NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF: GP

October 15, 1970

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General
Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned
U.S. Patents in STAR

In accordance with the procedures contained in the Code GP to Code USI memorandum on this subject, dated June 8, 1970, the attached NASA-owned U.S. patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,263,610

Corporate Source : Langley Research Center

Supplementary
Corporate Source :

NASA Patent Case No.: XLA-01141

Gayle Parker

Enclosure:
Copy of Patent

15

Aug. 2, 1966 K. F. RUBERT 3,263,610

QUICK-RELEASE CONNECTOR

Filed March 20, 1964 3 Sheets-Sheet 1

FIG. 1

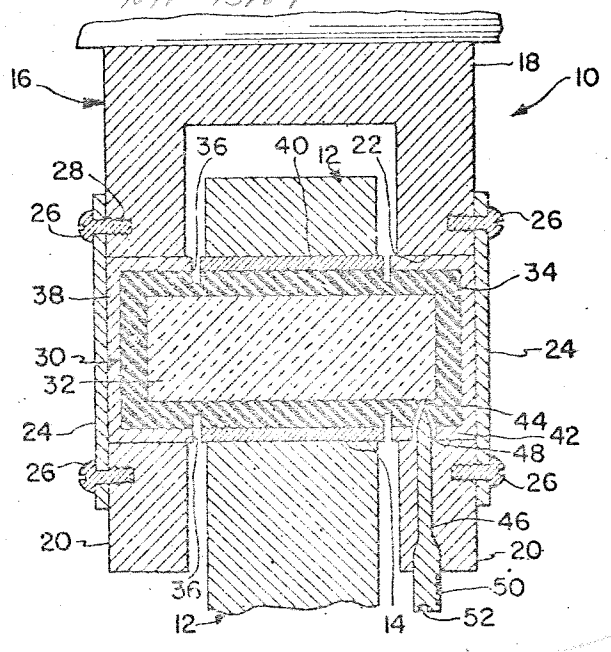
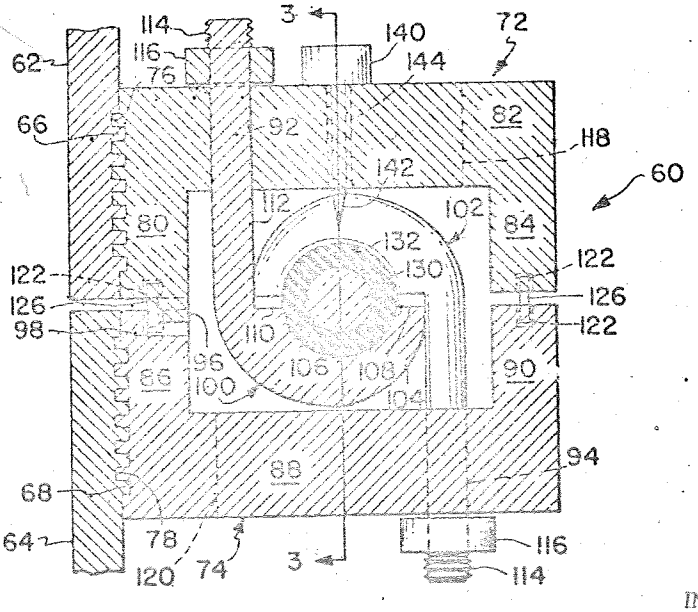


FIG. 2



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Aug. 2, 1966 K. F. RUBERT 3,263,610

QUICK-RELEASE CONNECTOR

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FIG. 3

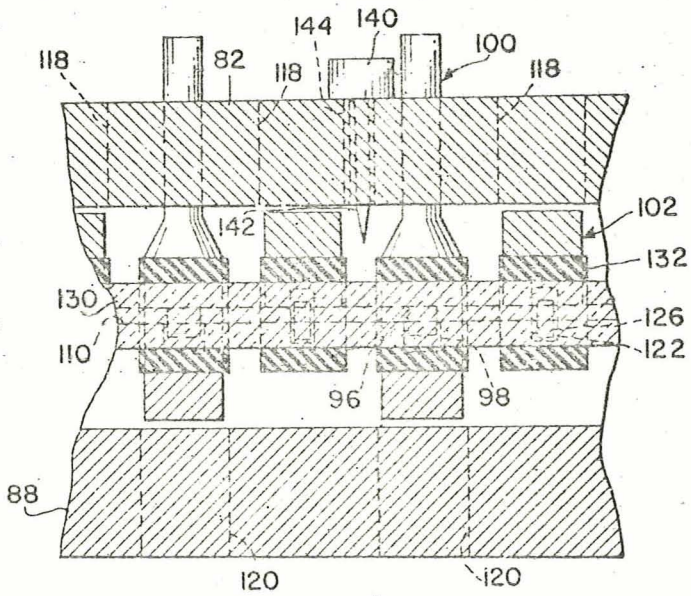
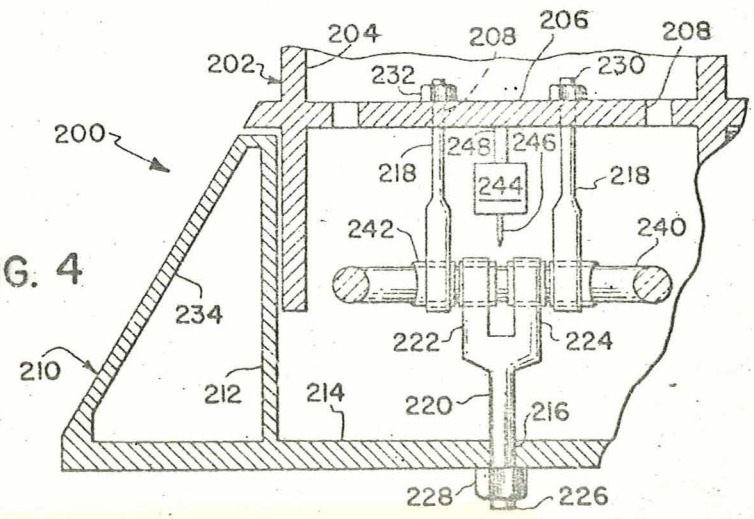


FIG. 4



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Aug. 2, 1966 K. F. RUBERT 3,263,610

QUICK-RELEASE CONNECTOR

Filed March 20, 1964 3 Sheets-Sheet 3

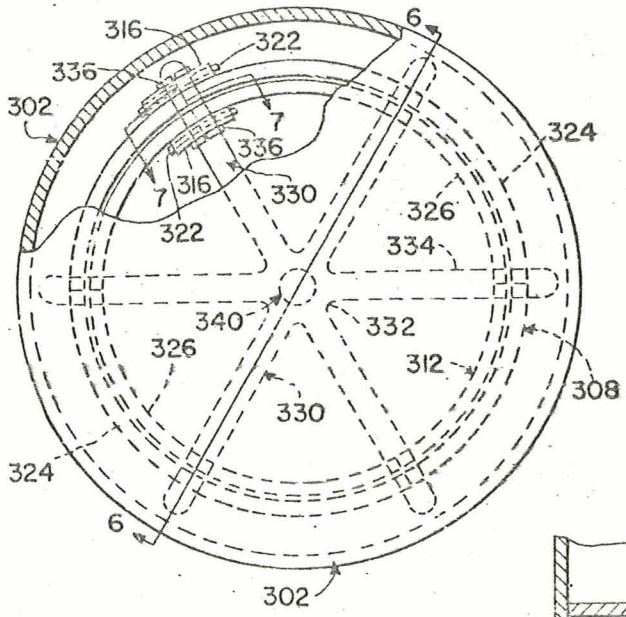

FIG. 5

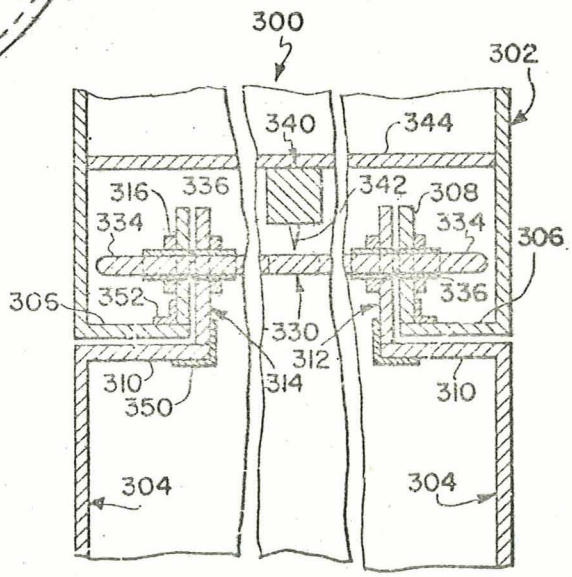

FIG. 6

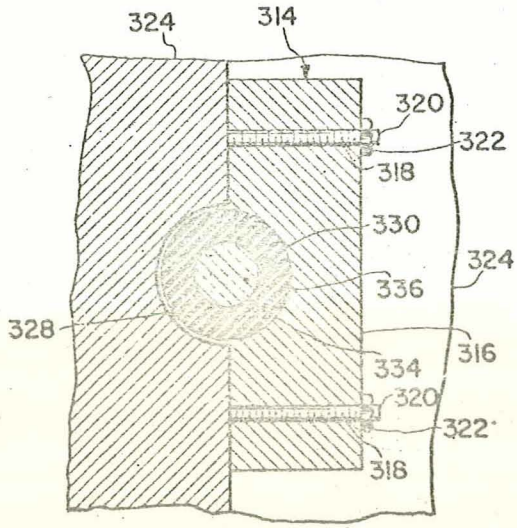

FIG. 7

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United States Patent Office

3,263,610

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3,263,610

QUICK-RELEASE CONNECTOR

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Filed Mar. 20, 1964, Ser. No. 353,632

19 Claims. (Cl. 102—49)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates generally to a connector and more particularly to a quick-release connector which utilizes a disintegratable member. More specifically, one embodiment of the invention relates to an interstage connection for rocket vehicles.

Previously, quick-release connectors have required and used mechanical apparatus for effecting the separation of two elements. These known types of quick-release connectors, such as automatic shutoff valves, usually have structures which fragmentate upon the occurrence of a predetermined event or at a predesignated time. The fragments of the connectors which remain are hazardous and there is resulting undesirable debris. Where two sections or stages of a multistage rocket were involved, the prior structure consisted of devices such as explosive bolts wired for simultaneous explosion or elastic deforming members intended to deflect uniformly in a manner so as to achieve release through physical displacement of the parts. Previously known arrangements for interstage connectors present difficulties in design in that simultaneous release of all points of the attachments is difficult to be obtained. That is, the separation is seldom free of interference from closely associated parts. This results in tipoff, asymmetry of separation and a deflection of the upper stage from its intended flight-path.

The present invention overcomes the above difficulties by using in a connector for an interstage locking mechanism, "tempered glass" which has the characteristic of disintegrating into a sand-like material. The remnants of the glass are not sharp or hazardous and are of little volume. Further, upon local failure of the connector, there is a substantially instantaneous and uniform disintegration of the connector which permits symmetrical separation of the associated elements.

Accordingly, it is an object of the instant invention to provide a positive connection which is capable of transferring loads and that when punctured will instantaneously and uniformly disintegrate to effect a disconnect.

Another object of this invention is to provide a frangible connector which instantaneously disintegrates into minute particles which are not dangerous.

A further object of the instant invention is to provide a frangible connector, which upon being struck sharply to cause local failure, instantaneously and uniformly disintegrates to permit complete release at the occurrence of a predetermined event.

Another object of this invention is to provide a coupler which utilizes a frangible element for connecting opposed members that are to be symmetrically separated at a predetermined time.

A further object of the present invention is to provide an initiator which strikes a disintegratable connector to effect pulverization thereof with the attendant uniform and instantaneous separation of connected members.

Still another object of the instant invention is to provide an interstage coupler which utilizes a tempered glass connector protected by a resilient bushing that extends between opposed anchors associated with each of the stages and which has an initiator located so as to strike

the connector at a predetermined time and thereby cause uniform and instantaneous separation of the two stages.

Another object of the instant invention is to provide a safety device for use when instantaneous and uniform separation of members is necessary in which an initiator impinges upon a connector that uniformly disintegrates.

Still another object of the instant invention is to provide an expendable release device wherein local failure of a monolithic connector effects simultaneous release of all sections.

A further object of this invention is to provide a connector which disintegrates when caused to exceed a predetermined deflection due to overload of transmitted forces.

Still another object of the instant invention is to provide a method of disconnecting elements at a predesignated time or when predetermined conditions exist.

Generally, the foregoing and other objects are accomplished in accordance with this invention by provision of a monolithic tempered glass connector element. This element may extend through opposed elements to be released at a predetermined time. For example, it may be a member such as a shear pin, a circular ring, a spoke-shaped element, or an article of any other configuration desired. The material from which the frangible connector element is made is relatively strong and therefore capable of transferring loads from one element to another. As is well known, tempered glass has the characteristic of great tensile stress in the interior of the material which is balanced by compressive forces near the surface of the material. Upon local failure of the material, as by means of a scratch or puncture going through the compressive layer at the surface or by means of a sharp blow, the entire member disintegrates almost instantaneously into a pulverized or comminuted material. In order to prevent undesired damage to the connector element, it is generally surrounded in the force-transmitting areas by a resilient bushing. An initiator, such as a sharp blade or projectile, is provided for inducing local failure at the occurrence of some predetermined event. Such an initiator may be actuated by pyrotechnic, electrical or mechanical devices well known in the prior art. It is also contemplated that the initiator may be a member such as a screw having a sharp point located such that a predetermined amount of deflection of the connector element causes the screw to induce local failure and, consequently, separation of the elements connected.

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a cross-sectional view of one configuration for the connector of the instant invention;

FIG. 2 is a cross-sectional view of another embodiment of an inventive connector capable of use in connecting multistage rockets;

FIG. 3 is a partial cross-sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is an elevational view with portions cut away to more clearly show a heavy-duty connector;

FIG. 5 is a sectional plan view, with portions omitted for clarity, showing another embodiment of the inventive connector element;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 5; and

FIG. 7 is an enlarged sectional view taken on line 7—7 of FIG. 5.

Referring now to the drawing wherein like reference numerals designate identical or corresponding parts throughout the several views and more particularly to

FIG. 1 wherein a quick-release device or coupling, generally designated by numeral 10, is shown as establishing a positive connection between members 12 and 16. The coupling shown in FIG. 1 is typical of those for transmitting loads between two elements and in which failure is desirable upon the occurrence of a predetermined event. Member 12 has an opening or bore 14 extending therethrough and could be a member such as the tongue of a farm implement. Element 16 is a U-shaped member having a base portion 18 and legs 20 which also have apertures or bores 22 therethrough. For example, element 16 could be equivalent to the hitch portion of a load-drawing vehicle, such as a tractor or truck. In order to prevent movement or loss of the connecting member, to be described more fully hereinafter, cover plates 24 are located on the outer surface of legs 20 and are secured in place by screws 26 threaded into bores 28 in legs 20.

Frangible connector 30 is shown as a shear pin or its equivalent which substantially fills apertures 14 and 22 in members 12 and 16 respectively. Connector 30 has an interior portion which acts as load-transmitting member 32 composed of tempered glass. Surrounding pin 32 is resilient bushing 34 made of rubber, neoprene or some equivalent type of plastics. A metal container extends substantially completely around bushing 34 and acts as a further protection against undesired damage or failure of pin 32. Slots or grooves 36 extend substantially about resilient bushing 34 to form a protector which will be easily separated when the shear forces acting on coupler 30 are extensive enough to cause failure of pin 32. The ends of bushing 34 are covered by metallic caps 38 and 42, the latter having slot or aperture 48 which permits screw 46 to extend to a predetermined point near pin 32 because of access hole 44 in bushing 34. The central area of bushing 34 between slots 36 is protected by metallic cylinder 40.

Screw 46 is shown in FIG. 1 as extending from the outer end of leg 20 into hole 44 and is thereby permitted contact with pin 32 on the occurrence of a predetermined force. Screw 46 has the normal groove 52 to facilitate rotation and location thereof and is also shown as having indicia 50 which designate the depth to which screw 46 is to be placed in order that, upon application of a force causing a predetermined amount of deflection of pin 32, the pin will encounter the sharp end of screw 46 and be punctured. Since tempered glass is in a constant state of stress with the interior portion of pin 32 in tension and the surface in compression, puncture of the outer surface results in local failure which causes pin 32 to disintegrate and thus permits separation of members 12 and 16. In view of the above, it is apparent that by properly setting screw 46 at a predetermined depth, pin 32 will be caused to disintegrate and separation of elements 12 and 16 effected when the forces exceed designed limits.

Multistage rockets require separation of the individual stages during flight. In order to prevent tipoff of the stage or stages of the rocket which continue in flight, it is necessary to provide symmetrical release of the stage being discarded. When the stages to be separated have closely associated parts, there is a tendency for one portion of those parts not to be released as rapidly as the other portions and consequently the stages do not separate symmetrically and one of the stages is caused to veer from its desired flightpath. FIGURE 2 shows an embodiment of the instant invention which overcomes the problem of asymmetrical separation of stages in a multistage rocket. The frangible connection generally designated by numeral 60 may be either free-standing or capable of application to individual stages prior to their being connected. The frame or skin 62 of an upper stage has heavy-duty threads 66 on the interior face thereof and adjacent the portion to be connected to lower stage frame or skin 64 which has interior heavy-duty

threads 68 adjacent the portion to be connected to the upper stage.

The connection has channels 72 and 74 which are associated with the upper and lower stages respectively and are so related as to form a box-like structure. Channel 72 is oriented upside down and includes outer flange 80, inner flange 84 and base 82. Lower channel 74 has outer flange 86, base 88, and interior flange 90. The external faces of outer flanges 80 and 86 are respectively provided with heavy-duty threads 76 and 78 which are adapted to matingly engage threads 66 and 68 on the interior face of upper and lower stage frames 62 and 64. Base 82 of channel 72 has aperture or bore 92 extending therethrough adjacent and parallel to outer flange 80. Similarly, base 88 of channel 74 has aperture or bore 94 extending therethrough adjacent and parallel to flange 90.

As best seen in FIG. 2, flange 80 has stud or boss 96 adjacent the inner face thereof and flange 86 is provided with recess 98 adjacent its inner face. As is readily apparent from the drawing, boss 96 interfits with recess 98 to assist in preventing relative lateral movement of channels 72 and 74 of coupler 60.

To provide a positive connection between the two stages and permit ease of release, hook members 100 and 102 are alternately located in the opening formed by channels 72 and 74. These hook members are identical and have base portion 104 provided with a trough or seat 106 and faces 108 and 110 on one edge thereof. Trough or seat 106 is on what might be called the inner face of base 104 and shaft or arm 112 extends from base 104 on the same side thereof. Shaft or rod 112 is adapted to extend through aperture 92 or 94 in flange members 72 and 74 and is provided with threaded end 114. Nuts 116 are threaded on shaft 112 about threads 114. Generally, the stages of a rocket are cylindrical in shape and accordingly the connector would be of circular configuration. Therefore, channels 72 and 74 would also have a circular configuration in plan. Tempered glass connector 130 is also in the shape of a ring and of a size to fit within the opening between channels 72 and 74. However, it is obvious that should a shape other than circular be desirable, channels 72 and 74 could be attached by means other than threads and connector 130 could be made of any desired shape that would fit within the structure to be utilized. In order to protect connector 130, bushings 132 are provided intermittently therearound. That is, bushings 132 are located so as to protect connector 130 where it would contact hooks 100 and 102.

As indicated hereinabove, apertures 92 and 94 are spaced to permit shafts 112 of hooks 100 and 102 to extend through channel members 72 and 74. These apertures are alternatingly positioned on a line substantially parallel to the longitudinal axes of the channel members in order to provide a space between pairs of hooks 100 and 102. To facilitate assembly of a positive connection, slots 118 and 120 are provided in bases 82 and 88, respectively, to permit insertion of hook members 100 and 102. Therefore, once channels 72 and 74 have been positioned with their threads matingly engaging the frames 62 and 64 of the respective stages of the multistage rocket, hook elements 100 and 102 may be inserted through the channels to effect connection. These slots also function to permit complete release of the hooks and stages once separation has occurred.

Actuator 140 is located at any convenient position which will permit initiator 142, such as a sharp blade or projectile, to impinge connector 130. As is clear from FIGS. 2 and 3, bushing 132 is in actuality a series of individual resilient elements which are intermittently spaced about connector 130 to protect it from premature damage by troughs 106 of hooks 100 and 102. Thus, actuator 140 and initiator 142 should be located so as to permit initiator 142 to pass through opening 144 and strike glass ring 130 where it is unprotected by bushing

132. When initiator 142 strikes connector 130, the outer surface of the tempered glass material of which connector 130 is comprised will fail and connector 130 will disintegrate into a sandlike pulverized material almost instantaneously. Thus, the two stages of the rocket are permitted to separate symmetrically.

Hooks 100 and 102 may be connected about connector ring 130 subsequent to channels 72 and 74 being matingly engaged with frames 62 and 64. However, in some instances, it may become advisable to assemble connection 60 prior to mating the individual stages of the rocket. Under such circumstances, the connection 60 may be built or constructed as a "free-standing" element. If the connection is completed with the exception of engaging the threads on channels 72 and 74 with frames 62 and 64, it may be necessary to provide flanges 80, 84, 86, and 90 of channels 72 and 74 with mating bores or holes 122. Keys 126 fit in bores 122 for preventing relative rotation between channels 72 and 74 and, therefore, assist in preventing premature injury or damage to connector 130. Obviously keys 126 must not be so large as to cause friction between themselves and bores 122 when separation is effected. Once connection 60 has been fully assembled, it would be attached to one of the stages; for example, frame 64 would receive the free-standing assembly by the mating engagement of threads 68 and 78. Subsequently, frame 62 of the upper stage would be engaged with threads 76 on channel 72 by rotation of the upper stage until a positive connection had been accomplished.

Another embodiment of the invention is shown in FIG. 4 wherein heavy-duty coupler 200 is shown to be comprised of upper section 202 and lower section 210. Upper section 202 has vertical element 204 which may be of circular, rectangular or any desired configuration in plan (not shown). Attached to vertical flange 204 is horizontal member 206 which is provided with several apertures 208 which are circumferentially located adjacent and in spaced relation to vertical flange 204. Lower section 210 has vertical flange 212 and associated horizontal member 214 which is provided with apertures 216, circumferentially spaced adjacent vertical flange 212. The spacing and number of apertures 208 and 216 will depend upon design criteria for loads anticipated during launch and the number of hooks 218 and 220 necessary for transmission of loads between upper section 202 and lower section 210. As shown in FIG. 4, upper section 202 is provided with hooks 218 which extend through apertures 208 to threaded portion 230 for receiving nuts 232. Lower section 210 is provided with hooks 220 that have a pair of arms 222 and 224 which are spaced from one another to form a yoke-shaped element. The shaft portion of hook 220 is provided at its extremity with threads 226 which are adapted to matingly engage nut 228 and thereby effect a positive connection of hook 220 with lower section 210. Although FIG. 4 shows and the members are described as being hooks, it is to be understood that elements 218 and 220 could be loops or solid members with apertures therethrough depending upon design criteria and accessibility for assembly of connection 200.

Connector 240 is shown as made of tempered glass and as being of a monolithic construction which conforms to the configuration of upper section 202 and lower section 210. However, it is apparent that frangible connector 240 may be of any desirable configuration which is readily adaptable for being enclosed by vertical flanges 204 and 212. Bushings 242, preferably made of a resilient material, are positioned about connector 240 so as to provide protection against damage during assembly of connection 200 or which might be caused by vibration or other movement of hooks 218 and 220. Actuator 244 is located within the enclosure formed by flange 204, member 206, flange 212, and member 214 and is supported by strap 248. Initiator 246 is of sharp blade or projectile shape or some other well known construction and is associated with actuator 244 in a position so as

to contact connector 240 in an area which is not covered by a portion of bushing 242. Actuator 244 is of any well known construction, for example, a pyrotechnic member in which activation may be induced by some electrical or pressure source. Activator 244 causes initiator 246 to impinge connector 240 and thereby effect local failure which causes connector 240 to disintegrate almost instantaneously and permits simultaneous and uniform separation of upper section 202 from lower section 210.

A further embodiment of the instant inventive connection which may be used as an interstage connector or in some other environment which requires quick release of two members is shown in FIGS. 5, 6, and 7. FIG. 6 shows first section 302 and second section 304 which are to be connected for quick release. Section 302 has inwardly directed base flange 306 and coupling rim 308 which respectively engage or are adapted to abut base flange 310 and coupler rim 312 of lower or second section 304. As more clearly shown in FIG. 5, coupler rim 308 is constructed of a series of segments 324 and coupler rim 312 is made up of several segments 326. Segments 324 and 326 are similar and would only vary depending upon the configuration of sections 302 and 304. For example, the circular configuration of FIG. 5 would require the arc and, accordingly, the length of segment 326 to be slightly less than the arc length of segment 324. Segments 324 are adapted to abut one another in end-to-end relationship with the adjacent ends thereof having apertures or openings 328 which receive one half of connector element 330 and bushing 336, to be described more fully hereinafter.

Fastener 314 has halves 316 which are attached to and conform to the cross-sectional shape of segments 324 and 326 adjacent and about openings 328 in the edges of the latter. Fastener halves 316 are provided with mating bores 318 which receive bolts 320. Bolts 320 are threaded at least at each end thereof for receiving nuts 322 to effect position connection of fastener halves 316.

As shown more clearly in FIG. 5, connector 330 is formed with hub 332 and a plurality of spokes 334. The number of spokes 334 and their angular relationship to one another will be determined by the number of segments 324 and 326 with their associated edge grooves. In order to protect connector 330 from premature damage and possible failure, the areas of spokes 334 which extend through the edge grooves of adjacent segments 324 and 326 are covered with resilient bushings 336.

One method of assembling connection 300 is to locate a pair of segments 324 and a pair of segments 326 with their associated fastener halves 316 already attached in the proper location at the edge grooves. Connector 330 would then be positioned so as to extend through the opening formed between the segment pairs and with bushing 336 in place. Bolts 320 would then be placed in bores 318 and nuts 322 applied to cause a positive connection of adjacent segments 324 and similarly with respect to segments 326. Subsequently, another segment 324 would be placed lengthwise of the segments 324 already connected and another segment 326 would also be so positioned and fastener halves 316 connected by means of bolts 320 and nuts 322. Thus, it is seen that by continuation of this procedure, the connection would be assembled with, as shown in FIG. 5, a circular configuration having connector 330 located centrally thereof. Accordingly, a free-standing coupler is constructed which is ready for attachment to first section 302 and second section 304. In order to effect the connection of the free-standing assembly, angles 350 are provided for connecting segments 326 to base flange 310. Similarly, angle members 352 effect connection of segments 324 to base flange 306. Once angles 350 and 352 have been properly secured, first section 302 and second section 304 are positively connected.

In order to provide for separation of first section 302 and second section 304, actuator 340 of conventional design, is provided with an initiator 342, also of conventional configuration, such as a sharp object or projectile, associated therewith. Actuator 340 is designed to actuate initiator 342 upon occurrence of a predetermined event or at a predetermined time and thereby cause connector 330 to disintegrate and permit instantaneous and uniform separation of sections 302 and 304.

In operation, until the moment of release arises, the connector performs its first function of transmitting the loads required to assure positive connection between the two elements or sections. Positioning is obtained in the usual way by a proper registering of mating sections and a state of controlled loading on the connecting piece is established through use of the resilient bushings or gaskets. When release is desired, the connector is caused to fail locally through the medium of the actuator and initiator either at a single point or at symmetrically located points about the connector. In consequence of the local or point failure, the equilibrium between the inner tensile stresses and the outer compressive stresses is destroyed and the connector disintegrates almost instantaneously into a granular material resembling sand and, consequently, all connection between the sections is destroyed.

Although primarily disclosed for the instantaneous release of connected sections, the use of tempered glass mechanical parts for expendable release devices has many applications within the scope of the contemplated invention. For example, it could be used as an emergency release bolt for securing doors to areas of restricted access, as a stop unit to operate protective relays in case of overloads that cause excessive deflections, as quick-release stoppers for pressure vessels either for desired quick-opening action or as pressure release protective devices, and as a connection for jettisoning devices. Thus, it is seen that the use of tempered glass for mechanical connections or safety devices has many applications which would fall within the contemplation of the present invention.

The quick-release or safety devices as disclosed hereinabove have the features of speed, uniformity, reliability and completeness with which separation is accomplished. The glass parts completely disintegrate practically instantaneously permitting symmetrical separation without leaving any mechanical strength.

When properly designed, these glass parts are very adaptable to quantity production from very low-cost materials and are impervious to deterioration from corrosion or moisture.

Obviously, many modifications and variations of the subject 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.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An expendable release device comprising: mounting means located on respective elements to be released; tempered glass means for connecting the mounting means to provide instantaneous release thereof; and actuator means for initiating failure of the frangible means whereby uniform and instantaneous separation of the elements occurs.

2. A locking mechanism comprised of: means for coupling a plurality of members to be disconnected; and tempered glass means associated with the coupling means for releasably securing the members whereby rupture of said glass means causes uniform release of all members.

3. A coupling mechanism comprised of: a plurality of elements to be releasably secured; anchor means on each of said elements; wholly comminutable tie means for releasably interconnecting said anchor means; and protector means for said tie means, disintegration properties of said tie means permitting instantaneous and uniform release of all elements upon fracture of said tie means.

4. A quick-release device comprised of: an instantaneously and wholly comminutable disintegratable connector element; protector means for preventing premature damage to said connector element; opposed elements to be releasably connected, said connector element joining said opposed elements; and initiator means for causing failure of said connector element whereby the connector element disintegrates and the opposed elements separate symmetrically.

5. In an overload release device the combination comprised of: initiator means; and comminutable means for securing elements of a hazardous structure together whereby, when desired environmental conditions are exceeded, the initiator means causes complete comminution of the comminutable means and thereby permits a reaction to environmental conditions of an instantaneous and uniform separation of elements with said comminutable means after failure appearing as only minute debris.

6. In a quick-release connector the combination comprising: a plurality of elements to be releasably secured together; attachment means associated with said elements; instantaneously comminutable tie means for releasably securing said attachment means together to provide instantaneous and symmetrical release of said elements; and initiator means for commencing failure of said tie means.

7. The quick-release connector of claim 6 wherein the attachment means includes apertures through portions of the elements; and said initiator means is a sharply pointed member.

8. The quick-release connector of claim 6 wherein means are provided for protecting said tie means.

9. The quick-release connector of claim 7 wherein the tie means is protected by a resilient bushing and a metal container; the initiator means has indicia for marking the location of the pointed member to create failure of said tie means at a predetermined deflection; cover plates provided for retaining the tie means within the elements to be connected and for ease of replacement of the tie means; and slots are provided in the metal container and resilient bushing in order to effect more rapid release.

10. The quick-release connector of claim 8 wherein the attachment means is comprised of alternatingly opposed hook members; the initiator means is a sharp blade; and the protector is interfitting channels.

11. In a quick-release connector the combination comprising: a plurality of elements to be releasably secured together and having threads thereon; tie means to provide instantaneous release of said elements; initiator means including a sharp blade for commencing failure of said tie means; protector means including interfitting channels; the opposed flanges of said channels having mating recesses; a key located within said recesses to prevent relative movement of said channels; one flange of said channels having threads for attaching said channels to said elements; attachment means including alternatingly opposed hook members associated with said channels; and resilient bushing means for protecting said tie means adjacent said hook members.

12. In a quick-release connector the combination comprising: a plurality of sections to be releasably secured together; attachment means having opposed fastener elements associated with said sections; tie means having a frangible ring with the property of being instantaneously disintegratable upon rupture for releasably securing said attachment means together to provide uniform release of said sections; resilient bushings intermittently spaced at said opposed fastener elements and surrounding portions of said tie means for protection thereof; initiator means having a sharp blade for commencing failure of said tie means; and actuator means whereby the actuator means causes motion of the initiator means which ruptures the

frangible ring to permit instantaneous and uniform release of the sections.

13. The quick-release mechanism of claim 12 wherein the attachment means are alternating hooks with the hooks from at least one element having a pair of spaced arms; said hooks having threaded shafts with nuts securing said hooks in place.

14. In a quick-release connector the combination comprising: a vehicle having a plurality of stages; inwardly extending base flanges and upwardly extending coupling rims on adjacent edges of said stages; said coupling rims having a plurality of segments; recesses in the ends of said rim segments; attachment means having fastener halves secured to each of said segments adjacent said recesses; tie means extending through said recesses for releasably securing said attachment means to provide instantaneous and uniform release of said stages; resilient bushings located in the recesses of said rim segments and fastener halves to protect said tie means from premature damage; angles securing said upwardl, extending coupling rims to said inwardly extending base flanges; initiator means for rupturing said tie means; and actuator means for causing activation of said initiator means.

15. The quick-release connector of claim 14 wherein said tie means is comprised of a hub with spokes.

16. In a quick-release device the combination comprised of: a plurality of elements; each of said elements having flanges with rims; tie means extending through said rims and having the property of being instantaneously disintegratable upon rupture; actuator means; means

associated with said actuator means for initiating failure of said tie means, whereby the actuator means causes the initiator means to impinge and rupture the tie means to provide instantaneous disintegration of the tie means and uniform release of said elements.

17. The quick-release device of claim 16 wherein said rims are comprised of a plurality of segments positioned end-to-end.

18. The quick release device of claim 16 wherein fastener halves are associated with said rims to secure said tie means in place.

19. The quick-release device of claim 16 wherein said tie means is monolithic tempered glass; and means for protecting said tie means located in the areas where said tie means extend through said flanges.

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