July 14, 1953 A. ROXBURGH ET AL 2,645,696

ELECTRIC CIRCUIT BREAKER

Filed Dec. 21, 1950 2 Sheets-Sheet 1

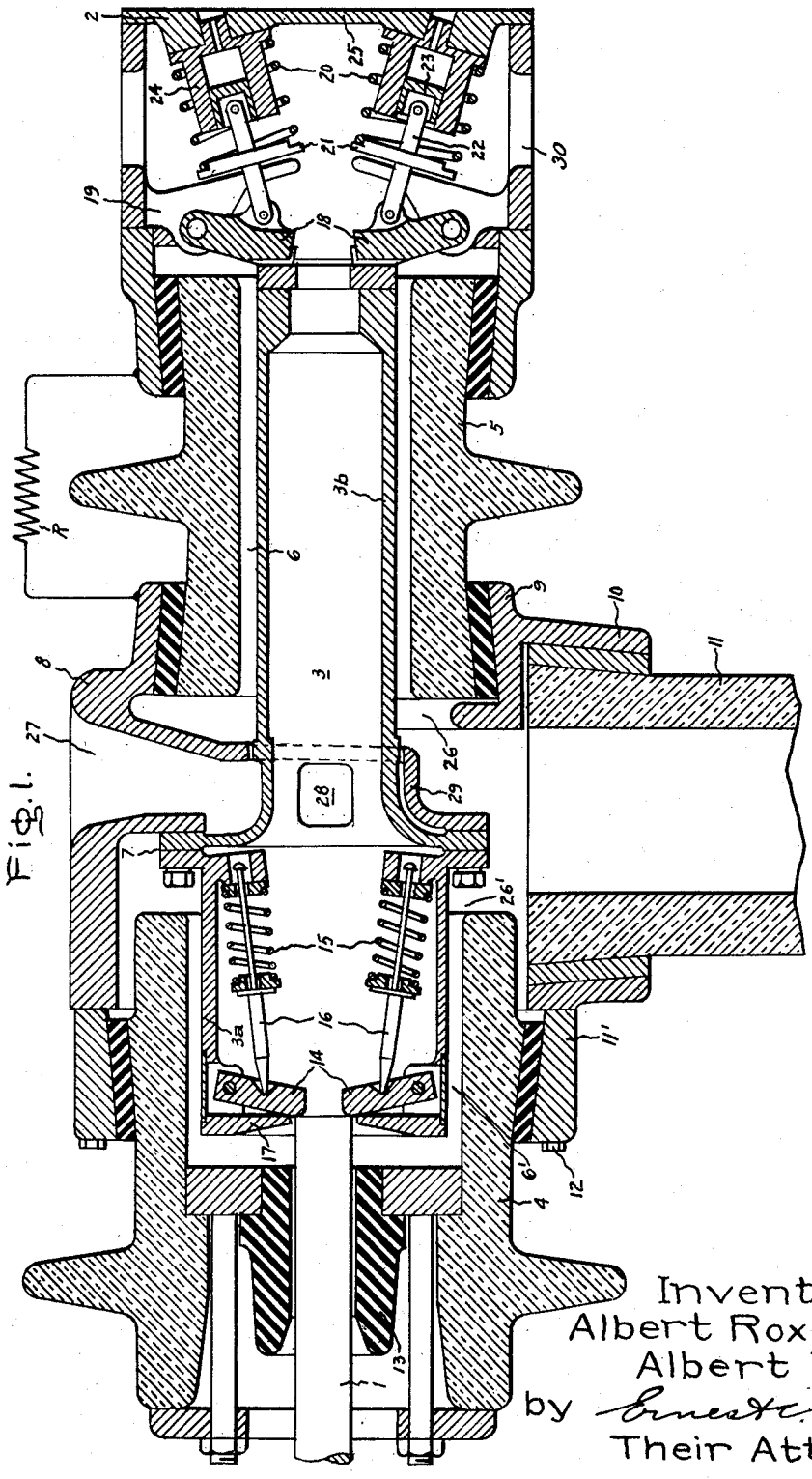

Fig. 1.

Inventors:
Albert Roxburgh,
Albert Leigh,
by Ernest C. Britton
Their Attorney.

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Fig. 2.

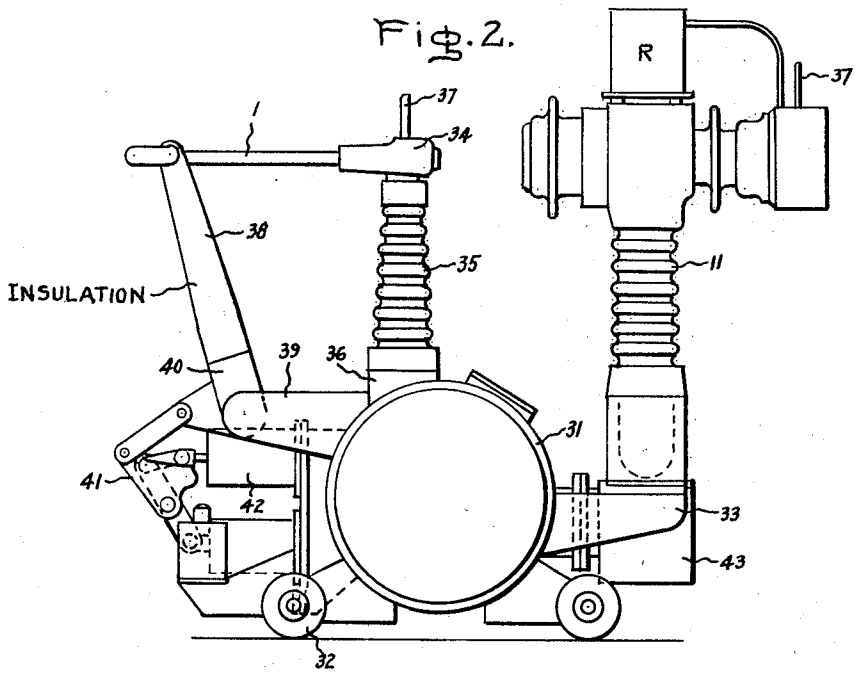
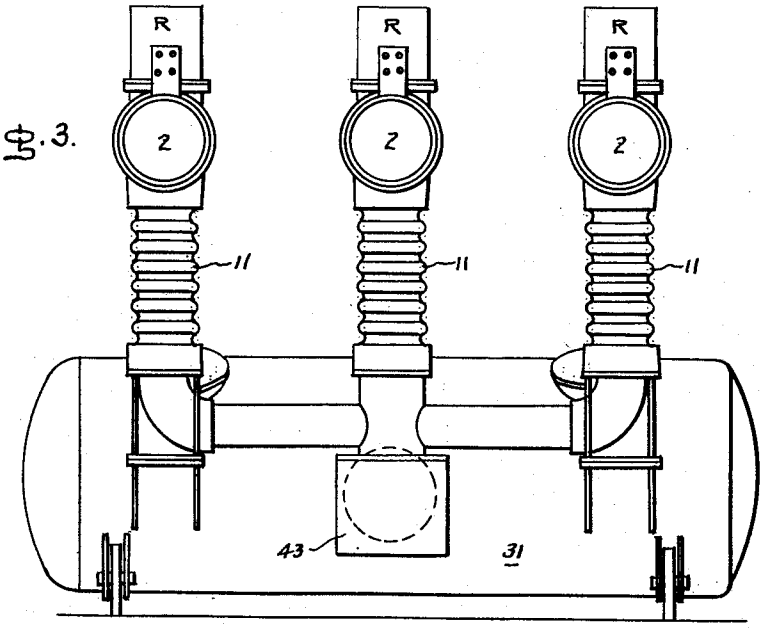


Fig. 3.



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Albert Leigh,
by Ernest C. Britton
Their Attorney.

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ELECTRIC CIRCUIT BREAKER

Albert Roxburgh, Willesden, London, and Albert Leigh, Kenton, Harrow, England, assignors to General Electric Company, a corporation of New York

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9 Claims. (Cl. 200—148)

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This invention relates to high voltage electric circuit breakers and more particularly to gas blast circuit breakers having interrupting contacts biased toward the closed position and arranged in series with isolating contacts and wherein resistance means is connected in parallel with the interrupting contacts.

In circuit breakers of this type a blast of gas is used to extinguish the arc drawn between the interrupting contacts after separation thereof and resistance means connected across the interrupting contacts is for the purpose of limiting the recovery voltage peaks tending to cause a restrike of the arc between the interrupting contacts. Since the resistance in parallel with the interrupting contacts allows current to bypass the interrupting contacts after the arc is extinguished at these contacts, it is necessary to interrupt this current at the isolating contacts. In high voltage breakers such interruption may prove difficult, if not impossible, unless special provision for interrupting the arc at the isolating contacts is made.

The principal object of this invention is to provide improved means for interrupting the resistance current in a gas blast circuit breaker having resistance means in parallel with its interrupting contacts and for thereafter introducing an isolating gap into the circuit after the resistance current is interrupted.

According to the invention an interrupter having main interrupting contacts in series with isolating contacts and having resistance means in parallel with the main interrupting contacts is constructed so that the isolating contacts are separated by a blast of gas, which, in addition to separating these isolating contacts, also extinguishes the arc drawn therebetween after interruption of the main arc drawn between the interrupting contacts. Thereafter a suitable isolating gap is established by means which quickly increases the distance separating the isolating contacts after the arc drawn therebetween is extinguished.

The invention will be better understood with reference to the accompanying drawings in which Fig. 1 is a cross sectional view showing the circuit breaking elements of a gas blast breaker constructed in accordance with the invention; Fig. 2 is an end view of a circuit breaker embodying the circuit breaker element shown in Fig. 1; and in which Fig. 3 is an elevation of a three-phase circuit breaker evolved from the single-phase construction shown in Figs. 1 and 2.

Referring to Fig. 1 of the drawings, the breaker

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is furnished with a double ended circuit interrupting unit with one end of which is associated a retractable isolating and resistance current interrupting contact 1 while the other end is provided with an interrupting contact 2. The retractable contact 1 is conductively associated with one terminal of the breaker, while the interrupting head 2 forms the second terminal of the breaker. In the circuit-making position illustrated, the contacts 1 and 2 are conductively connected through a stationary hollow conducting member 3. The member 3 is, for the most part, enclosed within an outer insulating casing, formed in two parts 4 and 5, between which and the conducting member 3 are formed annular spaces 6' and 6 respectively. The hollow conducting member 3 is also made conveniently in two parts 3a and 3b which are separately joined together at a flanged joint 7, the flange on the right-hand portion 3b of the conducting member 3 being also used as a means for supporting the member 3 from a central generally cylindrical mounting casting 8. The casting 8 is extended to provide a flange 9 into which the right-hand portion 5 of the insulating casing is cemented or otherwise secured, while the depending flange 10 furnishes jointing means whereby the assembly of the whole interrupting unit is mounted upon a column insulator 11.

The left-hand portion 4 of the insulating casing is secured into a support flange 11' which is in turn separately attached to the mounting casting 8 by means of bolts 12. To the interior of portion 4 of the insulating casing is also attached an insulated throat member 13 through which the retractable isolating rod contact 1 enters to engage the left-hand end of the contact retainer 3a of the conducting member 3. Contact between the rod 1 and the conducting member 3 is established by the "fixed" contact means consisting of a plurality of radially arranged contact fingers 14 pivotally mounted on the inner periphery of the left-hand end of contact retainer 3a, the contact fingers 14 being biased toward engagement with the rod 1 by biasing springs 15 provided with thrust rods 16. The angular movement of the contact fingers 14 is restricted by means of a metallic arcing ring or bell 17 secured to the end of the contact retainer 3a.

It will be evident that by unscrewing the bolts 12, portion 4 of the insulating casing can be removed from the mounting casting 8 allowing access to the isolating contact fingers 14 for inspection or replacement. After removal of

the insulator 4, the contact retainer 3a can be removed at the flange joint 7, thus enabling the contact making means as a whole to be readily repaired or renewed.

The interrupting head 2 is secured to the right-hand end of the insulator 5 of the insulating casing and is also provided with movable radially arranged contact means, similar to that effecting contact at the isolating end of conducting member 3, in the form of a set of pivotally mounted contact fingers 18. The contact fingers 18 are pivotally mounted on an annular support 19 having radial slots in which the members 18 move. The contact fingers 18 are biased toward engagement with the adjacent arcing ring of conducting member 3 by means of biasing springs 20 which each engage a thrust disk 21 mounted on a connecting rod 22 pivotally connecting each contact finger with an abutment constituted by the piston 23 which is slidably arranged within a cylinder 24 mounted on the end plate 25 of the contact head 2.

The above-described movable contact means at either end of the member 3 are both constructed in a manner similar to the invention disclosed and claimed in U. S. Patent 2,427,195—Cox et al. granted September 9, 1947 while the piston-coupled interrupting contacts could be arranged as taught in U. S. Patent 2,413,555—Flurscheim, both of which are assigned to the assignee of this invention. The pivoted contacts are moved to provide a gap, across which an arc may form, as a result of the flow of pressure gas in accordance with the above patents and as hereinafter to be described.

A resistance means R is permanently connected in shunt relationship across the interrupting contacts 18, being bolted between contact head 2 and the metallic central mounting structure 8, good electrical contact being provided by appropriate faced pads (not shown) on these members for securing the terminals of the resistor R thereto.

The column insulator 11 is adapted, in addition to its above-mentioned function of supporting the circuit breaking assembly, to supply pressure gas to the annular space 6 around the conducting member 3. To this end the central casting 8 is suitably cored to provide a pressure fluid supply passage 26 proceeding from the bore of insulator 11 to annular space 6 while an exhaust passage 27 is provided to communicate with the interior of the conducting member 3 through appropriate port or ports 28. These inlet and exhaust passages are separated by a common dividing wall 29. When pressure gas is supplied through column insulator 11, it flows through the supply passages 26 and 26' along the annular spaces 6 and 6' so as to act upon the faces of the pivotally mounted contact fingers 14 and 18. These contact fingers are thereby respectively separated from contact with the adjacent end of the contact 1 and from conducting member 3 to form gaps across which the arcs form. Here, it will be understood that the contact springs may be adjusted so that the main interrupting contacts 18 open slightly earlier than the resistance interrupting contacts 14 in accordance with the teaching of U. S. Patent 2,222,719 to Prince, which is assigned to the assignee of this invention. Exhaust gas carrying arc products then flows away to atmosphere through the radial exhaust passages 30 from the interrupting head 2, some also flowing axially back through the bore of the conducting member 3 to exhaust through the side ports 28 and so to atmosphere via passage 27. The arcs formed at the main and isolating contact fingers 18 and 14 respectively are thereby subjected to the extinguishment effect of a blast of high pressure gas and the subsequent scavenging action; and since the current in the arc at the main contact fingers 18 is somewhat moderated by the current flow through the shunt resistance R connected between the interrupting head 2 and the mounting casting 8, the main arc is, to that extent, more readily suppressed. The resulting limited current flowing through the voltage limiting resistance R is readily broken at the gas-blown isolating contact fingers 14, and the products of any arcing thereat exhaust axially toward the ports 28 and join with the exhaust flow from the main contacts. Obviously, passages 26 and 26' and spaces 6 and 6' respectively may be appropriately proportioned for delivering say, a major blast for the interrupting contacts 18, with a minor blast directed to the isolating contacts 14. Subsequent to the extinguishing of the arcs by the blast of pressure gas, the rod contact 1 is retracted in order to introduce an isolating break into the circuit before the contact fingers 14 and 18 are restored to their contact making positions to which they are biased when the gas blast ceases. Thus, the contacts 1 and 14 operate effectively as isolating contacts well adapted to interrupt resistor current and supplementing the interruption of the main arc drawn by the contacts 18.

If desired, a further resistance, preferably one having a non-linear characteristic, may be permanently connected between the contact retainer 3a and a supplementary isolating contact displaced downstream from the contact fingers 14 by being disposed, for example, in the space at the left-hand end of throat member 13 and arranged for making sliding engagement with the contact rod 1. If such a further resistance is provided, any arc which forms between the contact fingers 14 and the rod 1 is correspondingly limited by the further resistance in shunt with it and which also would be readily extinguished by the blast of pressure gas flowing toward it. Thus, the subsequent retraction of rod 1 through throat member 13 in any event will be followed by an axial flow of pressure gas which extinguishes any arc which may form when the rod 1 is withdrawn from contact with the above-mentioned hypothetical sliding contact, the current to which would be limited by both resistances in series.

Because isolating means, such as the rod contact 1, is usually of considerable mass, it follows that movement of same is much more sluggish to produce a gap than, say, the low-mass gas-blown contacts 14. Accordingly, by applying the gas-blown contacts 14 to cooperate with the rod contact in accordance with our invention, very fast and effective circuit interruption is assured even though the isolating rod has not begun to move for several cycles subsequent to the actual instant of circuit interruption. Accordingly, high mechanical forces for producing abrupt opening of the isolating contact rod are rendered non-essential.

As a convenient means for supporting the circuit breaking unit, the arrangement shown in Figs. 2 and 3 may be used. As shown in these figures, a pressure gas reservoir 31 is mounted on rollers 32 to thereby constitute a triple-pole roll-out unit for ready installation or replacement. The pressure gas reservoir is provided with mounting structure 33 arranged to support

the lower end of column insulators 11 and thereby to support the three circuit breaking units. Each retractable contact 1 is in engagement with a sliding contact 34 supported on a pedestal insulator 35 which is in turn secured to a platform 36 mounted on the upper periphery of the tank 31. Terminals 37 to the isolating sliding contacts 34 and the interrupting heads 2 provide for the cable connections to and from the breaker respectively. An insulating operating lever 38 is joined at its lower end to each of three arms of a common bell crank lever 40 pivotally mounted on a bracket 39 secured to the structure of tank 31 which through linkage 41 and a single operating cylinder 42 is adapted to effect the simultaneous movement of the three retractable contacts 1. Simultaneous operation of the three interrupters is effected in well-known manner by release of a blast of air from the tank 31 through a blast valve 43 which is shown feeding to the three phases through a suitable manifold as shown in Fig. 3. While we have shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the invention in its broader aspects and it is, therefore, intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. An electric circuit breaker comprising a pair of interrupting contacts, a pair of isolating contacts arranged in series with respect to said interrupting contacts, resistance means connected in parallel with said interrupting contacts, means including a housing structure in which all of said contacts are normally disposed for directing a blast of pressure gas to said interrupting and said isolating contacts to cause separation thereof and to extinguish the arcs drawn therebetween during a circuit interrupting operation, an opening in said housing structure through which one of said isolating contacts is movable, and independent motivating means disposed outside said housing structure for withdrawing said one of said isolating contacts outwardly through said opening after interruption of the arc drawn at said isolating contacts so as to establish an isolating gap between said isolating contacts.

2. An electric circuit breaker comprising a pair of interrupting contacts, a pair of isolating contacts arranged in series with respect to said interrupting contacts, resistance means connected in parallel with said interrupting contacts, housing structure for said contacts, means for directing a blast of pressure gas to said interrupting and said isolating contacts to cause separation thereof and to extinguish the arcs drawn therebetween during a circuit interrupting operation, an opening in said housing structure through which one of said isolating contacts is movable, and motivating means disposed outside said housing structure for withdrawing said one of said isolating contacts outwardly through said opening after interruption of the arc drawn at said isolating contacts so as to establish an isolating gap between said isolating contacts.

3. An electric circuit interrupter comprising a stationary conducting member, an interrupting contact biased toward engagement with one end of said member, resistance means connected between said interrupting contact and said member, contact means disposed at the other end of said member, a retractable isolating contact normally in engagement with said contact means, said contact means and said retractable contact being normally biased into engagement, means for causing a blast of gas to separate said interrupting contact from said member and to extinguish the arc drawn therebetween and for causing said contact means to separate from said retractable contact and to extinguish the arc drawn therebetween, and means for moving said retractable contact away from said isolating contact means after interruption of the flow of current through the breaker.

4. An electric circuit interrupter comprising a stationary conducting member, an interrupting contact biased toward engagement with one end of said member, resistance means connected between said interrupting contact and said member, contact means disposed at the other end of said member and electrically connected therewith, a retractable isolating contact normally in engagement with said contact means, said contact means being normally biased into engagement with said retractable contact, means for causing a blast of gas to separate said interrupting contact from said member and for causing said contact means to separate from said retractable contact and means for moving said retractable contact in a direction away from said contact means and said member after interruption of the flow of current through the breaker.

5. An electric circuit interrupter comprising a stationary tubular conducting member, an interrupting contact biased toward engagement with one end of said member, resistance means connected between said interrupting contact and said member, contact means disposed within said member at the other end thereof, a retractable isolating contact normally in engagement with said contact means, said contact means being normally biased into engagement with said retractable contact, means for causing a blast of gas to separate said interrupting contact from said member and to extinguish the arc drawn therebetween and for causing said contact means to move inwardly with respect to said member thereby to separate said contact means from said retractable contact and to extinguish the arc drawn therebetween, an opening in said member through which gas may escape from within said member, and means for moving said retractable contact away from said contact means and said member after interruption of the flow of current through the breaker.

6. An electric circuit interrupter comprising a stationary tubular conducting member, an interrupting contact disposed exteriorly of said member and biased toward engagement with one end thereof, resistance means connected between said interrupting contact and said member, contact means disposed within the other end of said member, a retractable isolating contact normally in engagement with said contact means, said contact means being normally biased into engagement with said retractable contact, means for supplying a blast of gas to the exterior of said member to separate said interrupting contact from said member and to extinguish the arc drawn therebetween and for causing said contact means to separate from said retractable contact and to extinguish the arc drawn therebetween, means for establishing communication between the space within said member and atmosphere so as to allow gas within said member to escape, and means for moving said retractable

contact away from said contact means and said member after interruption of the flow of current through the breaker.

7. An electric circuit breaker comprising housing structure, a hollow tubular conducting member disposed within said housing structure, an interrupting contact disposed at one end of said member and biased into engagement therewith, a retractable isolating contact normally disposed adjacent the other end of said member, contact means disposed within said other end of said member and biased toward engagement with said retractable isolating contact, means for supplying a blast of fluid into said housing structure, exhaust means including an opening in said member intermediate the ends thereof for affording communication to atmosphere from the inside of said member, the blast of fluid supplied to said structure being effective to cause opening movement of said interrupting contact and of said contact means, and means for moving said retractable contact in a direction away from said member and said contact means after the interruption of the flow of current through the breaker.

8. An electric circuit breaker comprising a tubular member formed of conducting material, an apertured member secured to said tubular member at one end thereof, a retractable contact substantially coaxially disposed with respect to said tubular member and positioned outside said tubular member but having one end thereof normally disposed in the aperture in said apertured member, a second contact pivotally mounted within said tubular member, means for biasing said second contact into engagement with said retractable contact when said retractable contact is in its normal position, means for directing a blast of gas through the aperture in said apertured member and into said tubular member for causing said second contact to separate from said retractable contact and to extinguish the arc drawn therebetween, and means for moving said retractable contact in a direction away from said second contact after extinguishment of the arc between said contacts.

9. An electric circuit breaker comprising a tubular member formed of conducting material, an apertured member secured to said tubular member at one end thereof, a retractable contact substantially coaxially disposed with respect to said tubular member and positioned outside said tubular member but having one end thereof normally disposed adjacent said apertured member, a second contact pivotally mounted within said tubular member, means for biasing said second contact toward engagement with said retractable contact when said retractable contact is in its normal position, means for directing a blast of gas into said tubular member for causing said second contact to separate from said retractable contact and to extinguish the arc drawn therebetween, and means for moving said retractable contact out of engagement with said second contact after extinguishment of the arc between said contacts.

ALBERT ROXBURGH.
ALBERT LEIGH.

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