June 28, 1966 H. W. AUSTIN ETAL 3,258,010

PROTECTIVE HEADGEAR

Filed June 19, 1963 4 Sheets-Sheet 1

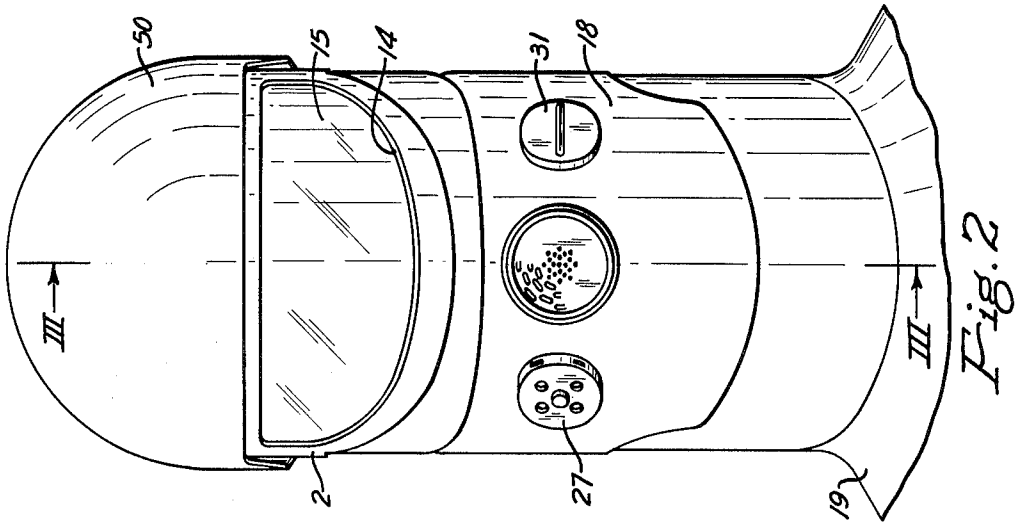

Fig. 2

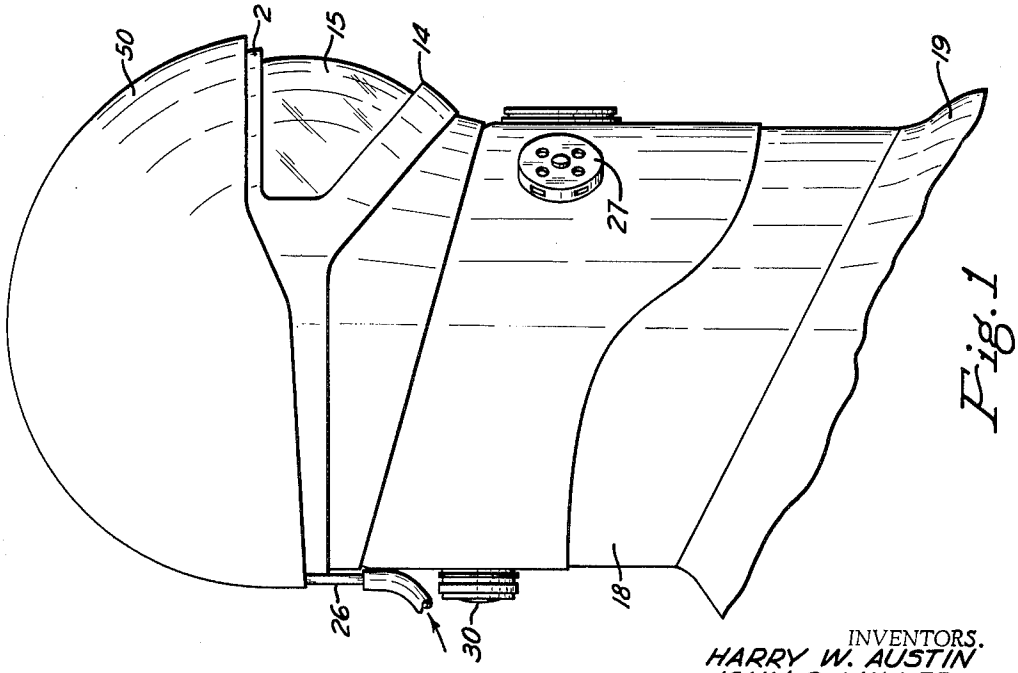

Fig. 1

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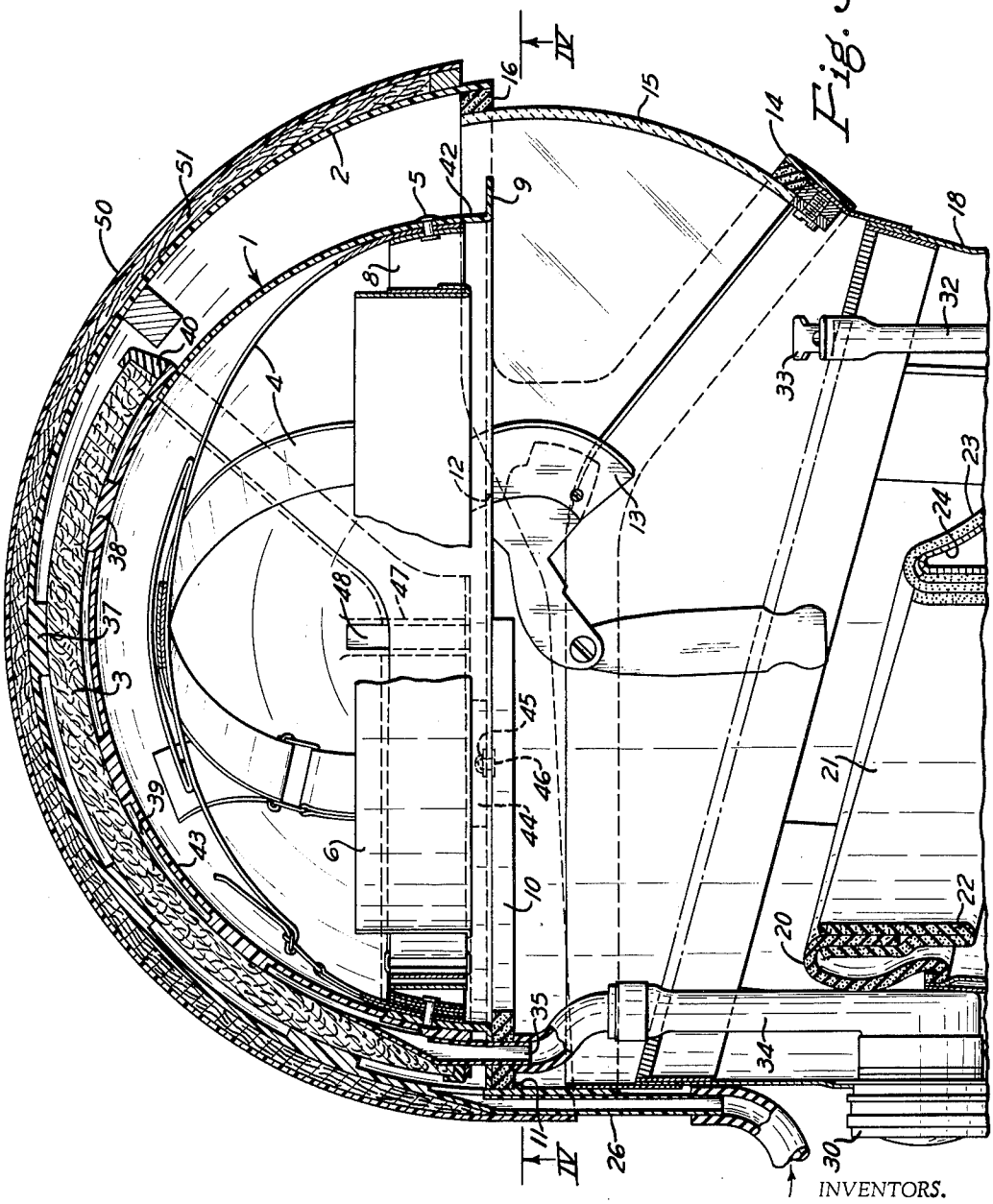
Fig. 3



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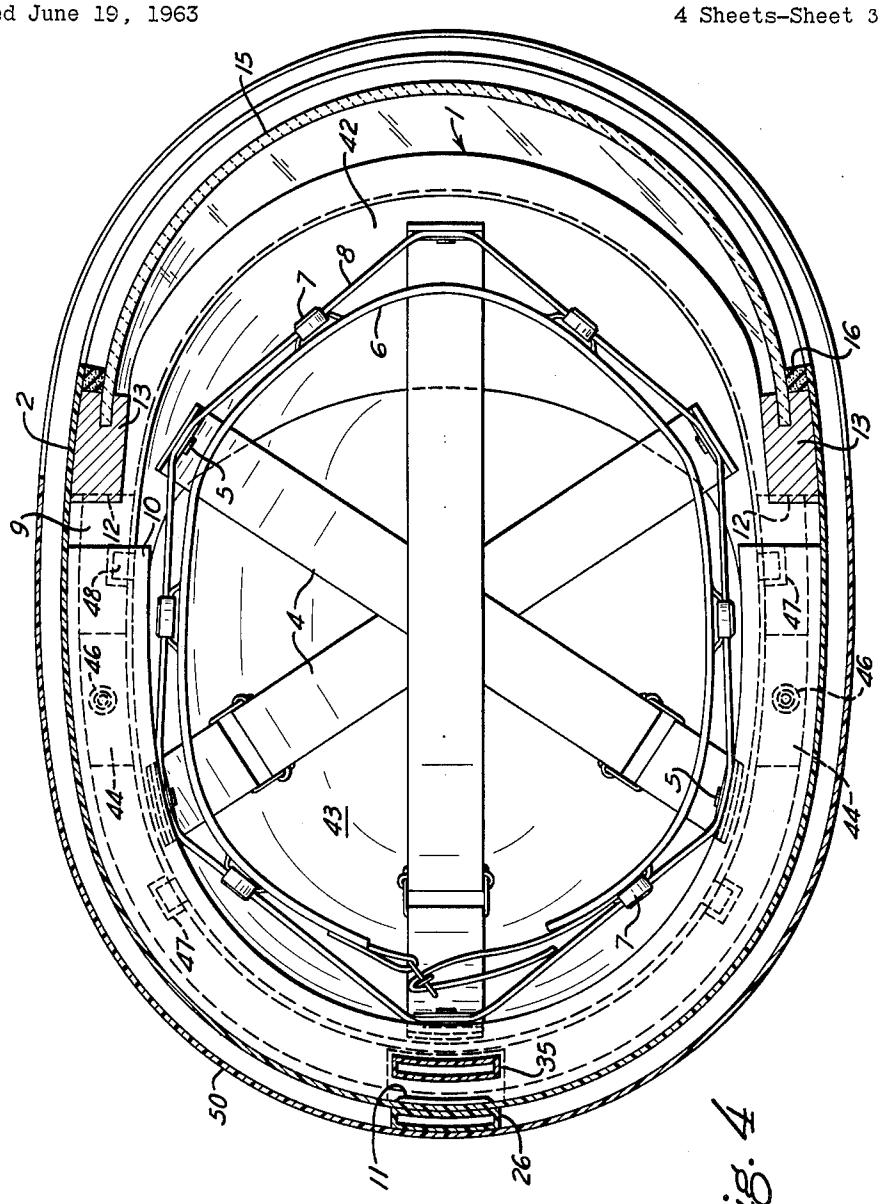

Fig. 4

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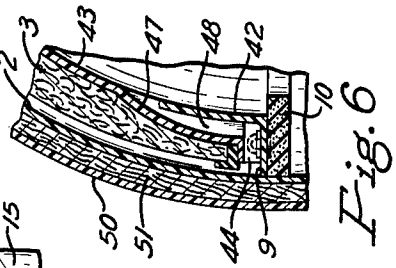

Fig. 6

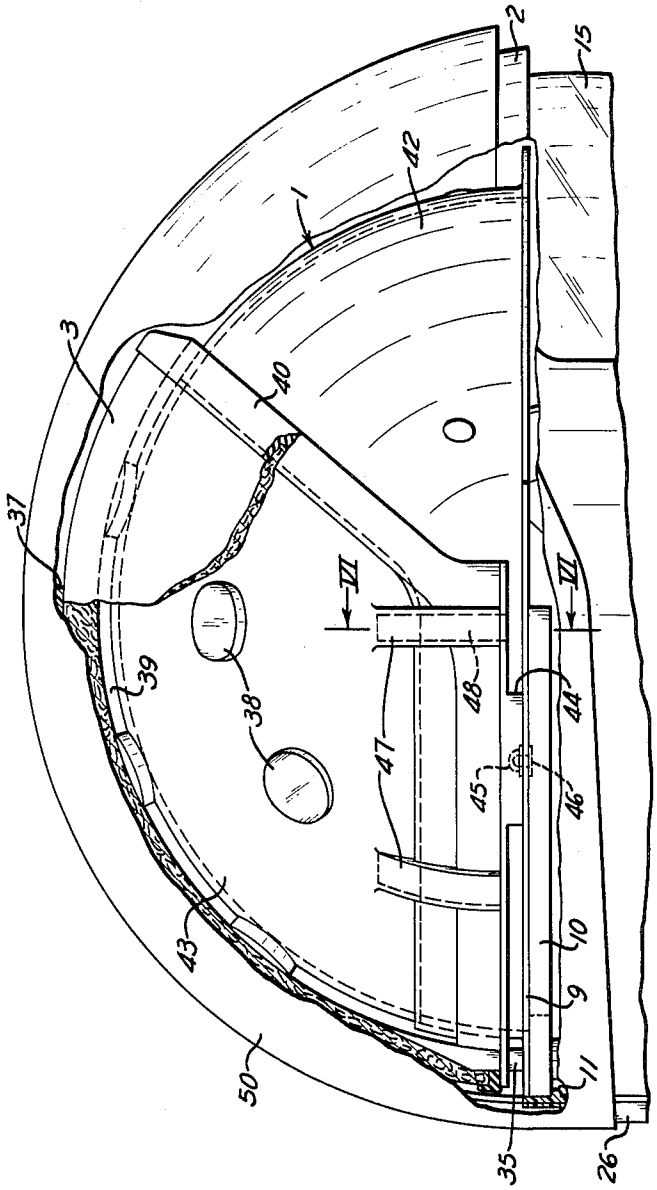

Fig. 5

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United States Patent Office 3,258,010 Patented June 28, 1966

3,258,010

PROTECTIVE HEADGEAR

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Filed June 19, 1963, Ser. No. 289,044
4 Claims. (Cl. 128—141)

This invention relates to protective headgear that encloses the head and face and that is sealed around the neck so that the air that the wearer breathes can be controlled.

In such a case it often is desirable to pump air into the headgear for the wearer to breathe. It is easy to filter the air because a filter can be located near the air supply mechanism. However, if the air supply fails or cannot be used for some reason, the wearer of the headgear must depend on his lungs to draw air into it. This air likewise should be filtered. It also is desirable to be able to protect the head from projectiles and shell fragments, but heretofore this has required a relatively heavy helmet which is tiring to wear.

It is among the objects of this invention to provide headgear which protects the head from projectiles and the like, which contains an emergency air filter, in which the filter can be replaced quickly and easily when necessary, and from which the ballistic part of the helmet can be detached when desired.

In accordance with this invention there is an inner helmet shell for receiving the head and an outer helmet shell covering the inner shell but spaced from it. Disposed between the helmet shells is a filter shell which is spaced from the other shells to form air spaces at its opposite sides. The edge of the air space between the filter shell and one of the helmet shells is sealed to form a closed chamber, to which an air inlet passage is connected for receiving air from the outside of the headgear in order to filter that air before it it inhaled. Preferably, the outer shell is enclosed by a rigid cover shell, in which there as a compressed mat of synthetic nonelastic elongatable fibers to help protect the head from injury by projectiles and metal fragments that may strike the helmet.

The preferred embodiment of the invention in illustrated in the accompanying drawings, in which

FIG. 1 is a side view of the headgear connected with a protective suit;

FIG. 2 is a front view thereof;

FIG. 3 is an enlarged vertical section of the helmet taken on the line III—III of FIG. 2;

FIG. 4 is a horizontal section looking upwardly along the line IV—IV of FIG. 3;

FIG. 5 is a fragmentary side view of the helmet with parts broken away; and

FIG. 6 is a fragmentary vertical section taken on the line VI—VI of FIG. 5.

Referring to FIGS. 3, 4 and 5 of the drawings, the basic headgear is formed from three nesting shells, an inner helmet shell **1** that fits over the head, an outer helmet shell **2** that covers the inner shell but is spaced from it, and a filter shell **3** disposed between the two helmet shells. The inner shell, which may be made from any suitable strong but lightweight material, contains an adjustable suspension unit that fits over the head and holds that shell away from the head. The suspension unit may be formed from a cradle of straps **4** attached at their lower ends to the lower part of the shell by rivets **5**, and from a headband **6** supported by clips **7** from a surrounding suspension band **8** also held by the rivets. The bottom of the shell is surrounded by an integral flange **9**, the rear half of which is wider than the front portion.

The outer shell **2** is engaged by the outer edge of the rear half of flange **9**, to the bottom of which a sealing strip **10** may be glued for tight frictional engagement with the outer shell. To connect the inner and outer shells together, the outer shell is provided inside with a rib **11** at its back for engaging the overlying sealing strip, while the front portions of the wide part of flange **9** project into horizontal notches **12** in the backs of blocks **13** secured to the inside of the outer shell. The two shells will flex enough during assembly to permit the inner one to be snapped into the outer one. It is the engagement of the outer shell with flange **9** that limits the distance that the outer shell can be moved down on the inner shell so that a space will left between them. The outer shell extends below the inner one to cover the ears and to form in front of the eyes and nose a large window opening **14** that normally is closed by a horizontally curved transparent vizor **15**, which is supported by the outer shell and can be swung up between the inner and outer shells when it is desired to open the window. The opposite ends of the vizor may be mounted in blocks **13**. The marginal portion of the window in its closed position engages a gasket **16** surrounding the window opening.

Suspended from the lower edge of the outer shell is a flexible neck enclosure, which includes a gas-impervious fabric sleeve **18** that has a lower end adapted to be detachably connected to the top of a protective suit **19** as shown in FIGS. 1 and 2. The upper and lower ends of the sleeve are separated by a flexible collar member **20** provided with a neck-receiving opening **21** that has a soft elastic collar band **22** extending vertically from it for snugly fitting around the neck of the wearer. The outer edge of the collar member is joined throughout its length to the inside of the sleeve. This collar member forms a partition that extends across the sleeve, except for the neck opening which is closed by the neck of the wearer, and the collar member therefore seals off the upper part of the sleeve from the lower part so that the wearer's head is enclosed in air-tight headgear while the vizor is down. The front of the collar band and the portion of the collar member in front of it are provided with a placket **23** which, together with the neck opening **21**, forms a large enough opening for the head of the wearer to pass through after the placket has been opened by operating its gas-tight fastener, preferably a zipper **24**.

This headgear is intended to be used with a positive pressure air system, such as a back pack (not shown) carried by the wearer, which filters air for breathing and pumps it into the headgear, preferably through an inlet duct **26** connected with an opening in the back of the outer shell. To maintain a pressure inside the headgear of about one inch of water, the exhalation valve **27** (FIGS. 1 and 2) that is mounted in the front part of sleeve **18** above collar member **20** is loaded to that pressure. The incoming air flows forward around inner shell **1** above flange **9** and sweeps across the inner surface of the vizor to prevent it from fogging.

It is a feature of this invention that in case the positive pressure breathing system fails, an emergency system is provided, by which the wearer of the headgear can supply himself with filtered air for a considerable period of time. For this purpose the sleeve **18** is provided above the collar member, preferably near the back, with an inlet valve **30** for air. The front part of the sleeve contains a second exhalation valve **31**, provided inside the sleeve with a flexible exhalation tube **32** having a mouth piece **33**. When not in use, the tube is folded to get it out of the way and to shut off the valve. As the air entering through the inlet valve will be unfiltered, filter shell **3** is used for filtering it before it can be breathed. Accordingly, as shown in FIG. 3, the inlet valve is connected by

a flexible tube 34 with the lower end of an inlet duct 35 extending up through sealing strip 11 and flange 9 into the space between the inner and outer shells where the filter is located. The filter shell is curved to fit over the inner shell and may be made of any suitable material, such as polystyrene or a mat of fibers.

To expose both sides of the filter shell, it is spaced from the two helmet shells. This can be done by projections on the filter itself, or, as shown, by a number of small integral projections 37 and 38 on the adjacent surfaces of the two helmet shells. The edge of the space thus formed between the filter shell and one of the helmet shells, most suitably the inner shell, is sealed in order to form a closed chamber 39 for receiving unfiltered air from inlet duct 35. Sealing of the edge of the filter shell and of chamber 39 may be done by a gasket 40 of rubber or other plastic material, which also seals and bonds the filter shell to the inner shell. Air from chamber 39 flows out through the filter into the space between the filter shell and the outer helmet shell and then flows down past the front half of flange 9 to the face of the wearer. When the back pack is inoperative, the emergency system functions automatically by lung power to allow outside air to enter through the inhalation check valve 30. Expired air is exhaled through exhalation valve tube 32 and valve 31.

Preferably, the inner shell is formed in two parts from a head-encircling base portion 42 and a removable crown portion 43 behind the upper position of the vizor. The filter shell is secured only to the crown portion. The suspension unit is attached to the base portion. The crown portion has an outwardly offset marginal area that overlaps the upper edge of the base portion and is spaced from flange 9 by bosses 44 provided with sockets 45 receiving snap fastener studs 46 mounted in the flange. Since the filter shell and the crown portion of the inner shell are permanently joined together, they form an easily replaceable filter unit. To help ventilate the inner shell in order to keep the head cool, crown portion 43 may be provided with outwardly offset portions 47 extending upwardly from its lower edge to points a short distance above the upper edge of base portion 42 to form vertical channels 48, through which filtered air from outside the filter shell can flow up into the inner helmet shell.

This headgear can also be adapted for ballistic protection by applying to the outer helmet shell a rigid cover shell 50 lined with a compressed layer or mat 51 of synthetic plastic fibers. Suitable fibers are polymer fibers that have a high tensile strength and are capable of non-elastic elongation, such as nylon, polyesters, polyvinylidene chloride and acrylics. Fibers from about three to five inches long are recommended. The outer helmet shell and the cover shell should be very light weight, but tough even under high loading rates so that they will not shatter. Metals and polycarbonates are suitable materials, polycarbonates being preferred because they provide the most protection with the least weight. The tough cover shell will deflect glancing objects, but if penetrated it will absorb energy and slow down the object. The mat will act like a net to catch and further retard the projectile because the fibers will absorb energy in being stretched. The cover shell and its fibrous lining fit the outer helmet shell well enough to stay in place, but can be easily removed if ballistic protection is not necessary.

We claim:

1. In headgear for enclosing the head and face, an inner helmet shell for receiving the head and having a head-encircling base portion and a removable crown portion, a suspension unit mounted inside said shell and connected to said base portion for supporting the shell on the head, an outer helmet shell containing the inner shell but spaced threfrom, a permeable filter shell disposed within the space between the hemet shells, means spacing the filter shell from both helmet shells to form air spaces at opposite sides of the filter shell, and means sealing the edge of the air space between the filter shell and said removable crown portion to form a closed chamber between the filter shell and inner shell, the helmet being provided with an air inlet passage connected with said chamber for delivering air thereto for filtration through said filter shell into the other of said air spaces.

2. In headgear according to claim 1, said filter shell being secured to said crown portion by said sealing means.

3. In headgear according to claim 1, means closing the space between the bottom of the rear half of the inner helmet shell and the outer helmet shell, and said inner shell being provided above said space-closing means with ventilation passages leading into the lower part of the inner shell from the space between the filter shell and the outer helmet shell.

4. In headgear according to claim 1, the inner helmet shell having a bottom flange engaging the outer shell around the rear half of the inner shell, and means holding the helmet shells in fixed relation to each other, said inlet passage being formed by a tubular member extending from said chamber down through said flange at the back of the shells.

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