

Feb. 11, 1964

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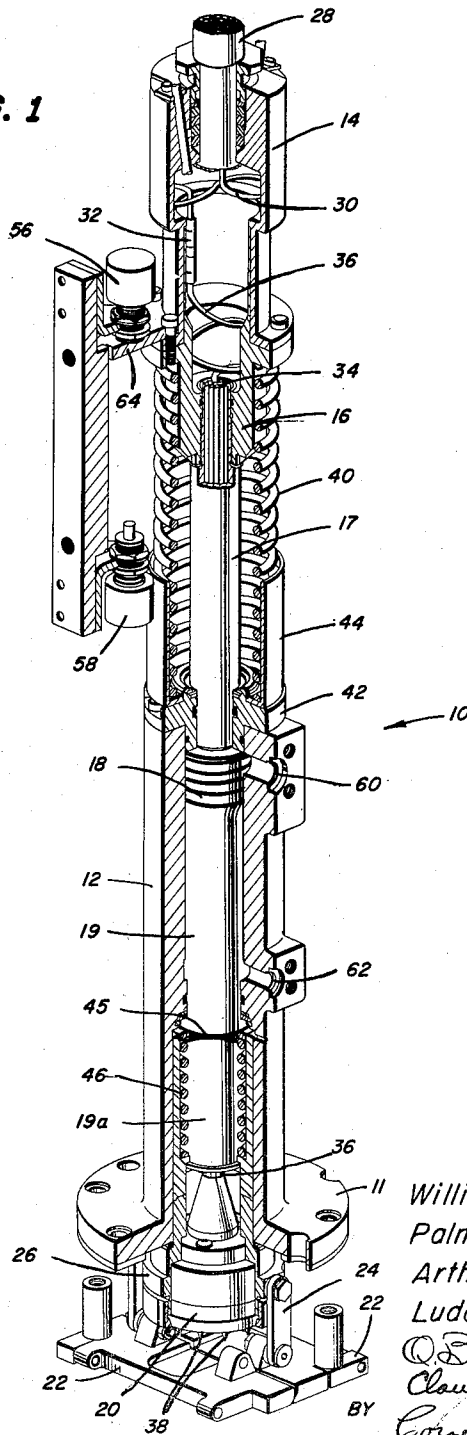
3,120,784

BOOSTER CONTACTOR

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6 Sheets-Sheet 1

FIG. 1



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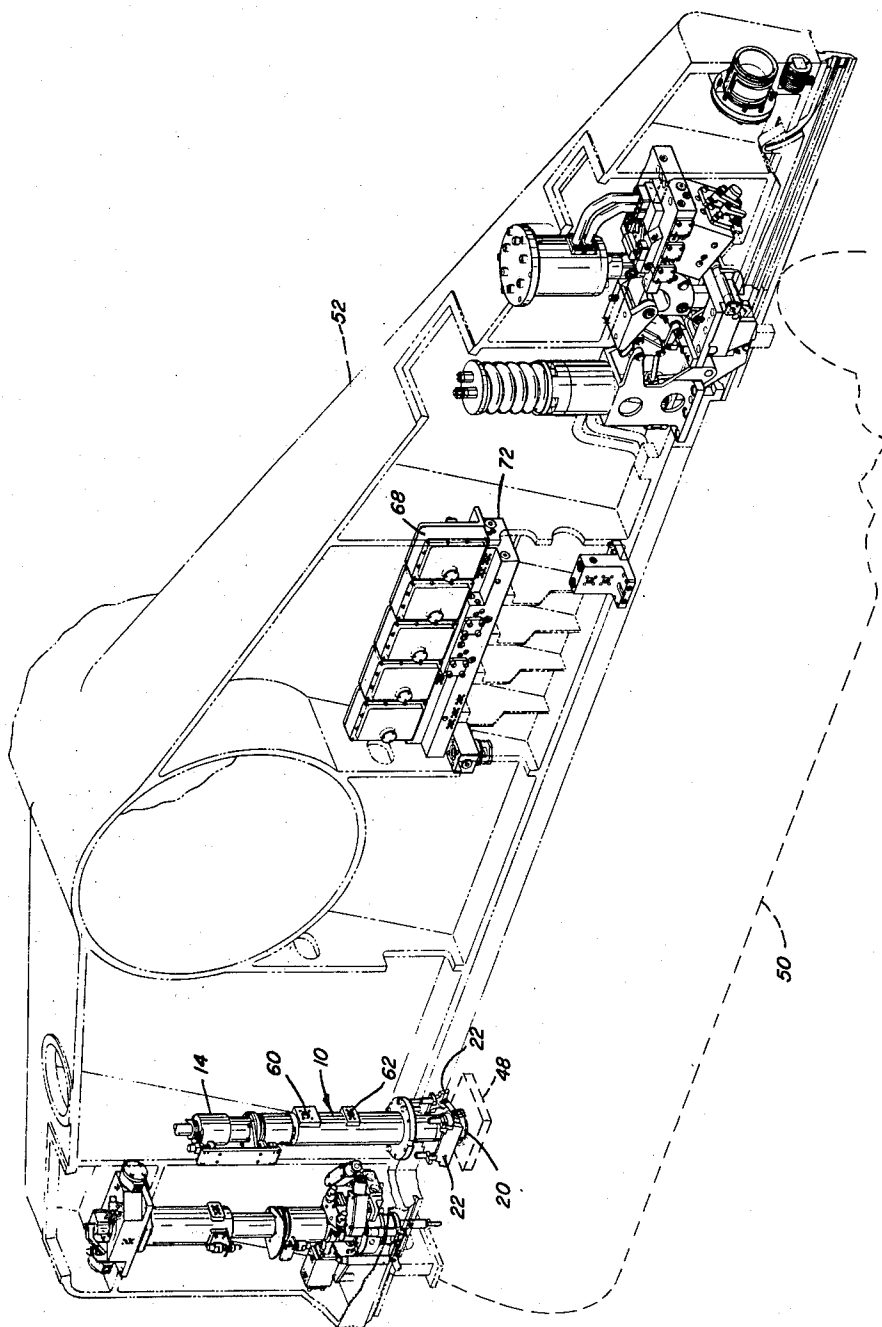
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BOOSTER CONTACTOR

Filed Feb. 19, 1962

6 Sheets-Sheet 2

FIG. 2



Feb. 11, 1964

W. M. MAGERS ET AL

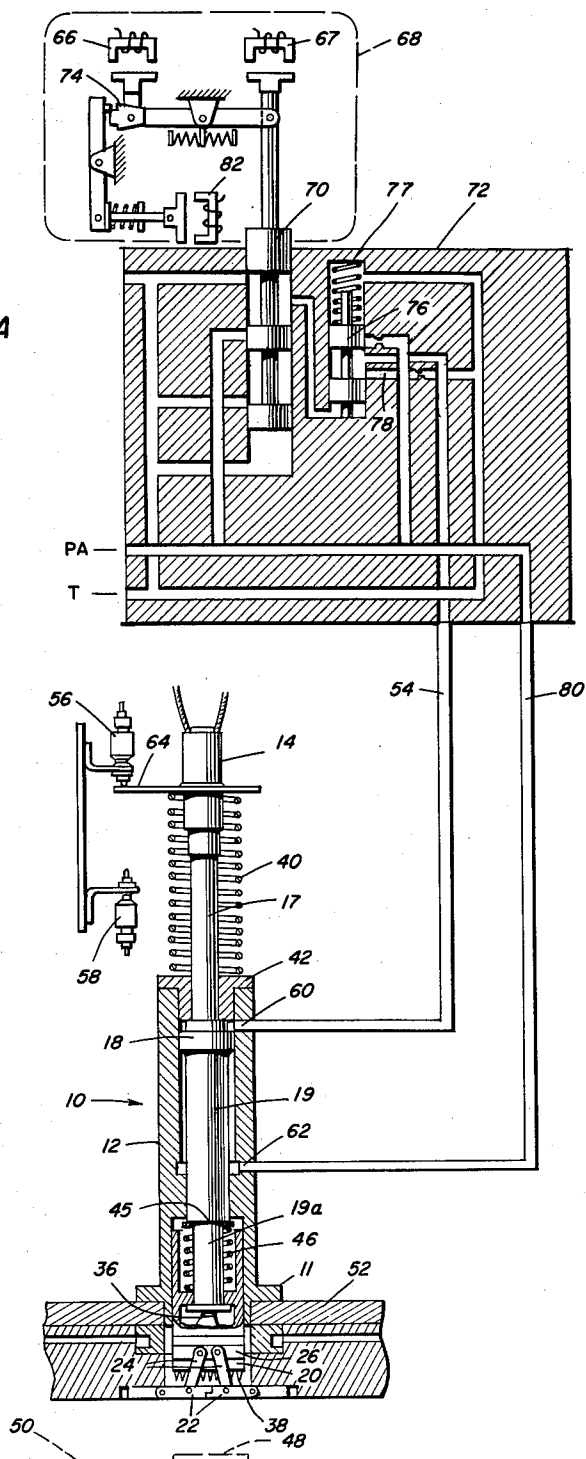
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BOOSTER CONTACTOR

Filed Feb. 19, 1962

6 Sheets-Sheet 3

FIG. 3A



Feb. 11, 1964

W. M. MAGERS ET AL

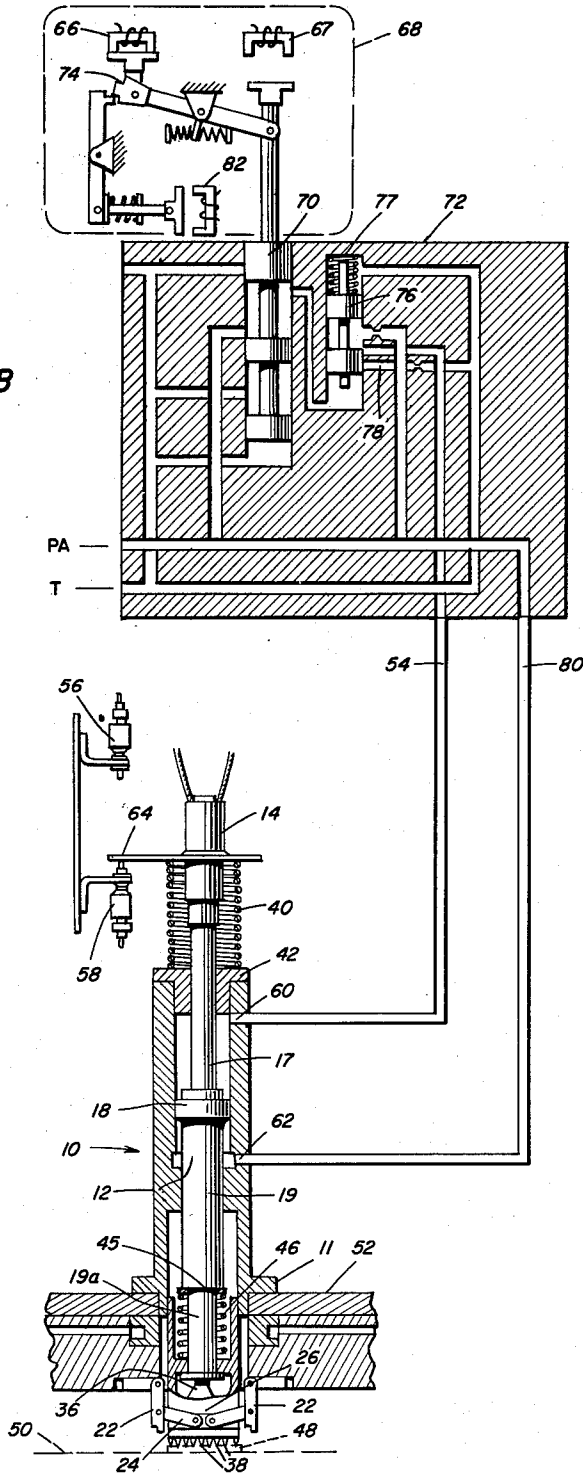
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BOOSTER CONTACTOR

Filed Feb. 19, 1962

6 Sheets-Sheet 4

FIG. 3B



Feb. 11, 1964

W. M. MAGERS ETAL

3,120,784

BOOSTER CONTACTOR

Filed Feb. 19, 1962

6 Sheets-Sheet 5

FIG. 5.

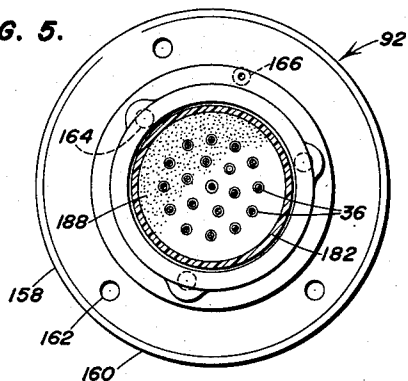


FIG. 6.

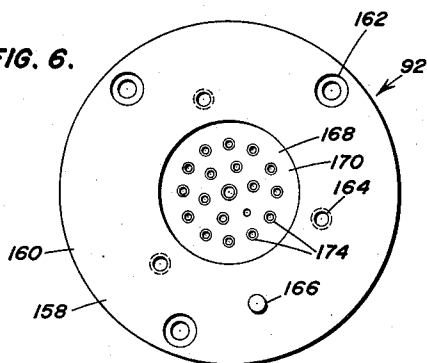


FIG. 7.

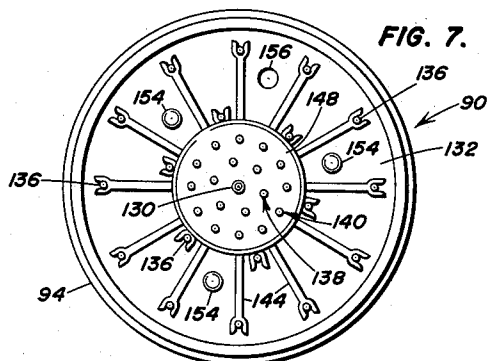
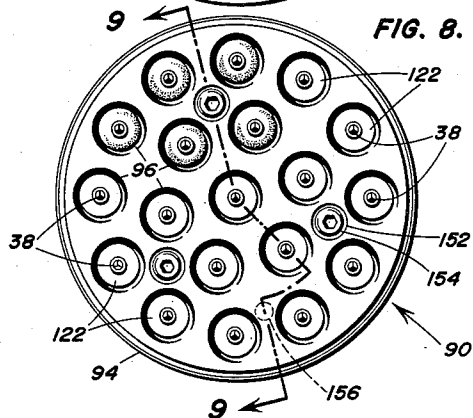
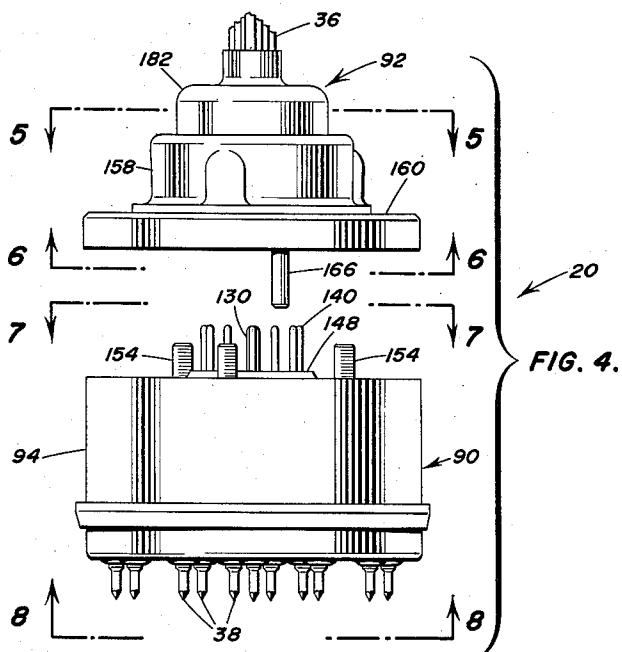


FIG. 8.



Feb. 11, 1964

W. M. MAGERS ETAL

3,120,784

BOOSTER CONTACTOR

Filed Feb. 19, 1962

6 Sheets-Sheet 6

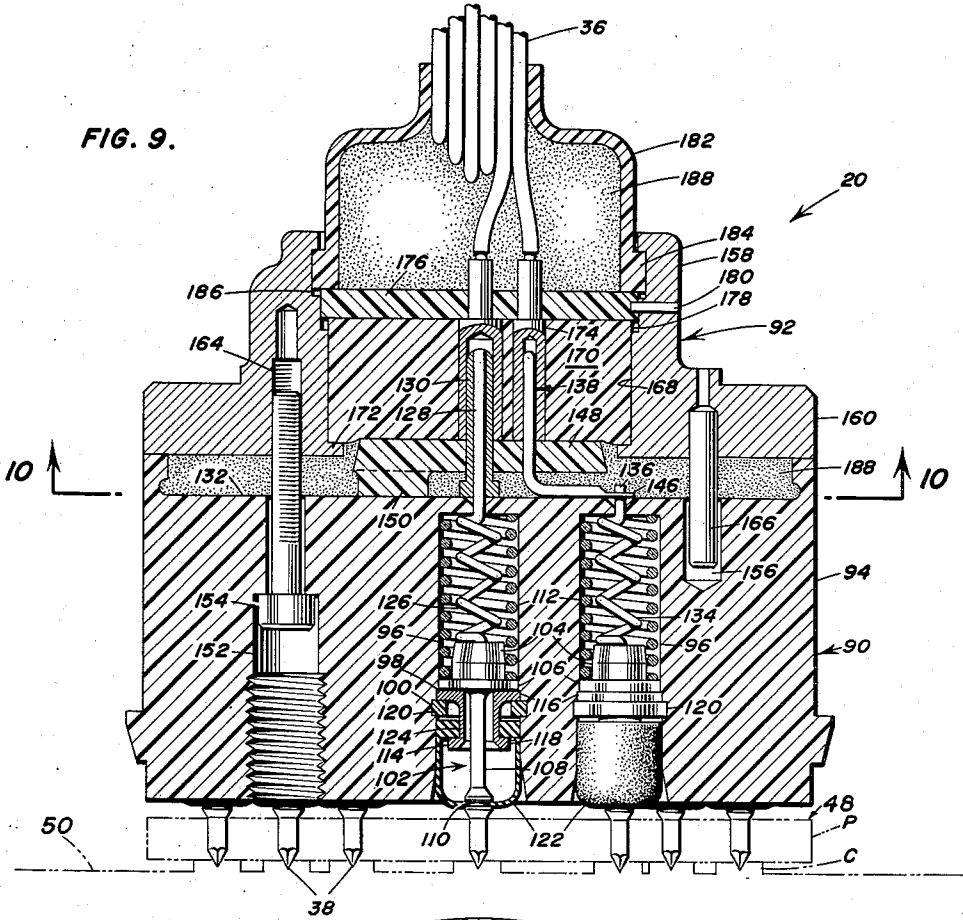
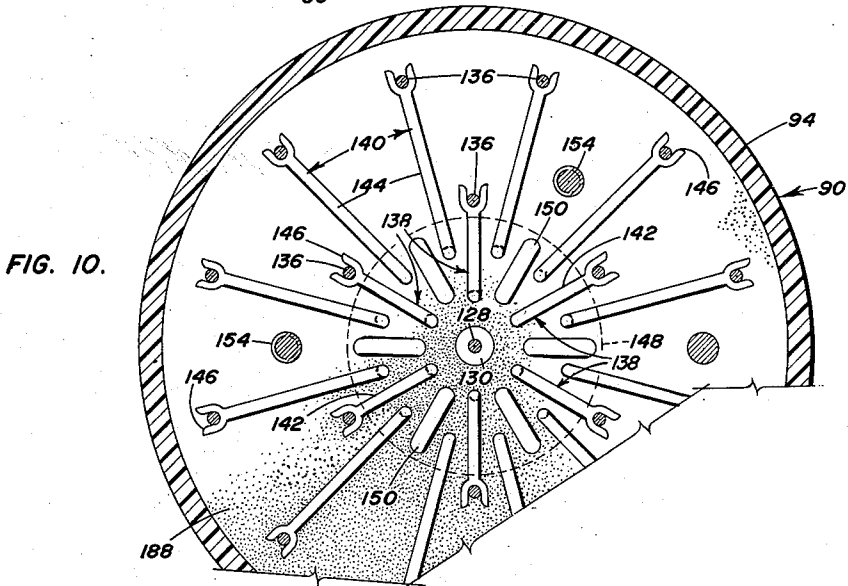


FIG. 10.

1

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BOOSTER CONTACTOR

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3 Claims. (Cl. 89—1.7)

This invention relates generally to electric connecting devices, and more particularly it pertains to an extensible electrical contactor.

Certain missile weapons require electrical warmup as a preflight condition. Therefore the launching system is required to be provided with a contactor which mates with a contactor pad on the missile weapon to supply this electrical warmup. Through the electrical connections in this contactor, warmup signals are transmitted to activate the missile guidance equipment and monitor missile response to prevent launching of a dud missile weapon.

It is an object of this invention, therefore, to provide a quickly extensible fail-safe electrical contactor for reliably establishing a plurality of circuits.

Another object of this invention is to provide a hydraulically operated extend-retract piston which is also a carrier of the electrical conductors for a contactor.

And another object of this invention is to provide continuous conductors between the fixed and movable parts of a piston extensible contactor.

Still another object of this invention is to provide a self-operated weather door for protecting said extensible contactor.

It is a further object of this invention to provide an extensible contactor which has piercing contact points to establish electric circuitry to weather proofed contact points of a missile weapon.

A further object of this invention is to provide a contactor head with independently sprung urged insulation piercing contact points which is weather proof and can be easily and quickly removed and replaced if damaged in service.

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

FIG. 1 is a cutaway view of a launcher weapon electrical contactor;

FIG. 2 is a skeletonized cutaway view of a launcher guide arm showing the relationship of a missile weapon supported thereon to the contactor illustrated in FIG. 1;

FIG. 3A is a schematic diagram of the hydraulic system when the contactor is in the retract position.

FIG. 3B is a schematic diagram of the hydraulic system when the contactor is in the extend position.

FIG. 4 is a vertical elevation of the contactor head illustrating the separation of the receptacle assembly from the plug assembly;

FIG. 5 is a cross section of the receptacle assembly taken on the line 5—5 of FIG. 4;

FIG. 6 is a bottom view of the receptacle assembly taken on the line 6—6 of FIG. 4;

FIG. 7 is a top view of the plug assembly as indicated by the arrows 7—7 of FIG. 4;

FIG. 8 is a bottom view of the plug assembly as indicated by the arrows 8—8 of FIG. 4;

FIG. 9 is an enlarged vertical section view of the assembled contactor head taken along the line 9—9 of FIG. 8 and showing the missile weapon contactor pad in phantom being engaged; and

FIG. 10 is a cross section taken on the line 10—10 of FIG. 9.

2

Referring now to the details of the drawings, there is shown in FIG. 1, an electrical contactor assembly designated generally by reference numeral 10. The major components of the electrical contactor 10 are a cylinder housing 12, a terminal housing 14, an intermediate tube 16, an extend-retract piston 18 located in the cylinder housing 12, a contactor head 20, and a set of doors 22, all of which will be described in detail subsequently.

The cylinder housing 12 forms the lower half of the electrical contactor assembly 10. Cylinder housing 12 is provided with a lower flange 11 for mounting and forms a base for all the other parts of the contactor assembly 10. The upper half of the contactor assembly 10 is formed by the terminal housing 14 and the intermediate tube 16. The upper end of rod 17 of the extend-retract piston 18 is screwed into the bottom of the intermediate tube 16. The extend-retract piston 18 has an intermediate rod portion 19 which extends down through the cylinder housing 12 and terminates in a flange portion 45. Extending downward from intermediate rod portion 19 is the lower rod portion 19a which is of lesser diameter than intermediate rod portion 19 and has the contactor head 20 attached at the bottom thereto. The upper rod 17 being lesser diameter than intermediate rod 19 giving the upper face of piston 18 a larger surface area than the lower face of piston 18.

The contactor head 20 is attached to a set of doors 22 which are hinged at one end to a guide rail portion of the guide arm 52 of the launcher. The doors 22 are provided with links 24 which are pivotally attached thereto at one end and to a sleeve 26 at their other ends. The doors 22 open at the beginning of the extend movement and close at the end of the retract movement of the contactor head 20.

An electrical cable 28 enters through the top of the terminal housing 14 with its individual leads 30 being connected to terminals 32 in ring array in the terminal housing 14. A length of similar cable 34 is mounted axially within the extend-retract piston 18. At its top, individual leads 36 of the cable 34 are also connected to the same terminals 32 in the terminal housing 14 and at the bottom the individual leads 36 are connected to the contactor head 20 which has a plurality of independently spring-tensioned sharp pointed contact points 38.

A return spring 40 is fitted over the intermediate tube 16 and it extends from the uppermost end of the intermediate tube 16 to a cap 42 provided on top of the cylinder housing 12. A spring retainer 44 on top of the cylinder housing 12 extends up to the intermediate tube 16. This return spring 40 keeps the piston 18 retracted when operating fluid pressure of the contactor assembly 10 is disconnected.

An over-ride compression coil spring 46 is mounted under a flange portion 45 at the lowermost end of rod 19 surrounding rod portion 19a in the cylinder housing 12. This over-ride spring 46 takes up the overtravel of the extend-retract piston 18 when, in extending, the contactor head 20 engages a contactor pad 48 on a missile weapon 50 supported on a launcher guide arm 52 as shown in FIGS. 2 and 9. It can readily be seen that when the piston 18 is extending, the entire unit, piston 18, rod 17, rod portions 19 and 19a along with contactor head 20 and sleeve 26 will move simultaneously. However, when the contactor head 20 comes into contact with the contactor pad 48 of the missile any over travel of the piston 18 will be taken up by spring 46 and the supporting flanges. By means of this feature the contactor head 20 will stop moving but the piston 18 can continue its downward movement compressing spring 46 and thereby preventing any damage to the contactor head 20, the missile or any other portion of the device. The sharp contact points 38 of contactor head 20 perforate a rubber-like protec-

tive pad P and embed themselves into contacts C of soft conductive material thus electrically "warming up" the weapon 50.

As previously mentioned, the electrical contactor assembly 10 is hydraulically operated. With reference to FIGS. 1, 3A and 3B, when an extend solenoid 66 in a solenoid housing 68 of the launcher guide arm 52 is energized, it shifts a valve 70 in a valve block 72, as shown in FIG. 3. The valve 70 remains in this position because of a spring-held detent 74 even though the solenoid 66 may become de-energized.

The valve 70 ports pressure fluid PA onto the bottom of another valve 76 and moves it upwardly against pressure of a coiled spring 77. As valve 76 moves upwardly, it cuts off a tank return port 78 to the tank T. Simultaneously, pressure fluid PA is directed into a conduit 54 which connects to a port 60 on the contactor assembly 10. Another port 62 thereon is always connected back through a conduit 80 to pressure fluid PA.

Thus, with pressure fluid PA against both sides of piston 18, piston 18, moves downwardly because it is of a differential area type with the larger area being on top. At the beginning of the extend movement of the piston 18, a projecting switch actuator 64 which is attached to the terminal housing 14 starts downwardly and a signalling electric switch 56 is de-actuated. Moving against the force of spring 40, piston 18 extends the contactor head 20 which opens the doors 22 and then the contact points 38 make electrical contact with the contactor pad 48 on the missile weapon 50.

Any continued movement of the piston 18 thereafter before it bottoms is absorbed by the over-ride spring 46 as shown in FIGS. 1, 3A and 3B. At the end of the downward movement of the contactor head 20, another electric signalling switch 58 is closed by the switch actuator 64 and the extend cycle of the contactor head 20 is complete.

To retract the contactor head 20, a solenoid 82 is momentarily energized to release detent 74 and simultaneously retract solenoid 67 is energized to assist the valve 70 to assume its retract position. In this position, valve 70 cuts off pressure fluid from the bottom of the valve 76 which spring-returns and cuts off pressure fluid to the conduit 54 and the top of the extend-retract piston 18 and returns the fluid to tank T.

Pressure fluid on the bottom of the extend-retract piston 18 together with the force of the return spring 40 urge it upwardly and the signal switch 58 is de-actuated. As the piston 18 moves upwardly, the links 24 close the doors 22. At the end of the retract stroke of the piston 18 and contactor head 20, the switch actuator 64 moves against the signal switch 56 to remotely indicate that the electrical contactor assembly 10 is in its retracted position.

The contactor head 20 is constructed as two plugged-together parts, a plug assembly 90 and a receptacle assembly 92 shown in FIG. 4. Thus, the plug assembly 90 having the contact points 38 can be readily replaced if the latter became damaged.

As best shown in FIGS. 7, 8, and 9, the plug assembly 90 of the contactor head 20 consists of a cylindrical plug body 94 of insulating material. A plurality of cylindrical cavities 96, one for each contact point 38 are formed in this plug body 94 parallel to its axis. Each cavity 96 is counterbored to provide a shoulder 98 and spaced therefrom a locking groove 100 is formed in the counterbore wall.

The contact points 38 are the lowermost portions of electrically conductive plungers 102 which work within the cavities 96. The top end of each plunger 102 is formed with a spring centering boss 104 having a lower flange 106 and the lower end is a slender shaft 108 which extends to the contact point 38.

A coiled spring 112 is seated in compression in the up-

per end of cavity 96 and against the flange 106 urging it downwardly against the upper flange 116 of an apertured eyelet-like insert 114. The insert 114 is retained against the previously mentioned counterbored shoulder 98 by a retaining ring 120 snapped into the locking groove 100.

A lower flange 118 of insert 114 receives a flange 124 of a soft rubber cup-shaped boot 122 which fits closely within the lower portion of the cavity 96 flush with the bottom surface of the plug body 94. The boot 122 is apertured at the bottom thereof and is received at this point in a sealing groove 110 on the shaft 108.

Centrally located contact point 38 of the plug assembly 90 has its plunger 102 electrically attached to a tubular plug pin 130 by means of a soldered-in connecting lead 128 having a coiled portion 126. This plug pin 130 is cast into a pin-spacing insulating disc 143 of insulating material along with a plurality of L-shaped plug pins 138 and 140 in an inner and outer circular array, respectively.

Horizontal legs 142 and 144 of the pins 138 and 140, respectively, extend radially from the underside of the insulating disc 143 between the radial barriers 150 formed therein as best shown in FIG. 10. The legs 142 and 144 of the pins 138 and 140, respectively, lie in potting compound 188 in a recessed face 132 of the body 94 and are formed with bifurcated ends 146. These ends 146 embrace and are soldered to short vertical portions 136 of coiled leads 134 in the cavities 96 directly beneath in the body 94. The coiled leads 134, in turn, are each attached to the spring centering boss 104 of one of the plungers 102 of the remaining contact points 38.

The receptacle assembly 92 to which the above described plug assembly 90 mates consists of an annular receptacle body 158 having a mounting flange 160 as shown in FIGS. 4, 5, 6, and 9. This flange 160 is provided with mounting holes 162 by which it is bolted to the previously-mentioned sleeve 26 of the extend-retract piston 18.

In the central bore 168 of the receptacle body 158, an insulating insert 170, as shown in FIG. 9, is secured against a flange 172. A plurality of shouldered female terminals 174, one for each pin 138 and 140 and the central plug pin 130, are positioned in holes formed in this insert 170. A terminal retaining disc 176 rests on top of the insert 170 in a counterbore 178 of central bore 168. Pin 180 extending through the sidewall thereof into the disc 176 holds it in place.

The upper ends of the terminals 174 are attached to the previously mentioned leads 36. These are protected by a potting cap 182 having a flange 184 which snaps into a groove 186 of the receptacle body central bore 168 and is filled with an epoxy potting compound 188.

The plug assembly 90 and the receptacle assembly 92 are assured of correct mating by means of an indexing hole 156 in the former and an indexing pin 166 in the latter. Securing cap screws 154 passed through counterbored apertures 152 of the body 94 into threaded holes 164 of the receptacle 92 are conveniently accessible from the contact point side of the plug assembly 90 should the necessity arise for replacement of the latter.

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 launcher having a launcher guide arm, a booster contactor fixedly secured within said launcher guide arm, said booster contactor having a housing, a cylinder disposed within said housing, a differential area piston sealably and slidably disposed within said cylinder, actuating means for moving said piston along said cylinder whereby said piston is at the retract position when at the upper end of said cylinder and at the extend position when at the lower end of said cylinder, an upper

5

rod portion attached to the upper side of said piston, said upper rod portion being sealably and slidably disposed through said housing, a flange means attached to said upper rod portion, a first biasing means disposed between said flange means and said housing for biasing said piston to the retract position, an intermediate rod portion attached to the lower side of said piston, said intermediate rod portion being sealably and slidably disposed in said housing, a lower rod portion having a reduced diameter attached to said intermediate rod portion, a plurality of electrical leads extending through a bore which extends through said upper rod portion, said piston, said intermediate rod portion and said lower rod portion, a sleeve juxtaposed about said lower rod portion and slidably disposed in said housing, said sleeve being disposed so as to have an end portion extending from said housing, a first flange disposed on said lower rod portion, a second flange disposed within said sleeve, said second flange being disposed above and in overlapping relationship to said first flange, a second biasing means disposed between said second flange and said intermediate rod portion for urging said second flange against said first flange, a contactor head attached to said end portion of said sleeve extending from said housing, said electrical leads being connected to said contactor head, and protective means connected to said contactor head for opening upon movement of said piston to the extend position whereby upon movement of said piston to the extend position said contactor head is urged into mating contact with the contactor pad of a missile to apply power thereto.

2. In a missile launcher as described in claim 1 wherein said actuating means for moving said piston comprises a hydraulic circuit connected to a source of pressure, conduits and valving controlling the flow of fluid to said piston, upper and lower ports in the cylinder surrounding said piston, said ports alternately acting as inlet and outlet ports depending on the position of said control valves, whereby said differential area piston and said contactor head is extended when said control valves direct pressure fluid to the upper face of said piston via said upper port and connect said lower port to a return line and said differential area piston and said contactor head is retracted when said control valves direct pressure fluid to the lower face of said piston via said lower port and connect said upper port to a return line.

3. In a missile launcher having a launcher guide arm, a missile supported by said guide arm, a booster contactor fixedly secured within said launcher guide arm, said booster contactor having a housing, a cylinder disposed within said housing, a differential area piston sealably and slidably disposed within said cylinder, actuating means for moving said piston along said cylinder whereby

6

said piston is at the retract position when at the upper end of said cylinder and at the extend position when at the lower end of said cylinder, an upper rod portion attached to the upper side of said piston, said upper rod portion being sealably and slidably disposed through said housing, a flange means attached to said upper rod portion, a first spring disposed between said flange means and said housing for biasing said piston to the retract position, an intermediate rod portion attached to the lower side of said piston, said intermediate rod portion having a reduced diameter attached to said intermediate rod portion, a plurality of electrical leads extending through a bore which extends through said upper rod portion, said piston, said intermediate rod portion and said lower rod portion, a sleeve slidably disposed in said housing and juxtaposed about said lower rod portion, said sleeving being disposed so as to extend from said housing, a first flange disposed on said lower rod portion, a second flange disposed within said sleeve, said second flange being disposed above and in overlapping relationship to said first flange, a second spring disposed between said second flange and the end of said intermediate rod portion for urging said second flange against said first flange, a contactor head attached to the end extending from said housing of said sleeve, said electrical leads being connected to said contactor head, a pair of interengaging doors connected to said contactor head, the outer end of each of said doors being pivotally secured to said launcher guide arm, a pair of links pivotally connected to the inner ends of each of said doors, each of said links being pivotally secured to said sleeve whereby upon movement of said piston to the extend position said contactor head is urged into mating contact with the missile thereby to urge said links down and outward thus moving said doors into their open position, whereby upon movement of said piston to the retract position said contactor is disengaged from said missile and moved into the housing thereby to move said links in an upward direction to return said doors to a closed position to protect said contactor head.

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