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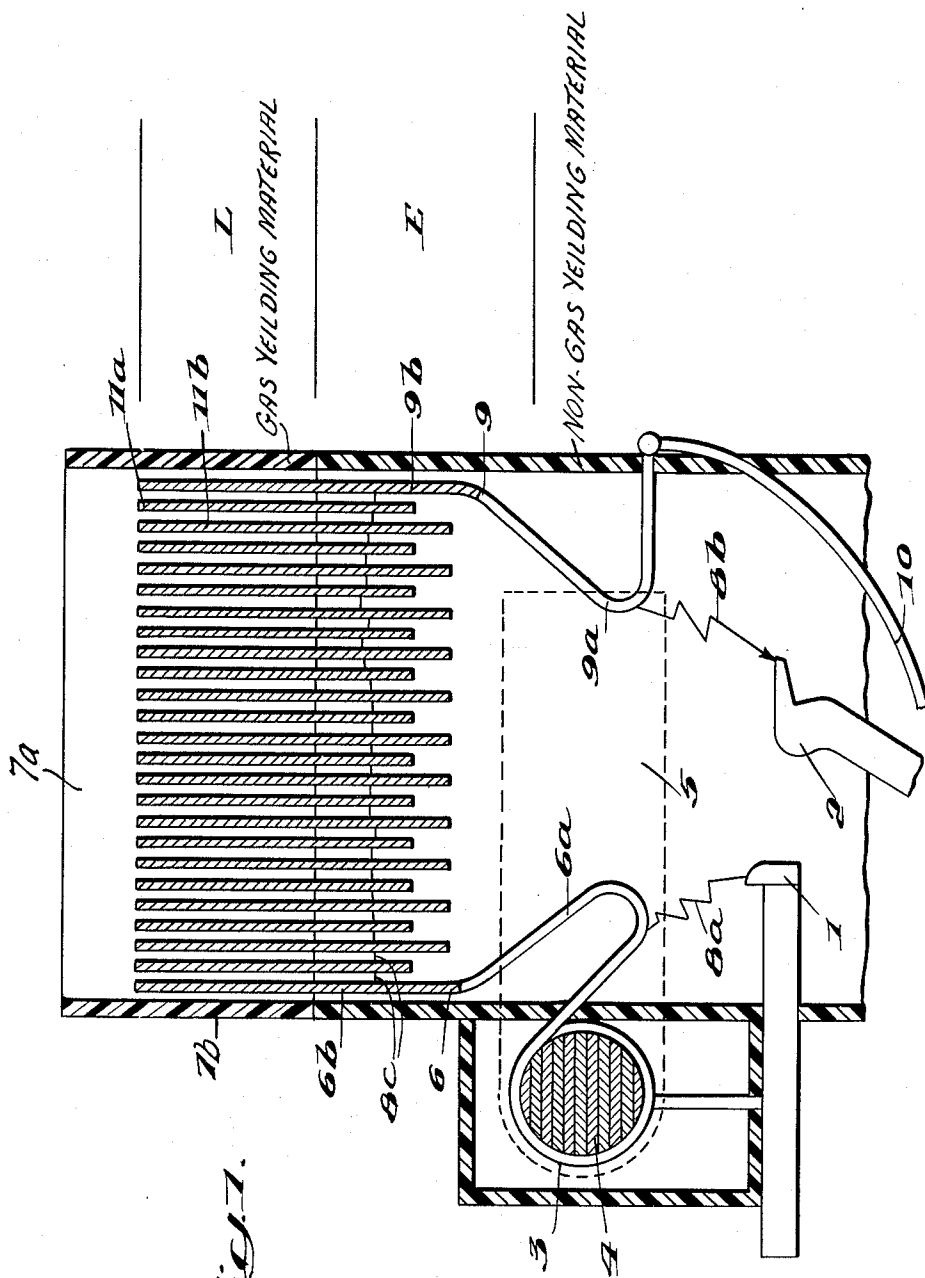
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HEAVY DUTY ELECTRICAL SWITCH WITH INTERRUPTION
POINT IN AIR AND MAGNETIC BLASTING OF ARC

Filed Jan. 29, 1963

2 Sheets-Sheet 1



Sheet 1

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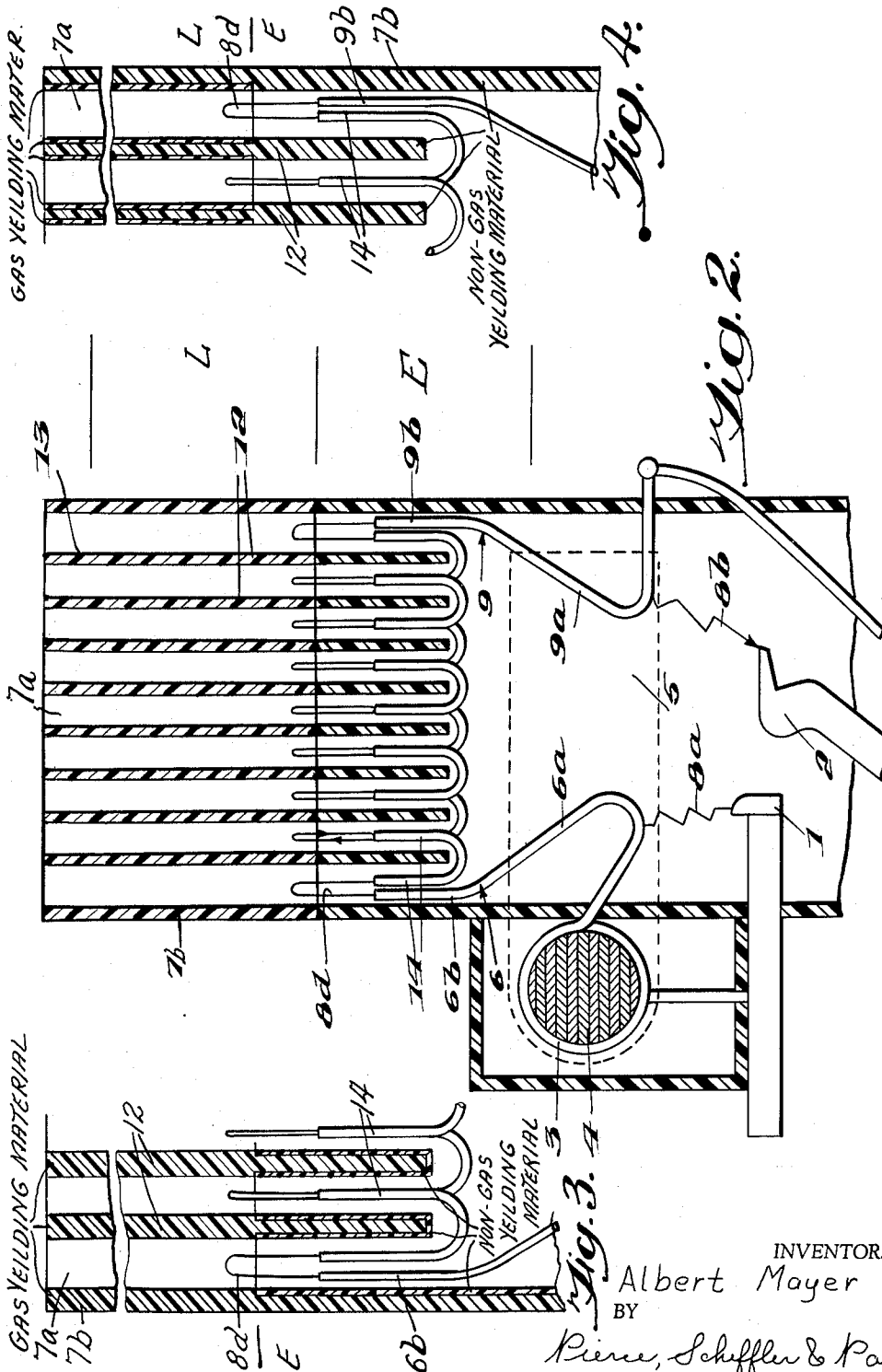
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HEAVY DUTY ELECTRICAL SWITCH WITH INTERRUPTION POINT IN AIR AND MAGNETIC BLASTING OF ARC

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3 Claims. (Cl. 200-144)

The present invention relates to electrical switch construction and in particular to electrical switches for breaking heavy power currents and which are operated in air in conjunction with a quenching chamber of insulating material into which the arc formed upon disconnection of the switch contacts is driven with the aid of a magnetic field. This magnetic field which serves to blow out the arc can be produced electromagnetically by means of a coil which is traversed by the switching current or it can be produced by using a permanent magnet.

Electrical switches of the foregoing type are known wherein the quenching chamber is formed in a body which consists entirely of a material which, under the action of the electric arc either does or does not give off a gas. The same is true with respect to the structure of any partitions employed to divide the quenching chamber into a plurality of part chambers which serve to sub-divide the arc into a plurality of partial arcs for easier quenching of the arc. Furthermore, it has been proposed to arrange gas-yielding insulating material parts near the zone of the origin of the arc, to facilitate the extinction of current-weak arcs in addition to blowing the arc with air. The known constructions, where the insulating material parts of the quenching chamber are either gas-yielding throughout or located at the origin or inflow zone of the arc, have the disadvantage in that they make penetration of the arc into the quenching chamber difficult. This is especially true when the quenching chambers contain partitions of metallic material, so-called lamination pockets, for the desirable objective of dividing the arc into smaller partial arcs whereby the cross-section at the inlet to the quenching chamber is divided into a large number of narrow gaps. As a result of the gas given off already at the inlet point, the pressure in the quenching chamber rises and thus renders difficult the penetration of the pressure wave moving in front of the arc and hence penetration of the arc itself into the quenching chamber.

The general object of the present invention is to provide an improved construction which avoids the above-noted disadvantages and without having to sacrifice the desirable use of gas-yielding insulating materials for the quenching chamber and narrow chamber apertures at the inlet zone. This objective is obtained, in accordance with the invention, by so constructing the quenching chamber that some of the walls of the chamber are comprised of two different insulating materials, these being arranged respectively in such manner that those wall portions of the quenching chamber located nearer the separable switch contacts, hereinafter called the inflow zone, consist of non-gas-yielding insulating material, while those wall portions of the quenching chamber located more remote from the switch contacts, i.e. in the so-called quenching zone, consist of gas-yielding material.

The foregoing as well as other objects and advantages inherent in the invention will become more apparent from the following description of two different embodiments of the invention and from the accompanying drawings wherein:

FIG. 1 is an illustration of one embodiment of the invention, the switch being shown in vertical longitudinal

section and including partition walls of metallic material for sub-division of the quenching chamber;

FIG. 2 is a view similar to that of FIG. 1 but illustrating a modification wherein partition walls of insulating material are used to sub-divide the quenching chamber into part chambers;

FIG. 3 is a partial vertical section of a further modification wherein the desired result is obtained by use of inserts of non-gas-yielding insulation materials in the walls at the inflow zone; and

FIG. 4 is a partial vertical section of still another modification wherein the desired result is obtained by use of inserts of gas-yielding insulation materials in the walls above the inflow zone.

With reference now to the construction shown in FIG. 1 of the drawings, the power switch is seen to include a stationary contact member 1 and a movable contact member 2 adapted to engage and be disengaged from contact member 1, the two contact members 1 and 2 being shown in the disengaged or open position. Contact member 1 is connected to one end of an exciter coil 3 wound on a core 4 of a transversely extending magnetic blow-out structure having a U-shaped configuration, the legs 5 of the magnetic structure extending horizontally and arranged in parallel spaced relation so that the magnetic field produced upon energization of coil 3 as the switch contacts separate passes between the legs 5 across a space which contains a vertical plane through the switch contacts 1, 2. The other end of coil 3 is connected electrically to an arcing horn 6 located at the left side of the quenching chamber established within the outer side walls 7a and outer end walls 7b which define this chamber. One end 6a of arcing horn 6 dips to a point between the legs 5 of the magnetic blow-out structure so as to transfer to it the left end portion 8a of the arc from the tip of switch contact member 1. The other end 6b of this arcing horn extends vertically along the inside of the left end wall 7b of the quenching chamber.

A second arcing horn 9 is located adjacent the right end wall 7b of the quenching chamber, this horn including a lower end 9a located between the legs 5 of the magnetic blow-out structure so as to transfer to it the right end portion 8b of the arc from the tip of switch contact member 2. The other end 9b of this arcing horn extends vertically along the inside of the right wall 7b of the quenching chamber. Arcing horn 9 is also electrically connected to a lower part of switch contact member 2 by a conductive bar 10 in the vicinity of the pivot connection for this contact member, not shown in the drawings. Also not shown are the drive members for effecting engagement and disengagement of the contact members 1, 2.

Included within the quenching chamber for the purpose of dividing the interior thereof into a plurality of part chambers are a plurality of parallel spaced metallic partition members arranged parallel to the chamber walls. These partition members are of two different lengths and these are arranged in alternation so that each one of the shorter lengths 11a is located between two of the longer length partition members 11b, and the longer length partition members 11b extend down further in the direction of the leg members 5 than do the shorter length partition members 11a. The partial arcs within the part quenching chambers defined between adjacent partition members 11a, 11b, are indicated by short lines 8c.

To the right in FIG. 1 three parallel spaced horizontal lines have been drawn to establish upper and lower zones of division of the quenching chamber. The lower zone designated E is called the inflow zone and reaches to a substantial distance above the lower edges of the partition members 11a, 11b as is clearly evident from FIG. 1, and the upper zone L is called the quenching zone. As

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illustrated in FIG. 1, the partial arcs 8c are seen to be still in the inflow zone E. Above the inflow zone E the insulating wall parts of the quenching chamber are composed of gas-yielding material, while below the quenching zone L, the insulating wall parts of the quenching chamber are composed of non-gas-yielding material. In its simplest form, the quenching chamber can be composed of two parts, the lower part including the inflow zone E being of non-gas-yielding insulating material, e.g. a ceramic, and the upper part including the quenching zone L being of gas-yielding insulating material, e.g., a plastic (fiber, acryl glass, and the like). However, since it is important that only those areas in the inflow zone E and in the quenching zone L which are exposed to the action of the arc be of non-gas yielding and gas-yielding materials respectively, it is possible to so construct the overall quenching chamber without a lateral dividing joint between the inflow and quenching zones. Thus the desired result can be obtained by an overall construction of the walls of the quenching chamber from a gas-yielding insulating material, there being arranged only at those areas of the inflow zone which are under action of the arc inserts of non-gas-yielding insulating material. Such an arrangement is illustrated in FIG. 3. Another possibility would be to construct the walls of the overall quenching chamber from a non-gas-yielding insulating material and to arrange at only those areas of the quenching zone which are under action of the arc inserts of gas-yielding material. Such an arrangement is illustrated in FIG. 4.

The arrangement as disclosed in FIG. 1 operates in the following manner. As contact members 1 and 2 are disengaged under load, the arc formed between these contact members will be driven upwardly by the electromagnetically derived motor force through the magnetic field between the plates 5, the ends of the arc being anchored on the horns 6, 9. As the arc reaches the inflow zone E it will be sub-divided by the partition members 11a, 11b into a large number of partial arcs 8c. Penetration of the arc into the relatively narrow gaps between adjacent partitions 11a, 11b is greatly facilitated by the fact that in this inflow zone, the insulating walls of the quenching chamber are composed of non-gas-yielding material, the partitions 11a, 11b projecting for a distance within this zone E. Subsequently, the partial arcs 8c will enter the quenching zone L and there they come into intimate contact with the chamber walls which are composed of gas-yielding insulating material and are cooled intensively by these gases, whereby after the current passage through zero, the switch current being of the alternating type, the re-ignition voltage of the arc will be increased so sharply that under normal operating conditions, no re-ignition of the arc will take place, i.e. the arc will be extinguished in a final manner.

With reference now to the embodiment of the invention illustrated in FIG. 2, wherein component parts corresponding to those in FIG. 1 have been given the same reference numerals, the partition walls within the overall quenching chamber are not metal as in FIG. 1, but rather are made from insulating material 12 and these walls divide the interior of the quenching chamber into compartments 13. The partition walls 12 are all of the same length and in order to establish a current connection for the arc between adjacent compartments 13, auxiliary U-shaped arcing horns 14 are provided. The leg portions of each horn 14 lie on opposite sides respectively of a corresponding partition wall 12 and hence extend for some distance into the compartments 13. The upper ends of the outermost arcing horn parts 6b and 9b terminate at the same level as the upper ends of the leg portions of the auxiliary arcing horns 14 and all horns terminate within the inflow zone E. Between adjacent connecting horns 14 in each compartment 13, and between horn part 6b and a leg of the adjacent horn 14, as well as between horn part 9b and a leg of the adjacent horn 14, the partial arcs are indicated by loop-like lines 8d. As

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in the embodiment of FIG. 1, the zig-zag lines 8a and 8b designate respectively the parts of the arc drawn between contact member 1 and horn part 6a, and between contact member 2 and horn part 9a. The inflow zone E and the quenching zone L are indicated to the right of the figure in the same manner as for the FIG. 1 embodiment.

Above the inflow zone E, the insulating parts of the quenching chamber and the partitions 12 consist of gas-yielding material. Below the quenching zone L, in particular in the vicinity of the inflow zone E, the quenching chamber walls and the partition members 12 consist of non-gas-yielding material. As has been described more specifically with respect to the embodiment of FIG. 1 the quenching chamber, including its partitions 12 are composed, in the simplest form, in two parts, the upper part, in the quenching zone L being of gas-yielding material, and the lower part, in the inlet zone E, being of non-gas yielding material. However, in accordance with the invention, as explained in connection with the FIG. 1 embodiment, the quenching chamber can be constructed without any dividing joint as between quenching and inflow zones.

The embodiment according to FIG. 2 operates in the following manner. Here again, as has been explained in conjunction with FIG. 1, the arc which is formed upon disconnection of contacts 1, 2 is driven upward and the ends of the arc are transferred to the lower arcing horn parts 6a, 9a in the inflow zone E. The partial arcs then forming between the auxiliary connecting horns 14, and between these and the horn parts 6a, 9b are then extended into loop form as shown at 8d and consist together with the horns 14 a solenoid, in known manner. Penetration of the partial arcs 8d into the compartments 13, whose width should preferably be as small as is practical, is greatly facilitated by the fact that the chamber walls in the inflow zone E consist of non-gas-yielding material, the horn parts 6b, 9b and the connecting horns 14 protruding only partly into the inflow zone E. Subsequently, the loop-like partial arcs 8d become further extended and rise into the quenching zone L where they come into intimate contact with walls consisting of gas-yielding material. The partial arcs 8d are cooled there in an intensive manner by the gases which evolve from the walls, and are finally extinguished. With the arrangement of FIG. 2, gas-yielding insulating materials which, to a certain degree leave conductive residues upon their decomposition by the arc, may also be used in the quenching zone L since the connecting horns 14 do not extend upwardly into the quenching zone.

In conclusion, it is desired to point out that while two different embodiments of the invention have been described and illustrated, the inventive concept is not limited to those embodiments but may reside as well in other modifications that come within the terms of the appended claims. The advantages of the improved construction are that one can thereby increase considerably the disconnecting capacity of a switch of this type with magnetic blow-out, and that for a given disconnecting rating such switches can be constructed with smaller dimensions than heretofore possible and are thus more economical.

I claim:

1. In an electrical power switch, the combination comprising a pair of separable switch contacts, a magnetic blow-out located above said switch contacts, a quenching chamber located above said magnetic blow-out and into which the arc is driven by said magnetic blow-out upon disconnection of said switch contacts, said quenching chamber being established by parallel spaced outer end walls, parallel spaced outer side walls and parallel spaced inner partition walls located between and parallel with said end walls, the lower edges of said partition walls terminating at a level above said switch contacts, the surfaces of all of said walls within said quenching chamber in the region of an inflow zone reaching upwardly to a

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level substantially above the lower edges of said partition walls being made only from a non-gas-yielding material so as not to impede penetration of the arc upwardly into said inflow zone, and the surfaces of at least said outer walls within said chamber above the upper boundary of said inflow zone being made from a gas-yielding material.

2. An electrical power switch as defined in claim 1 wherein said outer walls and also said inner partition walls of said quenching chamber are made from a gas-yielding material and wherein inserts of non-gas-yielding material are provided on all of said walls within said chamber below the upper boundary of said inflow zone.

3. An electrical power switch as defined in claim 1 wherein said outer walls and also said inner partition walls of said quenching chamber are made from a non-gas-yielding material and wherein inserts of gas-yielding material are provided on all of said walls within said chamber above the upper boundary of said inflow zone.

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rial are provided on all of said walls within said chamber above the upper boundary of said inflow zone.

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