May 27, 1969 J. GOODALL 3,447,119

ELECTRICAL TERMINAL CLAMPS

Filed Oct. 30, 1967 Sheet 1 of 3

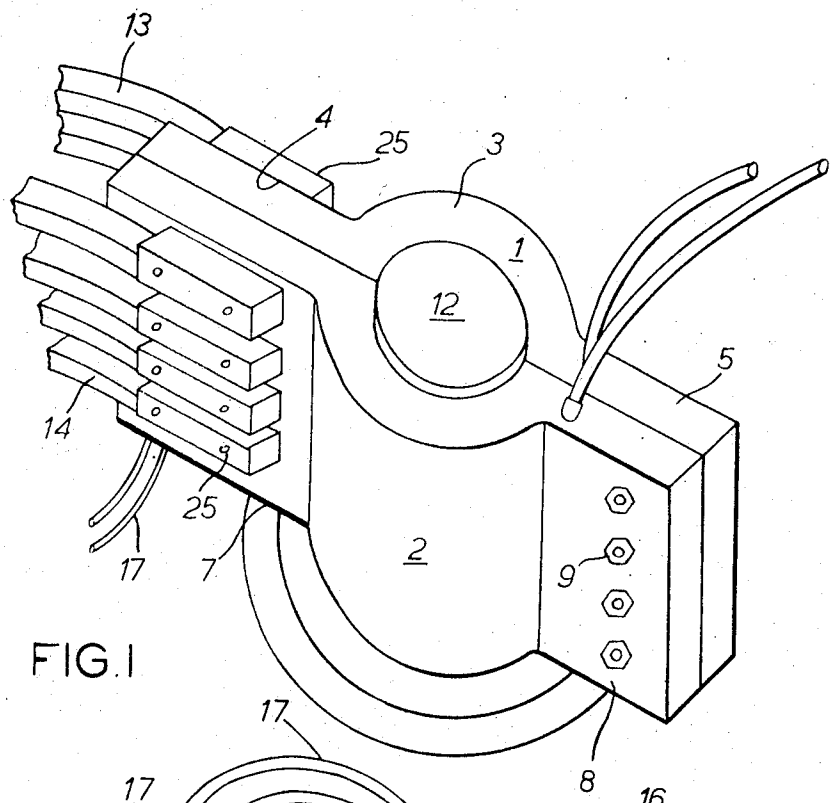


FIG. 1

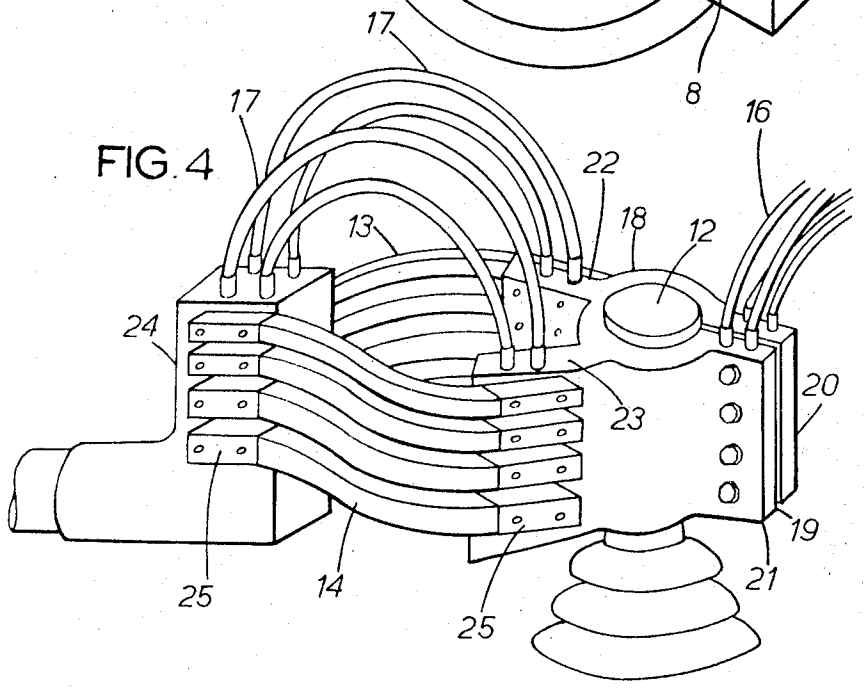


FIG. 4

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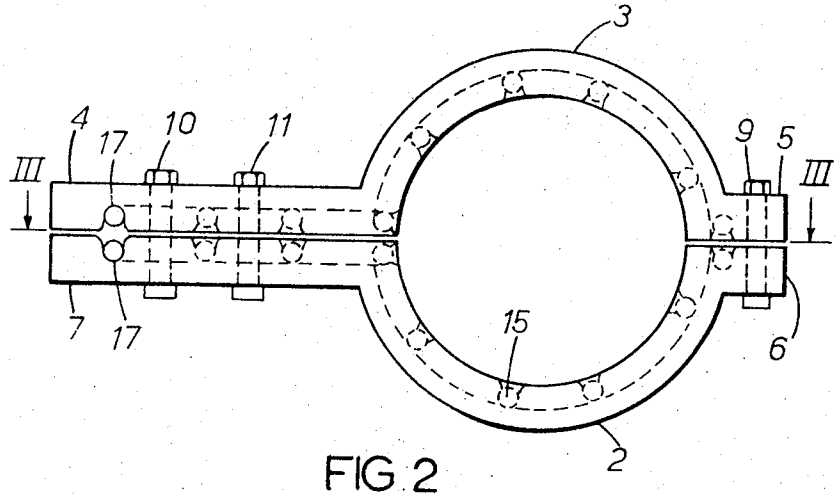


FIG. 2

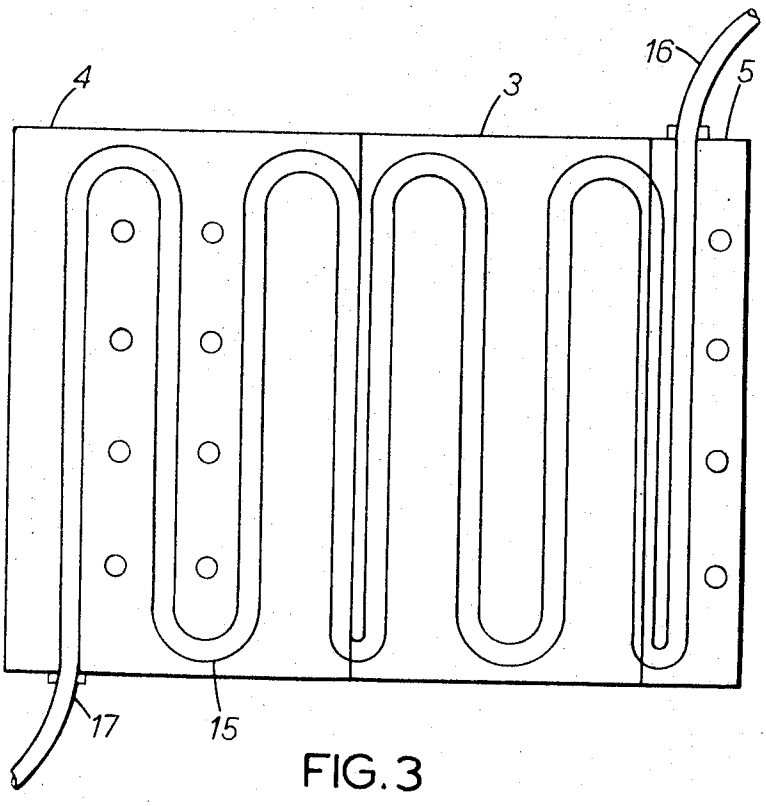


FIG. 3

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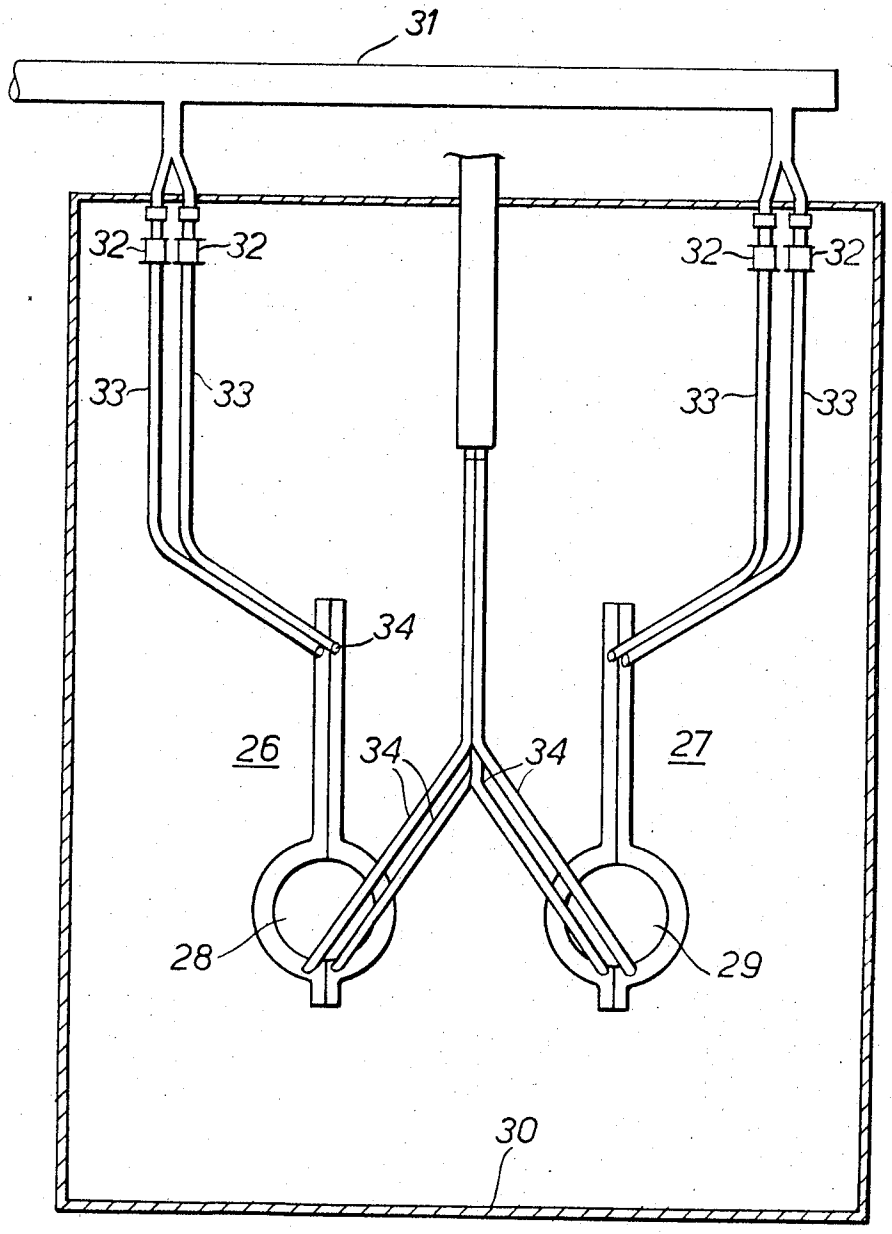


FIG. 5

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ELECTRICAL TERMINAL CLAMPS

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Int. Cl. H01r *13/00, 7/26*
U.S. Cl. 339—112 4 Claims

ABSTRACT OF THE DISCLOSURE

A high voltage terminal clamp for carrying heavy currents comprises an annular portion for surrounding a terminal post which is formed with gaps and wing portions clamped together to cause the clamp to grip a terminal post and ducting extends through the two portions of the clamp in parallel and is coupled through insulating ducting to points away from the terminal so that liquid coolant may be circulated through the ducting to cool the clamp without the risk of causing damage through short circuits.

This invention relates to electrical terminal clamps and has an important application in terminal clamps for electrical transformer bushings.

In many cases in which a clamp surrounds a terminal post carrying a heavy current the temperature both of the clamp and of the post tends to be unduly high, especially in equipment in which these parts are enclosed as in isolated phase enclosures.

Direct liquid cooling of a terminal post is so difficult as to render it almost impracticable since any leakage of the liquid coolant in the neighbourhood of the high voltage parts may cause damage and moreover electrical leakage along the liquid ducts to low voltage parts must be minimised.

The main object of the invention is to provide an improved construction of the terminal clamp which permits cooling of the clamp and terminal post which it surrounds and at the same time meets these requirements to an appreciable extent.

According to the present invention a high voltage terminal clamp attached to a high voltage heavy current carrying terminal comprises an annular portion encircling a terminal to make electrical contact therewith, at least one break in said annular portion, wing members extending radially from the ends adjacent a break, means for clamping the wing members together to cause the annular portion to grip a terminal, flexible electrical conductors attached to said wing members and coolant ducting extending through the clamp and coupled by ducting of flexible electrically insulating material to external supply and return ducts for the circulation of liquid coolant.

In some cases there may be additional wing members extending from positions on the annular members other than adjacent the breaks and carrying electrical connectors and coolant connections.

In other that the invention may be more clearly understood reference will now be made to the accompanying drawings in which:

FIGURE 1 is a pictorial view of one embodiment of the invention,

FIGURE 2 is a plan view of the device shown in FIGURE 1,

FIGURE 3 is a vertical section on the line III—III of FIGURE 2,

FIGURE 4 is a pictorial view of another embodiment of the invention, and

FIGURE 5 shows a device as shown in a phase compartment of a supply system.

In the arrangement shown in FIGURES 1, 2 and 3 the clamp is formed in two parts **1** and **2**, the part **1** comprises a part annulus **3** and wing members **4** and **5**. Similarly the part **2** comprises a part annulus **6** and wing members **7** and **8**. The wing members **5** and **8** are clamped together by bolts **9** and similarly the wing members **4** and **7** are clamped together by bolts **10** and **11** so as to grip the terminal **12**. It will be seen that the members **5** and **6** are short compared with the members **4** and **7**. The purpose of the increased length of the members **4** and **7** is to allow for attachment of the electrical connectors **13** and **14** which connect the clamp to external equipment, for example in cases in which the terminal **12** is a transformer terminal the connectors **13** and **14** could connect the clamp to the generator terminal for the phase concerned.

It will be appreciated that in the case of polyphase equipment there would be two terminals **12** and two terminal clamps for each phase of the system. In order to keep the temperature of the terminal assembly within required limits a coolant ducting **15** is provided; this extends along each part **1** and **2** of the coupling along a zig-zag path between the inlet pipe **16** and the outlet pipe **17**, the flows along the two parts being in parallel.

In the actual construction shown in FIGURE 2 the inner faces of the parts **1** and **2** are formed with channelling and piping is laid in the channelling to carry the coolant liquid. In cases in which the terminal clamp is used on a transformer fed from a generator the same coolant can be used the coolant passing through the two in series, it may also be combined with systems for cooling the coupling conductors between the generator and the transformer in cases in which such arrangements are used. In the case of a hydrogen atmosphere around the generator it is preferable for the coolant to flow through the generator last owing to the risk of hydrogen being absorbed in the coolant.

FIGURE 4 shows another embodiment in which the terminal clamp is formed in one piece with a continuous annular **18** having a single break at **19**, adjacent which break are wing members **20** and **21** which correspond to the members **5** and **6** of the previous embodiment and which are clamped together by bolts **9**. It will be appreciated that in this arrangement the clamp must have slight resilience so that when the bolts **9** are loosened it will not grip the terminal **12** sufficiently tightly to prevent its removal. The annular part **18** is formed with two radially extending wing members **22** and **23** which are electrically coupled by connectors **13** and **14** respectively to the terminal **24** which as above explained may be the outlet terminal of a generator supplying a transformer of which **12** is a terminal. The generator connections terminal is liquid cooled in the same manner as the terminal clamp above described, the ducts **17** connecting it with the transformer terminal clamp.

In the arrangement shown in FIGURE 4 the wing members **22** and **23** are solid so that the ducting will be internal and formed during manufacture. The electrical connectors **13** and **14** may be of flexible braided copper welded at each end to blocks **25** which in turn are bolted to the terminal in question.

The coolant ducting within the clamp may be of copper tubing and the liquid couplings may be of a flexible insulating material such for example as polytetrafluoroethylene.

By allowing for increased heat dissipation arrangements as above described permit the use of smaller terminals for the same current carrying capacity.

FIGURE 5 shows how two terminal clamps mounted **26** and **27** mounted on terminals **28** and **29** respectively

the assembly constituting one of the phase assemblies of an A.C. supply and being enclosed in a phase compartment bordered by walling **30**.

The coolant is fed from a supply manifold **31** through connectors to flexible ductings **33** respectively connected to the parts of the terminal clamps, the ductings **33** are of suitable insulating material e.g. P.T.F.E. and the connectors may be suitable unions between the P.T.F.E. and the metal tubing of the supply.

The actual tubing through the clamp can be of metal e.g. copper and again the P.T.F.E. would be coupled through suitable unions to the copper tubing, the unions being chosen to make liquid tight couplings.

Similarly discharge is through P.T.F.E. tubes **34** to a discharge ducting **35**.

It is important that leakage of liquid coolant within the phase compartment is avoided since as the terminal posts are at high potential any leakage of coolant could cause serious damage.

In cases which the invention is applied to a terminal clamp of a transformer fed from an A.C. generator having liquid cooling the generator coolant flow to the clamp coolant flow may be in series. For example the coolant output from the clamps **26** and **27** in FIGURE 5 may pass to a generator.

I claim:

1. A high voltage electrical terminal clamp for heavy current terminal comprising:

an annular portion adapted to encircle a terminal and make electric contact therewith, said angular portion having a grooved inner surface,

end surfaces defining at least one break in said annular portion,

wing members extending outwards from the ends adjacent the break,

means for clamping the wing members together to cause the annular portion to grip a terminal member,

flexible electrical conductors attached to said wing members,

coolant ducting located within the grooves of said annular portion and forming parallel flows of zig-zag form in the sections of the clamp on both sides of each break, and

ducting of flexible electrical insulating material connecting the ends of the ducting through the clamp with supply and return systems located away from the terminal which flexible ducting is attached to the clamp ducting in a fluid tight manner.

2. A high voltage electrical terminal clamp as claimed in claim **1** comprising polytetrafluoroethylene ducting connecting the ends of the clamp ducting with supply and return points in a supply system.

3. A coupling arrangement for a transformer having a pair of terminal posts comprising:

a pair of terminal clamps for engaging the terminal posts respectively,

each terminal clamp comprising:

an annular portion encircling the associated terminal post and having a grooved inner surface;

end surfaces defining at least one break in said annular portion;

wing members extending outwards from the ends adjacent the break;

means for clamping the wing members together to cause the annular portion of the clamp to grip the terminal post;

flexible electrical conductors for connecting each said wing members with an electrical supply;

coolant ducting located within the grooves of said annular portion and forming parallel flows of zig-zag form on both sides of said break,

flexible ducting of electrical insulating material for coupling the ends of said ducting;

means for passing coolant liquid through the ducting.

4. A high voltage electrical terminal clamp for heavy current terminal comprising:

two complementary parts each comprising a semicircular portion having wing members at its ends,

means for clamping the wing members of the two parts together to cause the clamp to surround and grip the terminal and make electrical contact therewith,

each part being provided in the inner surface thereof with a groove of zig-zag form,

coolant ducting located within each said groove and having an inlet and an outlet at opposite ends, and

ducting of flexible electrical insulating material connecting the ends of each section of coolant ducting with supply and return systems for coolant liquid and attached to the clamp ducting in fluid tight manner,

the clamp ducting providing a flow of coolant liquid around opposite sides of the terminal, and in close proximity thereto.

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U.S. Cl. X.R.

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