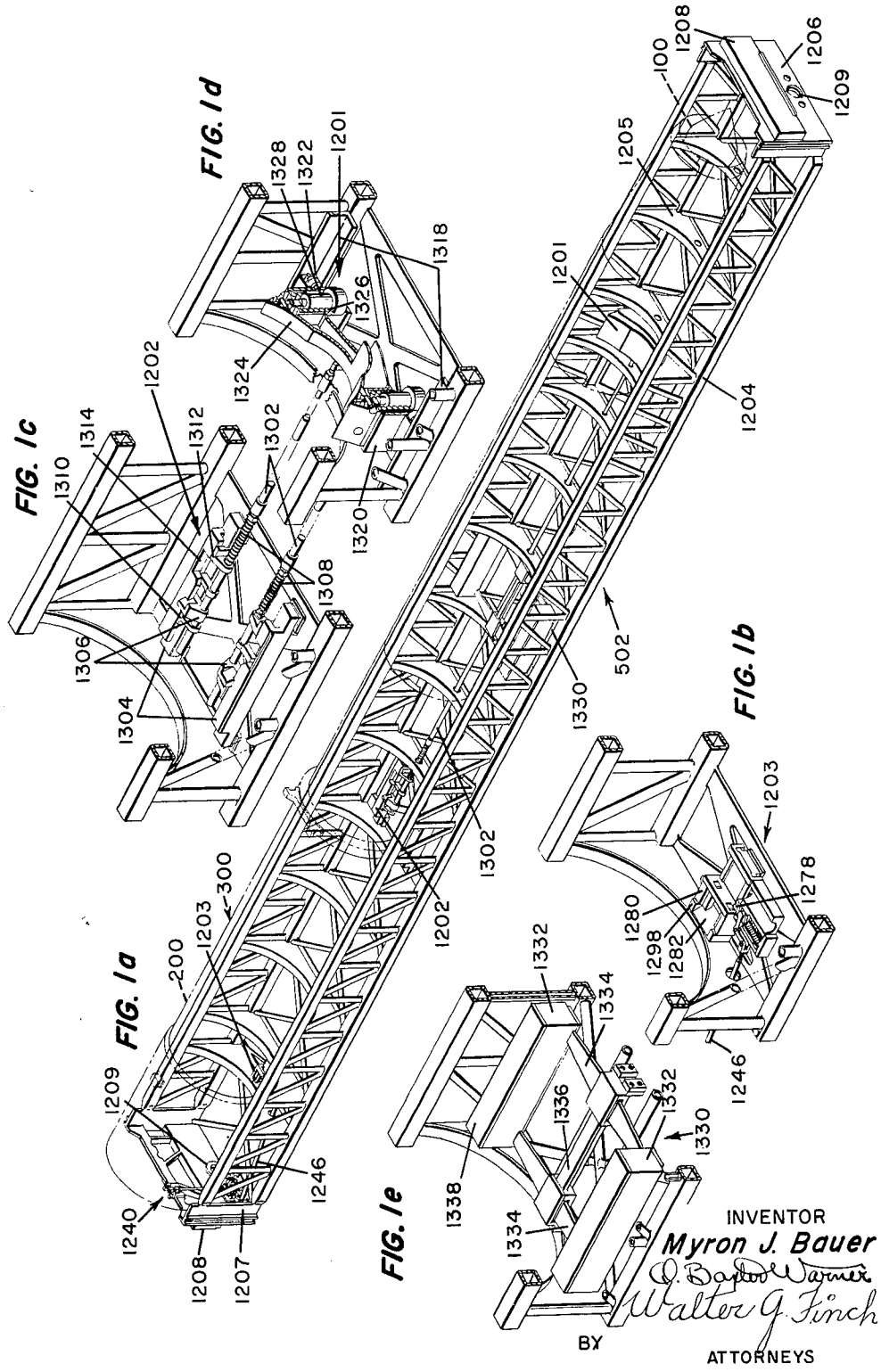
March 29, 1966 M. J. BAUER 3,242,809

READY SERVICE TRAY FOR MISSILE WEAPON

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READY SERVICE TRAY FOR MISSILE WEAPON

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FIG. 2d

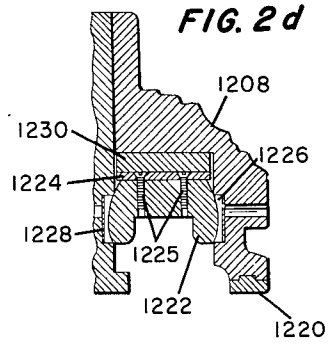


FIG. 2b

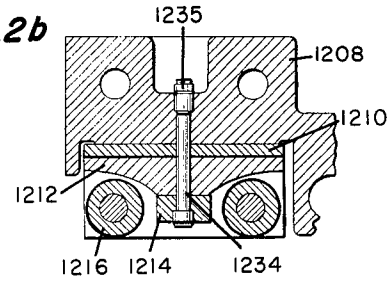
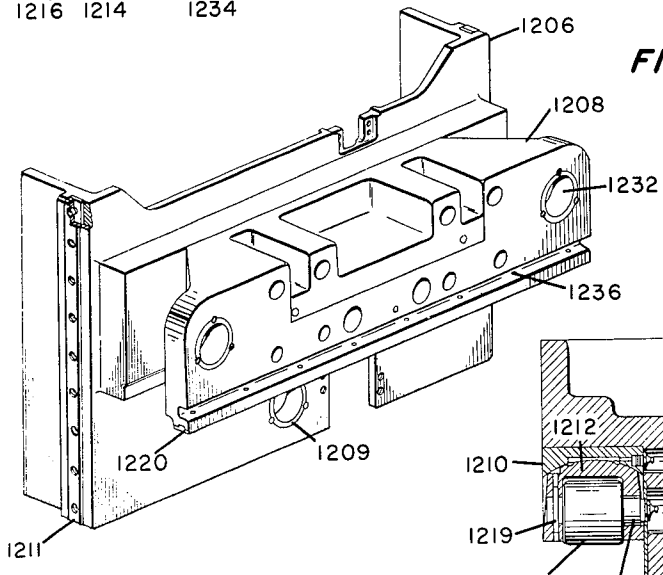


FIG. 2a



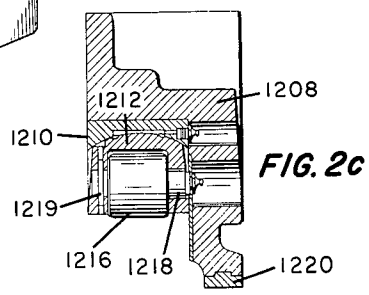


FIG. 2c

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READY SERVICE TRAY FOR MISSILE WEAPON

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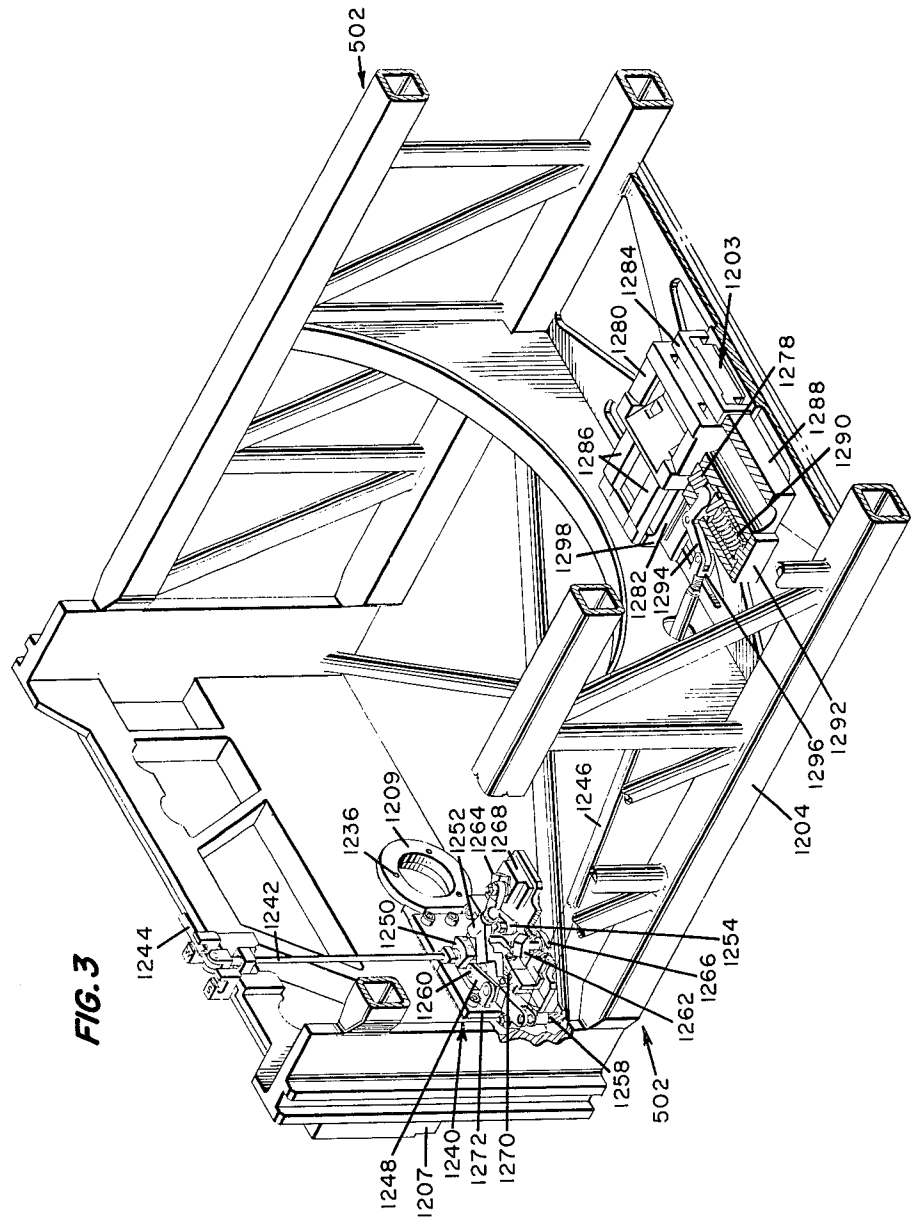


FIG. 3

READY SERVICE TRAY FOR MISSILE WEAPON

Filed Dec. 21, 1959 7 Sheets-Sheet 4

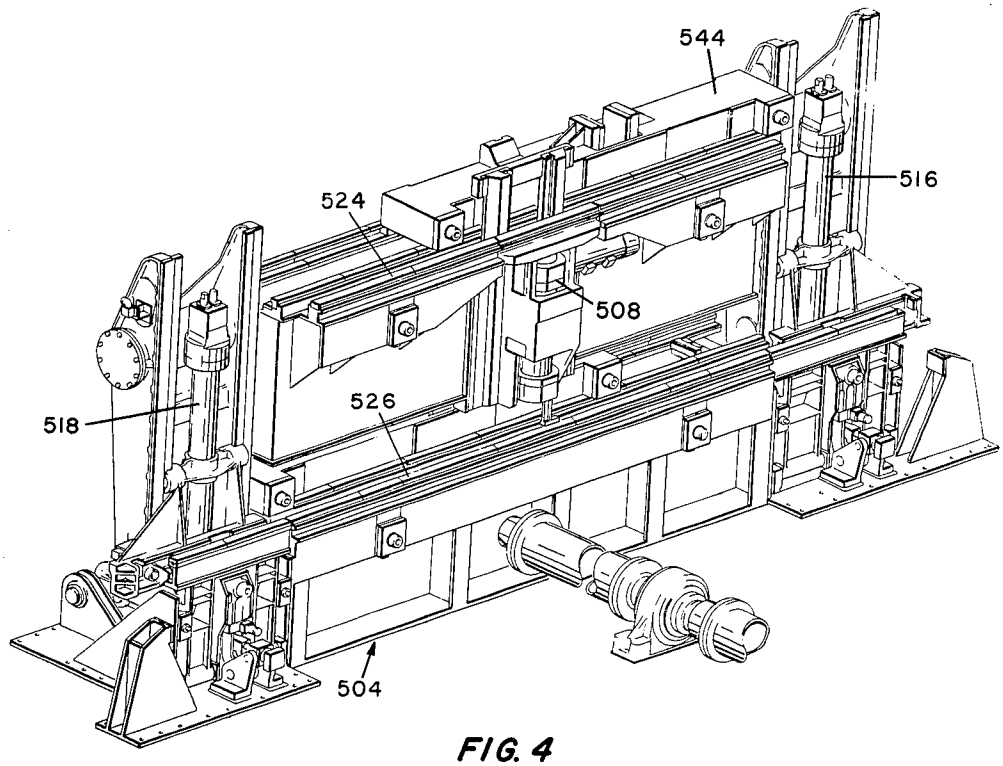


FIG. 4

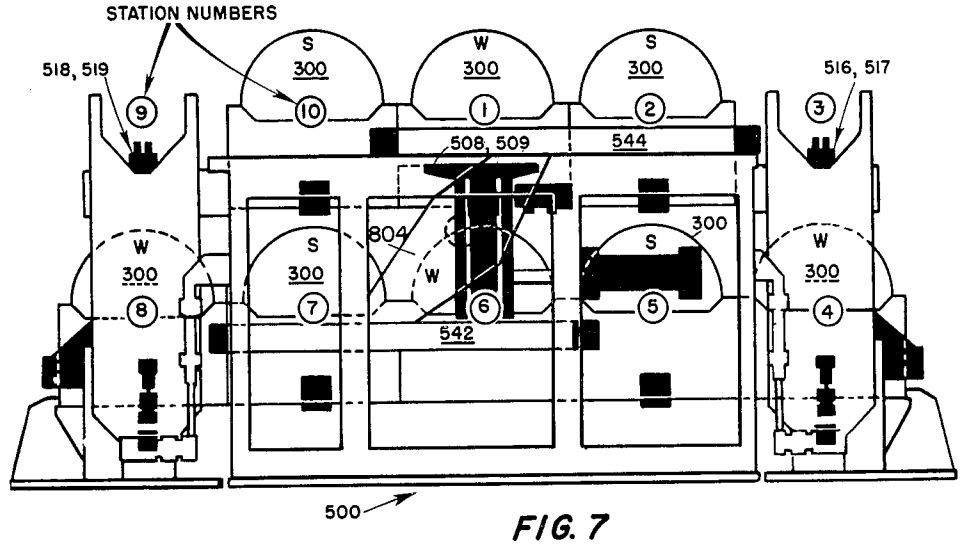


FIG. 7

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READY SERVICE TRAY FOR MISSILE WEAPON

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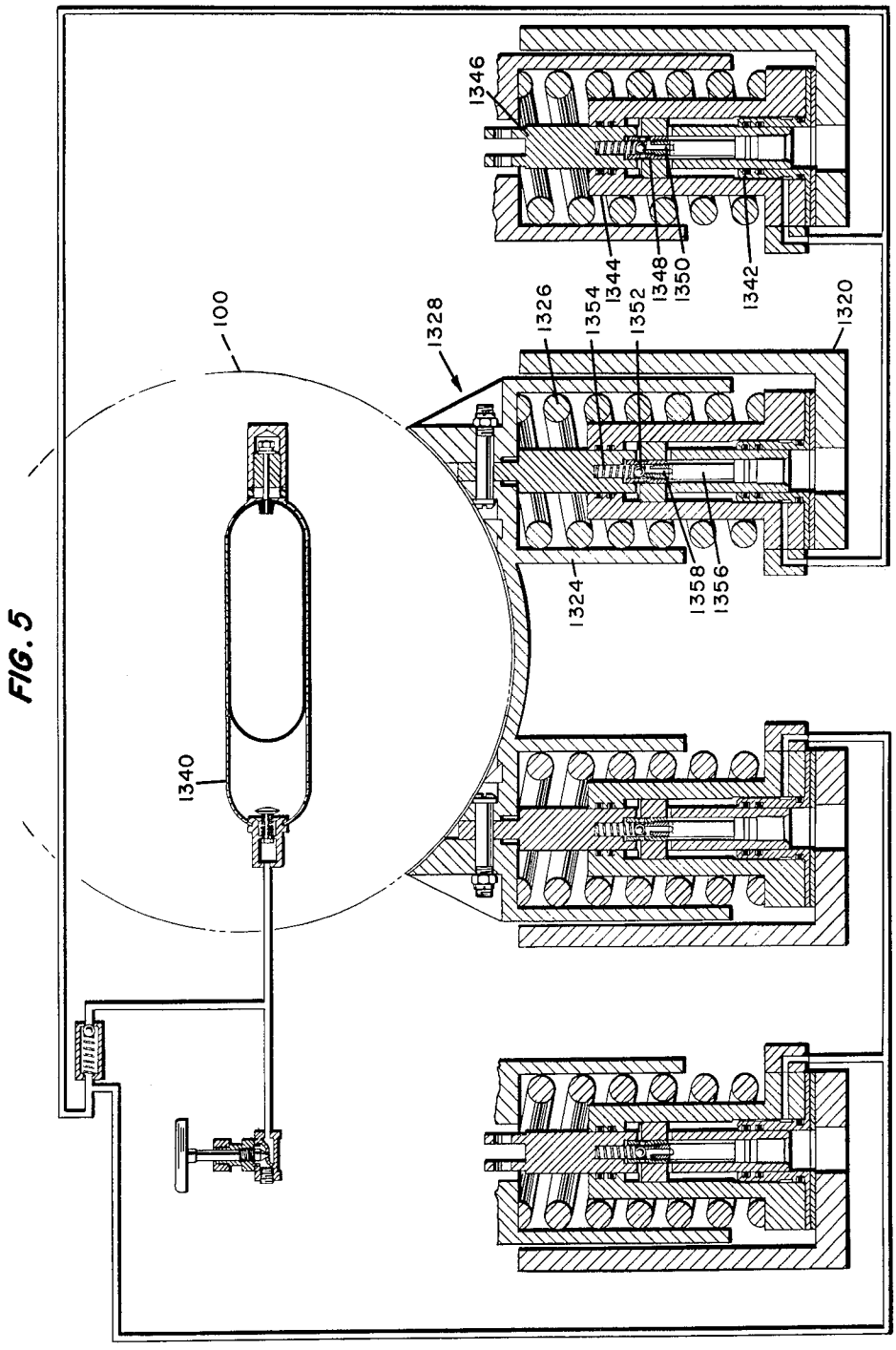


FIG. 5

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READY SERVICE TRAY FOR MISSILE WEAPON

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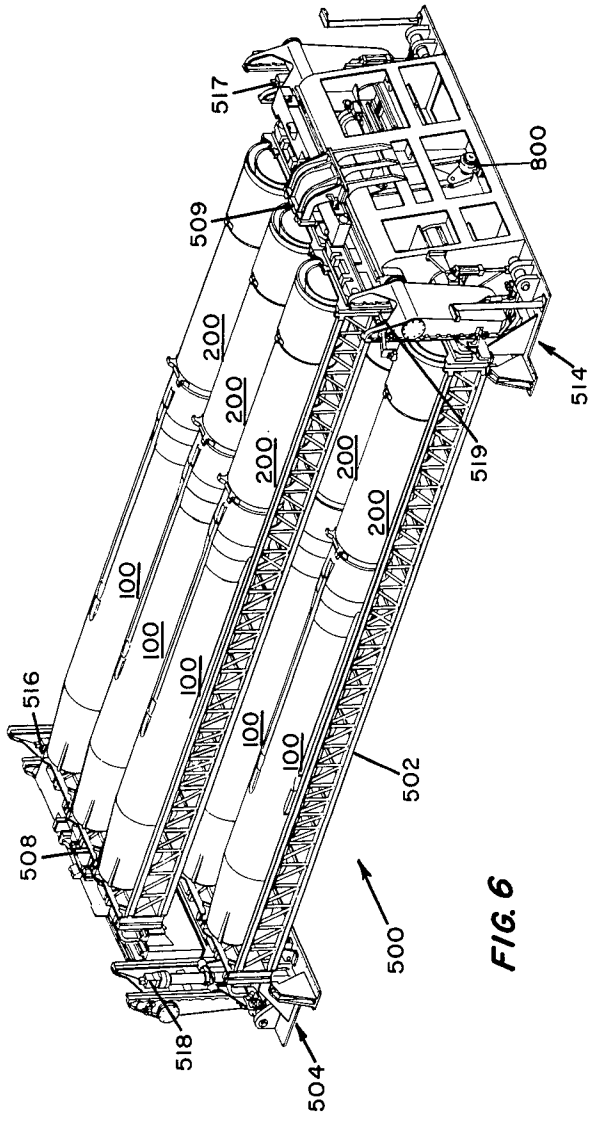


FIG. 6

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READY SERVICE TRAY FOR MISSILE WEAPON

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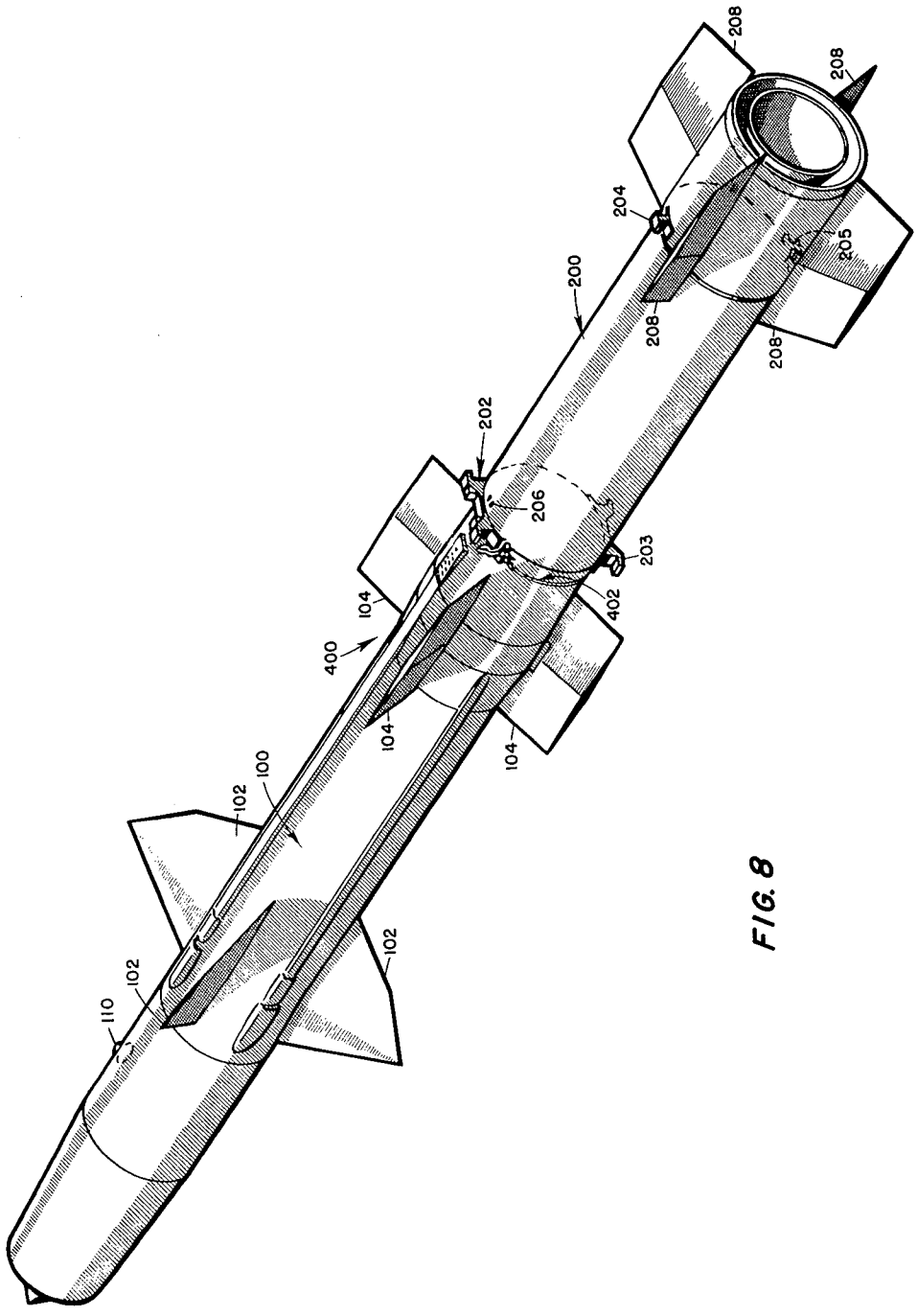


FIG. 8

United States Patent Office 3,242,809 Patented Mar. 29, 1966

3,242,809

READY SERVICE TRAY FOR MISSILE WEAPON

Myron J. Bauer, St. Paul, Minn., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Filed Dec. 21, 1959, Ser. No. 861,160
2 Claims. (Cl. 89—1.7)

This invention relates generally to article handling equipment, and, more particularly, it pertains to ordnance weapon trays for expeditiously and safely storing and manipulating delicate, clumsy, unwieldy or bulky missile weapons and automatically identifying them one from another.

The trays for missile weapons, often referred to as ready service trays, of this invention, are part of a ready service mechanism for a guided missile launching system which are the subject of copending patent applications entitled "Guided Missile Launching System," Serial No. 848,163, filed October 22, 1959, by Myron J. Bauer et al., and "Ready Service Mechanism for a Guided Missile Launching System," Serial No. 31,785, filed May 25, 1960, by Myron J. Bauer et al., respectively.

It has been the practice in the past to handle missile weapons and similar weapon articles by manual labor or perhaps with cranes aided by slings or extemporaneous pallets. As the state of the art progressed, the missile weapons or ordnance articles became more gross and heavy, and, at the same time, more complex and delicate or subject to damage from rough handling. Furthermore, a demand has arisen for automatic, rapid selection of a particular missile weapon or ordnance article type from a store of missile weapons or ordnance articles at a particular station and quick transfer thereof to a further station for disposal thereof.

It is, therefore, an object of this invention to provide a protective storage and handling tray for ordnance weapon articles.

Another object of this invention is to provide an article engaging tray mechanism.

Another object of this invention is to provide an article identifying mechanism in a holding tray.

Still another object of this invention is to provide a load status signalling mechanism for an article storage tray.

And yet another object of this invention is to provide a cradling support in a weapon handling tray.

Another object of this invention is to provide a shock absorber for an article cradled in a supporting tray.

Another object of this invention is to provide an empty tray vibration cancelling mechanism.

And yet another object of this invention is to provide leveling rollers and skids for lateral transport and support of article trays.

In accordance with the invention, there are provided ready service trays for storing and handling of missile weapons. These trays are part of a ready service mechanism of a guided missile launching system. Each ready service mechanism contains eight trays. Each tray contains one mated missile-booster combination having either an S-type missile (standard type warhead) or a W-type missile (atomic type warhead).

Each missile-booster combination is secured in the bottom of its respective tray by lower forward and lower aft shoes of the booster. The missile is also centrally cradled in the tray but is not secured thereto.

The trays function as an integral part of the ready service mechanism. These trays support the missile-booster combinations in the ready service mechanisms. Any movement of the missile-booster combinations, with respect to the trays, is restricted during indexing of the trays in the ready service mechanisms.

Each tray indicates, through its ready service mechanism, its load status to the appropriate control panels in the guided missile launching system. This indication of the tray is given at all tray stations except two stations, which are normally empty. In addition, an empty tray indication is given at the rear center hoist and at the right rear end hoist. The end hoist indication is associated with strikedown of missile-booster combinations.

When the tray with the selected missile type is hoisted to a loader, tray components, which operate in conjunction with the ready service mechanism, release the lower forward and aft booster shoes so that the missile-booster combination can be transferred to the loader.

Each booster contains two pair of shoes that are located on diametrically opposite sides, at the fore and aft ends of the booster. When the missile-booster combination is in a ready service mechanism, it is supported and secured by the bottom pair of shoes in the tray. However, when the missile-booster combination is transferred to the loader, it is suspended by an upper pair of booster shoes from the rail of the loader.

Each tray consists of a tray truss frame or weldment, to which is mounted a missile-type selection indicator, an empty tray vibration absorber, an aft shoe receptacle and latch, a forward shoe receptacle, and a vibration dampener for the forward support of the missile of the missile-booster combination. The forward and aft ends of each tray are provided with a roller bracket.

The tray consists of an elongated rectangular all-steel weldment or truss frame formed by four horizontal rails which are joined by tubing. Except for the ends, the tray is of an open frame construction.

In addition to the tubing, the tray is braced by a plurality of spaced crescent-shaped plates which are vertically welded inside the tray. These plates are used as brace plates and they do not support the missile booster.

Each tray contains bumper strips which are located at each end on the outboard sides. Each bumper strip fits into a vertical recess and it is secured in place by socket head cap screws. The bumper strips cushion the bumping of the trays and reduce the metallic clanging of trays rubbing together.

Many other objects and attendant advantages of this invention will become more 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*a* is an isometric view of a tray assembly, with dot-dash lines showing a missile-booster combination in place in the tray assembly;

FIG. 1*b* is a detailed isometric view of a tray aft latch, partly in section, illustrating the latched position in the tray assembly;

FIG. 1*c* is a detailed isometric view of a portion of a forward shoe receptacle, partly in section, in latched position in the tray assembly;

FIG. 1*d* is a detailed isometric view, partly in section, of a missile vibration dampener for the tray assembly;

FIG. 1*e* is a detailed isometric view, partly in section of an empty tray vibration absorber for the tray assembly;

FIG. 2*a* is a dimetric view of the front end of a tray assembly;

FIG. 2*b* is a front elevation of a roller bracket;

FIG. 2*c* is a side elevation of the roller bracket;

FIG. 2*d* is a side elevation of a rocker;

FIG. 3 is an enlarged isometric view of a missile type indicator and aft shoe receptacle and latch assembly, partly cut-away and partly in section;

FIG. 4 is a dimetric view of a front stand;

FIG. 5 is a hydraulic schematic showing details of a missile vibration absorber;

FIG. 6 is a dimetric view of a typical ready service mechanism, fully loaded with missile-booster combinations; and

FIG. 7 is an outline drawing of a ready service mechanism in normal stowed position; and

FIG. 8 is a perspective view of a missile weapon.

Referring now to FIGS. 1*a* to 1*e*, inclusive, 6, and 7, of the drawings, the trays **502** are elongated, rigid, basket-like structures with rollers and skids at their ends which are adapted for sideways travel and hoisting in a ready service mechanism **500**.

The ready service mechanism **500**, basically, is an intermediate storage and ready access arrangement for ordnance weapon articles, such as missile-booster combinations **300**, each formed of a missile **100** and a booster **200**, held together by a clamping ring **402**, shown in FIG. 8. In essence, the ready service mechanism **500** consists of a pair of spaced stands **504** and **514** which support between them a plurality of the trays **502**.

By means of rails, tray engaging latches, shuttling crossheads and end hoists, the plurality of trays **502** may be moved, substantially as a unit, in a rectangular under-up-over-and-down path until a desired tray is positioned where required.

Each ready service mechanism **500** contains eight trays **502**. Each tray **502**, in the present invention, contains one mated missile-booster combination **300**. As shown in FIG. 8, each missile-booster combination **300** consists of the missile **100** and the booster **200** secured together by the clamping ring **402**. When the wings **102** and fins **104** are mounted on the missile **100** and fins **208** to the booster **200**, the missile-booster combination **300** becomes a missile weapon **400**. The missile **100** is provided with a warhead arming mechanism **110**, while the booster **200** is provided with an arming mechanism **206**. The missile-booster combination **300** is secured in the bottom of the tray **502** by lower booster forward and aft shoes **203** and **205**, respectively, shown best in FIGS. 6 and 8. The missile **100** is cradled intermediate its ends in the tray **502** but is not secured thereto. This means that the missile-booster combination **300** is supported at three places in the tray **502**, namely, at the lower booster aft shoe **205**, at the lower booster forward shoe **203**, and at the missile support cradle.

Each ready service mechanism has ten tray stations, as shown best in FIG. 7, but contains only eight trays **502**. The stations are numbered in a clockwise direction from 1 to 10 starting at station **1**, the center hoist position. Normally, stations **9** and **3** are empty, except during actual indexing of the trays **502** from one station to another. In order to move a tray **502** to another station, all trays **502** must be indexed (moved) clockwise or counterclockwise. Furthermore, one complete indexing cycle of the ready service mechanism **500** moves the trays **502** only one station (clockwise or counterclockwise). For example, to move the tray **502** in station **4** to station **1**, two complete indexing cycles of ready service mechanism **500** are necessary.

In function, the trays **502** operate as an integral part of the ready service mechanism **500**. The trays **502** support the missile-booster combinations **300** in the ready service mechanism **500** and restrict any movement, with respect to the trays **502**, during indexing of the trays **502** in the ready service mechanism **500**.

Each tray **502** indicates, through its ready service mechanism **500**, its load status to appropriate control panels in the guided missile launching system. This indication is given at all tray stations except **3** and **9**, which are normally empty. In addition, an empty tray indication is given at a pair of center hoists **508** and **509** and at the pairs of lower outboard end hoists **516**, **517**, and **518**, **519**, respectively. The end hoist indication is associated with strikedown of a missile-booster combination.

When the tray **502** with the selected missile type, that is, S-type or W-type, is hoisted to the overhead tramway

or loader, tray components, which operate in conjunction with the ready service mechanism **502**, release the lower forward and aft booster shoes **203** and **205**, respectively, for transfer of the missile-booster combination **300** to the loader. The empty tray **502** then returns to the ready service mechanism **500**.

It should be understood that when the missile-booster combination **300** is in ready service, it is supported and secured by the bottom pair of its lower forward and aft booster shoes **203** and **205**. When the missile-booster combination **300** is transferred to the loader, it is suspended by an upper pair of similar booster shoe **202** and **204** from the loader rail, all shoes being shown in FIGS. 6 and 8.

Each tray **502**, as shown in detail in FIG. 1*a*, consists of a tray truss frame or weldment **1204**, to which is mounted a missile-type selection indicator **1240**, an empty tray vibration absorber **1330**, an aft shoe receptacle and latch **1203**, a forward shoe receptacle **1202**, and a vibration dampener **1201** for the forward support of the missile **100** of the missile-booster combination **300**. The forward and aft ends of each tray **502** are provided with a roller bracket **1208**, as shown in FIG. 2*a*.

The tray **502** consists of an elongated rectangular all-steel weldment or truss frame **1204** formed by four horizontal rails which are joined by tubing. Except for the ends, the tray **502** is of an open frame construction, as shown in FIG. 1*a*.

In addition to the tubing, the tray **502** is braced by a plurality of spaced crescent-shaped plates **1205** which are vertically welded inside the tray. These plates **1205** are used as brace plates and they do not support the missile **100** or booster **200**.

Each tray **502** contains bumper strips **1211** which are located at each end on the outboard sides, as shown in FIG. 2*a*. Each bumper strip **1211** fits into a vertical recess and it is secured in place by socket head cap screws. The bumper strips **1211** cushion the bumping of the trays **502** and reduce the metallic clanging of trays rubbing together.

As shown in FIGS. 1*a* and 2*a*, a bushing **1209** is mounted in recesses at both frame ends **1206** and **1207** of the tray **502**. Each bushing **1209** is secured by three socket-head cap screws and lockwashers **1236**, as shown in FIG. 3.

The frame end **1206** or **1207** of the tray **502** includes the roller bracket **1208**, two saddles **1210**, two trucks **1212**, two keepers **1214**, four rollers **1216**, four eccentric pins **1218**, a shoe **1220**, a rocker **1222**, a plate **1224**, two bearings **1226**, two bearing shims **1228**, and a pad **1230**, all arranged as shown in FIGS. 2*a* to 2*d*, inclusive. Both ends **1206** or **1207** of the tray **502** are essentially the same, differing only in that there is no rocker **1222** or missile type indicator **1240** provided for the front end **1206** of the tray **502**.

The roller bracket **1208** is bolted to the frame end **1206** or **1207** with six socket-head cap screws, lockwashers, and nuts, and it is the main supporting member of the assembly. Two bushings **1232**, identical to those on the ends of the frame end **1206** of the tray **502**, are mounted in the same manner in recesses near the edges of each roller bracket **1208**. These bushings **1232** as well as the bushings **1209** serve as receptacles for tray locking bars for securing the trays **502** within the ready service mechanism **500**.

The saddles **1210**, shown in FIG. 2*b*, are steel members machined flat on the upper surface to mate with the under surface of the recesses in the trucks **1212** within the roller bracket **1208**. The underside of each saddle **1210** is machined cylindrically to mate with the cylindrically machined upper surface of the trucks **1212**, as shown in FIG. 2*c*.

Each truck **1212** carries two rollers **1216** which ride on needle bearings and which are secured to the truck **1212** by means of the eccentric pins **1218** and roll pins

1219. The two trucks 1212, with their four rollers 1216, carry the weight of the end of the tray 502 and the missile-booster combination 300 on tray roller tracks 524 or 526, shown best in FIG. 4. The trucks 1212 are adjusted by rotating the eccentric pins 1218 in order to distribute the weight evenly on all rollers 1216.

Each truck 1212 is secured against its saddle 1210 by means of the keeper 1214 and a bolt 1234 nad a nut 1235, as shown in FIG. 2*b*. The bolts are tightened just sufficiently to hold the truck 1212 in place, but are loose enough to permit the truck 1212 to slide a few degrees in the fore and aft direction.

This motion, because of the cylindrical shape of the bearing surfaces, permits each truck 1212 to adjust itself to keep the rollers 1216 lying flat on the tracks 524 and 526, and thus correct for any vertical misalignment during operation of the ready service mechanism 500. When adjustment is correct, the eccentric pin 1218 and truck 1212 are drilled and roll pinned to prevent further rotation of the eccentric pin 1218.

The shoe 1220, shown best in FIGS. 2*a* to 2*c*, is a hardened and ground strip of steel which provides a path for rollers provided on the end hoists of associated ready service mechanism 500. The shoe 1220 supports the weight of one end of the tray 502 and the missile-booster combination 300 when the tray 502 is being raised or lowered by these hoists. The shoe 1220 is secured to the bracket 1208 with eight socket-head cap screws and lockwashers 1236.

The rocker 1222, illustrated best in FIG. 2*d*, is a cylindrically machined block of steel, and it is located between the two trucks 1212. Rocker 1222 rides against the tray roller track to prevent endwise movement of the tray 502. The rocker 1222 rests between, and is retained in position by two bearings 1226, which are adjusted for clearance by means of two shims 1228.

Plate 1224 is secured to the top of the rocker 1222 by four screws 1225 and it presses against the rubber pad 1230. Any endwise movement of the tray 502 causes the rail to push against one side of the rocker 1222 and causes it to turn slightly, thus distorting the pad 1230 and providing a buffer action to halt the end movement of the tray 502.

The missile type selection indicator 1240 works in conjunction with the aft shoe receptacle and latch 1203, while the missile vibration dampener 1201 functions in conjunction with the forward shoe receptacle 1202. Also, the aft shoe receptacle and latch 1203 as well as the forward shoe receptacle 1202 function simultaneously. The empty tray vibration absorber 1330 absorbs vibrations of the tray 502 when the tray is empty, that is, when the missile-booster combination 300 is not positioned therein.

The missile-type selection indicator 1240 is located at the aft end of the tray 502, as shown in FIG. 1*a*. It is horizontally mounted in the lower right-hand corner of the tray 502, as illustrated in FIG. 3. A vertical actuator rod 1242 extends upwardly therefrom to the top of the tray 502 where a handle 1244 is attached thereto. The missile-type selection indicator 1240 operates in conjunction with the aft shoe receptacle and latch 1203. It is connected to the aft shoe receptacle and latch 1203 by a latch actuator rod 1246, shown in FIGS. 1*a* and 3.

The main components of the missile-type selection indicator 1240 include a latch actuator arm 1248, which is connected to the latch actuator rod 1246 from the aft shoe receptacle and latch 1203; a Y-shaped switch actuator arm 1254 and detent cam 1250, which are splined to the vertical, hand-operated actuator rod 1242; and the handle 1244. In addition, the selection indicator 1240 includes two spring-loaded actuator caps 1262 and 1264 and switch actuators 1266, mounted in actuator blocks 1268. It also includes a pair of compression springs 1270, a switch actuator 1258 which is keyed to the latch actuator arm 1248, and a mounting bracket 1272, all arranged as shown in FIG. 3.

When a missile-booster combination 300 is loaded into the tray 502, the aft shoe receptacle and latch 1203 seeks the latch actuator arm 1248 on the indicator 1240. When engaged into the hand-operated detent cam 1250, a spring loaded detent 1252 on the latch actuator arm 1248 locks the Y-shaped switch actuator arm 1254 which extends one of a pair of switch actuators 1266 to indicate an S-type or W-type missile 100S or 100W of a missile-booster combination 300 in the tray 502.

The switch actuator 1258 is also located where the latch actuator rod 1246 and latch actuator arm 1248 are joined together. This actuator 1258 indicates an empty tray 502 at the center hoists 508 and 509 and the position for outboard strikedown of a missile-booster combination 300.

When a tray 502 is to be unloaded of its missile-booster combination 300, an unlatching piston, not shown, extends into the tray 502 and contacts a roller 1260, shown in FIG. 3, on the latch actuator arm 1248 to uncock the latch actuator arm 1248 and latch the actuator rod 1246. The actuator rod 1246 retracts a receptacle latch plunger 1278 so that a pair of lower aft and forward booster shoes 205 and 203 of the missile-booster combination 300 may be disengaged from the tray receptacles 1203 and 1202, respectively.

The components of the missile-type selection indicator 1240 operate when the missile-booster combination 300 is loaded into the tray 502 or when the missile-booster combination 300 in the tray 502 is being removed. During loading of a missile-booster combination 300 into a tray 502, the lower booster aft shoe 205 is moved back in its receptacle 1203 until the latch plunger 1278 extends and locks a shoe guide block 1280, as illustrated in FIG. 3. When the latch plunger 1278 extends, the latch actuator rod 1246 is pulled ahead to pivot the latch actuator arm 1248 so that its spring-loaded detent 1252 contacts the detent cam 1250, with the actuator arm 1248 being cocked.

The detent 1252 is depressed against the pressure of its spring. The empty tray switch actuator 1258 attached to the latch actuator arm 1248 is then moved forward. In this position, the actuator 1258 misses a tray-empty signal switch, not shown, mounted thereunder in the strikedown station and in the center hoists of the ready service mechanism. The tray 502 is now loaded with a desired missile-booster combination 300.

In order for an indication of an S-type or W-type missile 100S or 100W to appear on the control panels, one of the missile-type switch actuators 1266 must be extended on the selection indicator 1240 on the tray 502. The missile-type indicator handle 1244 is then set, it being assumed that the crew member at the tray 502 knows if the tray contains an S-type or a W-type missile 100S or 100W of the missile-booster combination 300.

The indicator handle 1244 at the top of the tray 502 is toggle positioned to correspond with the missile 100S or 100W in the tray 502. The bracket for the handle 1244 is marked "W" on the left side and "S" on the right side to indicate the missile type as previously mentioned. The indicator handle 1244 is spring-loaded so that it will not be dislodged into the opposite position by vibration of the tray 502. This applies to "Dud" indication, as will be described later.

The indicator handle 1244 is also pivoted so it can be moved within the "S" or "W" position thereof. With the handle 1244 spring positioned in an appropriate "S" or "W" slot, it is then pulled back. The missile-type indicator 1240 is now properly positioned to indicate the missile-type 100S or 100W loaded in the tray 502 at the control panels of the guided missile launching system.

When the indicator handle 1244 is pulled back, it rotates the vertically mounted actuator rod 1242. The detent cam 1250 and the switch actuator arm 1254, as

previously mentioned, are splined to the bottom of the rod **1242** and move with the indicator handle **1244**. Detent cam **1250** is rotated until the spring-loaded detent **1252** on the latch actuator arm **1248** engages a detent hole in the cam **1250**. When this occurs, the proper end of the Y-shaped switch actuator arm **1254** is locked on its actuator cap **1262** or **1264**.

The actuator **1258** depresses the actuator cap **1262** or **1264** causing the switch actuator **1266** to extend through the bottom. The switch actuator **1266** depresses the appropriate switch at each ready service station (except Stations **9** and **3**) to indicate the missile **100S** or **100W** in each station in the ready service mechanism **500**. The indication of the missile type **100S** or **100W** is relayed to missile-type indicator lights on the appropriate control panels of the system.

The aft shoe receptacle and latch **1203** is located near the aft end of the tray **502**, as illustrated in FIG. 3. It is horizontally mounted in the bottom and at the center of the tray **502**. The aft shoe receptacle and latch **1203** is connected to the missile-type selection indicator **1240** by the latch actuator rod **1246**.

The aft shoe receptacle and latch **1203** supports the aft end of the missile-booster combination **300** in the tray **502**. It also provides a bearing surface for the lower aft shoe **205** of the missile-booster combination **300**. The aft shoe receptacle and latch **1203** secures the aft booster shoe **205** and it restricts any fore and aft movement of the missile-booster combination **300** in the tray **502**.

During the loading of a tray **502** with a missile-booster combination **300**, when the booster aft shoe **205** becomes positioned, the latch of the receptacle **1203** locks the shoe **205** in position and additionally cocks the latch actuator arm **1248** on the missile type selection indicator **1240**. To unload the missile-booster combination **300** from the tray **502**, the latch of the receptacle **1203** is retracted through the latch actuator arm **1248** and latch actuator rod **1246**.

The components of the aft shoe receptacle and latch **1203** include a guide block support **1282**, which forms the base for the guide block **1280**; a stop bar **1284** on the forward end and right-hand and left-hand guide levers **1286** on the aft end; and two tension springs (not shown) which are mounted to the guide block **1280** and the stop bar **1284**.

Additional components of the aft shoe receptacle latch **1203** include a latch housing **1288** to which all latch parts are mounted, the previously mentioned latch plunger **1278**, a compression spring **1290**, a latch end plate **1292**, a latch actuator **1294**, and a threaded adjustment yoke **1296**, all arranged as illustrated in FIG. 3.

Because of the physical location and related function of its components, the aft shoe receptacle and latch **1203** is considered as a single unit. As shown in FIG. 3, the aft shoe receptacle components are mounted to the bottom of the tray **502**. The receptacle latch components are located alongside but are anchored to a vertical brace plate (not shown) at the forward end.

When the tray **502** is empty, the aft shoe guide block **1280** is located on the forward end of the receptacle and latch **1203** against the stop bar **1284**. The latch plunger **1278** is retracted but pressure from the spring **1290** keeps it in contact on the side of the guide block **1280**.

The plunger **1278** and guide block **1280** are provided with mating beveled surfaces. It is this contact between the surfaces of the guide block **1280** and plunger **1278** in addition to the tension springs which insures that the guide block **1280** will not wander from this position during vibration of the tray **502**. The guide block **1280** must be in this position for the loading of the missile-booster combination **300** into the tray **502**.

When a missile-booster combination **300** is loaded into the tray **502**, the lower aft booster shoe **205** enters the guide block **1280** of the receptacle and latch **1203**. The missile-booster combination **300** is lowered until the bottom surface of the lower aft booster shoe **205** is resting on the guide block which is provided without a bottom.

The missile-booster combination **300** is then moved aft in the tray **502**. The guide block **1280** and aft booster shoe **205** are moved aft with the protruding surfaces of the shoe **205** passing under the guide levers **1286**. The aft movement of the missile-booster combination **300** continues until the guide block **1280** contacts a raised end **1298** of the guide block support **1282**. At the end of travel, the spring-loaded latch plunger **1278** extends to lock the guide block **1280** in the position shown in FIG. 1*b*. When the latch plunger **1278** extends, the latch actuator arm **1248** on the missile-type selection indicator **1240** is then cocked.

When the missile-booster combination **300** is to be unloaded from the tray **502**, the receptacle latch plunger **1278** must be retracted to free the guide block **1280**. This is accomplished by hydraulically operated missile unlatching pistons on the ready service mechanism **500**.

When the necessary conditions are satisfied, the missile unlatching piston then extends. It contacts the roller **1260** on the free end of the latch actuator arm **1248** on the indicator **1240**, as shown in FIG. 3. The latch actuator arm **1248** is then pivoted. The latch actuator rod **1246**, which is connected to the latch actuator arm **1248**, is then pulled back to pivot the latch actuator **1294**. Actuator **1294** then retracts the latch plunger **1278** against the pressure of its spring.

The missile unlatching piston remains extended until the missile-booster combination **300** is moved forward by crane or otherwise so that the aft shoe guide block **1280** is against the stop bar **1284**. The aft booster shoe **205** is now free to be removed from the aft shoe receptacle and latch **1203**.

When the missile-unlatching piston retracts, the spring-loaded latch plunger **1278** extends so that it is against the side of the guide block **1280**. A beveled surface on the latch plunger **1278** contacts a mating surface on the guide block **1280** to hold it in this position.

The forward booster shoe receptacle **1202**, illustrated in FIG. 1*c*, is located in the tray **502** at the position shown. It is physically connected to the vibration dampener **1201** by two carrier rods **1302**. The forward shoe receptacle **1202** operates with the aft shoe receptacle **1203** of the tray **502** to receive the lower forward and aft shoes **203** and **205** of the booster. It supports the missile-booster combination **300** at its center support point in the tray **502**. The forward booster shoe receptacle **1202** provides a bearing surface for the lower forward shoe **203** and restricts any movement at this point of the missile-booster combination **300** in the tray **502**.

The components of the forward shoe receptacle **1202**, as shown in FIGS. 1*a*, 1*c*, and 1*d*, are left-hand and right-hand forward shoe tracks **1304**, left-hand and right-hand carrier links **1306**, two compression springs **1308**, and a pair of front and rear carrier link brackets **1312** and **1310**, respectively, all mechanically associated as shown. The carrier links **1306** are connected to the vibration dampener **1201** by means of the carrier rods **1302**.

The carrier links **1306** are supported by the front and rear carrier link brackets **1312** and **1310**. The brackets **1312** and **1310** are anchored to the shoe tracks **1304** with the carrier links **1306** being arranged to move back and forth thereon. A U-shaped part on the carrier links **1306** also travels in the shoe track **1304**. The compression springs **1308** on the forward end of the carrier links **1306** keep the vibration dampener **1201** and carrier links **1306** in their forward positions when the tray **502** is empty of a missile-booster combination **300**.

When the tray **502** is empty, the carrier links **1306** on the forward shoe receptacle **1202** are located in the forward position, butted against the front carrier link brackets **1312**. These links **1306** are maintained in this position by the compression springs **1308** located at the

front of the receptacle **1202**. In this position, the U-shaped part on the carrier link **1306** is aligned with an entry-exit slot or receptacle **1314** in the shoe track for the forward booster shoe **203**.

When the tray **502** is being loaded with a missile-booster combination **300**, the latter is horizontally lowered into the tray **502**. The outboard ends of the lower forward booster shoe **203** enter the rectangular-shaped openings formed by the carrier links **1306** and shoe track slots **1314**. The missile-booster combination **300** is then lowered until the forward booster shoe is supported by the shoe tracks **1304**.

The missile-booster combination **300** is then moved aft in the tray **502**. The carrier links **1306** and outboard ends of the forward booster shoe **203** are then moved aft in the shoe tracks **1304**. All lateral movement of the forward booster shoe **203** is restricted by the shoe tracks **1304**. Any fore and aft movement of the missile-booster combination **300** in the tray **502** is restricted by the aft booster shoe guide block **1280** at the aft booster shoe receptacle and latch **1203**, as shown in FIG. 3.

The compression springs **1308** on the front of the carrier links **1306** are then compressed. These springs **1308** are compressed against the front carrier link brackets **1312** by the carrier rods **1302**. When the tray **502** is empty of a missile-booster combination **300**, these springs **1308** hold the carrier links **1306** in their forward position.

When the tray **502** is to be unloaded of its missile-booster combination **300**, the latter combination **300** is moved forward. At the end of the forward movement of the missile-booster combination **300**, the lower forward booster shoe **203** is at the exit slots **1314** in the shoe tracks **1304** and the shoe **203** of the missile-booster combination may be raised out of the receptacle **1202**.

The missile vibration dampener **1201**, shown best in FIG. 1*d*, is the forwardmost component in the tray **502**. It is physically connected to the forward shoe receptacle **1202** by the two carrier rods **1302**. The missile vibration dampener **1201**, also referred to as the forward support, supports the missile **100** of the missile-booster combination **300** in the ready service tray **502**. It is a combined spring support and hydraulic damper unit. Dampener **1201** is physically connected to the forward shoe receptacle **1202** and moves fore and aft with it.

The missile vibration dampener **1201** consists essentially of a left-hand and a right-hand track **1318** which supports the dampener **1201** and allows it to move fore and aft. An outer housing **1320**, which forms the base for all the other components is provided for the missile vibration dampener **1201**, and it is mounted to the tracks **1318** by rollers **1322**.

An inner housing **1324**, which makes physical contact with the missile **100** is also provided and it is connected to the outer housing **1320** through four coil springs **1326** and four piston assemblies **1328**. The piston assemblies **1328** are hydraulically connected to a small accumulator **1340**, shown schematically in FIG. 5, which is horizontally mounted on the aft end of the dampener **1201**.

Two piston assemblies **1328** are located in each side of the dampener **1201**, one behind the other, as shown in FIG. 42. The coil spring **1326** is mounted over each piston assembly **1328**. Except for left-hand and right-hand locations, the piston assemblies **1328** are the same and each consists, as shown in FIG. 5, of two sleeves **1342** and **1344** anchored in the bottom of the outer housing **1320**.

A piston **1346** fits into both sleeves **1342** and **1344** and it is anchored to the inner housing **1324** at the top thereof. The inside of the piston **1346** contains an orifice **1348**, an orifice sleeve **1350**, a ball **1352**, and a spring **1354**. A plug **1356**, which is theaded into the bottom of the piston **1346**, has a valve stem **1358** formed on it. The plug **1356** supports the orifice **1348**, and the sleeve **1350** and holds them in place.

In summary, when a missile-booster combination **300** is loaded into tray **502**, it is supported at three places, namely by the lower forward and aft shoes **203** and **205** of the booster in the receptacles **1202** and **1203** and by the vibration dampener **1201** beneath the central part of the missile **100**. The previously mentioned four coil springs **1326** in the dampener **1201** support the weight of the missile **100** of the missile-booster combination **300**. Each coil spring **1326** is mounted over the piston assembly **1328** effectively in parallel, as shown in FIG. 5.

The piston assemblies **1328** act as relief valves and are set at 3000 p.s.i. During normal operating conditions, the fixed orifice **1348** in the piston assembly **1328** allows the hydraulic fluid to pass from one side of the piston **1346** to the other.

In the event of a high impact shock, when the hydraulic pressure on the bottom of the piston **1346** exceeds 3000 p.s.i., it unseats the ball **1352**. This allows other hydraulic fluid in addition to that of the fixed orifice **1348** to enter the chamber at the top of the piston **1346**. When the pressure on the bottom of the piston **1346** drops to below 3000 p.s.i., the ball **1352** reseats on the top of the orifice plug **1356**. Any hydraulic fluid returning to the bottom of the piston **1346** must pass through the fixed orifice **1348** below the ball **1352**.

The empty tray vibration absorber **1330**, illustrated in FIG. 1*e*, is horizontally mounted in the tray **502**. It is located between the forward shoe receptacle **1202** and the missile vibration dampener **1201**. The function of the empty-tray vibration absorber **1330** is to absorb vibration of the tray **502** when it is empty.

The components of the vibration absorber **1330** include two rectangular-shaped housings **1332** which are connected and supported by two bonded leaf springs **1334**. The vibration absorber **1330** is anchored to the tray **502** by a mounting bracket **1336** located at the center of the bonded springs **1334**.

Each housing **1332** is divided into a series of eight internal compartments and contains 40.5 lbs. of steel shot and one quart of Silicone oil which are evenly distributed into the individual compartments. The top of the housing **1332** is closed with a cover **1338** which is bolted to the housing **1332**. The bottom of each housing **1332** is provided with two stop plates which contact the tray **502** after approximately ¾ inch downward travel thereof. Each housing **1332** has a stop bracket which contacts the bottom of the tray after approximately ¾ inch travel in the upward movement. This limits the travel of the housing **1332** to approximately ¾ inch in either direction.

Any vibration of an empty tray **502** is transmitted into the tray vibration absorber **1330**. The vibration absorber **1330** counteracts any up and down movement of the tray **502**. It cancels the movement of the tray **502** and tends to neutralize it.

The trays **502**, as previously mentioned, form a part of the ready service mechanism **500**. The ready service mechanism **500** is shown in FIG. 6 and consists of the front stand **504** and a rear stand **514** between which a plurality of trays **502** are supported in two tiers upon horizontal rails. The stands **504** and **514** have cooperatively operating pairs of end hoists **516** and **517** on the right side and similar cooperatively operating pairs of end hoists **518** and **519** on the right side. A pair of cooperative center hoists **508** and **509** are also provided for the upper tier only.

A tray indexing mechanism **800** is arranged to shift the top and bottom tiers of trays **502** oppositively either clockwise or counterclockwise in the ready service mechanism **500**.

As shown in FIG. 7 and as previously mentioned each ready service mechanism **500** has ten ready service stations. These stations do not move but each station represents the space which can be occupied by one tray **502**. If it is desired that an S type missile-booster combination **300** is to be raised by the pair of center hoists **508** and

509 to an overhead tramway or loader (not shown), the missile-booster combination 300 in station 4 is first raised in its tray 502 to station 3 by the right end pair of hoists 516 and 517. The indexing mechanism through an index arm 804 and a pair of crossheads 542 and 544 moves the upper tier of trays 502 leftward and the lower tier of trays 502 rightward. The desired S type missile-booster combination 300 is thus positioned from station 2 to station 1 where it can be lifted and removed from its tray 502 and the ready service mechanism 500.

Obviously many modifications and variations of the present invention are possible in 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 is:

1. In a missile launching system for launching missiles provided with at least one pair of fore and aft arranged handling shoes, a top-loading missile tray for storing and handling said missiles comprising an elongated truss structure of substantially rectangular cross-section shaped to define an upwardly opening missile-receiving trough extending substantially throughout its length, a releasably lockable aft shoe receptacle means mounted adjacent one end of said tray to receive the aft most of said handling shoes, a missile type indicating means interconnected with and actuated by said aft shoe receptacle means when the latter means is moved between its locked and unlocked positions, a releasably lockable forward shoe receptacle means slidably mounted on said tray forwardly of said aft shoe receptacle means to be selectively movable between locked and unlocked positions, a vibration dampener means slidably mounted on said tray forwardly of said forward shoe receptacle means,

said dampener means being mechanically interconnected with said forward receptacle shoe means and slidably actuated thereby.

2. A missile tray as defined in claim 1 wherein said aft shoe receptacle means comprises a guide block slidably mounted to move between locked and unlocked positions, a spring-biased latch plunger coacting with said guide block to releasably retain the latter in its locked position, said missile type indicating means being connected to said latch plunger to be actuated thereby.

References Cited by the Examiner

UNITED STATES PATENTS

2,417,347	3/1947	Brown	188—1
2,484,722	10/1949	Nickelsen et al.	248—358
2,880,681	4/1959	Markestein et al.	248—358 X
2,896,447	7/1959	Phillips et al.	188—1
2,903,124	9/1959	Carver	89—1.7
2,910,879	11/1959	Hanks	248—23 X
2,928,535	3/1960	Simmons et al.	206—46
2,933,183	4/1960	Koelsch	206—46

FOREIGN PATENTS

626,923	7/1949	Great Britain.

OTHER REFERENCES

Aviation Week, All-Terrain Vehicle Handles Corporal, July 22, 1957, page 59.

Ground Support Equipment, October/November 1959, page 104. Missile Tray Made by B and P.

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