

April 21, 1970

D. B. CLARK ET AL

3,507,974

ELECTROMAGNETIC SHIELDED DOOR STRUCTURE

Filed March 6, 1968

3 Sheets-Sheet 1

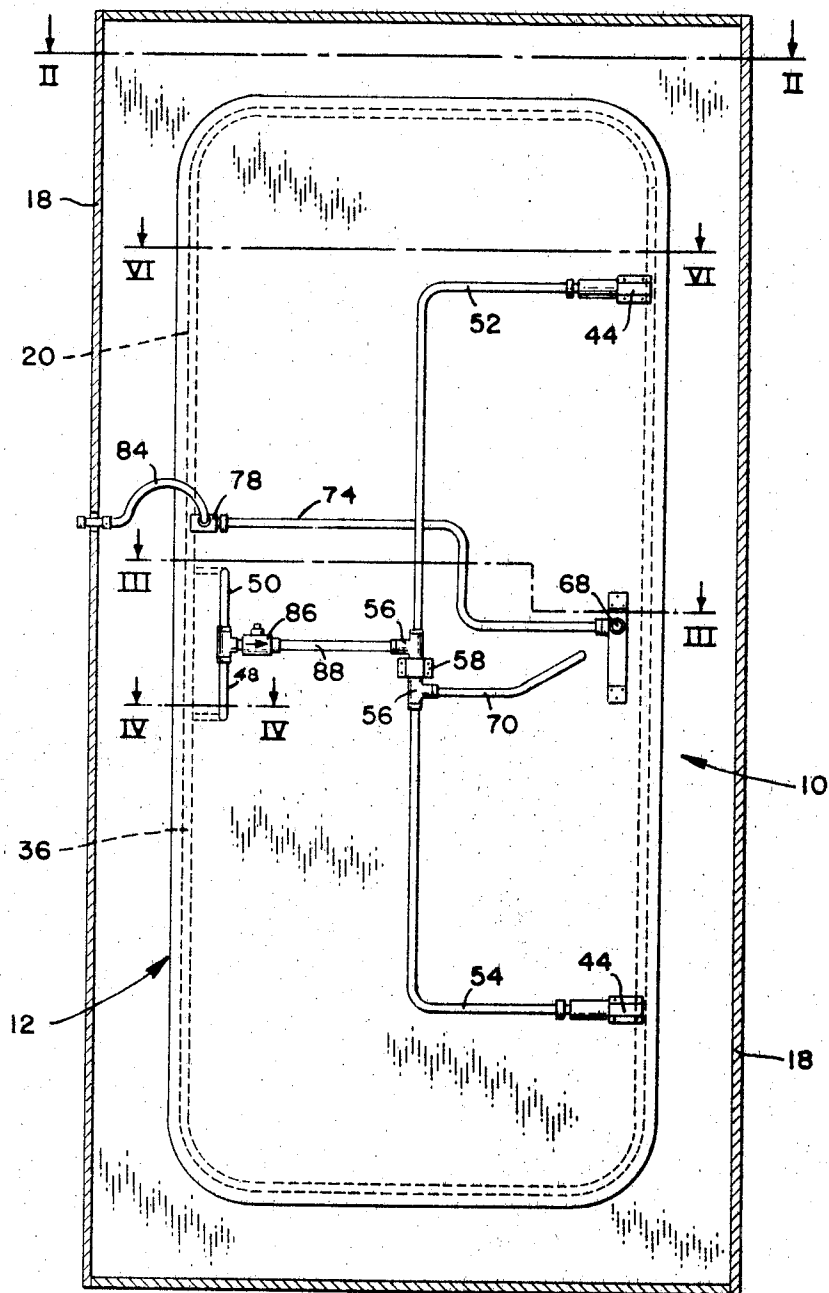


FIG. I.

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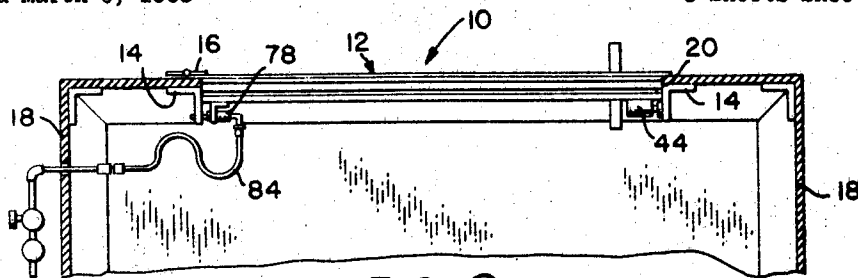


FIG. 2.

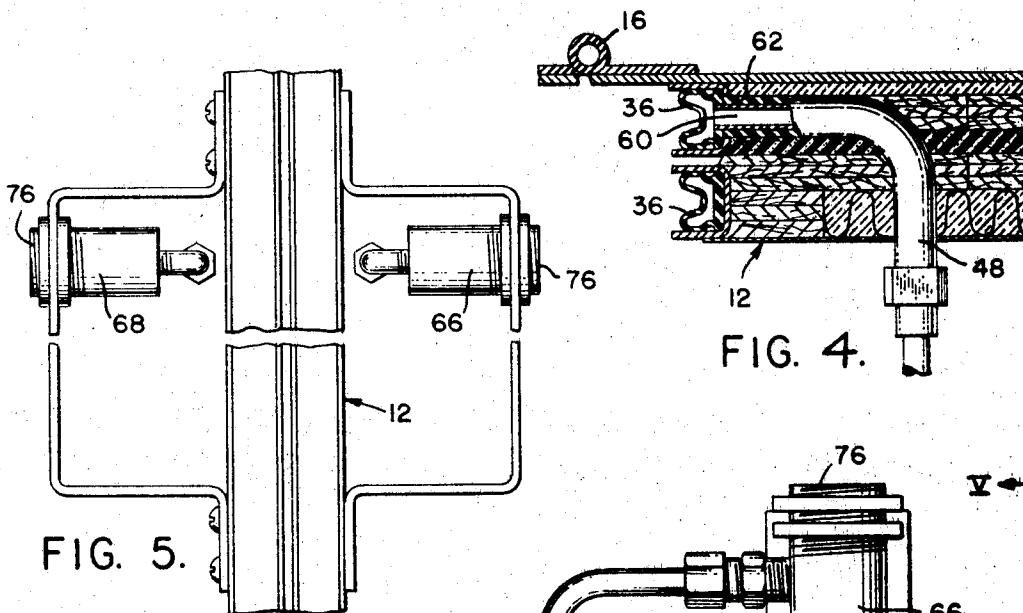


FIG. 4.

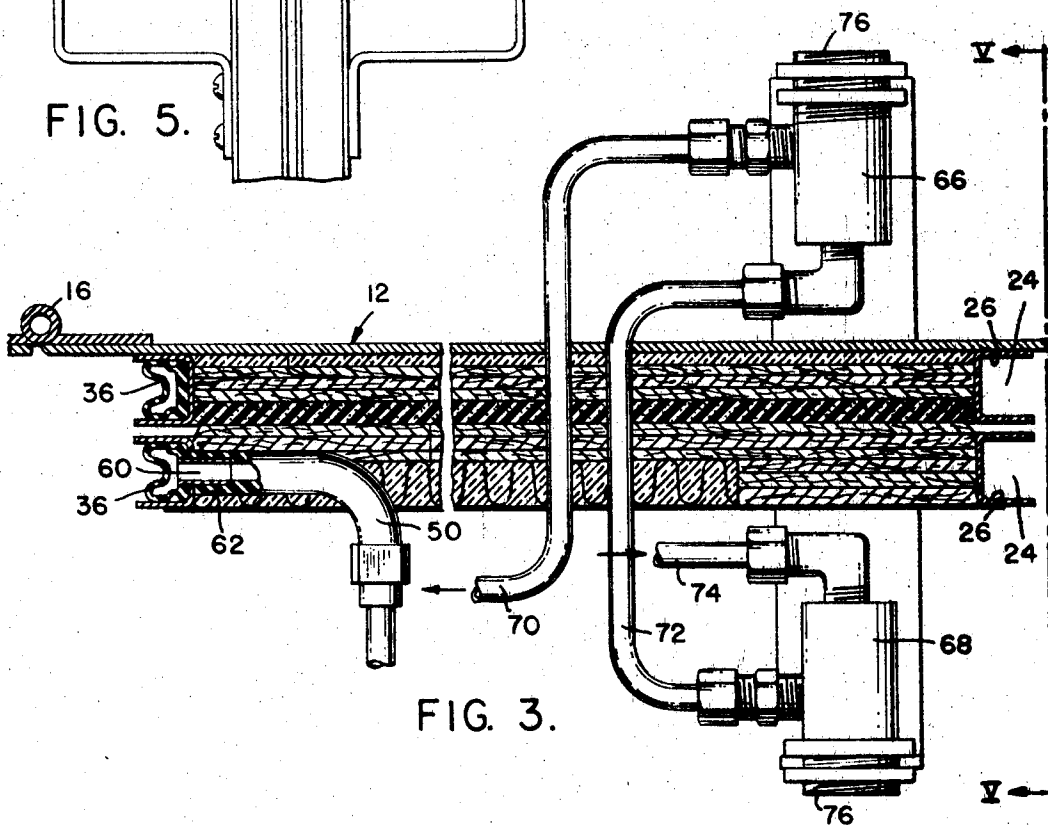


FIG. 3.

**April 21, 1970**

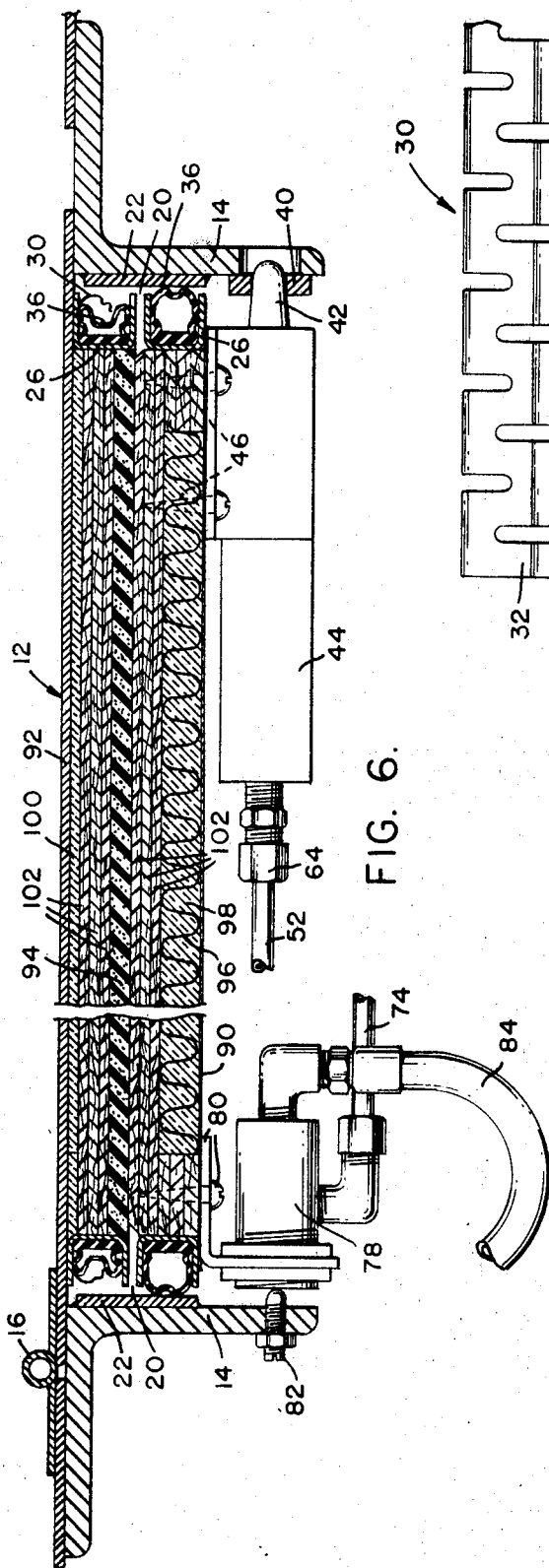
D. B. CLARK ET AL

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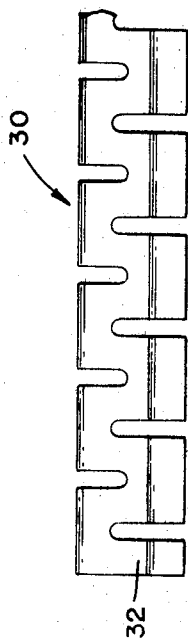
# ELECTROMAGNETIC SHIELDED DOOR STRUCTURE

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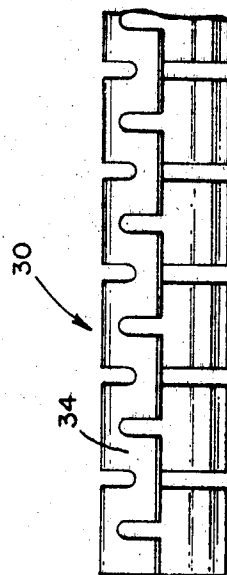
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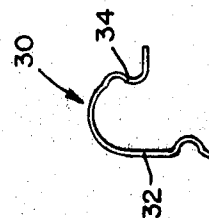


FIG. 10.

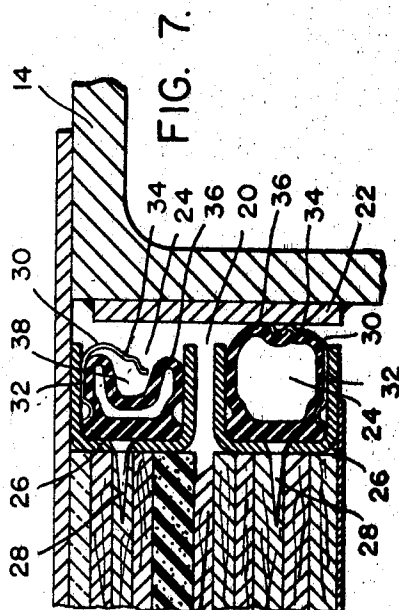


FIG. 7.

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## 3,507,974 ELECTROMAGNETIC SHIELDED DOOR STRUCTURE

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Calif., assignors to the United States of America as  
represented by the Secretary of the Navy  
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Int. Cl. H05k 9/00; E06b 7/23

U.S. Cl. 174—35

7 Claims

### ABSTRACT OF THE DISCLOSURE

The description discloses an electromagnetic shielded door structure wherein the door has a peripheral groove about its edge and means disposed within the groove for electromagnetically shielding the door when in a closed position. Such means may include elongated finger stock which is flexible so as to engage a door frame in a flexed position and to disengage the door frame in a relaxed position; and an elongated bladder which is inflatable to force the finger stock to its flexed position in engagement with the door frame and deflatable to allow the finger stock to relax to its disengaging position.

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

Electronics equipment which is carrying classified information or which will electromagnetically interface with other nearby electronics equipment is often shielded by an enclosure. In order to gain access to such an enclosure an electromagnetic shielded door is employed which has a metallic strip or finger stock mounted around its edge to make electromagnetic sealing contact with a metallic door frame. Previously existing shielded doors have the finger stock mounted exteriorly about the edge of the door which has caused several problems. One main disadvantage is that the finger stock protrudes from the edge of the door when it is open which allows the finger stock to become easily damaged by nearly foreign objects as well as passing personnel who cannot resist the temptation to give the delicate finger stock a little twist. This finger stock upon becoming bent will leave an area of disengagement between the finger stock and the metallic door frame which allows stray electromagnetic waves to escape from the shielded enclosure. Once the finger stock has become bent out of shape it is normally necessary that the entire strip be removed and replaced which is a time consuming and expensive process. Another disadvantage of exteriorly mounted finger stock is that the door is very difficult to push open and closed because of the wiping action between the finger stock and the metallic door frame. This wiping action is necessary to clear the metallic components of oxides and films deposited thereon so that at the place of their engagement an electromagnetic seal can be effected.

The patent to Dunn entitled "Doors for Radio Shielded Enclosures," Patent No. 2,757,225, discloses an approach where difficult door opening and closing can be obviated. While Dunn mounts exteriorly his finger stock to the edge of the door, he utilizes an inflatable bladder for flexing the finger stock into engagement with the metallic door frame after the door has been closed. In solving one problem, however, Dunn creates another problem, namely: providing insufficient wiping action between the finger stock and the metallic door frame to clear these metallic components of oxides and films. Further, the exteriorly mounted finger stock in the Dunn patent can become eas-

ily damaged while the door is open and will become difficult to replace once it has been so damaged.

The present invention provides an electromagnetic shielded door which overcomes the aforementioned problems of prior art shielded doors by mounting an inflatable bladder and the finger stock within a groove which extends about the edge of the door. The finger stock is flexible enough to engage the door frame in a flexed position and to disengage the door frame in a relaxed position. The inflatable bladder retains the finger stock within the groove and upon becoming inflated forces the finger stock to its flexed position in engagement with the door frame and upon deflation allows the finger stock to relax to its disengaging position. In this manner the door can be easily opened and closed and the finger stock can be controlled to make the necessary electromagnetic seal after the door is in its closed position. When the bladder is deflated the finger stock can be easily removed and replaced when desired. By disposing the finger stock entirely within the groove when the bladder is deflated the finger stock will be protected from damage by outside elements. By employing finger stock which is generally U-shaped in cross-section, a good wiping action can be obtained when one leg of the finger stock is forced against the metallic door frame by the inflated bladder. This wiping action can be increased by slightly convoluting the finger stock. Further, by an unusual configuration of the bladder and the finger stock we have been able to obtain an acoustic seal around the edge of the door in addition to our electromagnetic seal.

An object of the present invention is to overcome the aforementioned problems of the prior art electromagnetic shielded doors.

A further object is to provide an electromagnetic shielded door structure which can be easily opened and closed and which will effect necessary wiping action between the electromagnetic sealing components.

Another object is to provide an easily opened and closed electromagnetic shielded door which has finger stock which is inaccessible to damage and which can be easily replaced.

Still another object is to provide an effective electromagnetic shielded door which is easy to operate.

Yet another object is to provide an effective electromagnetic shielded door which also provides an acoustic seal.

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

FIG. 1 is a plan view of the shielded door as seen from inside the enclosure;

FIG. 2 is a view along plane II—II of FIG. 1;

FIG. 3 is a view taken along plane III—III of FIG. 1;

FIG. 4 is a view taken along plane IV—IV of FIG. 1;

FIG. 5 is a view taken along plane V—V of FIG. 3;

FIG. 6 is a view taken along plane VI—VI of FIG. 1;

FIG. 7 is an enlarged view of the edge of the door and door frame of FIG. 6;

FIG. 8 is a side view of a finger stock gasket;

FIG. 9 is a top view of the finger stock gasket; and

FIG. 10 is a cross-sectional view of the finger stock gasket.

Referring now to the drawings wherein like reference numerals designate like or similar parts throughout the several views, there is shown in FIGS. 1 and 2 an electromagnetic shielded door structure 10 which includes a door which is hung in a door frame 14 by any suitable means such as a hinge 16. The door 12 provides access to a compartment or enclosure 18 which is adapted to enclose radio frequency electronics equipment (not

3

shown). The enclosure 18 as well as the door 12 are constructed of a radio frequency shielding material. The material which may be employed for the door 12 will be described in more detail hereinafter. Upon closing the door 12 it is imperative that the edge 20 thereof provide an electromagnetic seal with the door frame 14 so that stray radio frequency waves cannot escape from the enclosure 18.

As shown in FIGS. 6 and 7, our invention obtains an unique electromagnetic seal between the edge of the door 12 and the door frame 14. The door frame 14 may be constructed of angle irons and connected to these angle irons by any suitable means, such as bonding or spot welding, may be brass plates 22 which extend around the entire edge of the door 12 adjacent and in close proximity to the door edge 20. The entire door edge 20 is provided with a groove 24, or as shown in our exemplary embodiment, a pair of such grooves 24. These grooves may be constructed in the door edge 20 by any suitable means such as mounting channel members 26 to the edge of the door by screws 28 which extend through the base of the channel members into the door body.

In order to make an electromagnetic seal with the plate 22 elongated finger stock gaskets 30, as shown in detail in FIGS. 8 through 10, may be disposed within each channel member 26. The finger stock 30 is flexible in its transverse plane and may be generally U-shaped in cross section when in a relaxed position. The finger stock may be constructed of any suitable shielding material such as a beryllium copper alloy. As shown in the top channel 26 of FIG. 7, the finger stock 30 in its relaxed condition may have one leg 32 which engages one leg of the channel 26 in a generally parallel fashion and another leg 34 which may be entirely disposed within the channel 26 opposite to and in disengagement with the brass strip 22. As shown in the bottom channel 26 of the FIG. 7, the leg 34 of the finger stock has been flexed to an engaging position with the brass plate 22 so as to make an electromagnetic seal therewith. In the actual operation of the invention both finger stocks 30 are either in a relaxed position or a flexed position and they are shown in FIGS. 6 and 7 in different positions only for description purposes.

Also disposed within each channel 26 is an elongated inflatable bladder 36 which, in both its deflated and inflated condition, engages the finger stock leg 32 and forces it into retaining engagement with the leg of the channel 26. As shown in the bottom channel 26, the bladder 36 is inflatable to force the finger stock to its flexed position so that the finger stock leg 34 is in engagement with the brass plate 22 and, as shown in the top channel 26, the bladder is deflatable to allow the finger stock to relax to its disengaging position so that the finger stock leg 34 is located within the channel and disengaged with respect to the brass plate 22. With this arrangement, upon inflation of the bladder 36, the finger stock leg 34 will wipe across the brass plate 22 toward the center of the door so as to clean these metallic components of any oxides and films and thereby make a tight electromagnetic seal therebetween. This seal may be enhanced by providing the finger stock leg 34 with a convolution as shown in FIG. 7. The other legs 32 of the finger stock may also be convoluted so that it may be more easily retained within the channel 26 by the bladder 36. It is to be understood that a seal may be accomplished by means other than finger stock, such as an elongated gasket which is generally U-shaped in cross section.

As shown in FIG. 7, the bladder 36 may be generally rectangular in an inflated condition and may be provided with an elongated centrally located recess 38 in its deflated condition. The recess 38 is oppositely disposed from the brass plate 22 and the finger stock leg 34 may extend within this recess. The finger stock leg 34 may stop short of full extension across the bladder 36 or the channel 26 so that when the bladder is inflated, as shown in

4

the bottom channel 26 of FIG. 7, a portion of the bladder 36 directly engages the brass strip 22. In this manner an acoustic seal is effected in addition to the electromagnetic seal previously discussed. The means for inflating and deflating the bladders 36 in order to effect these seals will be described in detail hereinafter.

In order to lock the door 12 a latch mechanism may be provided on the inside of the door. As shown in FIG. 6, this mechanism may include a latch plate 40 which may be connected to the frame angle iron 14 by any suitable means such as welding. The latch 40 may be provided with an opening and the angle iron 14 may be provided with a similar aligned opening for receiving a latch pin 42. The pin 42 may be slidable longitudinally within an elongated housing 44 which is mounted to the inside surface of the door 12 by any suitable means such as an integral flange which is fixed to the door by screws 46. A pair of such latch mechanisms 44 may be employed, as shown in FIG. 1. A means for operating these latch mechanisms will be explained in detail hereinbelow.

The bladders 36 and the latch mechanisms 44 may be operated by a fluid pressure system which may be either pneumatic or hydraulic. This system, which is best illustrated in FIGS. 1 through 5, may include feeder lines 48 and 50 which are connected to respective bladders 36, and feeder lines 52 and 54 which are connected to respective latch mechanisms 44. These feeder lines may be fluid connected by T connectors 56 and the lines may be mounted against the inside surface of the door by an arcuate flanged member 58 which is screwed against the door. FIG. 4 illustrates the connection of the feeder line 48 to the one bladder 36 and FIG. 3 illustrates the connection of the feeder line 50 to the other bladder 36. Both of these feeder lines extend into the internal structure of the door 12 and may have a central tube 60 which extends into the interior of the respective bladder 36 under forced sealing engagement and may have an exterior rubber-like insulative covering 62 which seals against the exterior of the respective bladder.

As shown in FIG. 6, the internal tube of the line 52 may be connected to the latch housing 44 by a fitting 64. The pressure from this tube may operate on a piston (not shown) which is located within the latch housing 44 and is operatively connected to the latch pin 42. This piston may be biased by a spring (not shown) which withdraws the latch pin 42 from the latch 40 when pressure is not applied to the latch housing 44 through the line 52. The connection of the line 54 to the other latch mechanism 44 may be the same as described for the line 52.

The feeder lines 48, 50, 52 and 54 may be fluid connected to a pair of push button fluid valves 66 and 68, as shown in FIGS. 1 and 3. A fluid line 70 may extend between the bottom T connection 56 and the top push button valve 68, as shown in FIGS. 1 and 3. The push button valves 66 and 68 may be interconnected by a fluid cross-over line 72 which extends through the door 12. Connected to the push button valve 68 is a pressure source fluid line 74 which will be described in more detail hereinafter. Each of the valves 66 and 68 have a push button 76 which operates against a spring biased hollow cylinder (not shown) within each of the valves. When the push button 76 of either of the valves 66 and 68 is pushed pressure from the line 72 is bled through openings (not shown) of the valves to relieve the pressure within the bladders 36 and the latch fixtures 44. This will cause the bladders 36 to deflate and the latch pins 42 to withdraw to their unlocked positions.

When the push buttons 76 of the valves 66 and 68 are in their normal positions the pressure source line 74 applies pressure through the valves 66 and 68 and the line 70 to the bladders 36 and the latch fixtures 44. As shown in FIG. 1, the pressure source line 74 is connected to a push button fluid valve 78 which may be employed for actuating pressure to the bladders 36 and the latch fixtures 44. As shown in FIG. 6, the push button valve 78 may be

5

mounted to the inner surface of the door 12 by a bracket and screw 80 and may be located in the proximity of the frame angle iron 14 so that its push button will be depressed for actuation purposes by a set screw 82 which is threaded through the angle iron 14. As shown in FIGS. 2 and 6, a pressure line 84 may be connected to the push button 78 and may extend through the wall of the enclosure 18 to a fluid pressure source (not shown). Accordingly, when the door 12 is closed the push button fluid valve 78, which is similar to the valves 66 and 68, is actuated to connect the lines 84 and 74 so as to apply pressure to the bladders 36 and the latch fixtures 44 as described hereinabove. It is desirable that the latch mechanisms 44 be actuated before the bladders 36 are inflated and for this purpose a flow control valve or fluid restrictor 86 may be interposed in a line 88 which connects the feeder lines 48 and 50 to the feeder lines 52 and 54. Accordingly, when the fluid valve 78 is actuated pressure will be forcibly applied to the latch fixtures 44 with a slower buildup of pressure being applied to the bladders 36.

As shown in FIG. 6 the door 12 may be constructed of a series of laminations which provide both an acoustic and electromagnetic seal. The door 12 may comprise an interior perforated metallic layer 90, an exterior metallic layer 92, and therebetween there may be a sponge rubber layer 94, and an aluminum foil corrugated layer 96 which is filled with fiberglass 98, a chopped glass fiber and asphalt emulsion layer 100 and various wooden layers 102. It is to be understood that many possible designs may be employed for constructing the door 12.

It is to be understood that the finger stock 30, as illustrated in FIGS. 8 through 10, may take various forms with the exception of the generally U shape, as exemplified in FIG. 10. If desired, the finger stock may be simply a generally U-shaped strip without the various fingers as illustrated in FIGS. 8 and 9.

In the operation of the invention the user simply closes the door and the push button valve 78 is automatically actuated to apply pressure to the bladders 36 and the latch fixtures 44. At this time the latch pins 42 are quickly actuated to lock the door and the bladders are slower in their response to inflation due to the control valve 86. Both bladders 36 will be inflated and both finger stock gaskets 30 will be forced against the brass plate 22 and in doing so they will wipe toward the center of the door to clear both the finger stock gaskets and the brass plate 22 from any oxides and film deposits thereon. This then ensures a good electromagnetic seal between these components. It should be noted that the door can be easily closed since the finger stock does not come into contact with the brass strip 22 until after the door is in a fully closed position. When it is desired to open the door the user pushes the button of either of the valves 66 and 68 whereupon pressure is bled from the latch fixtures 44 and the bladders 36 causing the door to unlock and the finger stock 30 to disengage the brass strip 22. It should be noted that the finger stock legs 34 are withdrawn from a protruding position with respect to the edge of the door so as to be substantially inaccessible to any damage by foreign objects or users of the door. Further, the manner of retaining the finger stock 30 within the channels 26 enables them to be easily replaced if they should become damaged.

We claim:

6

1. An electromagnetic shielded door structure for use with a door frame of a type having an electrically-conductive surface formed peripherally of the frame adjacent the peripheral edge of a door hung therein, said door structure comprising:

a door provided with an electromagnetic shield, the door having its peripheral edges formed with a groove having an electrically-conductive facing disposed in electrical contact with said shield;

an elongate inflatable and deflatable bladder disposed wholly within said groove when deflated;

an elongate electromagnetic gasket having a leg disposed between and in contact with said bladder and said groove facing, said bladder being formed and disposed in constant engagement with said leg for retaining the gasket in the groove;

said gasket further having a resiliently-flexible second leg overlying said bladder and normally disposed wholly within said groove in a spaced disengaged relationship with said door frame surface;

said bladder and gasket being so arranged that, when the door is in its hung position, inflation of the bladder presses said second leg into tight engagement with said door frame surface for electrically coupling said surface with said door shield; deflation of said gasket permitting said flexibility-resilient second leg to return to its disengaged position.

2. The door structure of claim 1 wherein said gasket is generally U-shaped in cross-section with its first leg fixedly retained by said bladder and its second leg disposed for flexing movement about the first leg whereby inflation of said bladder causes said second leg to move in a swingable manner for producing a wiping and cleaning action on said door frame surface as said inflation progresses.

3. The electromagnetic door structure of claim 2 wherein said second leg is convoluted for facilitating said cleaning.

4. The electromagnetic shielded door structure of claim 2 wherein:

said bladder has an elongated recess when deflated; said second leg of the gasket normally being disposed within the bladder recess.

5. The electromagnetic shielded door structure of claim 2 wherein:

said bladder has a portion which seals directly against said door frame surface when the bladder is inflated.

6. The electromagnetic shielded door structure of claim 2 wherein each leg of said gasket is convoluted.

7. The electromagnetic shielded door structure of claim 2 wherein retention of said first leg in the groove is achieved solely by frictional engagement.

#### References Cited

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2,757,225 7/1956 Dunn ----- 174—35.4

DARRELL L. CLAY, Primary Examiner

U.S. Cl. X.R.

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