 1929. Serial No. 412,861.

This invention relates to certain new and useful improvements in expansible metallic diaphragms, adapted for use as imperforate sealing walls between two relatively movable members.

Devices of this character may be formed of a plurality of annular flexible plates of thin metal, which are alternately sealed together at their inner and outer edges so as to form a flexible corrugated tube, the free edges of the plates at the two ends of the series being sealed to the two relatively movable members so as to form a continuous imperforate but extensible wall joining these members. For example, in one of the inlet valves used to control the flow of steam into a radiator of a steam heating system, the movable valve member adapted to close the steam passage within the valve casing may be connected by such a diaphragm with the upper wall of the valve casing so that the movable valve operating mechanism may project down through this tubular sealing diaphragm and be movable from outside the casing, while at the same time a continuous imperforate upper wall is formed for the valve casing in all positions of adjustment of the valve member. While the flexible diaphragm here shown is designed particularly for use in such a valve mechanism it will be apparent that it is capable of other uses where such a sealing device is required.

Flexible diaphragms of this type have been constructed of a single piece of metal formed by rolling so as to secure a bellows-like structure. Such diaphragms are open to the disadvantage that the process of forming thins the metal walls at the edges which take the greatest amount of flexure. It is well known that to secure maximum endurance of a device of this character it is necessary to maintain uniform metal thickness so far as possible. The diaphragms have also been formed of a series of separate annular metal plates, the adjacent inner and outer edges of the series of plates being crimped together or formed with interlocking flanges, but all such constructions serve to weaken the metal at the locations subject to the greatest flexure, so that fracture of the diaphragm is most

apt to occur at these locations after a few cycles of operation owing to the increased intensity of the stresses at these weaker areas. Furthermore, it is usually necessary to use non-ferrous metals for the diaphragm plates in order to avoid oxidation or corrosion when subject to water and its vapors when used in heating systems, and other fluids when used in thermostats or similar constructions. It is often desirable to have temper in these packingless expansion diaphragms, and it is well known that the temper in non-ferrous metals is increased by cold working and is drawn by heating. It is therefore desirable to avoid heating operations in the process of assembling the diaphragm.

According to the present invention the diaphragm is formed by a process which tends to retain the temper in the metal and maintain uniform thicknesses throughout, and reinforce those portions subject to the greatest stresses thereby obtaining greater durability. The invention avoids soldered joints which are subject to bending stresses.

Briefly described, the invention contemplates joining the adjacent edge portions of a pair of the diaphragm plates by employing a metallic ring, preferably of softer metal than the plates, which is rolled over and clamped to flat edge portions of the diaphragm plates, the joints being subsequently tinned or soldered over in order to provide an absolutely tight joint. The connecting ring is so formed and applied that no spreading or buckling stresses will be applied to the diaphragm plates, and the joint will be reinforced and strengthened.

The general object of this invention is to provide a new method of sealing together the component plates of a flexible diaphragm, as briefly set forth hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide an improved form of flexible metallic diaphragm involving new and improved means for sealing together the adjacent edges of the component diaphragm plates.

Another object is to provide an improved form of connecting member for the dia-

phragm plates of a flexible metallic diaphragm.

Another object is to provide an improved packingless sealing device for use in an inlet valve.

Other objects and advantages of this invention will be more apparent from the following detailed description of certain approved forms of apparatus involving the principles of this invention.

In the accompanying drawings:

Fig. 1 is a central longitudinal vertical section through an inlet valve provided with a preferred form of the flexible diaphragm.

Fig. 2 is a sectional perspective view of the upper diaphragm plate.

Figs. 3 and 4 are similar perspective views of the two types of plates used in pairs to complete the flexible diaphragm.

Fig. 5 is a central sectional view illustrating the first step in assembling the connecting ring with a pair of adjacent diaphragm plates.

Fig. 6 is a view similar to Fig. 5 showing the connecting member rolled into engagement with the plates.

Fig. 7 is a central sectional view through a segment of a modified form of diaphragm.

Fig. 8 is a view similar to Fig. 7 showing another modification.

Referring first to Fig. 1, the inlet valve will first be briefly described to illustrate one preferred use for the improved flexible diaphragm. The valve casing 1 is formed with an inlet port 2 adapted to be connected with a pipe leading from the steam supply, and with an outlet port 3 adapted to be connected through nipple 4 with the inlet of a radiator. A movable valve member 5 is adapted to cooperate with a fixed valve seat 5' formed within casing 1 in order to close or open the steam passage through the valve casing. The valve disc 5 is mounted in a holder 6 which is swiveled to the lower end of valve stem 9 by spinning the flange 7 on the holder over the upper portion of the head 8 formed at the lower end of the valve stem. The upper portion 10 of valve stem 9, which is of non-circular cross section, is slidable vertically through a similarly formed opening in the guide plate 11 which is clamped to the upper end of valve casing 1 by means of bonnet 12 screwed at 13 onto the valve casing. An interiorly threaded nut 14 is rotatably mounted in bonnet 12 above the guide plate 11. An exteriorly threaded nut 15 is non-rotatably secured at 16 to the upper end of the valve stem, the nut 15 being threaded within nut 14 so that as nut 14 is rotated the nut 15, and consequently the valve stem and the valve 5 will be raised or lowered in the valve casing. Operating nut 14 is rotated by means of a suitable handle 17, and an indicating finger 18 cooperates with a dial 19 to indicate the adjusted position of the valve.

The flexible tubular metallic diaphragm indicated generally at 20 (with which this invention is particularly concerned) is connected at one end with the movable valve holder 6 and at the other end with the upper edge of valve casing 1 so as to form, together with the valve holder 6, a continuous imperforate wall closing the upper end of the valve casing in all positions of adjustment of the valve member, without interfering with the movements of the valve operating members which project through the upper open end of the valve casing.

The flexible diaphragm comprises a plurality of annular metal plates 21, 22 and 23 (see Figs. 2, 3 and 4), each formed of thin, preferably non-ferrous sheet metal. The flexibility of each plate may be increased by corrugating its intermediate portion as indicated at 25. The upper plate 21 is of somewhat greater outer diameter than the plates 22 and 23, so as to provide a flat horizontal ring portion 26 having a downturned edge 27, the portion 26 being adapted to be clamped between the upper edge of valve casing 1 and the outer edge portion of guide plate 11, as shown in Fig. 1. The other plates 22 and 23 are of generally similar size and conformation with the exception that the plate 22 is provided with a downwardly projecting outer flange 28 whereas the plate 23 is provided with an upwardly projecting flange 29, one of these flanges being of slightly greater diameter than the other so that they will project over one another or overlap as indicated in Fig. 1. The inner edge portions 30 of the several discs are flat and extend radially or substantially parallel to one another, and may all be of the same internal diameter.

Referring now more particularly to Figs. 5 and 6, 31 indicates a sealing ring of relatively soft metal, preferably softer than the metal of which the diaphragm plates are formed. This ring 31 is formed with a central outwardly projecting rib or tongue 32 of annular form adapted to project between two adjacent plates 23 and 22 and having parallel side face portions 33 adapted to contact the adjacent side faces of the edge portions 30 of the plates. At the base of each side of rib 32 is formed a laterally projecting triangular flange 34, approximately as long as the thickness of one of the diaphragm plates, and providing a shoulder 35 against which the inner edge portion of the respective diaphragm plates abut. Rearwardly of the triangular flanges 34, the ring 31 is formed with a pair of laterally projecting side flanges 36 of considerably greater length than the flanges 34 and separated therefrom by the outwardly flaring annular grooves 37.

A pair of the diaphragm plates 23 and 22 are first assembled at the two sides of the connecting ring 31 as shown in Fig. 5. The

flanges 36 are then spun or rolled outwardly against the outer faces of the edge portions of the two plates, as indicated in Fig. 6. This spinning operation is performed cold without the application of heat to either the ring 31 or the diaphragm plates, so as not to disturb the temper in the plates. The joined members are subsequently tinned over or soldered so as to provide a continuous and permanent joint. By providing the annular recesses or grooves 37 behind the shouldered flanges 34, the binding or clamping flanges 36 may be rolled over without applying any material spreading stresses to the inner edges of the diaphragm plates, and since the intermediate rib 32 and the outer flanges 36 are clamped flatwise against the parallel side portions of the inner edges of the discs, there are no forces tending to spread or buckle the discs in any direction. The inner edge portions of the discs are not bent or otherwise weakened, and the connecting ring 31 serves as a reinforcing member tending to strengthen this portion of the diaphragm assembly.

After pairs of the diaphragm plates have been secured together in this manner, the adjacent pairs may be assembled as shown in Fig. 1 and the overlapping outer flanges 28 and 29 soldered together so as to form a continuous corrugated diaphragm. In the example here shown, the improved connecting means is used only at the inner edges of the plates where the greatest bending stresses are exerted, and it will usually be sufficient to secure the outer edges by the simple overlapping joint just described. However, it will be apparent that the same form of connecting device could be applied to the outer edges of the disc by providing a ring similar to ring 31 but having its connecting ribs and flanges directed inwardly instead of outwardly. In such a construction, of course, the outer edge portions of the diaphragm plates would be formed flat and parallel with one another and the overlapping flanges 28 and 29 would be omitted.

A somewhat modified form of connecting ring is shown in Fig. 7, this modification being adapted for use where it is desired to space the flexible plate units a greater distance apart. In this form of the invention the connecting ring 38 is formed with a main rib or body portion 39 which may have any desired length or thickness and which has end faces 40 and rear shoulders 41 adapted to abut the side face and inner edge of one of the diaphragm plates. A metal clamping washer 42 is then placed over the outer face of the edge portion of the disc, and the outwardly extending flange portion 43 of the ring is spun over the outer face of the washer, all as indicated in Fig. 7.

In case the diaphragm plates have sufficient strength so there is no danger of buckling, the washers 42 may be omitted, and the

connecting ring 44 (see Fig. 8) provided with longer laterally extending side flanges 45 which are rolled or spun directly over the outer faces of the respective diaphragm plates.

In Fig. 8 is also illustrated a reinforcing ring 46 of soft metal which may be spun around the overlapped flanges 28 and 29 at the outer edges of a pair of diaphragm plates so as to seal and strengthen this joint. This reinforcing member could be added to any of the forms of diaphragms previously disclosed.

According to this invention we have disclosed a new method and means for joining the edge portions of the component diaphragm plates of a flexible diaphragm without weakening the plates or subjecting them to any undesirable spreading or buckling stresses. The connecting ring is formed of a softer metal than the plates, and its component parts are so separated that when rolled or spun into engagement with the plates no spreading stresses will be applied to the plates. Furthermore, the entire operation is carried out with the parts cold so that the temper in the plates will not be destroyed.

While the improved flexible diaphragm has here been shown by way of example as used in the inlet valve for a steam heating system, it will be apparent that this diaphragm is capable of uses in many other constructions, and this broad application of the invention is intended to be covered by the claims which follow.

We claim:

1. Means for sealing together the adjacent edge portions of two annular sheet metal discs of a flexible diaphragm comprising an annular ring of soft metal having shoulders which abut the edges of the discs and an annular rib intermediate the shoulders which projects between the discs, and laterally projecting side flanges, there being outwardly flared annular grooves between the shoulders and the side flanges, the side flanges being rolled over the shoulders and the outer faces of the edge portions of the discs.

2. An expansible diaphragm comprising a plurality of annular sheet metal discs, and means for sealing together the adjacent inner edge portions of a pair of the discs comprising a metal ring of softer metal having a central annular rib adapted to project between the adjacent sides of the edge portions of the discs, short laterally extending flange portions approximately as long as the thickness of the discs and adapted to abut the inner edges thereof, and longer lateral flange portions adapted to be rolled out over the shorter flanges and clamped against the outer faces of the edge portions of the discs.

3. An expansible diaphragm comprising a plurality of annular sheet metal discs, and means for sealing together the adjacent inner

- edge portions of a pair of the discs comprising a metal ring of softer metal having a central annular rib adapted to project between the adjacent sides of the edge portions of the discs, short laterally extending flange portions approximately as long as the thickness of the discs and adapted to abut the inner edges thereof, and longer lateral flange portions adapted to be rolled out over the shorter flanges and clamped against the outer faces of the edge portions of the discs, there being an annular outwardly flaring groove between the bases of each adjacent pair of long and short flanges to permit the longer flange to be rolled out without exerting radial spreading pressure on the disc. 70
4. An expansible diaphragm comprising a plurality of annular sheet metal discs arranged in pairs, the two discs of each pair having curved laterally extending overlapping flanges at their outer edges, a soft metal inwardly concaved ring clamped around the overlapped flanges and sealed thereto, the inner edge portions of the discs extending radially inward in substantially parallel relation, and means for sealing together the inner edge portions of the adjacent discs of two adjacent pairs comprising an annular soft metal ring having portions clamped over the edge portions of the two discs. 80
5. An expansible diaphragm comprising a plurality of annular sheet metal discs arranged in pairs, the two discs of each pair having laterally extending overlapping flanges at their outer edges, means for sealing these flanges together, the inner edge portions of the discs extending radially inward in substantially parallel relation, and means for sealing together the inner edge portions of the adjacent discs of two adjacent pairs comprising an annular soft metal ring having an outwardly extending portion projecting between the discs, laterally extending shoulders adapted to abut the inner edges of the discs, annular washers positioned on the shoulders outside the discs, and laterally extending flanges on the soft metal ring adapted to be rolled over the outer faces of the washers to clamp them against the discs. 85
6. An expansible diaphragm comprising a plurality of annular sheet metal discs arranged in pairs, the two discs of each pair having laterally extending overlapping flanges at their outer edges, means for sealing these flanges together, the inner edge portions of the discs extending radially inward in substantially parallel relation, and means for sealing together the inner edge portions of the adjacent discs of two adjacent pairs comprising an annular soft metal ring having an outwardly extending portion projecting between the discs, the laterally extending shoulders adapted to abut the inner edges of the discs, and laterally extending flanges adapted to be rolled over the outer faces of the edge portions of the discs, there being outwardly flared annular grooves between the shoulder portions and the ring flanges before the flanges are rolled over to prevent spreading stresses being exerted on the discs during the rolling process. 90
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