

May 14, 1963

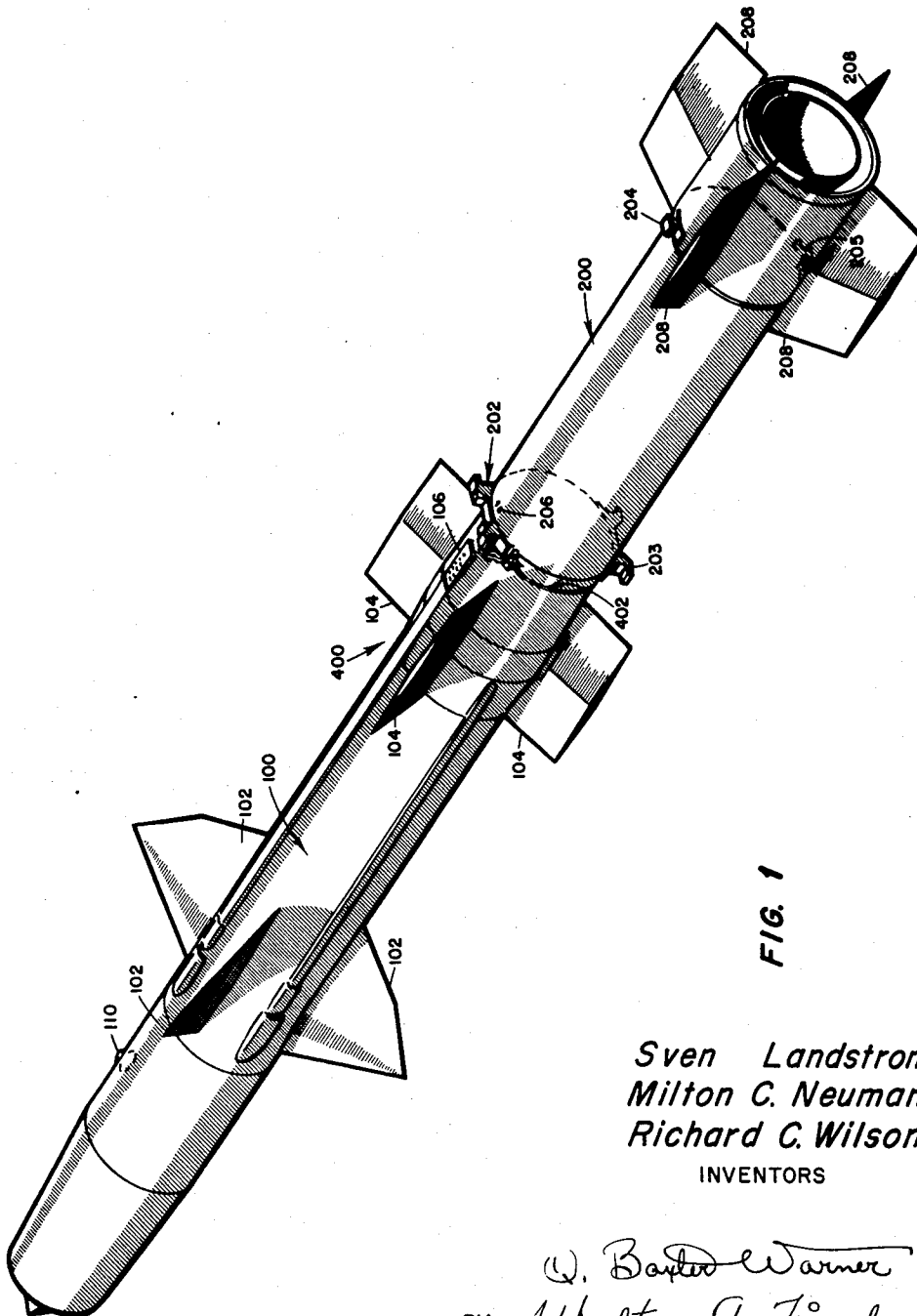
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3,089,925

WARMUP CONTACTOR FOR GUIDED MISSILE LAUNCHING SYSTEM

Original Filed Oct. 22, 1959

8 Sheets-Sheet 1



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May 14, 1963

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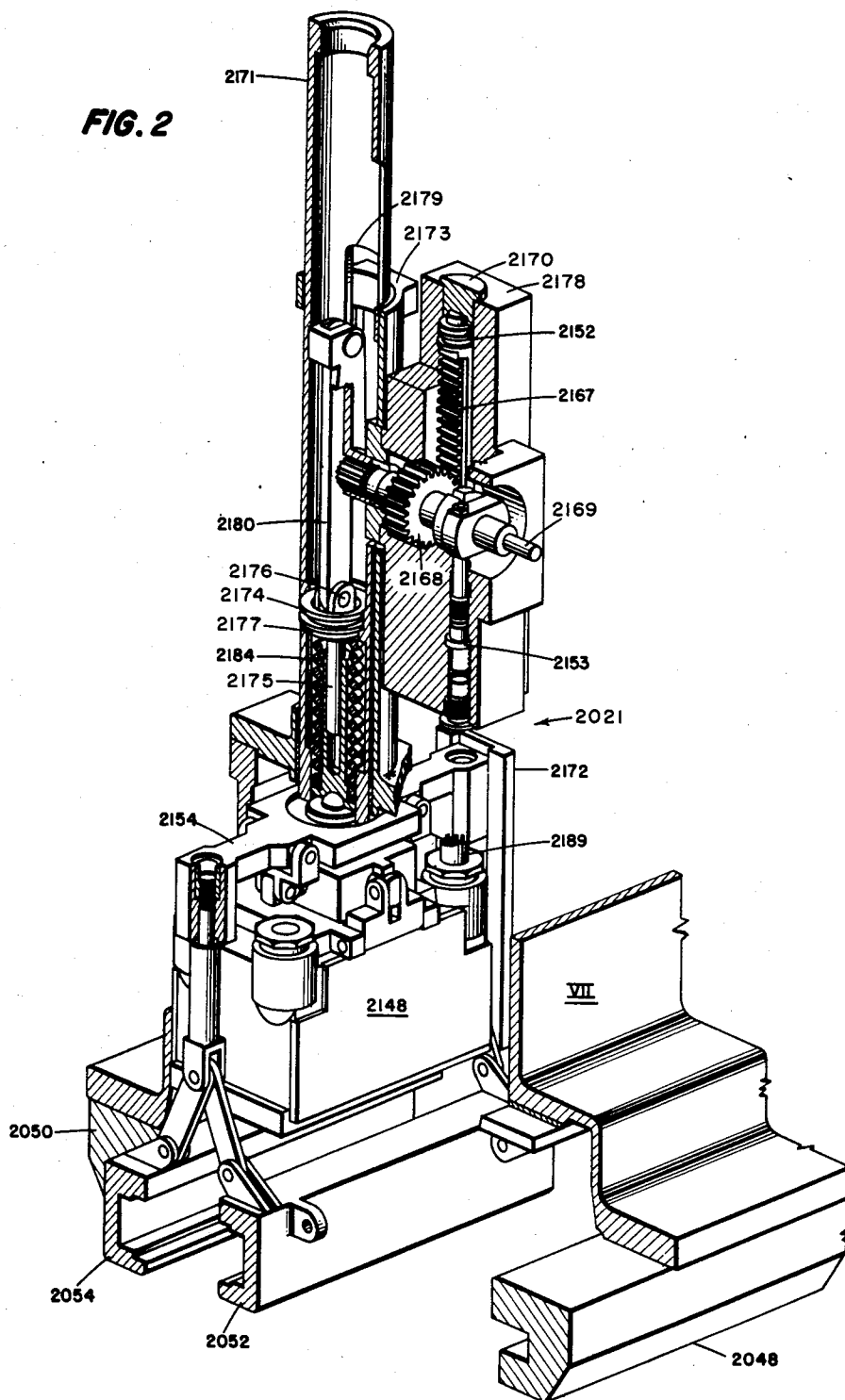
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FIG. 2



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FIG. 11

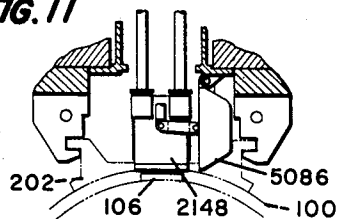
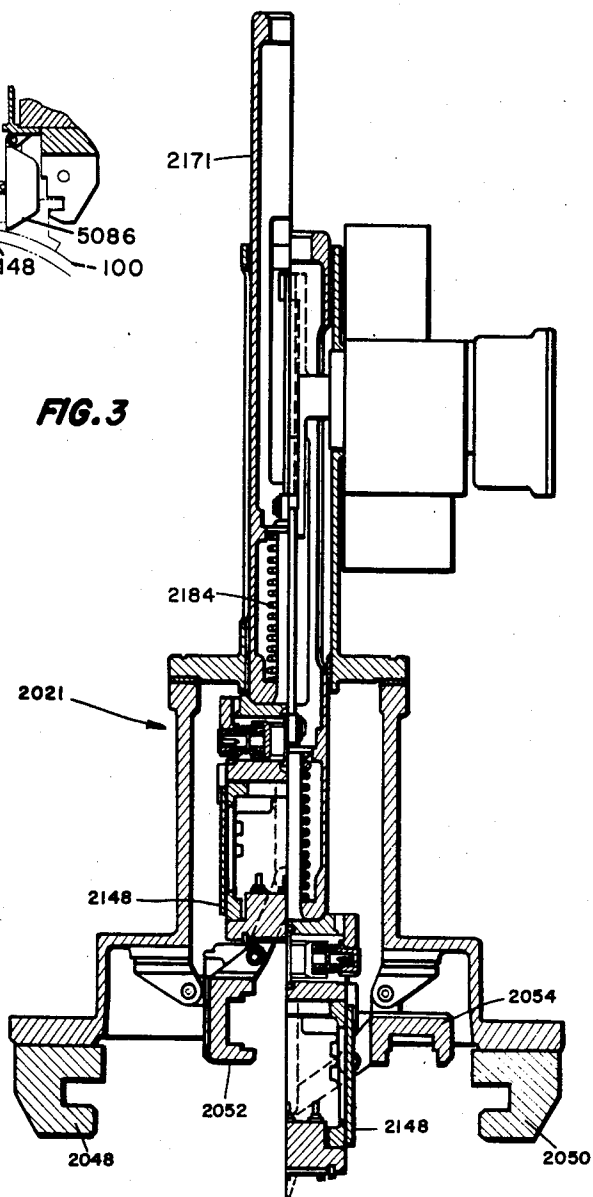


FIG. 3



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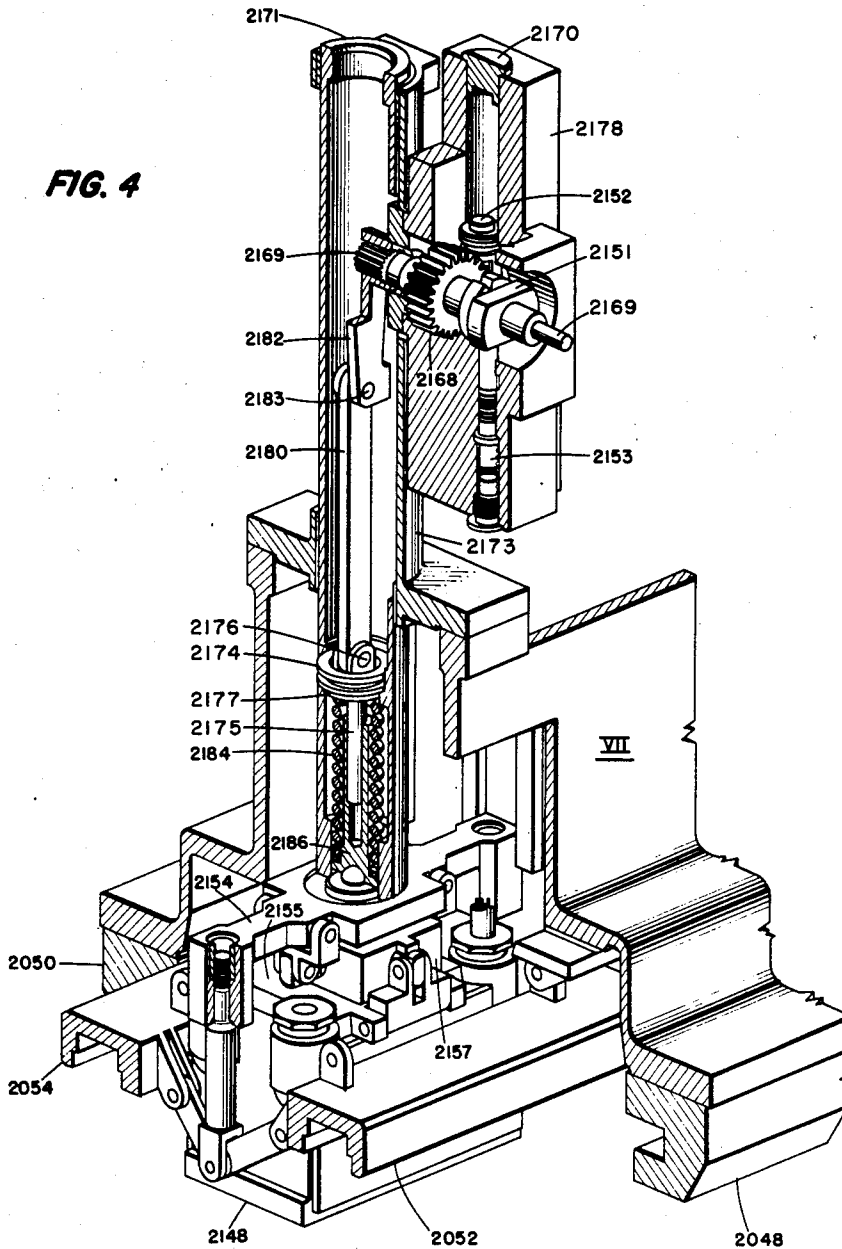
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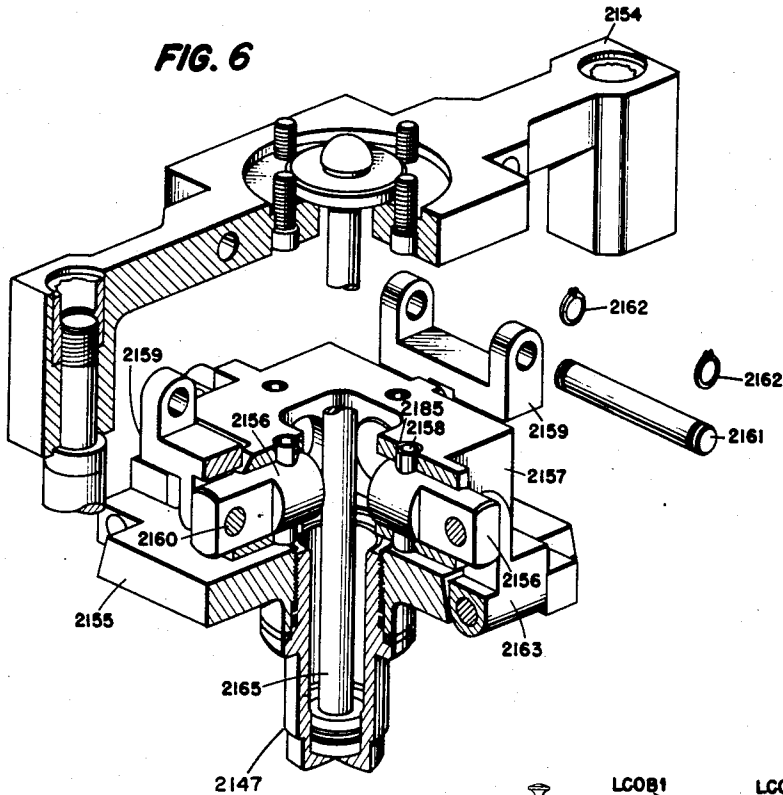
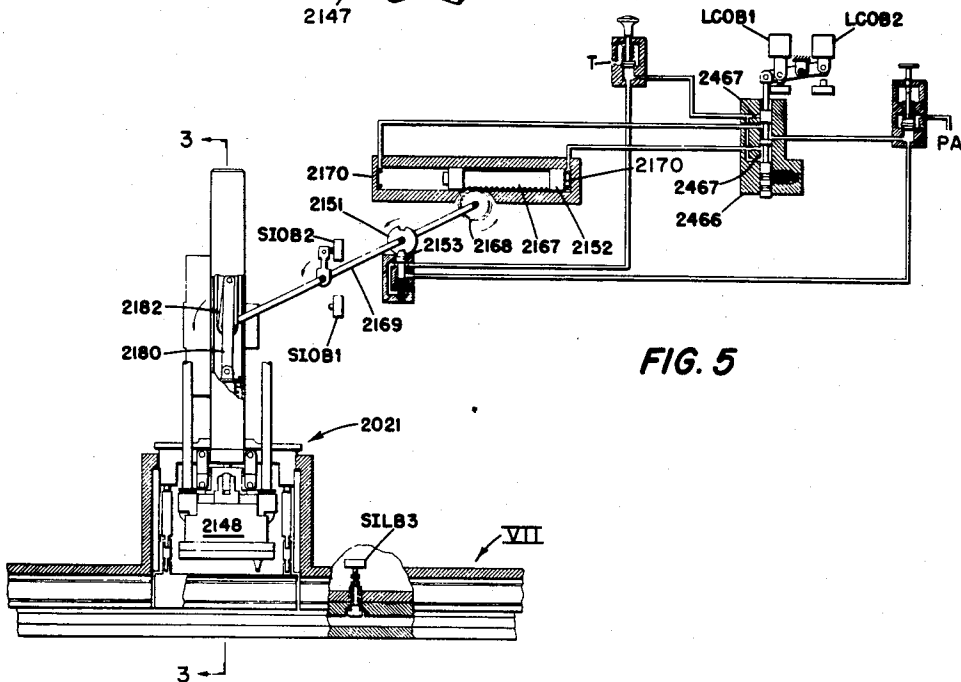
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FIG. 6



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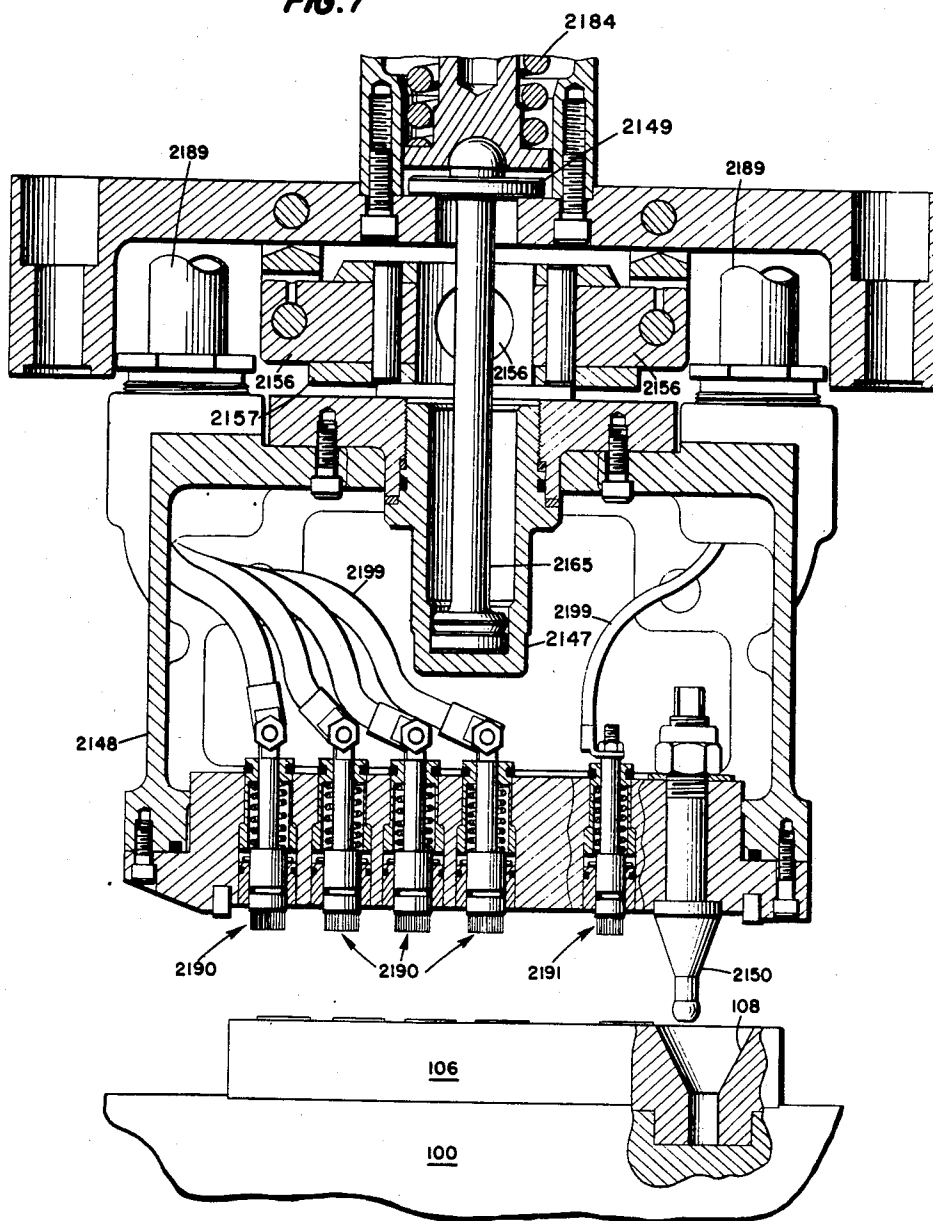
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FIG. 7



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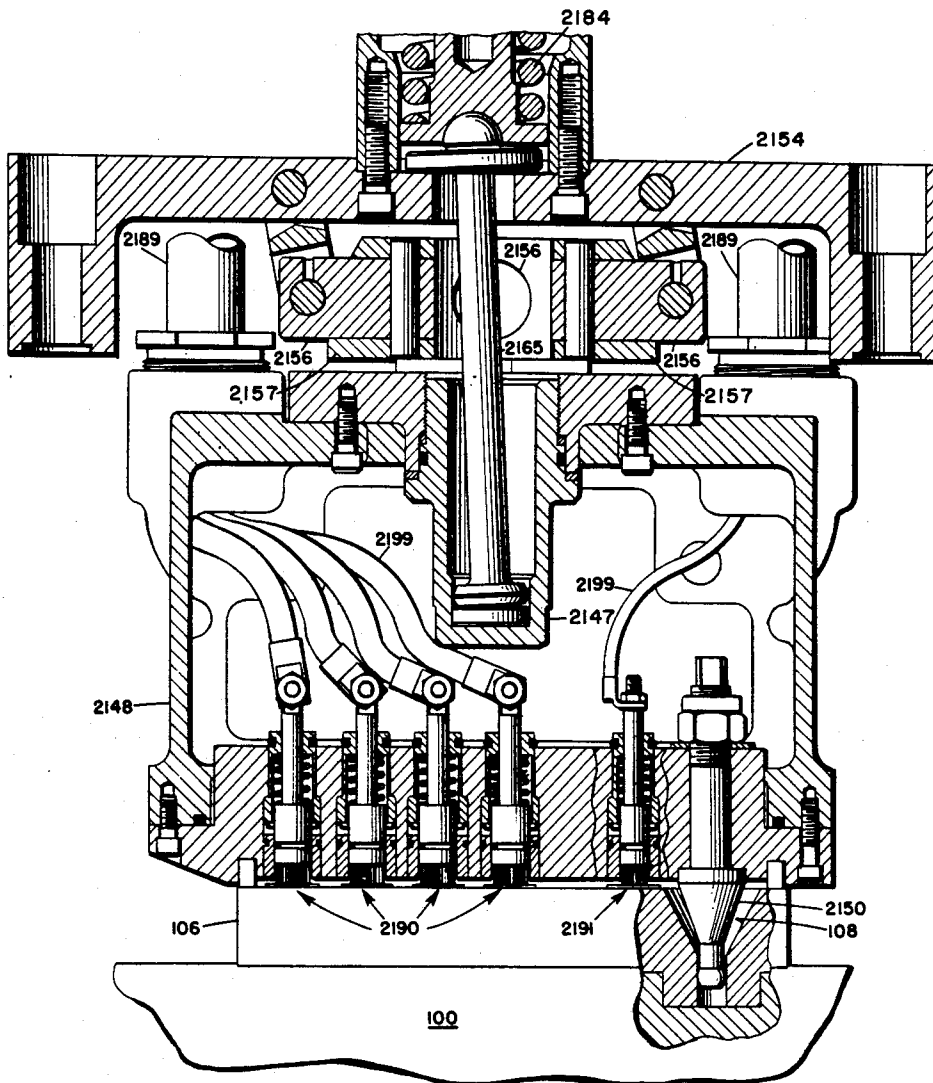
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FIG. 8



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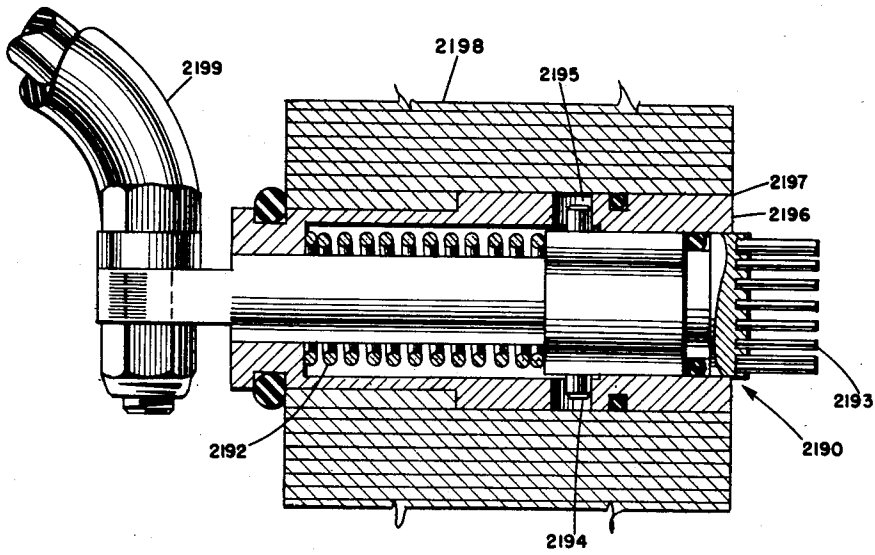


FIG. 9

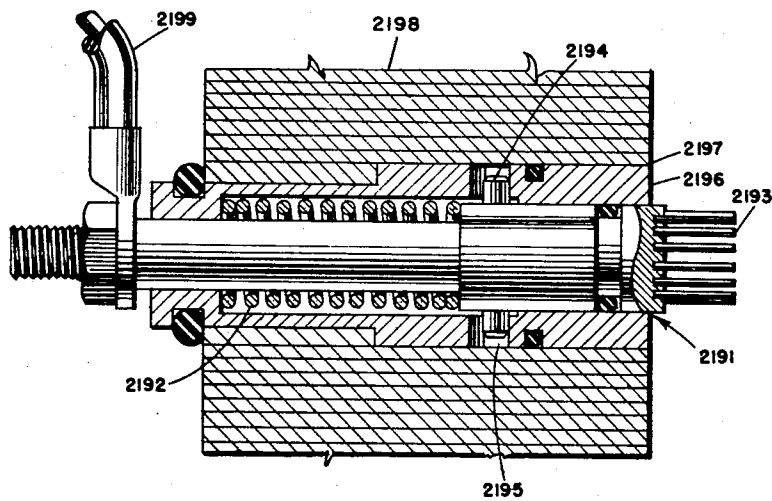


FIG. 10

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WARMUP CONTACTOR FOR GUIDED MISSILE LAUNCHING SYSTEM

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Original application Oct. 22, 1959, Ser. No. 848,163.
Divided and this application May 12, 1960, Ser. No. 11,386

6 Claims. (Cl. 200—23)

This invention relates generally to electrical contact devices, and more particularly it pertains to an umbilical connector arrangement for completing electrical circuitry in missiles.

This is a divisional patent application of a co-pending parent application entitled "Guided Missile Launching System," U.S. patent application, Serial Number 848,163, filed October 22, 1959, by Myron J. Bauer et al.

It is an object of this invention to provide a contact making arrangement for completing electrical circuitry from the exterior to the interior of a missile.

Another object of this invention is to provide a rapid acting automatic contact extender and retractor arrangement having a gentle but positive simple harmonic action.

Still even another object of this invention is to provide a contactor device for completing an electrical circuit to a contact pad spaced therefrom and consisting of a movable contact block connected to an external circuit, together with means for moving the contact block to the contact pad in simple harmonic motion so as to complete the connection to the external circuit.

Still another object of this invention is to provide an umbilical type contactor arrangement having rotary wiping heavy current bristle type contacts.

And yet another object of this invention is to provide an extending mechanism for a hydraulically controlled contacting device which cannot be overextended and which includes fail safe features in the event the hydraulic pressure for the operation thereof is lost.

In accordance with the invention, there is provided an umbilical type of contactor arrangement for completing electrical circuitry in a missile and to apply warmup power to the missile during assembly of aerodynamic surfaces to a missile weapon, and during other delays incident to preflight preparations of the missile weapon.

This arrangement consists basically of a movable contact block having a plurality of contact elements connected to an external circuit, together with a contact pad having a corresponding number of opposing contact elements.

In addition to the above, means are provided for moving the contact block in a simple harmonic motion to either extend or retract the contact block from the contact pad so as to complete or interrupt electrical circuits between corresponding contacts. Also, other means are provided for aligning the contact block with the contact pad.

These and other objects and advantages of this invention will become more readily apparent and understood from the accompanying specification and drawings in which:

FIG. 1 is a perspective view of a missile weapon illustrating a contact pad and suspension shoes;

FIG. 2 is a dimetric view, partly in section, of a warmup contactor incorporating features of this invention showing the contact box thereof retracted;

FIG. 3 is a cross-section taken along line 3—3 of FIG. 5 showing the right half of the warmup contactor extended and the left half retracted;

FIG. 4 is a dimetric view, partly in section, of the warmup contactor of FIG. 2, showing the contact box thereof extended;

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FIG. 5 is a schematic diagram of the hydraulic components for the warmup contactor;

FIG. 6 is an exploded view of a universal alignment head for the warmup contactor;

FIG. 7 is a cross section of the warmup contactor box and alignment head illustrating the beginning of the engagement thereof with the missile contact pad;

FIG. 8 is a cross section similar of FIG. 7 of the warmup contactor box and alignment head illustrating complete engagement thereof with the missile contact pad;

FIG. 9 is a vertical section partly in side elevation, of a high current contact of the warmup contactor;

FIG. 10 is a vertical section, partly in cross section, of a low current contact of the warmup contactor; and

FIG. 11 is an end elevation of an extended contactor box with a weather cover variation, with portions of the engaged missile being shown in phantom.

Referring now to FIG. 2 of the drawings, there is illustrated generally therein a warmup contactor 2021.

The warmup contactor 2021 is intended to engage an electrical contact pad 106 on a missile 100 of a missile weapon 400. This weapon 400 consists of the missile 100 having a plurality of wings 102 and fins 104, and a booster 200 having booster fins 208. The missile 100 is secured to the booster 200 by a clamping ring 402. The booster 200 is provided with upper forward and rear handling shoes 202 and 204, and lower forward and rear handling shoes 203 and 205, respectively, and an arming mechanism 206 for the booster. In addition, the missile 100 is provided with a warhead arming mechanism 110.

The warmup contactor 2021 is used to apply external electrical warmup power to the missile 100 during the assembly of the aerodynamic wings 102 and fins 104 and 208 and during other delays incident to the pre-flight preparations thereof. During this operation, the missile 100 is suspended by the pair of shoes 202 and 204 from a conveyer trunk section VII, illustrated partially in FIGS. 2 and 4.

The warmup contactor 2021 is supported above and extends and retracts, as shown in the split view of FIG. 3, and in FIGS. 2 and 4, approximately eight inches through the center of the conveyer trunk. The trunk section is provided with skid tracks 2048 and 2050 for supporting the missile 100, and also has drive chain tracks 2052 and 2054 therebetween. A section of the chain tracks 2052 and 2054 folds away to accommodate an extendable warmup contactor box 2148, shown in FIGS. 3 and 5.

The exact location of the contactor pad 106 on a missile 100 will vary due to mechanical inexactness in the structure of the missile and successive load cycles. As a result, the contactor box 2148 must be individually aligned to each missile 100 by a floating block 2157, illustrated in FIG. 6. This is accomplished by a counter-sunk locator socket 108, shown in FIGS. 7 and 8, in the missile contact pad 106.

The bottom of the contactor box 2148 is fitted with a round, tapered locator 2150 which extends beyond the contactor box 2148, as illustrated in FIGS. 7 and 8. Once the missile 100 has been positioned beneath the warmup contactor 2021, hydraulic fluid is ported to a rack piston 2152 and a pinion shaft detent 2153, as illustrated in FIGS. 2, 4, and 5. The pinion shaft detent 2153 is hydraulically released to permit the warmup contactor box 2148 to be extended approximately eight inches. As the warmup contactor box 2148 is extended, as shown best in FIG. 8, the locator 2150 engages the locator socket 108 and automatically aligns the warmup contactor box 2148 with respect to the contactor pad 106 of the missile 100.

A universal alignment head 2155, located just back of a guide yoke 2154, allows the contactor box 2148 to move

in a longitudinal and/or transverse direction to match the position of the contactor pad 106, as shown in FIG. 6.

Referring now to FIG. 7 of the drawings, the contactor box 2148 is shown in the centered free position, with the contactor box 2148 and pad 106 misaligned in one plane. FIG. 8 shows the contactor box 2148 aligned and engaged with the contactor pad 106 of the missile 100. Centering freedom of the contactor box 2148 is provided for similar misalignment in the transverse direction.

The previously mentioned universal alignment head 2155 to which the contactor box 2148 is mounted provides for plus or minus one half an inch displacement in the longitudinal and transverse directions. The universal alignment head 2155 is provided with four pivot bars 2156, as shown in FIG. 6. These pivot bars 2156 are vertically and pivotally mounted to the center or floating block 2157 of the universal alignment head 2155 by four vertical pins 2158.

An opposite pair of the four pivot bars 2156 are pivotally supported by two yoke brackets 2159 by means of horizontal pins 2160. The yoke brackets 2159 depend from the guide yoke 2154 by pivot shafts 2161 which are held in place by C-washers 2162. The remaining pair of pivot bars 2156 are pivotally pinned to a pair of hangers 2163.

The four vertical pins 2158 are press fitted to their associated pivot bars 2156 but are loosely fitted in oversize holes 2185 in the floating block 2157. Thus captivated, the pivot bars 2156 can rotate about their axes to a limited degree and compensate for a one and one-quarter degree tilt of the contactor box 2148 if required by an off-level missile contact pad 106.

In FIG. 7, the locator 2150 is shown misaligned with the locator socket 108 by approximately one quarter inch, while FIG. 8 shows the universal alignment arrangement providing the necessary compensation therefor.

Aside from the longitudinal angular and transverse variations in the position of the current contacts 2190 and 2191, the vertical positioning thereof must also be provided for. As shown in FIG. 4, there is provided a connecting rod 2180 for a crank 2182 which provides a fixed stroke of eight (8) inches. However, the contactor box 2148 travels less than this distance, depending on the vertical position of the missile contact pad 106.

An overtravel spring 2184 provided for the spindle 2171 permits the connecting rod 2180 to overtravel after the contactor box 2148 has engaged the missile contact pad 106. When the crank pin 2183 is in a self-locked, over-center position, the 500 pound overtravel spring 2184 through a plunger spindle 2186 governs the actual contact pressure of the components, that is, the warmup contactor 2021 and the contactor pad 106. Failure of hydraulic power will thus not affect the contact pressure of the warmup contactor 2021 with the contactor pad 106 of the missile 100. The overtravel spring 2184 provides an added function, best illustrated in FIGS. 7 and 8.

The universal alignment head 2155 is provided with a cap 2147 which receives one end of a tiltable pressure rod 2165. The rod 2165 takes the total vertical force of about 500 pounds which exists between the contactor box 2148 of the warmup contactor 2021 and the contactor pad 106 of the missile 100 upon contact. This force is distributed through the individual electrical contacts 2190 and 2191.

The compression of the overtravel spring 2184 is transmitted by the plunger spindle 2186 against the rod 2165. This force holds a flat head 2149 of the rod 2165 against the guide yoke 2154, normally keeping the flat head 2149 parallel therewith and the rod 2165 vertical to center the contactor box 2148 in the assembly.

If the contactor box 2148 shifts to align with the missile contact pad 106, the flat head 2149 pivots on one side further compressing the spring 2184, as illustrated by comparing FIGS. 7 and 8. The linkage on each side of the block 2157 holds the contactor box 2148 parallel with the contact pad 106. When the contactor box 2148 is re-

tracted, the pressure of the overtravel spring 2184 against the rod 2165 again centers the contact box 2148.

In FIGS. 9 and 10, the high current and low current contacts 2190 and 2191, respectively, are shown in detail for the warmup contactor 2021, shown in FIGS. 7 and 8. As shown, the current contacts 2190 and 2191 are individually spring-loaded by the springs 2192. The springs 2192 create pressure which holds the high and low current contacts 2190 and 2191 snugly in place during engagement with the contactor pad 106 of the missile 100. The current contacts 2190 and 2191 are also provided with beryllium copper wire bristles 2193 which are soldered to the ends of the contacts.

As a current contact 2190 or 2191 is compressed against its respective spring 2192, it is forced to revolve. This causes the bristles 2193 to move like a circular brush through the agency of a helix pin 2194, which passes through the center of the current contact 2190 or 2191, and is guided by a twisted cam slot 2195 in a contact quill 2196. The hexagon shaped quill 2196 is fitted to a hexagon socket 2197 in a phenolic insulator block 2198. This prevents the contact quill 2196 from rotating. Terminal wires 2199 enter into the contactor box 2148 through a plurality of separate flexible conduits 2189, as shown in FIGS. 7 and 8.

As previously mentioned, the contactor box 2148 is connected to the guide yoke 2154 through the universal alignment head 2155, with the guide yoke 2154 being attached to the end of a vertically mounted spindle 2171 through a semifloating linkage. The spindle 2171 is vertically guided in a housing column 2173 while the guide yoke 2154 slides in a pair of gibs 2172 mounted on the trunk section VII, as shown in FIG. 2.

The bottom end of the spindle 2171 is slidably attached to the connecting rod 2180 through the overtravel spring 2184 and a plunger 2175 in the following manner. The plunger 2175 is pivotally pinned to the connecting rod 2180 with a wrist pin 2176. Below this pivot point, the plunger 2175 is provided with a circular disc 2177. Two pins, not shown, located about two-thirds of the way down on the spindle 2171 hold an annularly grooved ring-like spring retainer 2174 thereto. The disc 2177 of the plunger 2175 is between this spring retainer 2174 and the overtravel spring 2184. Therefore, the spring pressure is against the retainer and not against the connecting rod 2180 and the crank 2182.

A valve block 2178 is mounted to the column 2173. An opening in the column 2173 accommodates a pinion shaft 2169. As the shaft 2169 rotates 180 degrees, the crank 2182 swings out and extends beyond elongated slots 2179 in the column 2173 and spindle 2171. As the crank 2182 rotates, the spindle 2171 slides within the column 2173. Another vertical elongated slot in the spindle 2171 allows clearance for the pinion shaft 2169 as the spindle 2171 lowers or raises.

The connecting rod 2180 makes a fixed stroke of eight inches, but the contactor box 2148 will travel less than this when mating with a missile contact pad 106. After the contactor box 2148 has contacted the contact pad 106, the rotation of the crank 2182 continues compressing until it is locked four degrees over center. When the contactor box 2148 strikes the contact pad 106, the overtravel spring 2184 compresses as the crank 2182 finishes its stroke. As the contactor box 2148 mates with the contact pad 106, the crank 2182 continues its rotation, with the spring putting approximately 500 pounds of pressure against the pad. When the crank 2182 is returned to the top, it goes over center four degrees, locking the assembly in the retract position.

The rack piston 2152 is installed in the valve block 2178. Each end of the valve block 2178 contains a dashpot type hydraulic buffer 2170 to buff the end-of-stroke movement of the piston 2152 and prevent metal-to-metal contact.

Hydraulic fluid is directed to either end of the piston

2152, driving it up or down. As the piston 2152 moves, a rack 2167 drives a pinion 2168. An idler, not shown, is placed in back of the pinion 2168 for the piston 2152 to roll against to prevent binding of the piston. The pinion 2168 drives a ball bearing mounted pinion shaft 2169 that is coupled to the crank 2182 on one end and the shaft detent 2153 on the other. Two cams 2151 are cut in the shaft 2169 which engage the detent 2153 in the raised and lowered position. Hydraulic pressure unseats the detent 2153, and allows the shaft 2169 to rotate. The contactor box 2148 is extended or retracted with the half turn rotation of the pinion shaft 2169, and the crank 2182. Sections of the loader chain tracks 2052 and 2054 are linked to the guide yoke 2154 and fold open when the contactor box 2148 extends, as shown in FIG. 3.

In FIG. 5, there is shown a schematic diagram of the warmup contactor 2021. A three-land warmup contactor selector valve 2466 directs accumulator pressure fluid to either end of the warmup contactor rack piston 2152. Orifices 2467 are located in separate hydraulic discharge or tank passages to control the flow of hydraulic fluid in the system. Both ends of the rack piston 2152 have the hydraulic buffers 2170 that decelerate the warmup contactor rack piston 2152 to a stop.

The motion of the warmup contactor piston or gear rack 2167 is almost at a constant velocity over the entire stroke. However, characteristics of the crank 2182 and connecting link 2180, in combination, give a simple harmonic motion to the movement of the contactor box 2148.

In addition to the rotation described for the pinion shaft 2169 and crank 2182, there are the four degrees of pretravel and four degrees of overtravel. This provides a shockproof locking feature of the warmup contactor 2021 on either side of the common centerline. When the accumulator pressure fluid is off, the pressure-released spring-loaded pinion shaft detent 2153 engages the cam 2151 on the pinion shaft 2169 to prevent it from rotating.

In FIG. 11, there is shown a variation of the present invention. Under conditions where chain tracks are not used in a conveyer trunk, the folding arrangement of the chain track sections is omitted. In place thereof, a hinged weather door 5086 may be arranged to pivotally swing over or aside the contact box 2148 when it retracts or extends relative to the contact pad 106 of the missile 100. The contact box 2148 may in this manner be protected from the weather with the missile absent and the contact box 2148 retracted and covered over.

The operation of the warmup contactor may be made automatic through the agency of electrical signals. A switch SILB3, for example as shown in FIG. 5, can sense the presence of a missile 100 in position on the skid track 2048 and 2050 of the trunk section VII. An electrical signal transmitted thereby to the appropriate solenoid LCOB1 or LCOB2 will extend or retract the contact box 2148 as desired.

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. A connector assembly for aligning and connecting a first member with a second member and comprising, operator means operable to move said first member in simple harmonic motion along a line to effect engagement or disengagement of said members, said operator means including a constant speed motor, linkage means connecting said motor to said first member in a manner to cause gradual acceleration and deceleration of the initial and terminal movements of said first member, said first member including a linkage connected member, an intermediate member, and a head member, said intermediate member being connected to said linkage connected member in

a manner to permit relative movement therebetween in a direction normal to said line, said head and said intermediate members being connected in a manner to permit limited relative movement therebetween in a direction normal to said line and said first direction, a pressure rod connecting said head member and said linkage connected member in a manner to urge said intermediate member and said head member toward a central position, and spring means operably connected to said linkage means in a manner to urge said members toward disengagement.

2. A contactor device comprising a housing, a spindle movable in said housing, drive means mounted on said housing and operably connected to said spindle for raising and lowering said spindle, a contactor box, linkage means connecting said box to said spindle for permitting said box to move in any direction transverse and relative to said spindle, and centering means retained within said spindle and bearing against said box for aligning said box with said spindle.

3. The contactor device according to claim 2 in which said drive means provides simple harmonic motion of said spindle through a given distance, and bias means interposed between said moving means and said spindle whereby said contactor box can be moved through a distance less than said given distance.

4. A contactor device comprising, a housing, a spindle slidably mounted in said housing, a guide yoke slidably mounted in said housing and attached to said spindle for movement therewith, drive means mounted on said housing for moving said housing, bias means interposed between said spindle and said drive means, a contactor box having a recess therein, linkage means connecting said box to said guide yoke for permitting said box to be moved transverse and relative to said spindle, and centering means interposed between said bias means and said recess.

5. A contactor device comprising a housing, a spindle movable in said housing, a plunger movably mounted in said spindle, drive means mounted on said housing for moving said plunger, bias means interposed between said drive means and said plunger, a guide yoke attached to said spindle, a contactor box, linkage means connecting said contactor box to said yoke for permitting said contactor box to move a limited distance in any direction transverse and relative to said yoke, a pressure rod having a flat head on one end, said flat head being retained between said plunger and said yoke, a recessed cap in said contactor box, said rod having the other end thereof bearing against said recessed cap, whereby as said contactor box is moved transverse to said yoke, said rod will be tilted thereby causing said flat head to raise said plunger within said spindle against the bias of said bias means.

6. A contactor device comprising a housing, a hollow spindle movable in said housing, a first plunger slidable within said spindle, a connecting rod pivotally attached at one end to said first plunger, a crank pivotally attached to the other end of said rod, said crank being rotatably mounted on said housing and within said hollow spindle, a second plunger slidably mounted between said first plunger and said spindle, bias means interposed between said second plunger and said first plunger, a guide yoke attached to said spindle, said yoke being slidable in said housing, a pair of yoke brackets pivotally mounted on said guide yoke, first pivot bars pivotally mounted on each of said yoke brackets, a floating block pivotally connected to said first pivot bars, a pair of second pivot bars pivotally connected to said block at right angles to said first pivot bars, hangers pivotally mounted on said second pivot bars, an alignment head pivotally attached to said hangers, said alignment head having a cap, a tiltable pressure rod having one end bearing against said cap and having a flat head on the other end, said flat head retained between said

spindle and said second plunger, and an electrical contactor box attached to said alignment head.

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