W. L. R. EMMET & E. M. HEWLETT.

ELECTRIC SWITCH.

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942,491. Patented Dec. 7, 1909.

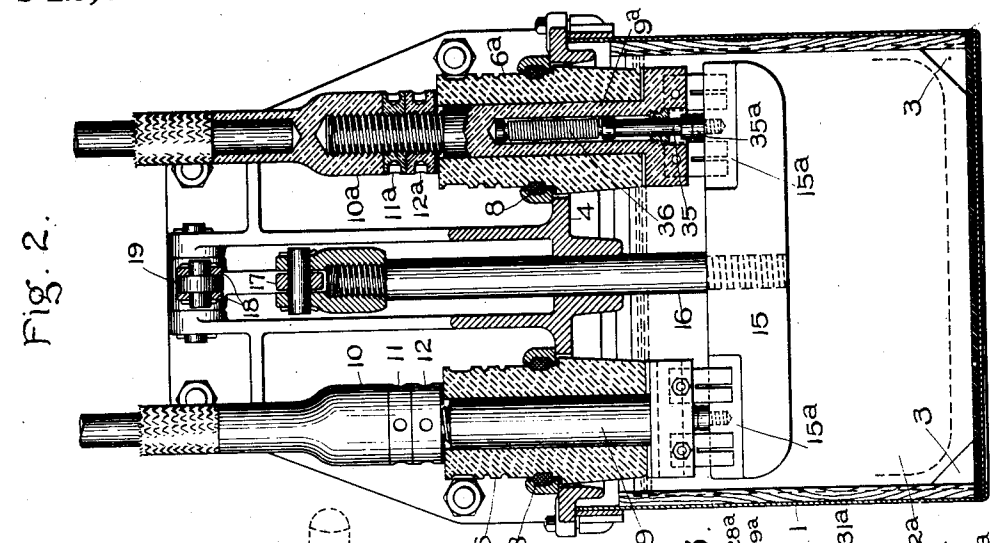

Fig. 2.

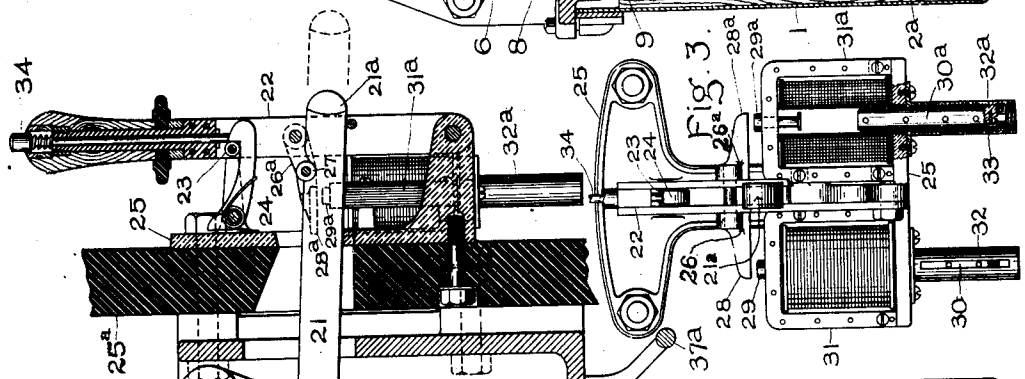

Fig. 3.

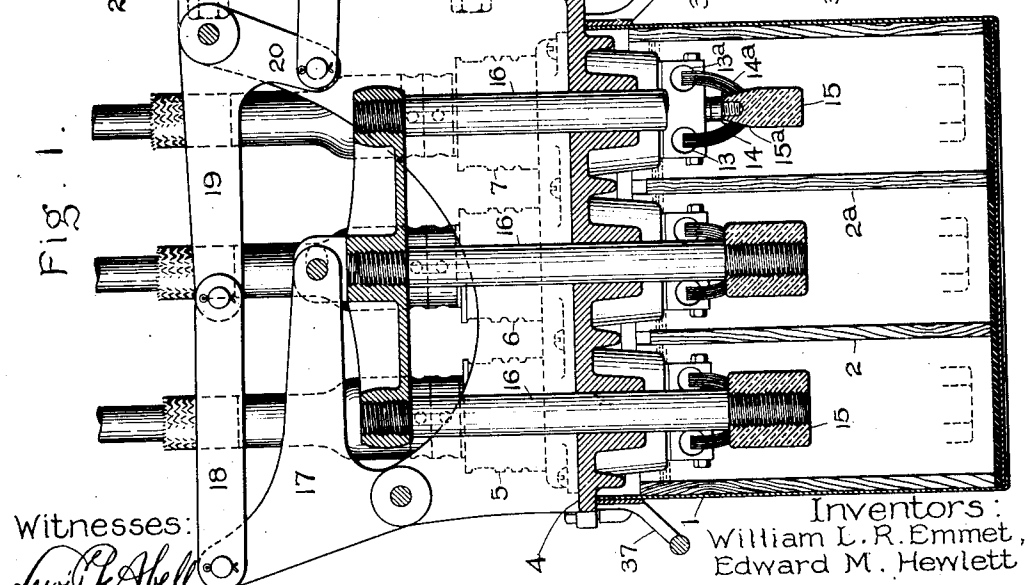

Fig. 1.

Witnesses:

Lewis P. Abell.

Benjamin B. Hull.

Inventors:

William L. R. Emmet,

Edward M. Hewlett

by Albert G. Davis Atty

UNITED STATES PATENT OFFICE.

WILLIAM L. R. EMMET AND EDWARD M. HEWLETT, OF SCHENECTADY, NEW YORK, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC SWITCH.

942,491. Specification of Letters Patent. Patented Dec. 7, 1909.

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To all whom it may concern:

Be it known that we, WILLIAM LE R. EMMET and EDWARD M. HEWLETT, citizens of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Switches, of which the following is a specification.

This invention relates to switches or circuit breakers for electric currents, the object being to permit the circuit to be made and broken effectively, without danger from fire or the holding over of the arc at the point of contact rupture.

A further object is to permit the switch to automatically open upon an occurrence of overload in the circuit in which it is included and to prevent resetting of the switch while the overload continues.

In carrying out the invention, we surround the point of contact rupture by an insulating liquid such as oil and provide for the movement of the movable contact downwardly in the oil, the stationary contacts being mounted so that soot which results from the carbonization of the oil by the arc formed on rupture will not deposit and interfere with the successful operation of the machine. This feature is not claimed herein, but is covered by our Patent No. 789,597, dated May 9, 1905, and the novel features of the present application relate more particularly to means whereby the circuit can be broken automatically and by which it is rendered impossible for an operator to close the circuit and forcibly hold it closed under overload conditions in the circuit.

In the accompanying drawings, which illustrate the invention, Figure 1 is a sectional view of a switch embodying our improvements, showing part of the switchboard on which the apparatus is mounted; Fig. 2 is a sectional view on a plane at right angles to that shown in Fig. 1; and Fig. 3 is a detail view of the escutcheon-plate which supports the overload magnets, showing also the construction of the latter.

1 represents an oil tank or receptacle for insulating fluid, which may be formed of galvanized sheet iron having overlapping joints riveted and soldered so as to form a fluid-tight vessel. It is lined with wood or other good insulator, and divided into a plurality of compartments by partitions 2, 2ª sliding in grooves formed in the side-walls of the tank. The lower corners of the partitions are cut off, as indicated at 3 in Fig. 2, to permit circulation of the insulating liquid through several compartments. The partitions rise preferably above the oil level as indicated in Fig. 1, and thus not only separate the tank into several independent compartments, but act as insulating barriers to prevent an arc striking from one pair of contacts to another.

The switch shown in the drawings is adapted for triphase alternating currents, though it will of course be understood that the improvements are not limited to any particular kind of currents, being applicable generally to currents of all kinds, nor are many of the improvements limited to any particular type of switch or circuit-breaker. The tank is provided with a cast-metal cover 4, bolted fast to the tank by means of ears provided on the cover and the tank respectively, as indicated in the drawings; and this cover has integral webs or walls forming bearings for the controlling and operating parts of the switch. In the cover are seated a number of insulating bushings 5, 6, 7, 6ª etc., one pair being allotted to each compartment of the tank. These bushings are seated in the cover and fastened by a lead joint, as indicated at 8. Through each bushing passes a metal stem 9, 9ª, the upper end of which is screw threaded to effect connection with a line connection or terminal 10, and jam nuts as 11, 12, 11ª 12ª, are provided to lock the stem fast to the bushing and to the terminal 10. The lower end of the stem 9 is formed as a contact terminal comprising a thick body of metal bored with two transverse holes, as indicated at 13, 13ª in Fig. 1, and the lower wall is split to permit the insertion of a bundle of laminated phosphor-bronze brush-contacts 14, 14ª. As will be evident from the drawings, we provide a pair of these contact terminals for each cell of the oil tank, located below the surface of the oil and which may be bridged by a reciprocating movable contact member or switch element, such as a brass-yoke or bridge piece 15, provided with a tapering edge at the top to wedge into engagement with the yielding brush contacts of the contact terminals, as indicated at 15ª on the extreme right of Fig. 1, in which the plane of

the section has been slightly altered to show the construction of the engaging contact surfaces. These bridging contacts are carried by a stem of insulating material such as wood, as represented at 16, of which there is one for each bridge piece. In the switch shown in the drawing, for triphase currents, there are three of these insulating rods, one end of each being screwed to the center of one of the bridge pieces and the other ends being fastened into a metal cross-head loosely journaled in the end of a bell-crank lever 17 by a slot and pin connection in which the slot is elongated to permit a slight lateral play. The other end of the bell crank lever is pivoted to a link 18 forming, together with an arm 19 of another bell-crank lever 20, a toggle which forms a power multiplying system for operating the movable contact member of the switch and is a desirable adjunct of the mechanism although not essential in all uses of the invention. The other arm of the bell-crank lever 20 is connected to a bar 21 sliding in an actuator, such as a manually operable switch closing means or operating lever 22, the latter being forked to accommodate it; on the end of the bar 21 is a stop 21[a] to engage the edges of the fork. This actuator or lever 22 carries a roller 23 coöperating with a restraining latch or detent 24, mounted on an escutcheon plate 25 secured to the front of the base or switchboard 25[a] and spring controlled, as indicated, so that when the handle on the manual actuator or operating lever 22 is grasped by the operator and is thrown in toward the board, the hook on the latch will pass over the roller and hold the actuator and connected parts in circuit closing position. Thus the switch may be closed and locked in a closed position. It is however, desirable to prevent closure of the circuit in case an overload or short circuit exists on the line, and we prevent this by means of a releasing device which automatically disconnects the contact member from the actuator in response to definite electrical conditions on the circuit and usually acts before the switch handle attains the fully closed position shown in Fig. 1, where the restraining latch retains the actuator and connected parts in circuit closing position. By means of this device we disconnect the actuator or operating lever from the bar 21 and permit the movable element of the switch to fall back to its open position in response to its normal bias.

The actuator and the movable element of the switch are disenagageably connected by means of a latch or similar normally positive connection, which normally maintains the actuator and the movable contact in operative engagement and which, in the specific form of switch shown, comprises pivoted arms 26, 26[a], carrying a roller 27 and forming a roller latch which normally, when the switch is closed, engages a notch in the upper edge of the bar 21, and holds the movable switch element in a closed position under normal operating conditions. The arms are pivoted to the operating lever 22 and are moved by an electro-responsive tripping device to disconnect the actuator and the movable contact under predetermined electrical conditions through projections 28, 28[a] which extend from the arms into the paths of steel pins 29, 29[a] lying in the paths of movement of the laminated cores 30, 30[a] (see Fig. 3) of the overload magnets. The restraining latch which holds the actuator in circuit closing position acts in train or series with the roller latch which forms a disengageable connection for transmitting the locking strain to the movable contact member, and thereby holds the switch contacts in engagement under normal operating conditions or permits disengagement at any time under abnormal conditions whether such conditions occur during the act of closure of the switch by the operator or afterward.

The overload magnets are made in duplicate, the several coils being connected in operative relation to the current phases of the polyphase circuit, and each magnet carries a frame or bundle of sheet iron plates riveted together, as indicated at 31, 31[a], surrounding the coil, the base being formed by an iron casting which is part of the escutcheon plate 25. A tubular or other guide 32, 32[a] is supported on the bottom of the magnet to retain the core, an adjustable nut taking into a thread on the inside of the tube, as indicated at 33, to limit the drop of the core and adjust the points or degrees of overload at which the switch shall be tripped. The coils of the magnet are placed in series with the switch and the switch leads, or in other suitable relation to the circuit controlled by the switch and when an overload exists the cores 30, 30[a] are lifted and strike the pins 29, 29[a]. The projections 28, 28[a] on the arms 26, 26[a], are of such a length that they will lie in the path of the pins 29, 29[a] when the shunt contacts hereinafter to be described are in engagement and before the main contacts of the switch have been firmly closed. If an overload exists and an attempt is made to close the switch, the roller 27 is automatically lifted from the notch in the bar 21, and the latter being released, the movable contact is disengaged from the actuator and the weight of the switch parts, with the assistance of the spring actuated shunt contacts, forces the switch open, thus preventing a complete closure under an overload, since the switch member can be released notwithstanding the operator may have the handle in his grasp. In case, however, no overload exists, the

pins 29, 29ª will not have been raised and the lever 22 and the bar 21 will remain connected, the switch being held closed by the latch 24.

To release the switch by hand, we provide a push pin 34, controlled by a coil spring, as indicated in Fig. 1, the lower end of which is in operative relation to the restraining latch 24, so that the latter may be pushed down and the handle or actuator released, the switch being thereby opened by gravity and the other controlling forces which give the switch a normal bias toward the open position.

We provide, in addition to the main laminated contacts already described, a pair of shunt contacts for each contact terminal, the construction of which is seen in Fig. 2. The contact terminals, being hollow, accommodate a phosphor-bronze rod 35 controlled by a spring 36 nesting in the hollow contact terminal. A flange or stop on the inner part of the rod limits the outward movement of the rod. This rod or shunt contact coöperates with another shunt contact 35ª of phosphor-bronze, screwed into the face of the bridge piece. The movable shunt contact 35 is given sufficient play to engage the shunt contact 35ª before the main contacts of the switch meet. Thus, when a closing movement is given to the switch, the shunt contacts are first brought together, and if an overload exists, the parts are freed from the actuator or handle, as already described, before the main contacts engage, but if the circuit is not overloaded, a continuing movement of closure brings the main contacts into engagement, and the switch is locked, by the restraining latch engaging the actuator, in closed position. The several springs 36 of the shunt contacts 35 serve to give a starting movement to the switch in opening and render its action prompt, and are particularly desirable in case of an automatic release due to overload, since when the cores or plungers 30, 30ª, are thrown up, the springs give a united effect sufficient to overcome the friction of the engaging parts and lever system and open the circuit. 37, 37ª represent handles by which the oil tank may be removed from the switchboard, for change of oil when necessary or for inspection of the parts.

While we have described our improvements in connection with an oil switch or circuit breaker, we wish it to be understood that many features apply indifferently to all types of automatic switches which are self-opening under predetermined electrical conditions.

What we claim as new and desire to secure by Letters Patent of the United States, is,

1. In an electric switch, a movable contact member, an actuator therefor, means for connecting said contact member with said actuator, a latch for engaging said actuator for holding said contact member in normal position, and means for breaking the connection between said contact member and actuator and leaving the latter restrained upon the occurrence of predetermined electrical conditions.

2. In an electric switch, a movable contact member, an actuator therefor, a latch connecting said contact member with said actuator, a latch engaging said actuator for holding said contact member in circuit-closing position, and means for breaking the connection between said contact member and actuator upon attempted closure of the switch during the existence of predetermined electrical conditions.

3. In an electric switch, a base, a movable contact member, an actuator therefor, a latch engaging said actuator to lock the same to said base, a latch for locking said contact member to said actuator, and electro-responsive means for unlocking said contact member from said actuator.

4. In an electric switch, a base, a movable contact member, an actuator therefor, means for restraining said contact member in normal position comprising means engaging said actuator and locking the same to said base, and means for preventing the operation of said switch during the existence of predetermined electrical conditions.

5. In an electrical switch, a movable contact member, a toggle for operating said contact member, an actuator, means for connecting said actuator with said toggle, means for engaging said actuator for holding said contact member in normal position, and electro-responsive means for breaking the connection between said actuator and toggle.

6. In an electrical switch, a base, a contact-carrying member, a toggle for operating said member, an actuator, a latch for connecting said actuator with said toggle, a latch for locking said actuator to said base, and electro-responsive means for breaking the connection between said actuator and said toggle.

7. In an electrical switch, a base, a movable contact member, a latch pivoted to said base, a member engaged by said latch, a latch pivoted to said member and adapted to restrain said contact member, and electro-responsive means for releasing said contact member.

8. In an automatic magnetic circuit-breaker, in combination with a base and separable coöperative contacts, manually operative means for closing the same, a latch on the base to engage the manually operative closing means, disengageable means for normally maintaining operative relationship between the manually operative means and

the contacts, and automatic magnetic means for breaking said operative relationship between the manually operative member and the movable contact, substantially as described.

9. In an electric switch, the combination of separable coöperative contacts, manually operative means for causing their engagement, means for causing the separation of said contacts, means for normally restraining the separating means, disengageable means for maintaining operative engagement between the manually operative means and the movable contact, and automatic magnetic means for actuating the disengageable means independently of the restraining means.

10. In an electric switch, the combination of fixed and movable contacts, a contact-supporting member, spring means for actuating said member to cause the separation of said contacts, a latch for normally restraining the spring actuation, a manually operable lever for bringing the movable contacts into engagement with the fixed contacts and for causing the engagement of the restraining latch, latching means for normally connecting the manually operable lever and the contact-supporting member, and automatic magnetic means for actuating said latching means to disconnect the manually operable lever from the contact-supporting member upon the occurrence of predetermined electrical conditions in the circuit independently of the restraining latch.

11. A circuit-breaker having make-and-break contacts for controlling the circuit, a reciprocating member for operating the same, an operating lever, a tripping device, said operating lever being provided with means for automatically disengaging a part of it from operative connection with said member when the latter has been fully moved to close the circuit during abnormal electrical conditions in the circuit, a stationary restraining latch for the operating lever, and means upon the return of the operating lever to normal for permitting the automatic restoration of said operating lever to operative relation with said member.

12. The combination, with a switch member, of a toggle for operating said member, a lever, a normally positive connection between said lever and a link of the toggle, and electro-responsive means for breaking the positive connection.

13. The combination, with a switch member, of a toggle for operating said member, a lever, a normally positive connection between said lever and a link of the toggle, and electro-responsive means for breaking the positive connection upon attempted closure of the switch during the continuance of predetermined circuit conditions.

14. The combination, with stationary contacts, of a bridging member, a toggle for cramping the said member into engagement with the contacts, a lever, a normally positive connection between said lever and a link of the toggle, and electro-responsive means for breaking the positive connection.

15. The combination, with stationary contacts, of a bridging member, a toggle for cramping the said member into engagement with the contacts, a lever, a stationary latch for the lever, a normally positive connection between said lever and a link of the toggle, and electro-responsive means for breaking the positive connection upon attempted closure of the switch during the continuance of predetermined conditions in the circuit.

16. A circuit-breaker having make-and-break contacts for controlling the circuit, a reciprocating member for operating the same, an operating lever, a stationary latch for the lever, a tripping device for disengaging the lever and member, and means for automatically rendering inoperative said lever when it has operated to close the circuit during the continuance of abnormal electrical conditions in the circuit.

17. A switch for electric currents, comprising separable contacts to open and close the circuit, means for closing them, means for causing the opening of the contacts, a locking device normally to hold them closed, and a releasing device responsive to current to release them independently of the movement of the closing means.

18. A switch for electric currents, comprising separable contacts to open and close the circuit, an operating handle to govern the switch, a latch to hold the handle closed, and an overload releasing device to control the switch independently of the operating handle.

19. An electric switch comprising an operating lever, a stationary detent for the lever, a movable contact biased toward opening movement when closed, means for releasing or establishing control of the circuit-closing device by said lever, and an automatic releasing device for cutting off the control of the operating lever when the latter is held by the stationary detent.

20. An electric switch comprising an operating lever, a movable contact, a toggle connection between the two, restraining means for the lever, and a releasing device responsive to current for freeing the toggle from the lever and thereby permitting the toggle to collapse and move said contact.

21. An electric switch comprising an operating lever, a movable contact, a toggle connection therewith, a handle for setting the toggle, and an overload release magnet for collapsing the toggle independently of lever movement.

22. A switch for electric currents, comprising separable contacts to open and close

a circuit, a member supporting the movable contacts, a manually operative member for actuating said member, a latch for locking the member supporting the movable contacts, a latch for locking the manually operative member, and automatic means responsive to predetermined current to release the member supporting the movable contacts after the switch has been latched closed independently of the manually operated member.

23. An electric switch, a movable contact member, an actuator therefor, a latch for connecting said contact member with said actuator, a second latch coöperating with said connecting latch for locking said contact member in normal position, said connecting latch intervening between said second latch and said contact member, and means for breaking the connection between said actuator and said contact member upon attempting to move said contact member to normal position during the existence or continuance of predetermined electrical conditions.

24. In an electric switch, a movable contact member, an actuator therefor, a latch for connecting said contact member with said actuator, a second latch coöperating with said connecting latch for locking said contact member in normal position, the locking strain being transmitted to said contact member through said connecting latch, and means for breaking the connection between said actuator and contact member upon attempting to move said contact member to normal position during the existence or continuance of predetermined electrical conditions.

25. In an electrical switch, a movable contact member, an actuating member, a latch carried by one of said members and adapted to engage the other to connect them in train, a second latch independent of said contact member and adapted to engage said train to lock said contact member in normal position, and means for breaking the connection between said contact member and actuating member upon attempting to move said contact member to normal position during the existence or continuance of predetermined electrical conditions.

26. In an electrical switch, a base, a movable contact-carrying member, an actuator for moving said movable contact member to current-closing position, a latch for locking said contact-carrying member to said actuator, a latch for engaging said actuator for locking it to said base, whereby the movable contact-carrying member may be locked in circuit-closing position, and electro-responsive means for unlocking said contact-carrying member from said actuator upon attempted closure of the switch during the existence of predetermined electrical conditions.

27. In an electric switch, a contact-carrying member, a toggle for operating said contact member, an actuator, a latch for connecting said actuator with said toggle, a latch engaging said actuator, and electro-responsive means for breaking the connection between said actuator and toggle.

28. In an electric switch, a base, a contact-carrying member, a toggle for operating said member, an actuator, a latch for connecting said actuator with said toggle, a latch for locking said actuator to said base, and electro-responsive means for breaking the connection between said actuator and said toggle.

29. In an electric switch or circuit-breaker, a movable contact, an actuator therefor, power multiplying means for setting the contact closed, means for disengageably connecting said actuator to said movable contact, and automatic magnetic means for disengaging said contact from said actuator to open the circuit independently of the actuator upon the occurrence of predetermined electrical conditions.

30. In an electric switch or circuit-breaker, a movable contact, an actuator therefor, power multiplying means for setting the contact closed, means for disengageably connecting said contact to said actuator, and automatic magnetic means for liberating the contact from the actuator upon attempted closure of the circuit under predetermined electrical conditions.

31. In an electric switch or circuit-breaker, a movable main and shunt contact, the latter being mounted to remain in engagement until after the main contacts are broken, an actuator for both movable contacts, power multiplying means for setting the contacts closed, means for disengageably connecting said contacts to said actuator, and automatic magnetic means for liberating the contacts from the actuator upon attempted closure of the circuit under predetermined electrical conditions.

32. An electric switch or circuit breaker comprising relatively movable contacts biased to open, an operating handle for closing said contacts, contact controlling mechanism cooperating with said contacts when said handle is in switch closing position to normally restrain said contacts closed and to always permit said contacts to separate and leave the handle in switch closing position, and an electric-responsive tripping device coöperating with said contact controlling mechanism.

33. An electric switch or circuit breaker comprising relatively movable contacts biased to open, an operating handle arranged to close said contacts and to be left stationary

in switch closing position, connections controlled by said handle for normally holding said contacts closed and for always permitting said contacts to separate and leave said handle in switch closing position, and electro-responsive means for controlling said connections to permit said contacts to separate.

In witness whereof we have hereunto set our hands this 12th day of February, 1901.

WILLIAM L. R. EMMET.
EDWARD M. HEWLETT.

Witnesses:
BENJAMIN B. HULL,
EDWARD WILLIAMS, Jr.