United States Patent [19]

Clason

[11] **3,891,896**

[45] **June 24, 1975**

[54] **VACUUM CIRCUIT INTERRUPTER**

[75] Inventor: **Jan Christiaan Clason**, Hengelo, Netherlands

[73] Assignee: **Hazemeijer B.V.**, Hengelo, Netherlands

[22] Filed: **Jan. 29, 1974**

[21] Appl. No.: **437,646**

[30] **Foreign Application Priority Data**

Jan. 30, 1973 Netherlands 7301313

[52] **U.S. Cl.** ..... **317/58;** 200/147 R; 317/75

[51] **Int. Cl.** **H02h 7/22**

[58] **Field of Search** ..... 200/147 R, 147 B; 317/58, 317/62, 75

[56] **References Cited**

UNITED STATES PATENTS

3,177,401	4/1965	Clausing	200/147 R
3,403,239	9/1968	Schramm et al.	200/147 R
3,789,268	1/1974	Klein	317/58 X

Primary Examiner—James D. Trammell
Attorney, Agent, or Firm—Watson, Cole, Grindle & Watson

[57] **ABSTRACT**

The invention provides the combined structure of vacuum circuit interrupter apparatus and current transformer switching apparatus. A coil, associated with the vacuum circuit interrupter apparatus for extinguishing the arc formed when two contact rods are separated to interrupt an electrical circuit, is also utilized as a primary winding of at least one current transformer, which provides a switching function unrelated to the enhancement of the arc extinguishing characteristics produced by the magnetic field generated by the coil. In an embodiment of the combined apparatus, the vacuum circuit structure, including the coil, is embedded in a synthetic resin body which also includes plug terminals connected to one of the contact rods and the end of the coil in order to provide a switching signal output. Additionally, the synthetic resin body includes two inverted U-shaped extensions having an aperture on each side of the vacuum circuit interrupter housing. The windings of the coil are embedded in the U-shaped extensions and a ring core and secondary winding, forming part of the current transformers, are mounted within each of the apertures.

3 Claims, 2 Drawing Figures

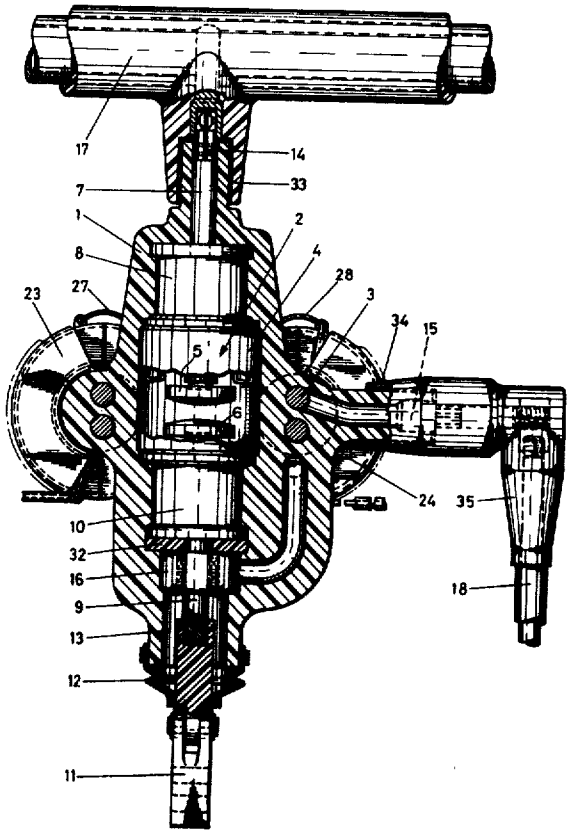


Fig. 1

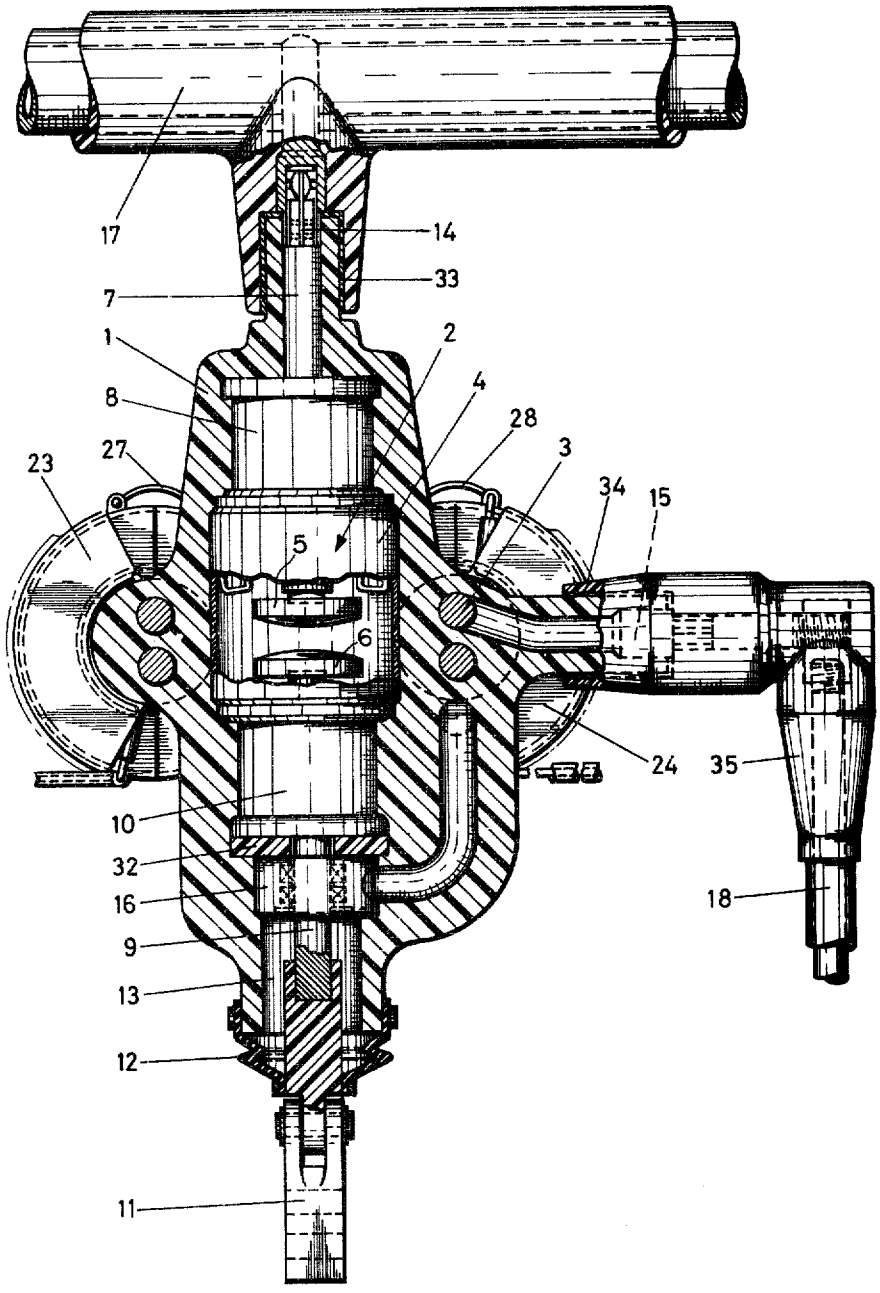
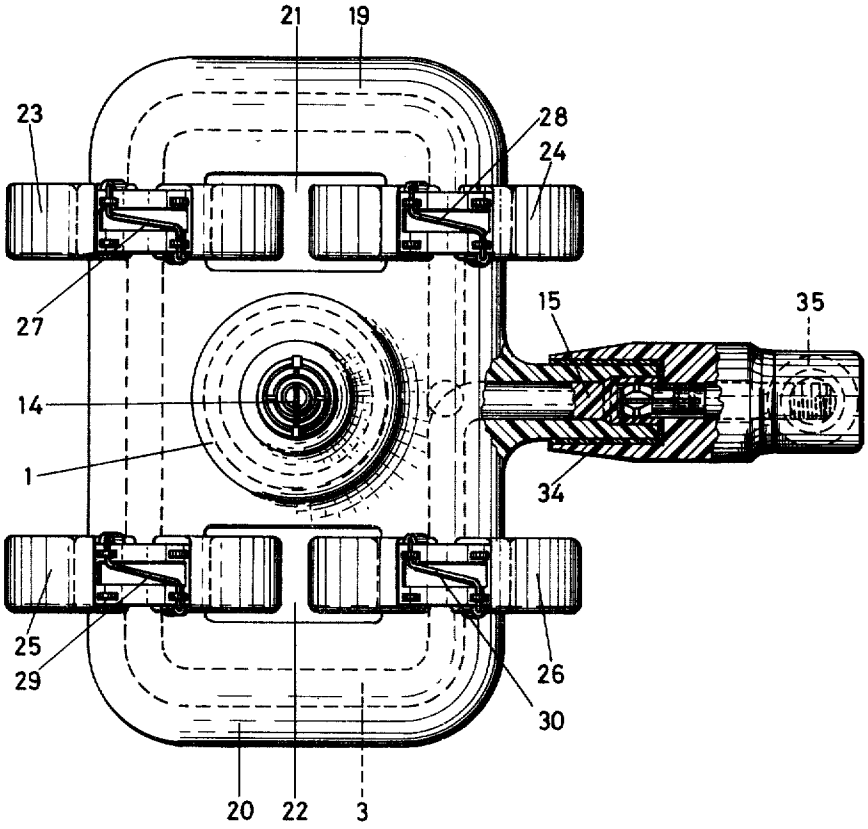


Fig - 2



VACUUM CIRCUIT INTERRUPTER

The invention relates to a vacuum circuit interrupter comprising a hermetically sealed housing, which is evacuated and including two contact members. One contact member is immovably mounted and supported by a stationary contact rod, which extends in sealed relationship out of the housing through an electric insulator. The other contact member is movable towards and from the stationary contact member and is supported by an axially movable contact rod, which extends out of the housing in sealed relationship by means of an electric insulator and a bellows. A coil is arranged around the housing and is coaxial with respect to the contact rods. One of the ends being electrically series connected to one of the contact rods, so that the current flow through the coil generates a magnetic longitudinal field at the two contact members. Such apparatus is known from the British patent specification 1.258.015.

The known vacuum circuit interrupter comprises a coil which is wound around the housing and is connected in series with the circuit of the vacuum interrupter. If the circuit interrupter has to be switched off, the axially movable contact member is withdrawn from the stationary contact member whereby an electric arc is formed between both contact members. The electric current, which has to be interrupted, flows through the coil and it generates a magnetic longitudinal field at the two contact. The magnetic field is substantially parallel to the arc to be interrupted and acts to keep the arc voltage low whereby the energy released in the circuit interrupter and converted into heat is restricted. Thereby the temperature of the interrupting parts is kept at a low level, so that contact erosion is reduced and the size of the contact members can be kept small. Furthermore the pressure of the gases which are released by the electric arc and which are bound to the surface of the metal parts will remain at a lower level at reduced temperature. Thereby a more favorable ratio is obtained between the volume of the circuit interrupter and its interrupting capacity.

The present invention has for its object to so arrange the coil around the housing of the vacuum circuit interrupter, that it will be suitable to function as the primary winding of a number of current transformers, which are present anyway for measuring and protecting purposes. Thereby the magnet coil will have a double function.

For this purpose the invention provides an apparatus of the type referred to above, which is characterized in that the coil is embedded in a solid insulating material and also forms the primary winding of one or more current transformers.

According to a further development the vacuum circuit interrupter together with the coil is completely embedded in synthetic resin, the synthetic resin body being provided with two plug connections, which are connected to the free contact rod and the free end of the coil respectively, by conductors extending in the synthetic resin body.

The synthetic resin body has two inverted U-shaped extensions, in which the turns of the coil are embedded and in the windows whereof the ring cores of the current transformers together with the secondary windings mounted thereon are accomodated.

The vacuum circuit interrupter according to present invention together with the current transformers forms a switching apparatus, which is very compact, completely protected from accidental contacts, safe in operation and maintenance free and can easily be included in completely insulated high voltage switching installations.

The invention will now further be explained in reference to the drawing, in which:

FIG. **1** is a longitudinal cross section of an interrupting apparatus according to present invention, and

FIG. **2** is a plan view of the vacuum circuit interrupter according to FIG. **1**, in which the bus bar system is omitted.

The vacuum circuit interrupter according to present invention mainly comprises a synthetic resin body **1**, in which the vacuum circuit interrupter **2** and the coil **3** are embedded. As it appears from FIG. **1** the coil **3** consists of two turns, the number of turns being dependent on the necessary longitudinal magnetic field between the contact members **5, 6** and on the field intensity which is necessary for the current transformers. The vacuum circuit interrupter **2** comprises the housing **4**, in which a vacuum is drawn, and the contact members **5, 6** disposed in said housing. The stationary contact member **5** is secured to the end of the stationary contact rod **7**, which extends out of the housing **4** in a vacuum tight fashion through the electric insulator **8**. The movable contact member **6** is secured to the end of the movable contact rod **9**, passing through a second insulator **10** and sealed onto the housing **4** by means of a bellows, which is disposed in said insulator **10** and is not visible on the drawing. Movable contact rod **9** is coupled to the driving mechanism **11**, which is sealed to the synthetic resin body **1** by means of a rubber bellows **12**. Said rubber sealing **12** serves to achieve an electric sealing between the movable contact rod **9** and the synthetic resin body **1**.

The synthetic resin body **1** is provided with the plug connectors **14, 15**, of which plug connection **14** is connected to the stationary contact rod **7**, and the other plug connection **15** is connected to the free end of the coil **3**. Coil **3** with its other end is electrically connected to the movable contact rod **9** through the current collecting contact **16**. In the present case the stationary contact rod **7** is connected to a bus bar system **17**, whereas the free end of the coil **3** is connected to an electric cable **18**.

Referring to FIG. **2**, the synthetic resin body **1** is provided with two inverted U-shaped extensions **19, 20**, defining the windows **21, 22**, respectively. The turns of the coil **3** are embedded in the inverted U-shaped extensions **19** and **20**. Four current transformers **23-26** are arranged in windows **21, 22** and the turns of the coil **3** constitute the primary winding of the current transformers. The current transformers **23–26** are ringcore transformers, which can be opened. Reference numbers **27–30** illustrate the bridging connections of the secondary windings of the current transformers.

Between the insulator **10** and the current collecting contact **16** is mounted an insulating ring member **32**, which is also embedded in the synthetic resin body **1**.

The synthetic resin body **1** has a reduced size, so that the spacing between the two plug connectors **14** and **15** is also small. In order to achieve the necessary voltage strength the synthetic resin body **1** at the plug connectors **14, 15** has a cylindrical shape and the cylindrical parts are provided with rubber sleeves **33** and **34** respectively, as is known from the German patent specification 1.180.447, in order to establish an electrically

sealed connection with the insulation of the bus bar **17** and the cable plug **35.**

What I claim is:

1. Vacuum circuit interrupter and current transformer switching apparatus comprising:

a hermetically sealed evacuated housing including two contact members;

a first contact rod mounted immovably along the longitudinal axis of said housing and extending in sealing relationship to the exterior of said housing;

a second contact rod mounted to be movable along the longitudinal axis of said housing and extending to the exterior of said housing through a sealing electric insulator and bellows;

a first contact member supported by said first contact rod;

a second contact member movably supported by said second contact rod; and

a coil wound around said first and second contact members coaxially with respect to said first and second contact rods, one end of said coil being electrically connected in series to one of said contact rods and the other end of said coil being connected to a plug terminal within said housing, whereby the current flow through said coil generates a magnetic field at said two contact members along the longitudinal axis of said housing, said coil being embedded in an insulating material and forming a primary winding of at least one current transformer.

2. Vacuum circuit interrupter and current transformer apparatus as in claim **1** wherein said insulating material is a synthetic resin body also enclosing said vacuum circuit interrupter and transformer apparatus, said resin body including two plug terminals, one of said plug terminals being connected to the other of said contact rods and the other of said two plug terminals being that plug terminal connected to the other end of said coil.

3. A vacuum circuit interrupter and current transformer apparatus as in claim **2** further comprising two inverted U-shaped extensions formed in said synthetic resin body and having an aperture on each side of said housing, the windings of said coil being embedded in said U-shaped extensions, a ring core and secondary winding of said at least one current transformer being mounted within each of said apertures.

* * * * *