

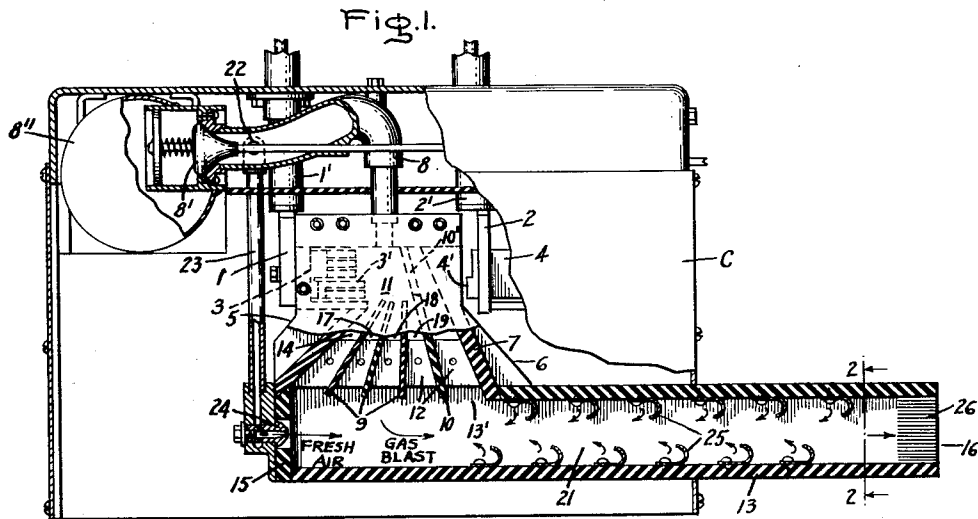
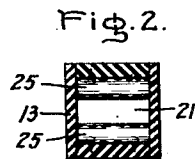
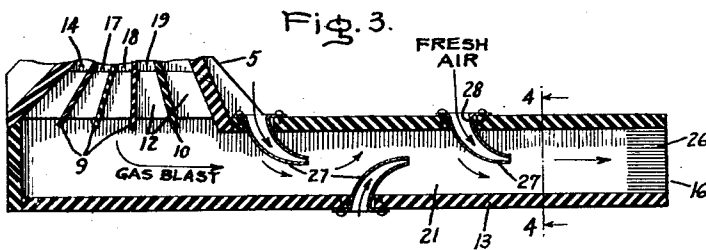
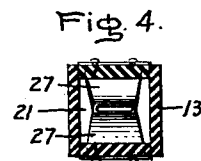
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GAS BLAST CIRCUIT BREAKER

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GAS BLAST CIRCUIT BREAKER

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8 Claims. (Cl. 200—148)

My invention relates to gas blast circuit breakers wherein the arc is interrupted in a chute or the like by a blast of gas under pressure, particularly to such circuit breakers for heavy duty indoor station operation where safety during heavy current interruptions as well as compactness in design are essential, and has for its principal object the provision of an improved gas blast circuit breaker capable of interrupting large short circuit or overload currents without material flame emission from the arc interrupting structure or chute.

The interruption of heavy current power arcs by a gas blast is often accompanied by a great deal of flame composed of incandescent particles of arc products including metal or other inorganic substances, and burning gases. This flame is obviously very objectionable if not completely confined, particularly in indoor stations since it tends to break down the dielectric strength of the surrounding air and thereby cause failure of the circuit breaker and also possible damage to adjacent apparatus. Furthermore, flame emission from the circuit breaker casing cannot be tolerated where there is a possibility of injury to station attendants.

It has been proposed to employ gas mufflers and various cooling devices at the exhaust part of the arc chamber for cooling the gases and suppressing or minimizing the emission of flame but arrangements heretofore used have in general been either inadequate in the case of large current interruptions or have required excessive space.

In accordance with my invention, an auxiliary supply of fresh air, i. e., oxygen, is introduced or caused to be introduced directly into a mixing chamber which also receives the hot arc gases and products thereof flowing directly from the region of arcing. This mixing of fresh air with the arc gases, which include incandescent particles, unburned hydrocarbons, carbon monoxide, et cetera, prior to the final exhaust of these gases promotes more complete combustion of the gases within the mixing chamber so that they are no longer liable to ignite upon reaching the atmosphere. Since there is not always sufficient oxygen in the interrupting blast to satisfy the requirements for complete combustion of all combustible gases and products involved, particularly where arc interrupting structure composed of hard fibre or other vaporizable organic material is used, the introduction of fresh air directly in the mixing chamber serves to promote the complete combustion of all un-

burned gases and solid particles. The comparatively cool fresh air also appreciably reduces the temperature of the exhaust arc gases.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing, Fig. 1 is an elevational view, partly in section, of a gas blast circuit breaker embodying the present invention, Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1, Fig. 3 is a fragmentary view in section of a gas blast circuit breaker generally similar to that of Fig. 1 illustrating another form my invention may assume and Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3.

The circuit breaker illustrated by way of example in Fig. 1 is of the air blast type and comprises the conductor terminals 1 and 2 to which the coacting contacts 3 and 4 are connected respectively. The terminals are suitably mounted in a main breaker housing or casing C by means of insulating bushings 1' and 2' respectively. The contact 4 which is in sliding contact with terminal 2 comprises a reciprocally movable blade member arranged to engage the finger contacts 3' of the stationary contact. The movable contact is suitably controlled and operated by mechanism not shown and the fixed contact is mounted in an insulating casing 5 defining the arc chute.

The casing 5 comprises spaced insulating side-walls 6 coacting with insulating end walls 7 to form a narrow fan-shaped arc chute leading from the coacting contacts. The contacts themselves separate within a narrow passage defined by insulating material composed preferably of hard fibre and this passage is in communication with an air supply conduit 8 which is arranged to be connected through a control valve 8' to a suitable source of air pressure, such as a reservoir 8'' supplied from a compressor unit (not shown). The valve control means for admitting air under pressure to the arc chute upon separation of the contacts form no part of the present invention and are omitted in the interest of simplicity.

Suitable arc extinguishing means, such as hard fibre barriers 9, extend fan-wise from the arc path between the insulating sidewalls 6 so as to divide the arc chute into a plurality of diverging passages. An additional insulating fibre barrier 10 extends continuously throughout the arc

chamber with the exception of a slot 10' of sufficient size to receive the blade contact 4. The extinguishing structure including the barriers 9 and 10 is composed of a suitable organic vaporizable material, and in addition to hard fibre may consist of materials such as urea or methylmethacrylate. These materials, although vaporizable under the influence of heavy arcs do not become conducting as in the case of ceramic materials.

In the arrangement so far described, admission of an air blast to the entrance of the arc chamber at 11 in accordance with separation of the contacts is effective to drive the arc which forms between the extended stationary finger contacts 3' and the arcing tip 4' of the movable contact into the arc chute passages so as to impinge directly on the exposed edges of the fibre barriers 9. As the hot blast flowing from the region of the arc is directed into the diverging chute passages, it soon encounters cooling structure constituting spaced copper plates 12 extending across the path of gas flow. This cooling structure, while effectively reducing the temperature and reducing the volume of the highly heated blast gases so as to minimize back pressure, may not, however, prevent flame emission beyond the barriers 9 in the case of heavy current interruptions.

An air blast circuit breaker of the character above described is disclosed and claimed in an application Serial No. 303,126, filed November 6, 1939, by D. C. Prince et al. for "Circuit breaking apparatus and method of operating the same," and assigned to the same assignee as the present invention.

It is known that insulating arc extinguishing structure composed of organic material such as hard fibre vaporizes when subjected to the intense heat of arcing. The resulting gases which include hydrogen, hydrocarbon gases and carbon monoxide are responsible to a great extent for the flame above described, particularly when these gases are vented to atmosphere in a highly heated state. The oxygen in the atmosphere at once unites with the highly heated combustible gases to cause burning thereof so that considerable flame may exist exteriorly of the breaker itself. In my invention an auxiliary supply of oxygen such as fresh air is introduced or caused to be introduced at a point beyond the region of arcing directly into the arc gases so as to cause substantially complete combustion of these gases and also cooling prior to their venting to atmosphere.

Referring again to Fig. 1, an insulating conduit 13 is connected to the casing 8 so as to be in direct communication with the exhaust ends of the diverging chute passages. Preferably, that end of the conduit nearest the point of initial formation of the arc, i. e., the end receiving the blast from the first diverging passage 14, is closed, except as hereinafter described, by an insulating wall 15. The opposite end of the conduit indicated at 16 is open for exhaust to atmosphere. The conduit 13, which can conveniently comprise either a cylindrical or rectangular (as shown) tube of insulation is suitably attached to the chute walls and is cut away at 13' to receive the blast gases from the arc chamber. It may extend laterally of and somewhat beyond the main breaker casing C as indicated by Fig. 1 for the purpose of providing more combustion space and allowing more complete combustion of the gases before they are finally vented to atmosphere.

In practice, this type of air blast circuit breaker is generally effective to interrupt arcing after

the movable contact has uncovered but one or two of the chute passages. Accordingly, the hot blast is mainly directed through the first passage 14 and the adjacent passage 17. The following passages 18 and 19 generally receive a comparatively fresh and cool gas blast after arc interruption so that in certain cases there may be sufficient oxygen, insofar as combustion requirements are concerned, within the conduit if air is used for the blast. Since the hot arc gases directed into the exhaust conduit 13 near its closed end must mix with comparatively cool fresh gas from passages 18, etc., before leaving the conduit combustion chamber, the exhaust gases are also appreciably cooled before final venting thereof.

However, in certain cases where the current to be interrupted is exceptionally high, or a blast containing little or no oxygen such as a CO₂ blast, or a different type chute using an "axial" blast for example instead of a "cross" blast as herein described are involved, it may be desirable to provide other means for promoting and insuring more complete combustion before final venting of the gases.

For this purpose, the conduit 13, which in effect comprises a combined mixing and combustion chamber 21 is provided with means for introducing, or causing to be introduced, an auxiliary supply of fresh air, i. e., oxygen, at a point beyond the region of arcing. With such an arrangement, the auxiliary supply of fresh air is received in the mixing chamber independently of the opening movement of the contact blade 4, or at least concurrent with flow of gas through the initially opened passages 14 and 17. In the preferred arrangement shown by Fig. 1, the main air blast supply conduit 8 is connected at a point 22 on the low pressure side of the control valve 8' to the closed end of the mixing chamber at 15 by means of a by-pass gas connection 23. A suitably designed nozzle 24 connected to the lower end of the by-pass is mounted in the chamber end wall 15 so as to direct by-passed fresh air directly from the conduit 8 to the mixing chamber 21 upon opening of the valve 8'. The nozzle 24 communicating with the connection 23 may obviously be adjusted as desired to vary the amount of auxiliary air admitted directly to the mixing chamber since the storage tank 8'' is generally operated at substantially fixed pressure.

Accordingly, the arc gases flowing from the passages 14 and 17 will be met by and mixed with an auxiliary supply of fresh air immediately upon entering the mixing chamber 21 regardless of whether or not the amount of oxygen admitted to the chute by other means is inadequate. This insures immediate initiation of the combustion operation and since the flow of gases at high pressure through the chute and venting structure is very rapid, it will be appreciated that this immediate initiation of combustion may be very important in suppressing flame at the exhaust.

For the purpose of more thoroughly mixing the auxiliary air supply with the combustible gases as they flow toward the exhaust end of the chamber, the chamber walls are provided with turbulators, such as cup-shape members 25 disposed along the path of gas flow as shown by Figs. 1 and 2 so as to introduce turbulence in the gas flow. The members 25 are preferably staggered as shown and are concave with respect to gas flow, although it should be understood that it is within the scope of my invention to use turbulators of various forms for causing more thorough mixing of the gases and thereby insur-

ing more complete combustion. The turbulators 25 are preferably composed of metal, such as copper for aiding in gas cooling and the exhaust end of the chamber is provided with spaced metal plates 26 for the same purpose.

In the form of my invention shown by Figs. 3 and 4, the hot blast gases directed into the combustion and mixing chamber 21 are mixed with fresh air that is drawn into the chamber directly from the atmosphere. In other words, the fresh air supply for insuring combustion of carbon monoxide, et cetera, is independent of the blast source although the blast action is utilized for the purpose of causing it to be introduced into the combustion chamber. Specifically, this is accomplished by directing the gas blast past aspirators or the like connecting with atmosphere so that by inductive action fresh air is drawn directly into the chute or combustion chamber for mixing with the hot blast gases. With this arrangement, the fresh air supply can be admitted directly to the chamber well beyond the point of arcing so that a supply of cool, oxygen-containing gas is always provided regardless of the possibility of unusually prolonged arcing.

Referring now to Fig. 3, an arc chute construction generally similar to Fig. 1 is shown and the same reference numerals are used to indicate similar parts. For introducing a fresh air supply directly from atmosphere to the chute beyond the region of arcing by means of the inductive or aspirating action of the blast, the insulating side walls of the conduit 13 are provided with aspirators 27 directly connecting the gas mixing space to atmosphere through openings in the conduit walls. This is clearly illustrated by Fig. 3, Fig. 4 being a sectional view taken along the line 4-4 of Fig. 3 looking into the chamber. As shown by Fig. 3, the insulating side walls of the conduit 13 are cut away at 28 at opposite sides of the mixing chamber 21 and the aspirators 27 are suitably mounted therein so that a high velocity flow of gas past the inner ends of the aspirators causes fresh air to be drawn into the chamber as indicated by the flow-direction arrows. As in the case of the turbulators in Fig. 1, the aspirators are preferably composed of metal so as to aid in cooling the gases.

It will therefore be seen that an independent supply of oxygen-containing gas is introduced by and in accordance with the operation of the gas blast into the combustion chamber well beyond the point of arcing. By reason of the number of fresh air openings, it will also be seen that the fresh air supply is thoroughly and uniformly mixed with the hot blast gases practically immediately upon entry to the combustion space.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

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

1. A gas blast circuit breaker comprising relatively movable contacts, means for directing a gas blast through the arc gap formed upon separation of said contacts, insulating structure including material giving off combustible gases when subjected to arc heat defining an arc chamber into which said gas blast is directed for extinguishing said arc, means also defining a combustion space into which the resulting hot and combustible blast gases flowing through said arc are

directed, and means for supplying at a point beyond the region of arcing additional oxygen directly to said chamber so as to mix with said hot and combustible gases in said combustion space.

2. A gas blast circuit breaker comprising relatively movable contacts, means for directing a gas blast through the arc gap formed upon separation of said contacts, organic insulating material defining arc extinguishing structure into which said air blast is directed for extinguishing said arc, a gas-mixing and combustion space into which the highly heated blast gases including combustible gases flowing from said arc extinguishing structure are directed, and means for supplying directly beyond the region of arcing fresh air to said mixing and combustion space.

3. An air blast circuit breaker comprising relatively movable contacts, means for directing an air blast through the arc gap formed upon separation of said blast contacts, arc extinguishing structure composed of organic vaporizable material disposed closely adjacent and in confining relation to said arc gap so as to be subject to vaporization under influence of the arc heat, means defining a gas-mixing and combustion chamber into which combustible blast gases from said arc gap are directed, and auxiliary fresh air supply means communicating directly with said combustion space at a point beyond the region of arcing for mixing fresh air with said blast gases to insure combustion thereof prior to final venting to atmosphere.

4. A gas blast circuit breaker comprising relatively movable contacts, means for directing a gas blast through the arc gap formed upon separation of said contacts, an insulating arc chute structure for receiving said gas blast as it traverses said arc gap and for confining the arc during the interrupting operation, a gas-mixing and combustion chamber for flame control in communication with said chute, and auxiliary air supply means for supplying air under pressure directly to said chamber at a point beyond said arc gap for causing mixing of the blast gases with comparatively fresh air within said chamber prior to final venting to atmosphere.

5. An air blast circuit breaker comprising relatively movable contacts, an air supply under pressure, means for directing from said supply an air blast through the arc gap formed upon separation of said contacts and an insulating arc chute structure into which the arc is driven and interrupted by said gas blast, a gas-mixing and combustion chamber for flame control in communication with said chute for receiving blast gases therefrom, said chamber having an exhaust vent, and means bypassing said chute for directing air under pressure from said supply directly to said chamber in accordance with operation of the interrupting blast to mix with said heated blast gases in said chamber for promoting complete combustion of the gases prior to flow from said exhaust vent.

6. A gas blast circuit breaker comprising relatively movable contacts, means for supplying a gas blast to the arc gap formed upon separation of said contacts, an insulating arc chute structure for directing said gas blast through said arc gap for interruption of the arc, said structure also including a combustion chamber into which the blast gases are directed, means for directing comparatively fresh air into said chamber to mix with the highly heated arc gases incident to the interruption of the arc, and means for causing turbulence of the mixed gases as

they flow through said chamber so as to promote combustion prior to venting of the gases to atmosphere.

7. A gas blast circuit breaker comprising relatively movable contacts, means for directing a gas blast through the arc gap formed upon separation of said contacts, insulating arc chute structure in which said arc is interrupted by said gas blast, said chute structure including a combustion space into which the highly heated blast gases from the arc are directed, and induction means for causing by and in accordance with the operation of said gas blast, introduction of comparatively fresh air separate from said gas blast into said combustion space to mix with said highly heated gases prior to venting of said highly heated gases from said combustion space.

8. A gas blast circuit breaker comprising relatively movable contacts, means for directing a gas blast through the arc gap formed upon separation of said contacts, insulating arc chute structure in which said arc is interrupted by said gas blast, said chute structure including a combustion space into which the highly heated blast gases from the arc are directed, and means connecting said combustion space with atmosphere including aspirating means for causing by and in accordance with the operation of said gas blast introduction of comparatively fresh air directly from the atmosphere into said combustion space to mix with said highly heated gases prior to venting of said highly heated gases from said combustion space.

DAVID C. PRINCE.