PUBLISHED
MAY 18, 1943.
BY A. P. C.

J. E. J. LANGUEPIN

RESISTANCE ELECTRIC WELDING MACHINES

Serial No.
333,867
Filed May 7, 1940
2 Sheets-Sheet 1

Fig. 1

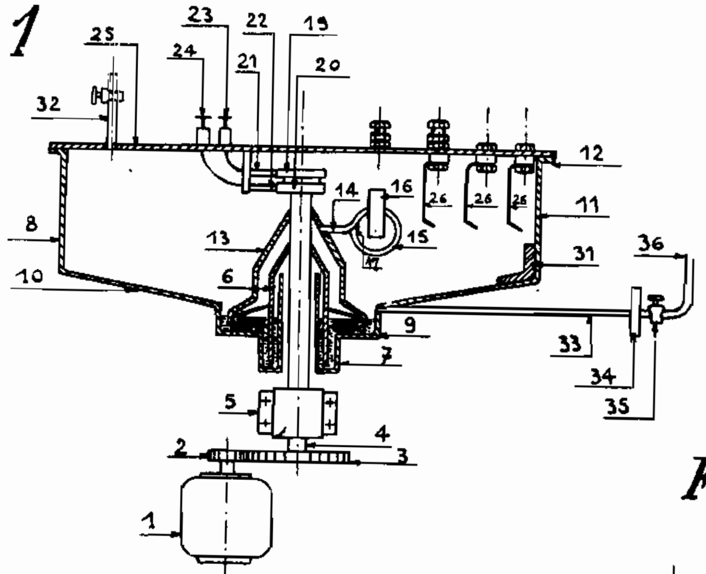


Fig. 4

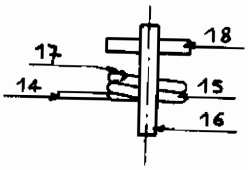


Fig. 2

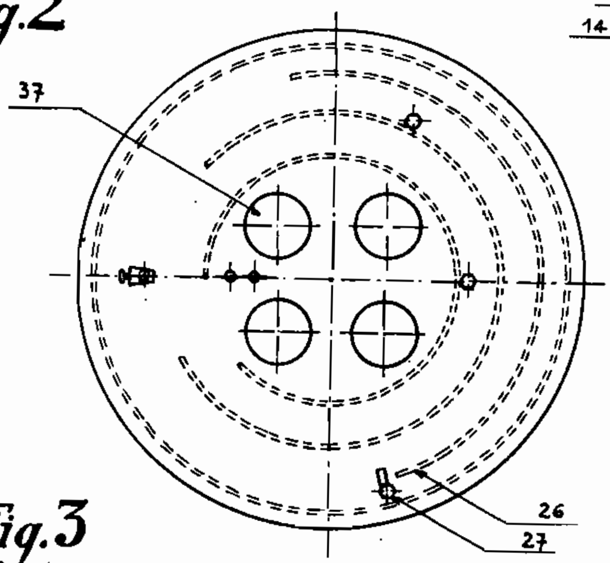
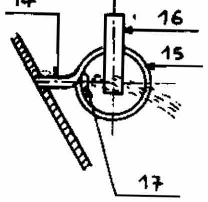


Fig. 3



Inventor,
J. E. J. Languepin
by: Glascock Downing & Seebold
Attys.

PUBLISHED
MAY 18, 1943.
BY A. P. C.

J. E. J. LANGUEPIN

RESISTANCE ELECTRIC WELDING MACHINES

Filed May 7, 1940

Serial No.
333,867

2 Sheets-Sheet 2

Fig. 5

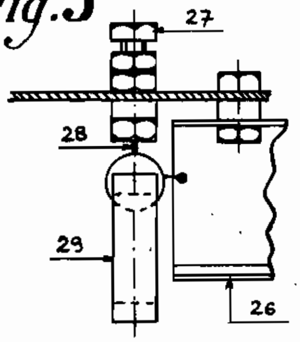


Fig. 6

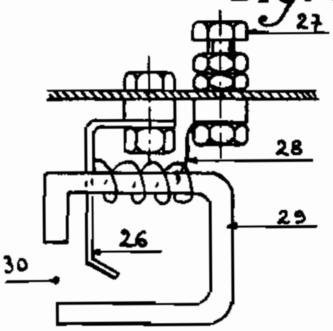
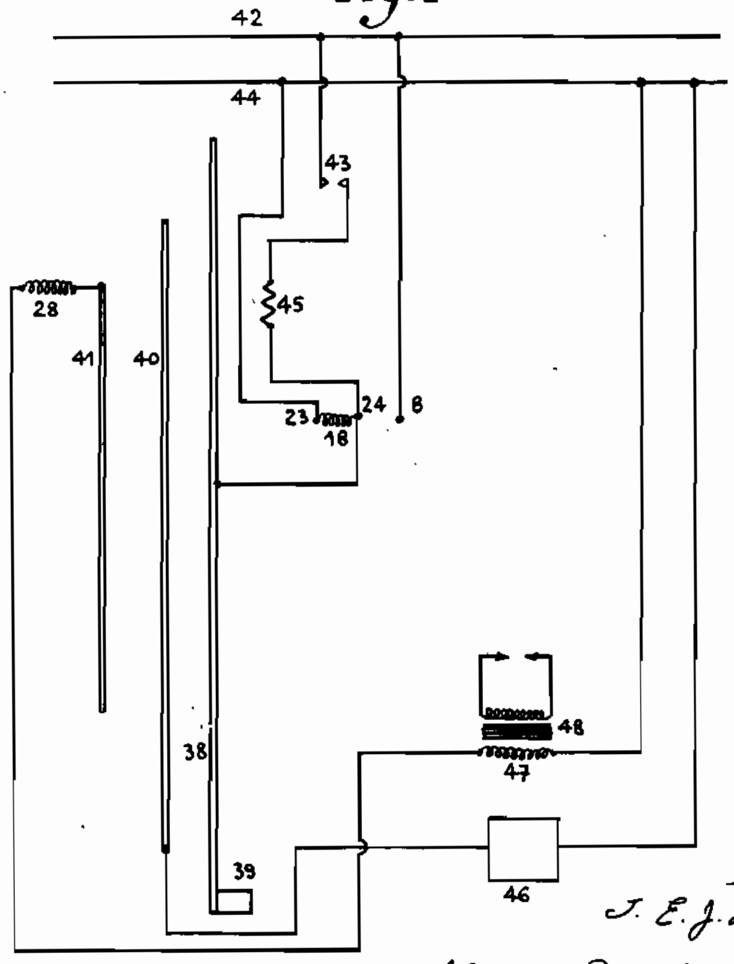


Fig. 7



Inventor,
J. E. J. Languepin

By: Glascock Downing & Seebold
Attys.

Published May 18, 1943

Serial No. 333,867

ALIEN PROPERTY CUSTODIAN

RESISTANCE ELECTRIC WELDING MACHINES

Jacques Emile Jules Languepin, Paris, France; vested in the Alien Property Custodian

Application filed May 7, 1940

Resistance electric welding machines are now more and more frequently used which are very powerful, complete the weld in a very short time and are held to supply the weld with a very accurately measured quantity of energy. In certain cases the pressure and the current intensity require to be varied during a welding operation the duration of which is only a short time.

Considerable difficulties are experienced in accurately fulfilling the several conditions or requirements above indicated.

Numerous devices have been proposed, and particularly either synchronised mechanical apparatus or thermionic switches are frequently used.

The object of the present invention consists in making use for that purpose of rotating mercury jet commutators enabling the synchronisation of the current set up and cut off and of the control of all the operations to be obtained.

Rotating mercury jet rectifiers are known since long and apparatus of this kind have been used for long periods in order to transform direct current into alternating current.

However it does not appear that these apparatus have been used as switching devices or commutators and to the best of the knowledge of the applicant their application to resistance welding machines has not yet been proposed.

The rotating mercury jet rectifiers commonly used always include a synchronous motor driving a shaft which in most cases is provided with blades forming the mercury pump. The mercury drawn from a tank is forced through a rotating horizontal pipe and the formed jet strikes contacts distributed around a circumference. The whole structure is generally enclosed in a case filled with lighting gas, nitrogen or preferably hydrogen or helium.

Although such an apparatus may be used with advantage with certain simple driving arrangements of welding machines, for example for current modulation of continuously operated welding machines, it does not generally suffice to answer the requirements of somewhat more complicated welding operations.

To meet this purpose, coils are arranged in the vicinity of the jet, adapted to deviate the mercury jet by an electromagnetic field acting on the current flowing through the jet.

Synchronous rotating switches show the drawback to remain in phase with the tension and not with the current. Thus it will be necessary to provide for the setting thereof by shifting the contacts to compensate for the phase displacement of the current. A more or less proper operation may thus be ensured as long as no variations occur in the power factor. Owing to the use of a coil through which the current itself is caused to flow and which acts on the mercury jet, an automatic shifting may be produced which will ensure the cut off when the current passes through its minimum value, irrespective of the value of the power factor.

These governing coils may be provided with a core made of magnetic material and may be arranged in the best way in accordance with the result to be obtained. In principle the length of the path of the mercury jet under the energising pole is selected so that the time of run is at least equal to the duration of half a period or of an entire number of half periods, in order to avoid too much a variation of the deflection. It is however to be understood that in accordance with the usual practice in the electrical construction, the governing magnetic system may be provided with one or more short circuited turns surrounding the whole or a part of the magnetic core for stabilising the deflection.

Such precautions are especially required when use is made for the welding operation of a non synchronised starting device, the moment the energising current being set up not being predetermined. For various controls several contacts, used together or by part, may be provided and segments arranged in succession or concentrically may also be provided.

In the annexed drawings:

Figs. 1 and 2 illustrate in sectional central elevation view and plan view, respectively, a simplified showing of a rotating mercury jet switch or commutator;

Figs. 3 to 6 are detail views of the apparatus.

Fig. 7 is a diagram of the electric connections.

Referring to the drawings, in Figs. 1 and 2, the parts of the apparatus of the kind referred to which are of usual construction and which are without influence on the desired result as soon as they are constructed according to the rules of the art, have been omitted or simplified in order to simplify the description.

The synchronous motor 1 actuates the toothed pinion 2 driving a toothed wheel 3 generally made of greater sizes. The toothed wheel 3 actuates a shaft 4 rotating in a bearing 5.

The toothed wheel 3 may be made of insulating material and the bearing 5 may be insulated from the supporting frame, or an insulating coupling may be inserted in the shaft 4 past the bearing 5. In any case the construction is to be made such that this shaft may be placed under electric tension without introducing difficulties or hindrance in the use of the apparatus.

The insulating arrangement may be made in numerous ways without exceeding the spirit of the invention.

The shaft 4 is provided with a small closed bell 6 extending in a tubular sheath 7 forming part of the casing 8 enclosing the active portion of the switch or commutator. This casing 8 forms a bucket at 9. This bucket and the sheath 7 are full of mercury and the bell 6 dipping in the mercury forms the hermetic seal which enables a properly selected atmosphere to be maintained in the casing. The casing 8 which is made of circular cross section includes a sloping part 10, a vertical part 11 and a flange 12 providing for a sealing joint.

The casing 8 as well as the other parts liable to contact with the mercury are made of steel or any other metal and carefully chromed to avoid any possible attack. The parts 9, 10 and 11 of the casing 8 may receive any particular shape, grooves or serrations, wings or extensions deemed useful to increase the contact surface with the mercury in order, on the one hand to ensure the cooling of said mercury, and on the other hand to increase the contact surface with the external air and to ensure the cooling of the whole structure.

According to the value of the current flowing through the apparatus, any useful means may be used to ensure the cooling, and particularly either a ventilator may be arranged under the casing 8 or this casing may be provided with a double wall enabling same to be surrounded entirely or by part with an oil bath cooled by means of a water cooling coil.

The casing 8 which supports an important part of the apparatus, is to be mounted on any suitable support ensuring an appropriate insulation of the casing which remains normally under current, while permitting the casing to be rotated about the shaft 4 a sufficient quantity to secure synchronism.

The bell 6 is externally provided with blades rotating in the bucket 9 full of mercury and tends to cause the mercury to rise in the conduit 13 made integral with the bell 8. From the conduit 13 the mercury is carried to the tube 14 shaped to form one or more coils 15 to which may be associated a core 16 made of magnetic material.

The jet or mercury escapes from the nozzle 17 and passes between the two pole pieces of the core 16. The magnetic core 16 also carries a coil 18, the entrance and outlet of which are connected to two rings 19 and 20, respectively, in engagement with brushes 21 and 22 which are connected to two terminals 23 and 24. These two rings are mounted in an insulated manner on an extension of the conduit 13 which rotates together with the latter. The brushes 21 and 22 as well as the terminals 23 and 24 are carried by a part 25 forming a cover for the casing 8. According to the sizes of the apparatus, which sizes are naturally variable with the value of the current and the speed of rotation, this part 25 is made of insulating material or of a piece of metal provided with a suitable number of insulating portions. The part 25 rests on the flange 12 of the casing 8 through the intermediary of a packing, and the packing is tightened by means of screws, bolts or springs.

Besides from the terminals already indicated, the part 25 carries various segments 26 insulated from another and connected with blades.

These segments may be placed on the same circumference or they may be arranged in a concentric manner as indicated Fig. 2.

The number and length of these segments will depend on the number and duration of the operations to be performed with the switch or commutator.

When a segment is to be used for the setting up and cutting off a great intensity liable of phase displacement relatively to the tension, there is provided a coil generating a correction field for the angle of displacement as hereinbeforc indicated.

This coil may be carried by the mercury jet forming pipe, as the coil 15, but arranged in a different plane. This coil may also be secured past the segment, as illustrated at the end of the segment 28 in Fig. 2.

The segment 26 is connected to the exterior by means of a terminal 27 and the intermediary of a coil arranged around a core 28. This core is disposed slightly in front of the segment 26 and at this place it is provided with an air gap 30 located at just the proper height for permitting the mercury jet to pass through. The external faces of the coil and of the core are naturally suitably insulated.

At places where heavy sparks are liable to occur in case of bad adjustment, strong and infusible insulators, such as quartz, indicated at 31, are disposed along the length of the wall or of the bottom of the casing 8.

A pipe 38 ending in the vicinity of the mercury surface enables the casing to be filled with an appropriate gas. A pipe 33 provided with a sieve 34, a cock 35 and a burner-like outlet 36, enables the gas to be ignited when a combustible gas is used while such an arrangement prevents the flame to propagate, in case of a premature lighting of said gas.

Observation holes 37 made of transparent material may be arranged on the cover 25 to enable the operation to be controlled.

The diagram of Fig. 7 illustrates the operation in the simple case of a spot welding machine operating at the flight. This example has been selected to show one of the applications only and does not limit in any way the use of the device.

In this case the switch comprises three segments 38—40—41. The mercury jet is such that it does not impinge on any one of said segments but passes below them.

The segment 38 extends almost the entire length of the circumference and is provided at its inlet end, in the direction of rotation of the jet with a small extension 39 extending enough in downward direction to meet the mercury jet.

One of the mains 42 of the supply line is connected through the starting contact 43 and through the intermediary of the resistance 45 to the terminal 24 of the coil 18, while the terminal 23 is connected to the other main 44 of the supply line.

When the contact 43 is closed, the coil 18 is energized. The mercury casing 8 is connected to the main 42 and the segment 38 is connected to the terminal 24. When the mercury jet meets the part 39, the current will pass through the mercury jet, and the latter will be deflected by the field generated in the coil 18. Thereupon the mercury jet will raise and impinge the segment 38. From this moment, the welding cycle may continue even when the button 43 is released.

After a certain angle displacement the mercury jet meets the segment 40 which is for example connected to the coil of an electro-valve 46, the other end of this coil being connected to the main 44, so that the electro-valve is supplied. After a predetermined time, the mercury jet meets the segment 41 which is connected to the primary winding 47 of the transformer 48 of a welding machine. However, this segment 41 is connected, through the intermediary of the coil 28 aforesaid, which will deflect back the mercury jet at the moment of the cut off to concord with the phase displacement of the current. When the current is cut off, the mercury jet will cut off the electro-valve and then release the segment 38.

The cycle will be continued or repeated as long as the contact 43 remains closed.

This example of simple nature shows how easy it is with a switch or commutator of this kind to control the operating cycle of a welding machine.

Naturally a larger number of segments or several mercury jets may be used. Also several switches or commutators may be associated, and may be actuated by a single or several synchronous motors.

These switches or commutators may be arranged in the same casing or in separate casings.

To execute somewhat more complicated operating programs or to control somewhat powerful welding machines, it has been found more convenient to make use of either two mercury jets or two commutators or switches, one of them, having a small output, ensuring the actuation of all the auxiliary apparatus, and the other, which is controlled by the former, and having a considerable output, cutting in and out the welding current.

When these commutators or switches have to deal with a small intensity only, they may be simplified, and in such a case they require a mercury jet of very small diameter and a very small power only. They may play the role of quick acting and synchronised relays.

The rotating mercury jet commutators or switches permit the actuation and control of welding machines or resistance welding machines as spot, butt or end, or continuous welding machines and either directly supplied in alternating current or operated with self or capacity accumulation.

The small power required to deflect the mercury jet enables to a certain extent the use of such commutators or switches as amplifying relays.

It is to be understood that without exceeding the limits of the invention, such modifications may be made in the usual designs of the commutators or switches of this kind, as are required by the value of the intensity to be cut out or of the duration of the cycle. In certain cases a separate mercury pump may be required rotating at a greater speed than that of the distributing shaft.

JACQUES EMILE JULES LANGUEPIN.