Sept. 9, 1958 K. H. KELLER ET AL 2,851,549

METALCLAD SWITCHGEAR WITH INTERLOCK

Filed Feb. 18, 1957 6 Sheets-Sheet 1

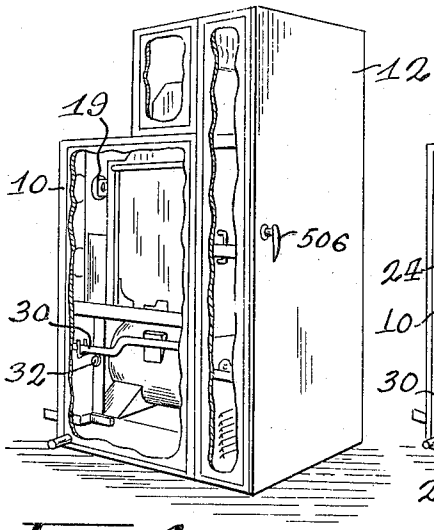


Fig. 1

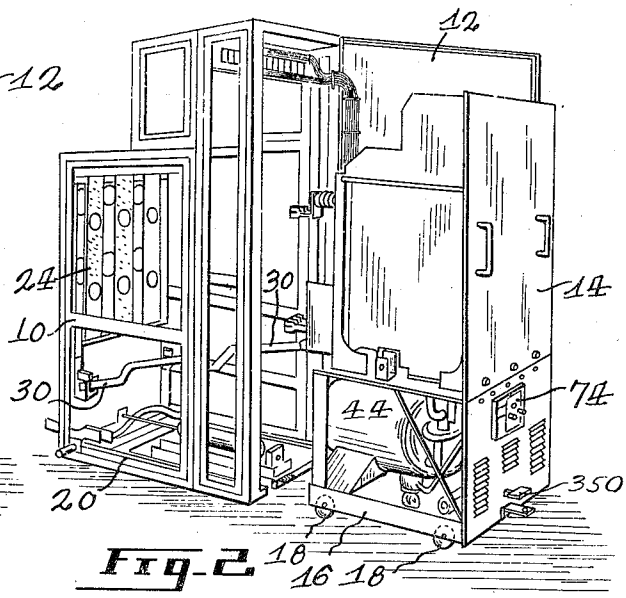


Fig. 2

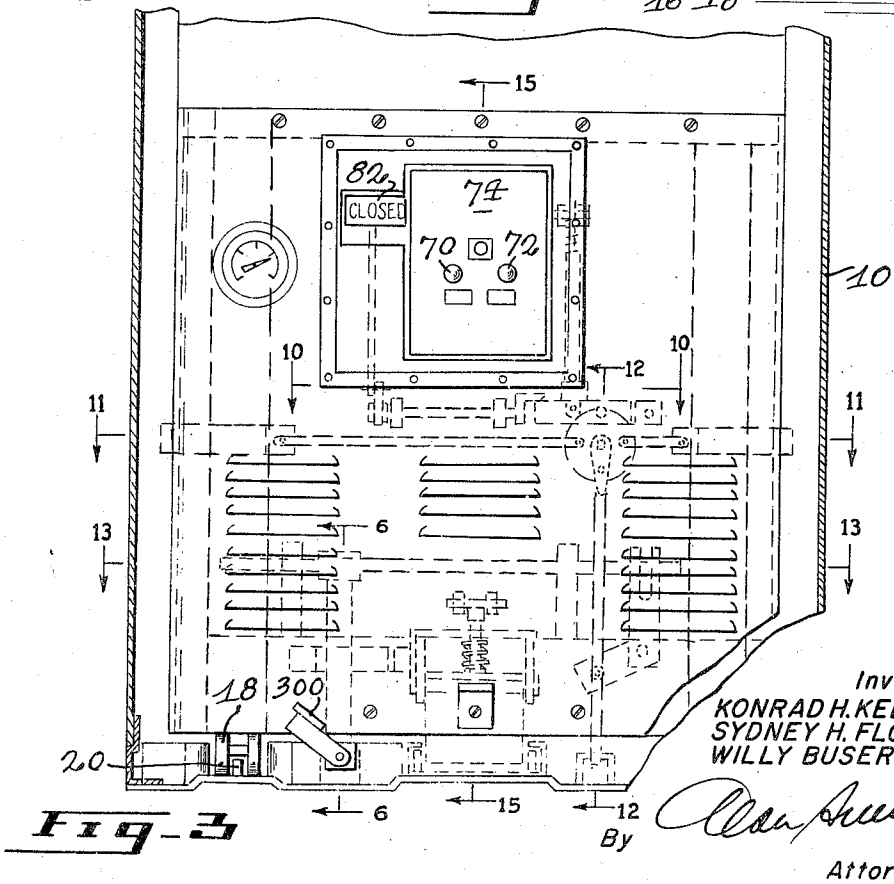


Fig. 3

Inventors
KONRAD H. KELLER
SYDNEY H. FLOOD
WILLY BUSER

By

Attorney

Sept. 9, 1958 K. H. KELLER ET AL 2,851,549

METALCLAD SWITCHGEAR WITH INTERLOCK

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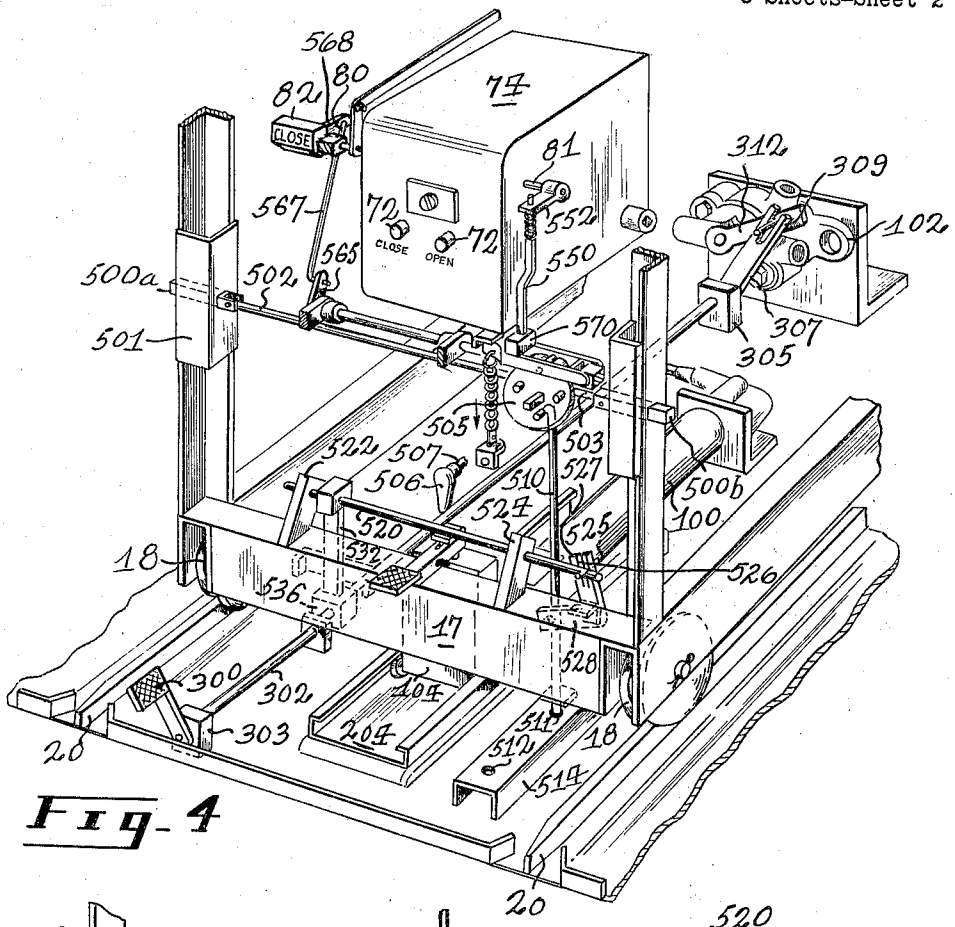


Fig. 4

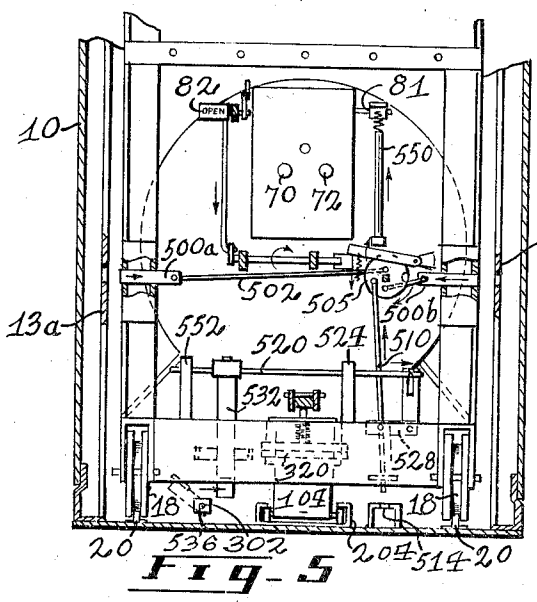


Fig. 5

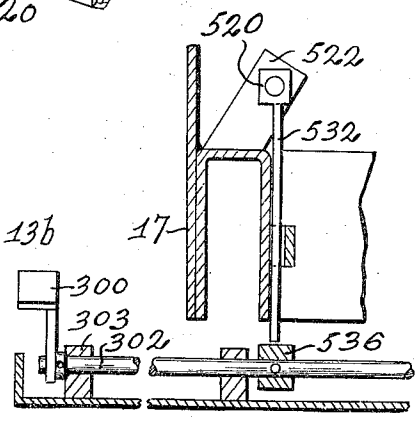


Fig. 6

Inventors
KONRAD H. KELLER
SYDNEY H. FLOOD
WILLY BUSER

By

Attorney

Sept. 9, 1958 K. H. KELLER ET AL 2,851,549

METALCLAD SWITCHGEAR WITH INTERLOCK

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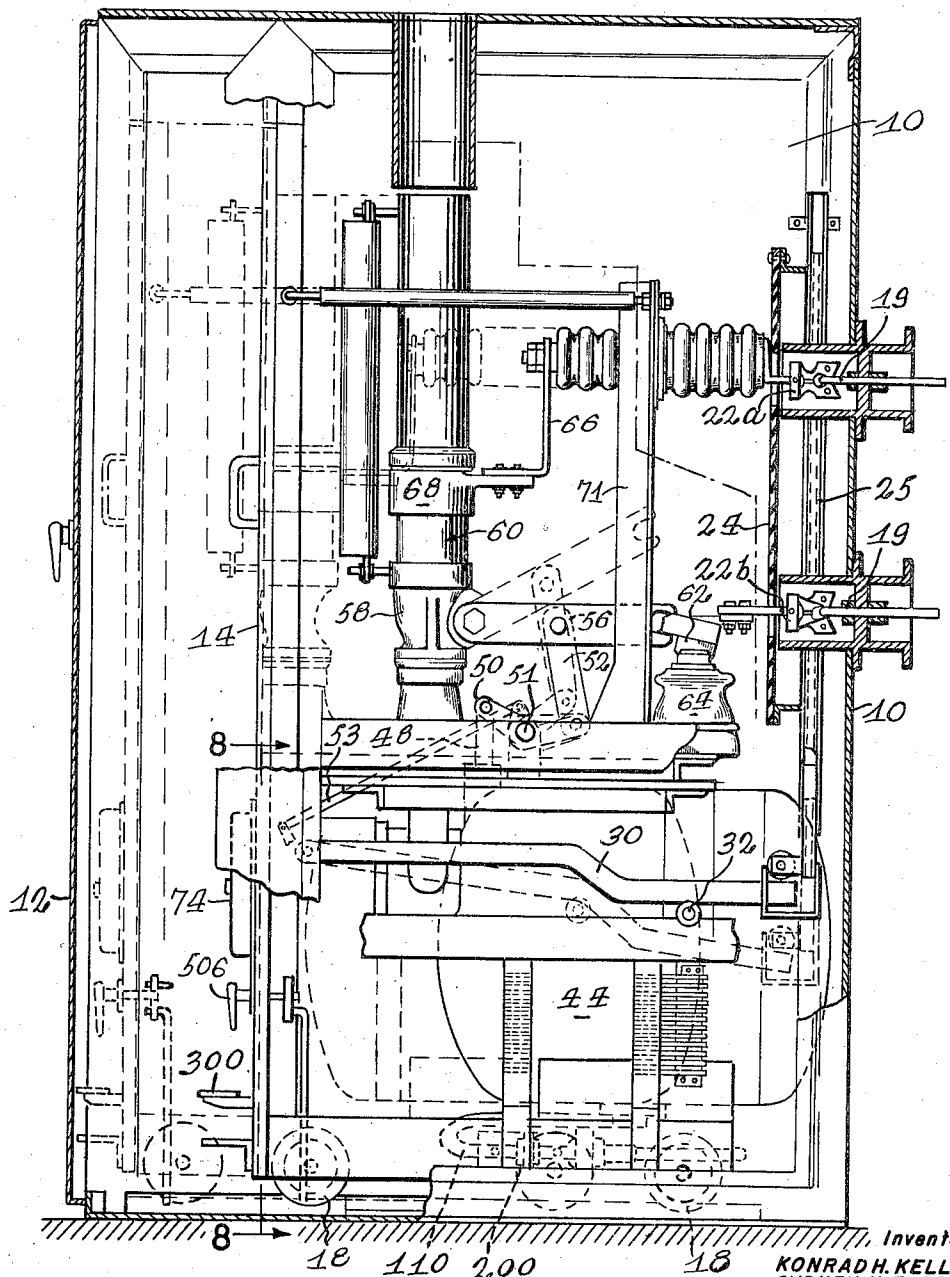


Fig-7

Inventors
KONRAD H. KELLER
SYDNEY H. FLOOD
WILLY BUSER

By

Attorney

Sept. 9, 1958 K. H. KELLER ET AL 2,851,549

METALCLAD SWITCHGEAR WITH INTERLOCK

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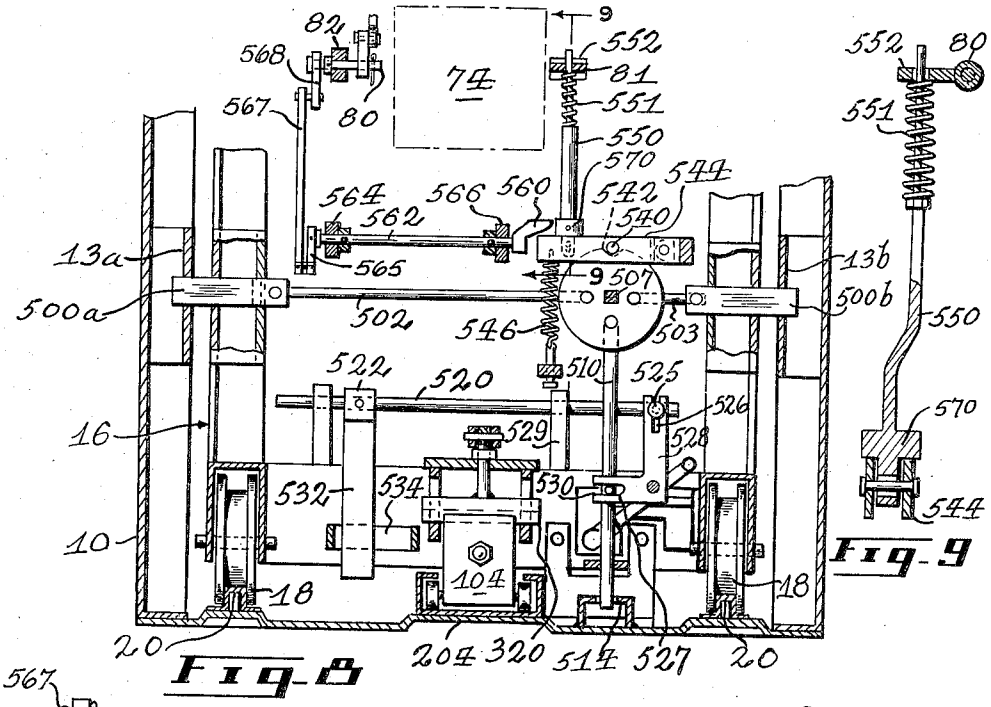


Fig. 8

Fig. 9

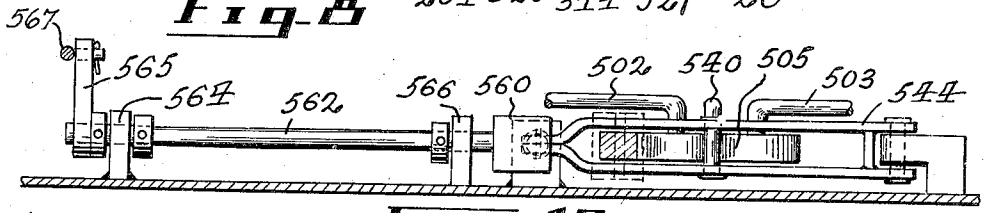


Fig. 10

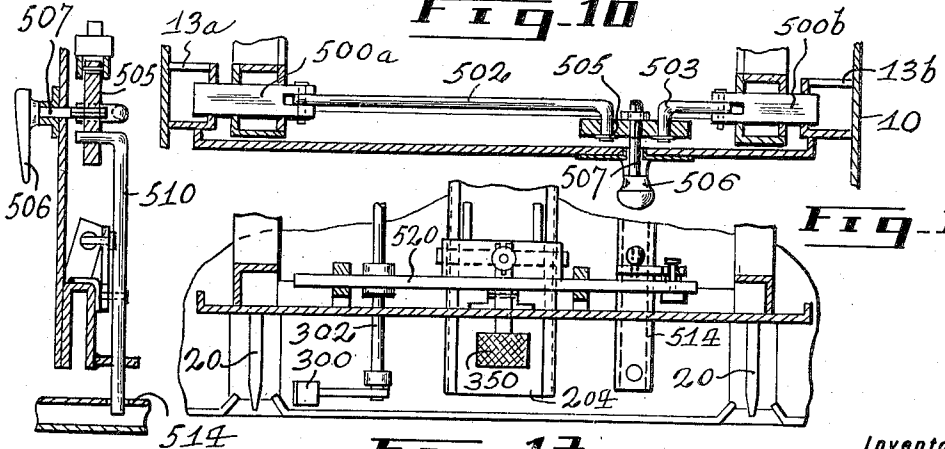


Fig. 11

Fig. 12

Fig. 13

Inventors
KONRAD H. KELLER
SYDNEY H. FLOOD
WILLY BUSER

By

Attorney

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METALCLAD SWITCHGEAR WITH INTERLOCK

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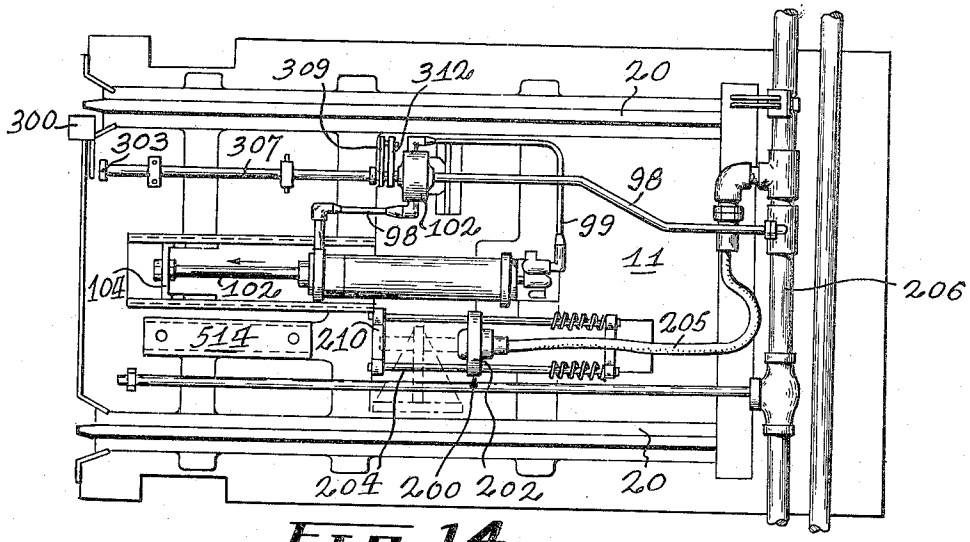


Fig-14

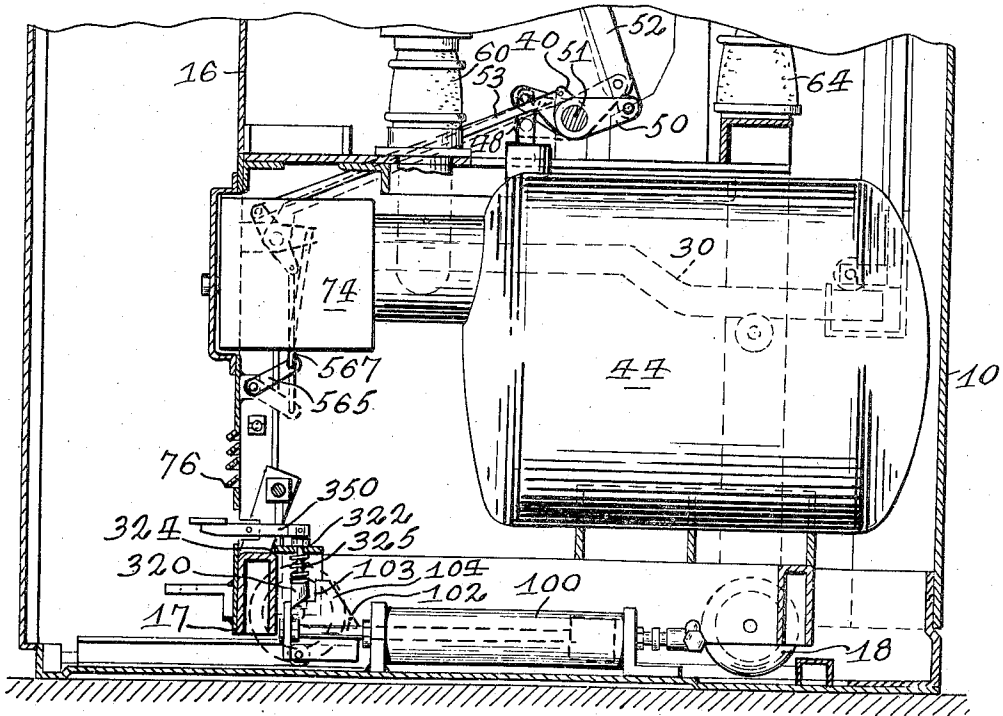


Fig-15

Inventors
KONRAD H. KELLER
SYDNEY H. FLOOD
WILLY BUSER
By
Attorney

Sept. 9, 1958 K. H. KELLER ET AL 2,851,549

METALCLAD SWITCHGEAR WITH INTERLOCK

Filed Feb. 18, 1957

6 Sheets-Sheet 6

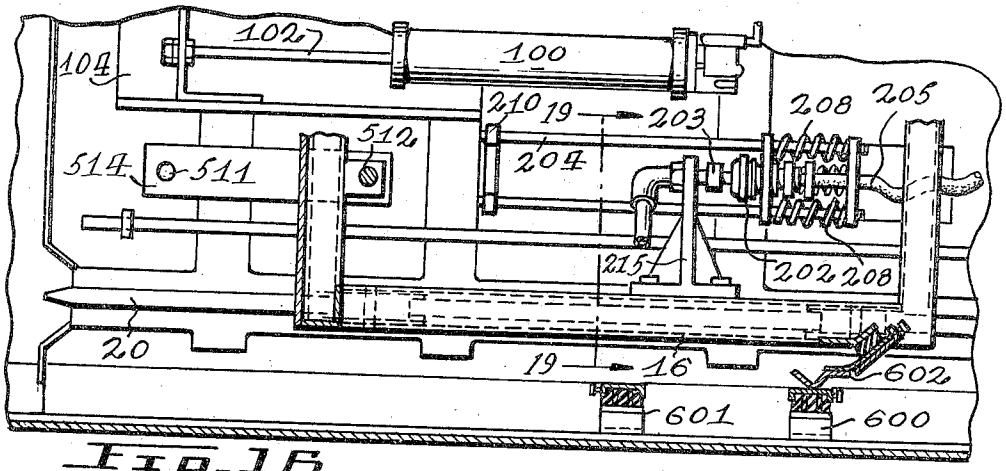


Fig. 16

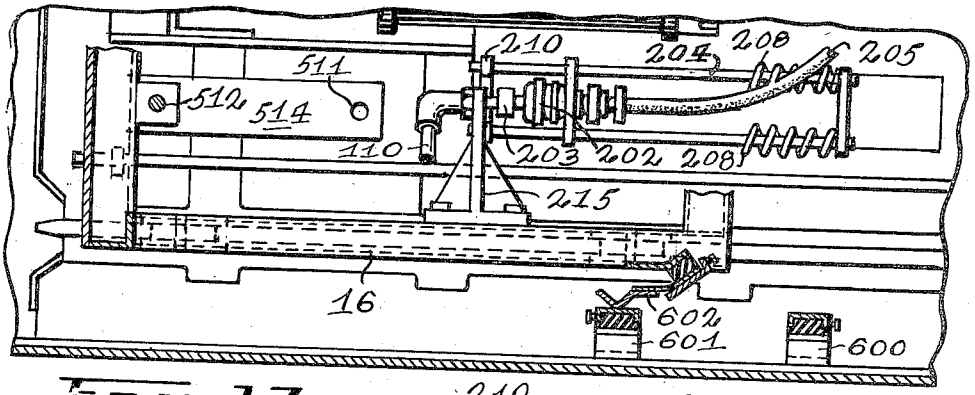


Fig. 17

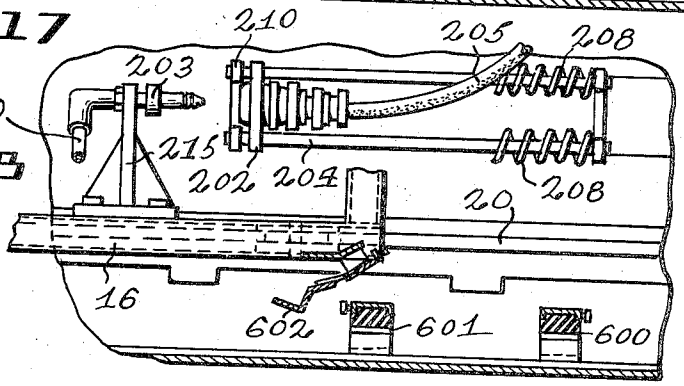


Fig. 18

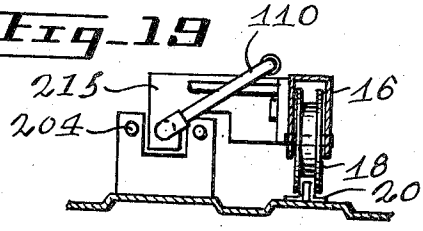


Fig. 19

Inventors
KONRAD H. KELLER
SYDNEY H. FLOOD
WILLY BUSER

By

Attorney

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Patented Sept. 9, 1958

2,851,549

METALCLAD SWITCHGEAR WITH INTERLOCK

Konrad H. Keller, Sydney H. Flood, and Willy Buser, all of St. Johns, Quebec, Canada, assignors to Brown Boveri (Canada) Limited, Montreal, Quebec, Canada, a corporation of Canada

Application February 18, 1957, Serial No. 640,635

7 Claims. (Cl. 200—50)

The invention is concerned with improvements in circuit breakers.

Circuit breakers of the air-blast type are in use in power transmission and distribution systems in many parts of the world.

The present invention relates to improvements in circuit breakers of this nature wherein a withdrawable cell unit carrying the circuit breaker is constructed as being readily removable from a cubicle housing to which the main contacts of the circuit are attached.

These cell units are usually designed to provide a minimum dimension withdrawable cell unit that is universally adaptable to indoor or outdoor metal clad assembles with units of the same rating generally constructed as being freely interchangeable in the cells.

It is often desirable in order to test the function of the circuit breaker as opposed to the function of the overall unit to withdraw the circuit breaker unit from its engaged position within the housing. This is accomplished in accordance with the circuit breaker of the present design by providing an intermediate or test position where the circuit breaker mechanism may be tested without the necessity of removing the breaker unit completely from its housing.

A preferred construction of a circuit breaker in accordance with the invention provides means whereby the circuit breaker mechanism as a unit may be moved to an intermediate test position where the main electrical connection is broken, a secondary electrical contact is made to operate the controls and an air connection is maintained to supply the necessary air pressure to test operate the breaker unit.

When the breaker is withdrawn to the test position or removed entirely from the cubicle, insulating bodies are provided which completely mask all live parts within the housing. In the test position the breaker is still connected to its control circuits and may be operated for testing.

Even with the provision of the insulating barriers and visual signals it is necessary to ensure that the circuit breaker unit cannot be moved relative to the cell unless the main circuit is previously broken. This would also apply in the case where the circuit breaker is in a position where the contacts would automatically engage if the breaker unit were returned to the cubicle after removal.

In accordance with a feature of the present invention, a system of mechanical interlocks is provided which positively prevents the withdrawal or insertion of a breaker unit unless the breaker is in the open position. In addition, a further interlock is fitted to prevent closing the breaker either by hand or electrically, unless it is fully inserted to operating position or withdrawn to the test position.

This is especially important when means are provided within the housings receiving the circuit breaker cells for automatically extending or withdrawing the circuit breaker unit, for example, when the circuit breaker units are extended or retracted by a pneumatic cylinder.

Having thus generally described the nature of the invention, particular reference will be made to the accompanying drawings, wherein there is shown by way of illustration, a preferred embodiment of a circuit breaker housing and circuit breaker cell unit embodying the means permitting the test conditions mentioned above and showing the safety interlocking system, and in which:

Figure 1 is a view in perspective elevation of a circuit breaker assembly embodying the features of the invention with portions of the housing walls broken to show the internal arrangement more clearly.

Figure 2 is a view corresponding in location to Figure 1 with the circuit breaker cell shown as being removed from the housing with the housing door in open position.

Figure 3 is an enlarged view showing in more detail the relative positions of the circuit breaker controls and the interlocking mechanism of the invention in front elevation.

Figure 4 is a diagrammatic view in perspective elevation of the essential elements of the interlocking assembly, the front panel of the circuit breaker cell being deleted for clarity.

Figure 5 is a front view of the construction shown in Figure 4 to illustrate the relative disposition of the interlocking members more clearly.

Figure 6 is a sectional view along the line **6—6** of Figure 3 to show the disposition and location of the release pedal mechanism.

Figure 7 is a view in side elevation and partially in section of the construction shown in Figure 1 with the cabinet structure removed to show the relative position of the circuit breaker terminals and the contact points of the housing frame more clearly.

Figure 8 is a sectional view of the construction shown in Figure 7 along the line **8—8**.

Figure 9 is a sectional view along the line **9—9** of Figure 8.

Figure 10 is a sectional view along the line **10—10** of Figure 3.

Figure 11 is a sectional view along the line **11—11** of Figure 3.

Figure 12 is a sectional view of Figure 3 along the line **12—12**.

Figure 13 is a sectional view of Figure 3 along the line **13—13**.

Figure 14 is a view in plan of the lower portion of the housing showing the guiding track and intermediate position lock in more detail.

Figure 15 is a side elevation partially in section of the lower portion of the apparatus shown in Figure 7 to show diagrammatically the locking linkage between the circuit breaker control mounted on the front panel of the circuit breaker withdrawable cell.

Figure 16 is a plan view partially in section of the lower portion of the breaker cell to illustrate the relative position of the air coupling connection and secondary electrical control connections when the breaker unit is in operative and closed position.

Figure 17 is a view corresponding in location to Figure 16 showing the relative positions of air coupling and secondary electrical connections in the intermediate or test position.

Figure 18 is a partial view corresponding in location to Figures 16, 17, showing the condition of the air coupling and secondary electrical connections in completely withdrawn location, all connections being broken.

Figure 19 is a cross-sectional view of the construction shown in Figure 16 along the line **19—19**.

With particular reference to Figures 1, 2 and 7, an airblast circuit breaker assembly of the type embodying means for intermediate test and an interlocking system in accordance with the present invention includes a housing frame **10** which may or may not be provided with a

door 12, and a withdrawable circuit breaker cell unit 14. The circuit breaker cell unit 14 is mounted on a supporting frame 16 provided with rollers or wheels 18. The rollers or wheels 18 are engaged with and are guided by spaced apart tracks 20 provided on the floor of the housing frame 10.

In the construction shown the main terminals 19 are mounted in the rear wall of the housing in alignment with the plugging contacts 22*a*, 22*b* of the circuit breaker unit 14. An insulating shield 24 is mounted for sliding movement so as to be adapted to mask the terminals 19 when the circuit breaker unit 14 is withdrawn. Levers 30 are pivotally connected to each side of the housing frame and are contacted by bosses or studs 32 extending from each side of the circuit breaker unit 14 during its travel. The motion thus imparted to the levers 30 is transmitted to a sliding frame 25 supporting the blocking insulating panel 24, see Figure 7, so that as the unit 14 is withdrawn the panel 24 is lowered, and when the unit 14 is reinserted in the housing the panel 24 is raised clearing the terminals 19.

The detailed construction and arrangement of the circuit breaker cell unit embodying means whereby air under pressure is utilized to open and close the breaker and extinguish the arc does not form a part of the present invention and therefore will be described generally only to indicate the relative positions of the various elements co-operating in the closed, intermediate testing, and fully withdrawn positions, and the interlocking safety features.

As previously described the breaker supporting frame 16 of the unit 14 includes a lower frame portion or dolly provided with wheels 18. Upper frame portions 71 support upper "make and break contacts" which are mounted above the main compressor tank 44. The breaker operating cylinder and piston are housed within the tank 44 and are not shown in detail. A shaft 48 extends from the piston above the tank 44 to a connection with a switch control lever 50 mounted on a shaft 51 and pivotally connected to an insulating rod 52. The rod 52 is pivotally connected to and actuates the disconnecting blade 56 pivotally mounted on a lower portion 58 of the arc extinguisher chamber 60. The blade 56 is adapted to engage and disengage with the contact brush 62 mounted on the supporting insulator 64. The lower plugging contacts 22*b* are also mounted on the insulator 64 in operative connection with the brush 62. The upper plugging contacts 22*a* are connected to a bus terminal 66 mounted on the contact tube 68 of the arc extinguisher 60. The action of the main piston and cylinder making and breaking the circuit is controlled through control buttons 70, 72 mounted in a control box 74 supported on the front panel 76 of the circuit breaker cell unit 14. A connecting rod 53 is provided from a lever 40 mounted on the shaft 51, operated by the main cylinder of the breaker to the control box so as to actuate the shaft 80 protruding from the control box thus giving a visual indication of the conditions of the breaker through the signal block 82. A connection from the control box also conditions the interlocking safety mechanism of the invention relative to the "open" or "closed" condition of the breaker.

Before going into the further details of the construction it should be mentioned that in the construction illustrated the withdrawal and insertion of the breaker unit 14 into and out of the frame 10 is accomplished through a compressed air cylinder 100 mounted on the base 11 of the frame and controlled through a selector valve 102. With particular reference to Figure 14 the cylinder 100 is provided with a piston 102 which is connected to a bracket plate 104 mounted for sliding movement in a guiding track 204. The bracket plate 104 is removably connected to the front of the supporting frame of the breaker cell unit as will be described in more detail later.

The breaker construction shown embodies means whereby the electrical connections and a source of air under pressure for the operation of the breaker unit are automatically coupled and uncoupled as well as providing means for the provision of air under pressure when the breaker cell is in an intermediate position for testing with the main contacts broken. This is accomplished in the present construction by providing a resiliently biased extended air coupling arrangement, indicated generally at 200, which acts to supply the compressor tank 44 at closed or test positions of the breaker but which is automatically uncoupled when the breaker cell 14 is withdrawn beyond the test position. This arrangement 200 includes one portion of a self-closing coupling 202 which is mounted for guided sliding movement on tracks 204 provided in the base of the frame. The inlet conduit 110 of the compressor tank 44 is provided with the mating half 203 of the coupling 202. The coupling portion 202 is normally urged towards the coupling portion 203 by springs 208 so that when the breaker is in closed position with the cell unit 14 fully in place a connection for air under pressure is provided through the conduit 205 directly to the main air pressure line 206. When the breaker unit 14 is partially withdrawn to the intermediate test position, which cannot be done unless the breaker is in "open" position, the coupling portions 202, 203 follow the travel maintaining the air coupling. The coupling portion 203 is mounted on a bracket 215 extending from the frame portion 16, so that movement of the frame 16 carries the coupling portions along the tracks 204.

With particular reference to Figures 16 through 19, the relative positions of the air coupling are shown in closed position (Figure 16), intermediate test position (Figure 17), and fully withdrawn (Figure 18). In the first position in addition to the air pressure connection contact is established through switch block 600 mounted on the side of the housing 10 and a switch blade assembly 602 mounted on the side of the supporting frame 16 of the cell unit 14 to maintain a secondary electrical circuit to the controls of the breaker. In the second (test position) the switch blade assembly 602 is moved into contact with a further switch block 601 so that the controlling elements are still provided with the necessary electrical power as well as air pressure.

Withdrawal of the breaker unit beyond the intermediate test position brings the coupling to the end of the travel of the tracks 204 into contact with the stop plate 210 so that the coupling portions 202, 203 are separated breaking the connection to the main air line 206. At the same time the switch blade assembly 602 is cleared from the second switch block 601.

Interlocking arrangement

As can be seen most clearly in Figure 14, air under pressure is supplied to the cylinder 100 through conduits 98, 99 leading from the main air line 206 and selector valve 102 respectively. The selector valve 102 and consequently the movement of the breaker unit 14 through the automatic means described is controlled by a foot pedal 300 mounted on the lower front portion of the panel 76. A link rod 302 rotatably mounted in a block 303 extends along the base of the housing 10 and through a corresponding supporting block 305. A shaft 307 having a bifurcate end 309 is connected with the control lever 312 of the selector valve 102.

As previously mentioned, the bracket plate 104 is normally disposed against the inside of the front frame portion 17 of the breaker cell and is retained in this position by the engagement of a resiliently biased locking bar 320 mounted in the cell unit frame. The bar 320 is mounted on a pin 322 slidably fitting through a bracket 324 with a spring 325 mounted over the pin 322 and normally urging the bar 320 into engagement with the correspondingly notched out portion 103 of the bracket plate 104 (see Figure 15). The upper end of the pin 322 is pivotally connected to one end of a pivotally mounted first actuated lever 350 mounted in the front panel 76. Depression

of the lever **350** raises the bar **320** and releases the cell **14** from contact with the plate **104** so that the cell can be completely removed from the housing frame **10**.

In accordance with the present invention, means are provided which prevent moving of the breaker cell unit **14** when the controls are in the "closed" position.

These comprise of a first interlock between the front supporting frame of the breaker cell unit whereby sliding latches **500***a*, **500***b* engage upright frame members **13***a*, **13***b* disposed at each side of the housing frame **10**, (see Figure 4).

The latches **500***a*, **500***b* are slidably mounted in brackets **501** secured to the upright cell frame members supporting the front panel **76** and are pivotally connected to actuating rods **502**, **503** which extend inwardly from the sides of the breaker unit to a connection with a main lock operating disc **505**. A connection is provided to the disc **505** from an operating handle **506** by a shaft **507** extending through the front panel **76**.

A further locking arrangement is provided between the housing frame **10** and the cell unit **14** in the form of a sliding rod **510** having one end pivotally connected to the cam disc **505** with the other end adapted to slidably engage with either of a pair of openings **511**, **512** provided in a channel member **514** mounted on the base of the frame **10** depending on the position of the cell unit **14** at full in or test position relative to the housing frame **10**.

An additional interlock is provided between the link rod **302** operated by the foot pedal **300** so that the automatic air operated cylinder **100** can not be operated until the previously described interlocks are operated. This interlock includes a sliding bar **520** that is mounted on supporting blocks **522**, **524** positioned on the lower front frame member **11** of the cell unit frame. One end of the slide bar **520** is provided with an outstanding bolt **525** which is engaged with one slotted end **526** of a bell crank **528** which is pivotally mounted on the frame member **11**. The other slotted end **527** of the bell crank **528** is engaged with an outstanding pin **530** recessed to the sliding rod **510**. A blocking plate **532** is mounted on the other end of the slide bar **520** and extends downwardly from the bar through a slotted guide bracket **534** disposed in alignment with a square plate **536** secured to the link rod **302**. With this arrangement, rotation of the control disc **505**, in either direction, actuates the sliding rod **510**, and through the linkage described, moves the sliding bar **520** bringing the lower end of the blocking plate **532** into or out of alignment with the square plate **536** and locks or releases the foot pedal **300**.

In accordance with the present invention the rotation of the control disc **505** through the handle **506** is possible only when the breaker unit is in open position. This is controlled by the engagement of a stop pin **540** in a cam recess **542** provided in the upper portion of the disc **505**. The stop pin **540** extends from the side of a bar **544** pivotally mounted on the cell unit frame with the bar **544** normally being resiliently urged downwards by a coil spring **546**. When the breaker is in "closed" position the movement of the bar upwardly to clear the pin **540** is prevented by a stop member **560**.

This is accomplished by mounting the stop member **560** on one end of a rod **562** which is mounted for rotation between supporting blocks **564**, **566** secured to the front portion of the cell unit frame. A lever arm **565** is secured to the other end of the rod **562** and is pivotally connected by a connecting rod **567** to a lever arm **568** extending from the rear of the signal block **82** mounted on the end of the shaft **80** extending from the other side of the control box **74**. The shaft **80** is connected to and is rotated by the movement of the piston shaft **51** operating the main breaker contacts. When the breaker is in "closed" position the stop member **560** prevents any possible movement of the bar **544** and consequently the

control disc **505**. Thus, all the interlocks described make it impossible to move the cell unit **14** relative to the housing frame **10**.

The movement of the control disc **505** also conditions the controlling mechanism so that the "close" control **70** cannot be operated between the intermediate test position and the first operating position. This is accomplished by a link **550** connected to a lever arm **552** extending from a second shaft **81** protruding from the control box **74**. A connection is made from the shaft **81** to the control **70** whereby it cannot be operated unless the lever arm **552** is in the correct position. The connection between the link **550** and the lever arm **552** is resiliently biased by a spring **551** and a stop **570** mounted on the end of the link **550** is placed in contact with the bar **544** so that when the bar **544** is moved upwards by rotation of the disc **505** to release the locking arrangement the shaft **81** is rotated locking the control as described.

Accordingly, unless the locking arrangements described are in full "locked" condition the "close" control of the breaker cannot be operated.

We claim:

1. An air blast circuit breaker control means embodied in a circuit breaker assembly having air operated circuit breaker means under the control of a secondary electrical circuit and being operable between a closed and open position for making and breaking a main electrical circuit, said circuit breaker assembly including a frame supporting first electrical terminals connected with said main electrical circuit and a main air pressure supply source having an engageable coupling; a withdrawable cell unit supporting said air operated circuit breaker means, and a secondary source of air pressure adapted to operate said breaker means, said secondary source of air pressure including an air supply coupling engageable with said main air pressure supply coupling; second electrical terminals connected with said breaker means and engageable with said first electrical terminal for connecting said breaker means to said main electrical circuit; means for moving said withdrawable cell unit relative to said frame between a first position wherein said first and second electrical terminals are connected and said secondary source of air pressure is simultaneously coupled to said main air pressure supply coupling, a second test position wherein said first and second electrical terminals are separated with said breaker means in open condition and said air pressure coupling maintained, and a third position wherein all connections are broken; interlocking means between said withdrawable cell unit and said frame and under the control of said breaker means whereby movement of said withdrawable cell unit relative to said frame between said first and second positions is prevented when said breaker means is in closed circuit making position.

2. An air blast circuit breaker control means, as claimed in claim 1, wherein said interlocking means includes a manually rotatable cam disc and there are means connecting said cam disc to said breaker controlling electrical circuit adapted to block said controls when said withdrawable cell unit is between said first and second position or between said second and third position.

3. An air blast circuit breaker control means, as claimed in claim 1, wherein there are spaced apart secondary electrical circuit connecting means mounted on said frame and a cooperating secondary circuit connecting means mounted on said withdrawable cell unit and engageable in sequence with said frame secondary circuit means whereby said secondary circuit for said breaker control is maintained when said cell unit is in either said first or second positions.

4. An air blast circuit breaker control means embodied in a circuit breaker assembly having air operated circuit breaker means under the control of a secondary electrical circuit and being operable between a closed and open position for making and breaking a main elec-

trical circuit, said circuit breaker assembly including a frame supporting first electrical terminals connected with said main electrical circuit and a main air pressure supply source having an engageable coupling; a withdrawable cell unit supporting said air operated circuit breaker means, and a secondary source of air pressure adapted to operate said breaker means, said secondary source of air pressure including an air supply coupling engageable with said main air pressure supply coupling; second electrical terminals connected with said breaker means and engageable with said first electrical terminal for connecting said breaker means to said main electrical circuit; said withdrawable cell unit being movable relative to said frame between a first position wherein said first and second electrical terminals are connected and said secondary source of air pressure is simultaneously coupled to said main air pressure supply coupling, a second test position wherein said first and second electrical terminals are separated with said breaker means in open condition and said air pressure coupling maintained, and a third position wherein all connections are broken; interlocking means between said withdrawable cell unit and said frame and under the control of said breaker means whereby movement of said withdrawable cell unit relative to said frame between said first and second positions is prevented when said breaker means is in closed circuit making position.

5. An air blast circuit breaker control means, as claimed in claim 4, wherein said interlocking means includes a manually rotatable cam disc and there are means connecting said cam disc to said breaker controlling electrical circuit adapted to block said controls when said withdrawable cell unit is between said first and second position or between said second and third position.

6. An air blast circuit breaker control means, as

claimed in claim 4, wherein there are spaced apart secondary electrical circuit connecting means mounted on said frame and a cooperating secondary circuit connecting means mounted on said withdrawable cell unit and engageable in sequence with said frame secondary circuit means whereby said secondary circuit for said breaker control is maintained when said cell unit is in either said first or second positions.

7. An interlocking assembly for a drawout type circuit breaker installation including a housing frame, circuit contact points on said frame, a withdrawable circuit breaker cell unit mounted within said frame and provided with circuit breaker contacts adapted to be engaged and disengaged with said circuit contact points, and circuit breaking control means adapted to actuate said cell circuit breaker contacts between engaged and disengaged positions; said interlocking assembly comprising, a rotatable cam disc mounted on said withdrawable cell unit, locking bars slidably mounted on said cell unit and engaged with said portions of said housing frame, said locking bars being engaged to and activated by said cam disc, a control handle connected to said cam disc, and linkage means between said circuit breaker control means, cam disc and sliding lock bars adapted to prevent movement of said disc through said control handle when said cell circuit breaker contacts and said circuit contact points are in engaged position.

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