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T. G. LAGERSTROM, ET AL  
SAFE AND ARM EJECTION SYSTEM

3,451,306

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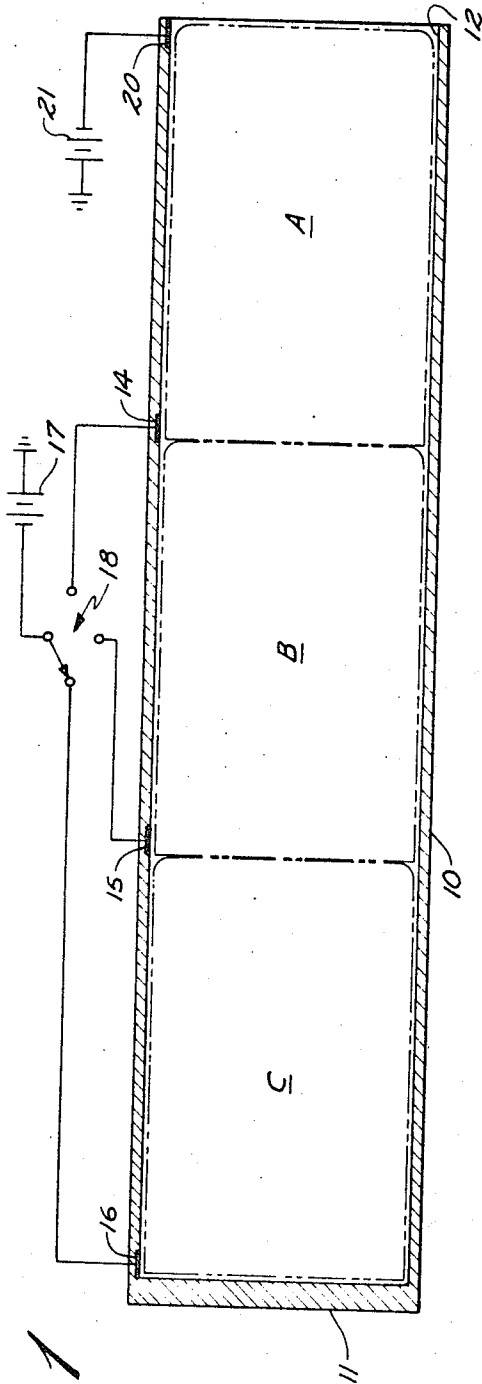
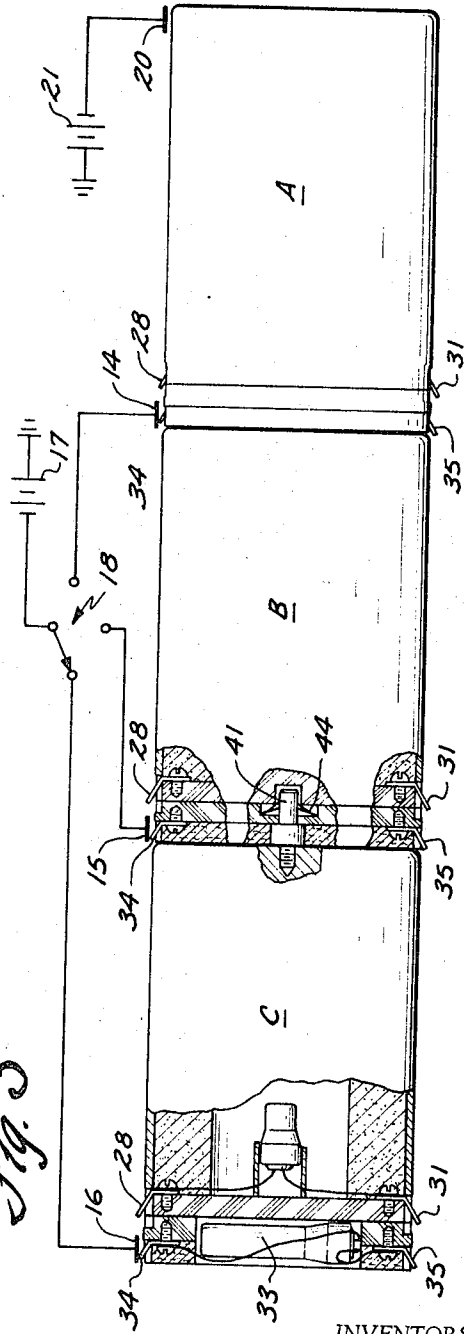


Fig. 3



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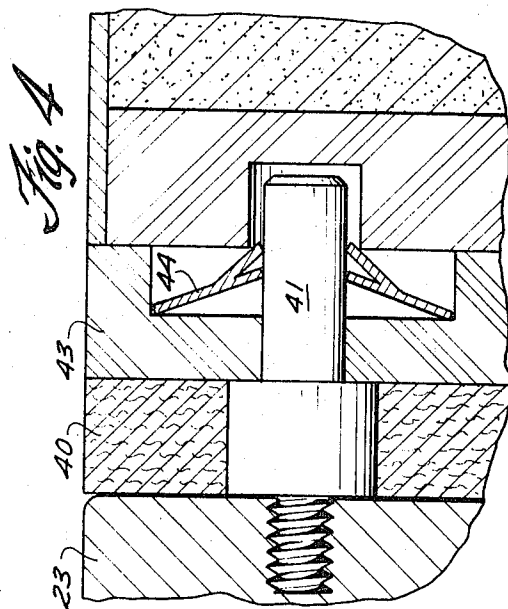
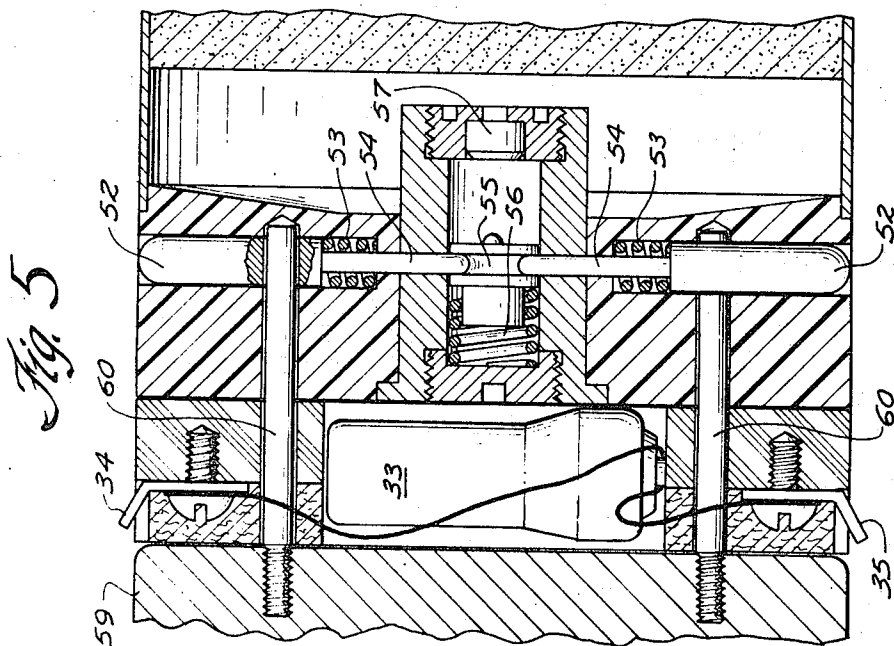
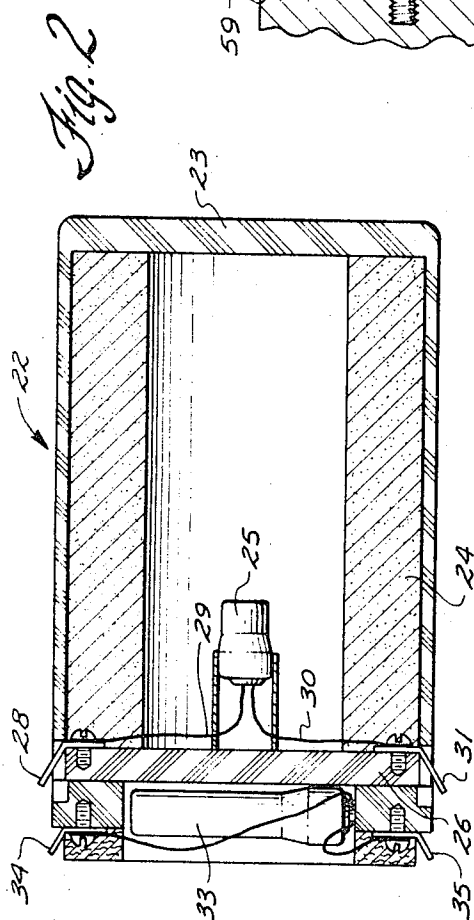
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## SAFE AND ARM EJECTION SYSTEM

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12 Claims

### ABSTRACT OF THE DISCLOSURE

A safe and arm ejection system for aircraft-carried, tube-launched items. Each tube load consists of a plurality of items releasably attached together to facilitate handling and loading. Rearward of each item is an electrically fired ejection device. A single item or a selected number, including all, can be ejected from the tube by firing the ejector of the rearmost item of those which are to be launched. As the selected items are launched, the unfired ejectors are fired as they leave the tube, thus positively separating the items. The items are armed as they are launched by a power supply contact in the case of electrically armed items and by bore-riding pins in the case of mechanically armed items. In addition, the bore-riding pins are held in the safe position by the mechanism which interlocks the items so the items cannot arm until adjacent items are separated.

### BACKGROUND OF THE INVENTION

*Field.*—This invention relates generally to an ejection system for ordnance items and more particularly to an ejection system which includes means for safing and arming the ordnance item.

Ordnance items such as bombs, flares and sonobuoys are commonly carried in groups in launchers suspended beneath the wings of aircraft. A preferred way to carry such items is in a launch tube which holds a plurality of ordnance items and ejects them individually or in groups. For safety's sake, it is desirable to keep the ordnance items in an unarmed condition until they have separated from the aircraft.

*Prior art.*—There are many safe and arm systems now in use, but all have disadvantages, the chief one being that they are complicated and expensive. For example, many systems require that the pilot of the aircraft arm the ordnance by means of mechanical linkages. This is not desirable because of the complications that such linkage adds to the structure of the aircraft, plus the high probability of malfunction, especially if the aircraft is being fired upon. In other systems the ordnance is partially armed before being loaded into the launch tubes, and requires certain movements to complete the arming. This arrangement is obviously less than desirable.

### SUMMARY OF THE INVENTION

The instant invention provides a safe and arm system for tube-launched ordnance items. The ordnance can be electrically or mechanically armed or activated. Briefly stated, this system comprises a launch tube, a plurality of ordnance items, an ejection system and an arming system. Each load of ordnance items consists of a "stack" composed of a plurality of the items releasably attached together to facilitate handling and loading. Rearward of each ordnance item is an ejection device which is electrically actuated through means carried by the launch tube. A single item or a selected number of items, up to and including the entire load, can be ejected from the launch tube at one time. Electrically armed ordnance items are armed by application of electrical power as

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they leave the launch tube, while mechanically armed items include bore-riding pins which allow arming only upon ejection from the tube. In addition, in the mechanically armed embodiment, adjacent ordnance items are interlocked with connector pins to hold them together and to lock the bore-riding pins in the safe position until separation.

The primary object of this invention is to provide a safe and arm system for tube-launched ordnance items.

Another object of this invention is to provide ordnance items which are kept unarmed until launch.

Still another object of this invention is to provide ordnance items which can be easily and safely handled.

Other objects, advantages and novel features of this invention will become apparent from the following detailed description when considered in conjunction with the accompanying drawings.

### THE DRAWINGS

FIGURE 1 is a side elevation, in cross section, of a launch tube constructed in accordance with the present invention, a load of ordnance items being shown in phantom;

FIGURE 2 is a side elevation, in cross section, of an electrically armed ordnance item in accordance with the present invention;

FIGURE 3 shows a plurality of the ordnance items of FIGURE 2 assembled as a single tube load; the electrical system mounted in the launch tube being shown for illustration;

FIGURE 4 is a showing, in cross section, of the means for coupling together a plurality of the items of FIGURE 2; and

FIGURE 5 is a showing, in cross section, of the operating mechanism of a mechanically armed ordnance item constructed in accordance with this invention.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

#### Launcher

The launcher is shown in FIGURE 1 and consists of a cylindrical launch tube 10 having a closure 11 at its aft end and a launch port 12 at its forward end. For exemplary purposes only, the launcher is shown and described in conjunction with a load of three ordnance items. Obviously, however, it could be designed for more or less than three. Inasmuch as the ordnance items are ejected from the launch tube by means such as ejection gasifiers or squibs, cold gas propellant, springs, or the like, the launch tube contains the hardware necessary to activate such ejection means. This system advantageously comprises a plurality of electrical contacts 14, 15 and 16 positioned in the inside of launch tube 10 to activate each of the ejectors, one of which is associated with each ordnance item, by the application of electrical power. Contacts 14, 15 and 16 are connected to an electrical power source 17 through a selector switch 18. A fourth electrical contact 20, in communication with an electrical power source 21, is located in the mouth of launch port 12 in such a position as to engage and activate each ejection device as it passes through. The operation of this mechanism and its importance to the system will be explained below.

Launch tube 10 can be carried beneath the wing of an aircraft, with launch port 12 facing opposite to the direction of flight so that a minimum amount of force is needed to eject the ordnance items. However, the details and mounting on the aircraft and its interrelationship with the aircraft, or with any other vehicle, forms no part of this invention.

*Electrically armed ordnance item*

FIGURE 2 shows, partially in cross section, an electrically armed ordnance item 22 constructed in accordance with the present invention. This item can be a bomb, flare, sonobuoy, depth charge or the like, the invention not being restricted to any particular type of ordnance. Ordnance item 22 comprises a casing 23 of outside diameter approximately equal to the inside diameter of launch tube 10. Casing 23 encloses and holds the payload 24 and its electrically operated arming or actuating means 25. Mounted near the rear closure 26 of casing 23 is a spring contact 28 which is in electrical communication with arming or activating means 25 through a lead wire 29. Also shown are grounding wire 30 and contact 31, to complete the electrical circuit through arming means 25. Rearward of closure 26 and attached thereto is an electrically fired jettisoning charge 33, which has a spring-loaded electrical contact 34 and a grounding contact 35.

A load for the launch tube 10 consists of a plurality of identical items. These items 22 are attached together for easy, safe handling and for ease of loading into the launch tube. A load of three identical electrically armed ordnance items is shown in FIGURE 3, the electrical system mounted in launch tube 10 being shown for illustration. Each of the electrical contacts 34 of the jettisoning means 33 of item 22 is in electrical communication with one of contacts 14, 15 or 16 which are mounted in tube 10 as shown also in FIGURE 1. Selective application of electrical power to one of the ejecting means 33 will cause all of the ordnance items between it and launch port 12 to be ejected. Thus, it is possible to eject all of the items in the launch tube by firing one ejection charge.

As before stated, it is advantageous to construct a "stack" of ordnance items 22 which are releasably attached together. This can be accomplished by providing a series of connector elements on the forward end of each item, the details of one such system being shown in FIGURE 4. A connector element 40 is attached to the forward end of each of the items 22. This element 40 carries connecting studs 41 which protrude forward. The rear portion of each of the items 22 includes a connector element 43 with spring-loaded fasteners 44 which are engaged by studs 41 to hold adjacent units together. In addition, rear closure 11 of launch tube 10 also carries a connector element and associated studs, and this unit, not shown, engages the rearmost of the ordnance items when the stack is inserted into the launch tube. In addition to securing the load of items in the tube, this arrangement will cause proper alignment of the electrical contacts on the ordnance items with those mounted in the tube.

*Mechanically armed ordnance item*

The launch tube of FIGURE 1 can also be used with a load of ordnance items which are mechanically armed or activated. These mechanical items are similar to the electrical ones pictured in FIGURES 2 and 3 except for the fact that the arming or activating means is mechanically operated and the connector mechanism is more sophisticated. FIGURE 5 shows in detail the system for safing and arming a mechanically activated item, as well as the connection and interrelationship between adjacent items. The mechanical items each have a rear portion which includes an electrically activated ejection means 33, with associated power contact 34 and grounding contact 35. The mechanical arming or activating means comprises a plurality of bore-riding pins 52 which are biased outward by springs 53. By means of rods 54, these bore-riding pins 52 engage firing pin or trigger 55 and restrain it from movement. This condition exists when pins 52 are in their inward position, as held by the bore of launch tube 10, for example, and firing pin 55 is engaged while in its rearward position, although biased forward by spring 56. Movement of pins 52 outward unlocks firing pin 55 so that it will strike element 57 to arm or activate the ordnance item.

Obviously, bore-riding pins 52 will be held in their inward

position and thus firing pin 55 held in a disarmed position when they are cammed by contact with the bore of launch tube 10. In order to hold pins 52 in this inward position when the stack of items is outside of the launch tube, a unique interaction between adjacent ordnance items is presented by this invention. As shown in FIGURE 5, mounted on the forward end 59 of each ordnance item are a plurality of connector pins 60. These connector pins 60 protrude through the rear portion of the forward ordnance item to engage bore-riding pins 52 and lock them in the inward position. This can most advantageously be accomplished by providing a hole through each of pins 52, the respective connector pins 60 fitting into the hole. Thus, the bore-riding pins are held in the inward position even when not engaging the launch tube, and the ordnance items, once assembled in an interengaging stack, are kept in a disarmed condition. The bore-riding pins of the rearmost ordnance item are engaged by connector pins mounted on a plate, not shown, which then becomes a part of the ordnance load. In order to align contacts 34 of the ordnance ejecting means with power contacts 14, 15 and 16 in the tube, the rear plate in the ordnance stack can have openings to receive alignment pins mounted in the tube, in the same manner as the electrically triggered items.

## OPERATION

This system provides means for singular or plural launching of both electrically and mechanically armed ordnance items. Each item has an ejecting means associated with it. This can, for example, be an electrically fired explosive squib. Referring now to FIGURE 1, by means of switch 18 electrical power can be supplied to any one of power contacts 14, 15 and 16. If power were applied to contact 14, the squib rearward of ordnance item A would fire, and item A would be ejected through port 12. Application of electrical power to contact 15 will cause the squib associated with item B to fire, and both items forward of it, A and B, will be ejected. Similarly, exploding the rearmost squib, that behind item C, results in all three items being ejected. The ejection of the mechanically armed items is accomplished in an identical manner.

In the case of both types of ordnance, a plurality of items are releasably attached together to form a single tube load. Separation is accomplished by firing each of the previously unfired ejection squibs as it passes through the launch port 12. Power is applied to contact 20, mounted in the mouth of launch port 12. As each of ordnance items passes through launch port 12, the squib firing contact 34 will momentarily touch power contact 20, thus firing the unexploded ejection squibs 33 and causing separation of the ordnance.

The firing of each ejection squib as the ordnance items leave the launch tube is extremely important in the case of the mechanically armed items, for these items cannot be armed unless adjacent items are separated, thus removing locking pins 60 from engagement with bore-riding pins 52, allowing the latter to move outward to release the firing pin 55. If pins 60 are withdrawn while the items are still in the launch tube, the bore-riding pins 52 will cam on the inside of the launch tube; still holding firing pin 55 in the unarmed position until the ordnance item leaves the tube. This invention thus provides a double safing feature which is very important, for it positively precludes arming of the ordnance item while it is still in the launch tube.

Electrically activated ordnance items are armed by means of power contact 20 as they are expelled from the launcher. Arming contact 28 is positioned in the rearmost portion of the ordnance item and, along with squib contact 34, touches power contact 20 as the ordnance item leaves the launch tube, thus setting in operation the arming or activating mechanism at the last possible moment. Such arrangement holds to an absolute minimum the chances of an electrically activated item being armed while still in the launch tube.

The instant invention, therefore, presents an entirely

new concept for launcher and ordnance item design and interrelationship. Both electrically armed and mechanically armed ordnance items can be used with the launcher. The chances of an item becoming armed while in the launch tube are held to a minimum. In addition, the ordnance items are easily handled and are kept in an unarmed condition by being interlocked. Many modifications and variations of the invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

We claim:

1. A launching system for ordnance items, comprising: a launch tube having a launch port at one end thereof, and a plurality of ordnance items adapted to be longitudinally aligned within said launch tube and to be ejected through said launch port, each of said ordnance items being releasably coupled to an adjacent ordnance item and each having ejection means mounted on the end thereof remote from said launch port, said launch tube comprising means adapted to activate a selected one of said ejection means to eject all of said ordnance items positioned between said selected ejection means and said launch port, and means adapted to activate said ejection means of each of said ejected ordnance items as they pass outwardly through said launch port to effect uncoupling of said ejected ordnance items.
2. The launching system of claim 1 wherein each of said ordnance items comprises arming means, and said launch tube comprises means for activating said arming means of each ordnance item as it passes outwardly through said launch port.
3. The launching system of claim 2 wherein said arming means comprises an electrically operated arming device, and electrical power-receiving means mounted externally on each ordnance item and being electrically connected to said arming device; and wherein said arming device activating means comprises power-supply means mounted on said launch tube adjacent said launch port and being so positioned as to contact said power-receiving means as said ordnance items pass outwardly through said launch port.
4. The launching system of claim 1 wherein each of said ordnance items includes arming means comprising an arming trigger movable between a safe position and an armed position, means for biasing said trigger toward said armed position, and means for releasably locking said arming trigger in said safe position, said locking means being cammed to a locking position by said launch tube and being biased toward an unlocking position, whereby upon ejection of said ordnance items from said launch tube, said locking means ceases to be cammed by said tube and is moved to said unlocking position, thereby enabling said arming trigger to be moved to said armed position.
5. The launching system of claim 4 wherein said locking means comprises a pin movable between an inner locking position and an outer unlocking position, spring means for biasing said pin toward said outer position, said pin being adapted to be cammed by said launch tube to said inner position, said pin engaging said trigger when in said inner position to lock it in said safe position, and being out of engagement with said trigger when in said outer position.

6. The launching system of claim 5 wherein each of said ordnance items comprises a connector mounted thereon and engaging said pin of an adjacent ordnance item to prevent movement of said pin to said outer unlocking position, whereby when each ordnance item and the adjacent ordnance item are separated, said connector is disengaged from said pin to enable movement of said pin to said outer position.

7. The launching system of claim 1 wherein each of said ordnance items comprises movable arming means, and wherein said ordnance items are releasably coupled by a connector on each ordnance item in engagement with said arming means of an adjacent ordnance item to prevent arming movement of the arming means of said adjacent ordnance item.

8. The launching system of claim 1 wherein said ejection means comprises an electrical actuated gas generator.

9. A launching system for ordnance items, comprising:

a launch tube having a launch port at one end thereof, and

a plurality of ordnance items adapted to be longitudinally aligned and releasably coupled within said launch tube and to be ejected through said launch port, each of said ordnance items comprising

a casing,

a payload in said casing,

means for activating said payload, said means comprising an arming member movable on each ordnance item between a safe position and an armed position, and a locking member in releasable engagement with the arming member of an adjacent ordnance item to retain said adjacent arming member in said safe position while said ordnance items are coupled.

10. The launching system of claim 9 wherein said arming member comprises a pin movably mounted on each ordnance item and being movable between an inner safe position and an outer armed position, said pin being biased toward said outer position by spring means and being adapted to be cammed to said inner position by engagement with said launch tube.

11. The launching system of claim 10 wherein said locking member comprises a connector on each ordnance item in releasable engagement with the pin of an adjacent ordnance item to lock said adjacent pin in said inner safe position.

12. The launching system of claim 9 further comprising means for uncoupling said ordnance items as they are ejected through said launch port to effect release of the locking member of each ejected ordnance item.

#### References Cited

##### UNITED STATES PATENTS

193,885	8/1877	Davis	102—40
1,917,813	7/1933	Ruhlemann	89—1
2,381,332	8/1945	Boldt	89—1.5
2,402,391	6/1946	Goddard	89—1.5
2,960,037	11/1960	Raech et al.	102—76
2,981,192	4/1961	Grandy	102—78
3,139,795	7/1964	Altschuler	89—1.818

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