C. H. KICKLIGHTER.

ELECTRIC RIVETING.

APPLICATION FILED DEC. 15, 1916.

1,236,090. Patented Aug. 7, 1917.

FIG. 1.

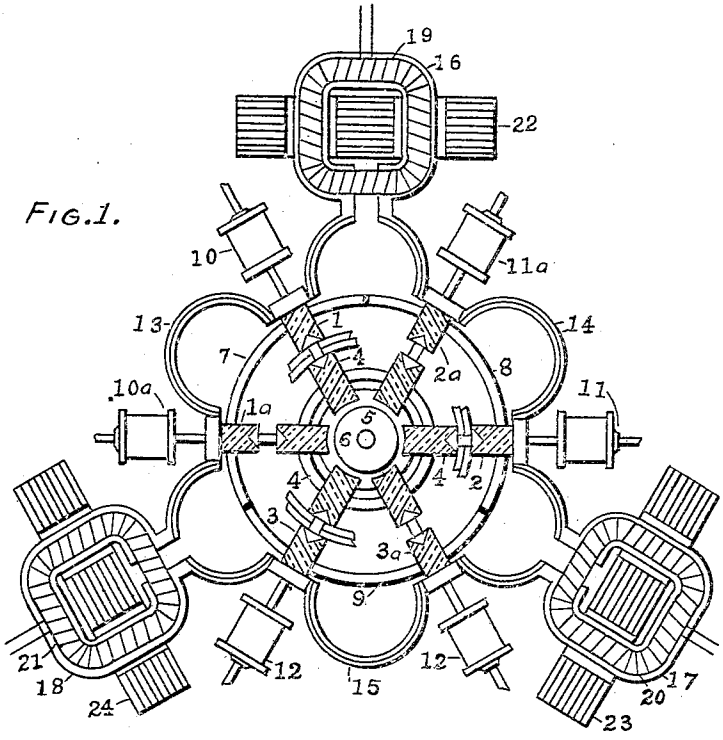
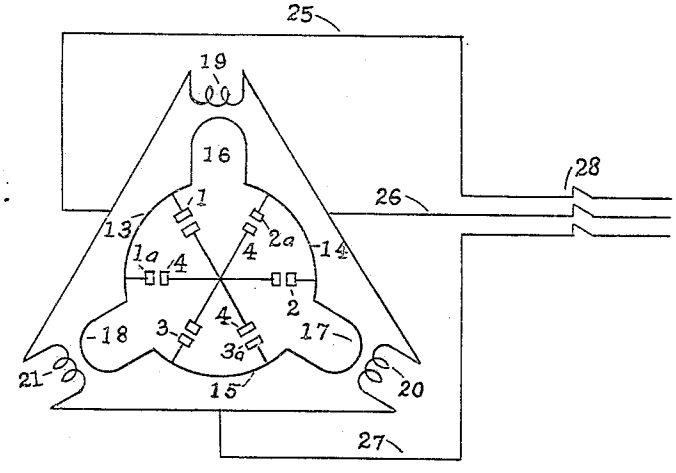


FIG. 2.



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ELECTRIC RIVETING.

1,236,090. Specification of Letters Patent. Patented Aug. 7, 1917.

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To all whom it may concern:

Be it known that I, CHARLES H. KICKLIGHTER, a citizen of the United States, residing at Macon, in the county of Bibb and State of Georgia, have invented new and useful Improvements in Electric Riveting, of which the following is a specification.

My invention relates to an apparatus and method for riveting by electric means and its object is to provide an apparatus and method for heading rivets in cylinder seams by the use of polyphase currents.

Briefly stated, the apparatus consists of a set of transformers disposed about the position of the work and adapted to apply polyphase heating currents to a plurality of rivet blanks inserted in holes through the circular seam around the circumference thereof. Means are also provided for collecting the currents from the inside ends of the rivet blanks and reuniting them on a member or members of neutral potential within the cylinder. The method consists of passing the polyphase heating currents radially through a plurality of uniting rivet blanks to a neutral point within and of simultaneously subjecting these rivet blanks to mechanical pressure.

Figure 1 is a sketch illustrating a three-phase electric riveting machine with the secondaries delta-connected and adapted to head the rivets in a circular seam of a metal cylinder at a plurality of points disposed around said seam.

Fig. 2 is a diagram of the electrical connections in Fig. 1.

Fig. 1 illustrates a riveting apparatus, in which a set of heading dies 1—1ª, 2—2ª and 3—3ª are disposed opposite to a series of engaging terminals 4—4—4 which in this case also consist of a set of heading dies. Terminals 4—4—4 are adapted to be pressed out radially against the ends of rivet blanks projecting from the inside of a circular seam. These engaging terminals 4—4—4 may be forced outward by a conical sleeve 5 sliding on a shaft 6 or by other well known mechanical means. The heading dies 1, 1ª, 2, 2ª, 3 and 3ª are supported by a guiding yoke forming a complete circumference around the work and which is divided into three segments 7, 8 and 9, properly insulated from one another.

The heading dies 1—1ª, 2—2ª and 3—3ª are adapted to be forced radially inward against the ends of rivet blanks projecting from the outside of a circular seam by pneumatic or hydraulic pressure in cylinders 10—10ª, 11—11ª, 12—12ª, or by other means. The conductors 13, 14 and 15 serve to connect the heading dies to the secondaries 16, 17 and 18 of a set of three-phase transformers. The primaries 19, 20 and 21 of these transformers, wound about cores 22, 23 and 24, are connected to the source of supply in one of the usual methods of connection.

The transformers are arranged so as to surround the work and the secondary conductors 13—14—15 with the transformer secondaries 16—17—18 form an unbroken yoke or circumference about the work. The loops in conductors 13—14—15 are for the purpose of giving greater flexibility to permit the free motion of the heading dies.

For the sake of simplicity it is not attempted to show the connection of the primaries to the three-phase supply. This may be any one of the ordinary methods of connections well known in the art, as the delta or star connection.

Fig. 2 is a diagram showing the electrical connections of the apparatus of Fig. 1. The primaries 19—20—21 are delta-connected and are connected by leads 25—26—27 and switch 28 to the source of three-phase supply. The connection of the heading dies 1—1ª, 2—2ª and 3—3ª to the secondaries 16—17—18 by conductors 13—14—15 is plainly illustrated in this diagram. The interconnection of the contact or heading terminals 4—4—4 is also plainly illustrated.

In Fig. 1, for the sake of simplicity, only small sections of the circular seam are shown. Between the heading dies 1—2—3 and the corresponding terminals 4—4—4, rivet blanks are illustrated as passing through holes in the two plates at a circular seam. After the heading operation by dies 1—2—3, the dies are raised out of contact with their rivets and dies 1ª—2ª—3ª may be similarly brought down against other rivets, three-phase heating currents may be passed through these rivets and heads formed thereon, etc.

For the sake of clearness the heading dies are shown in section. In the illustration the terminals 4—4—4 are supposed to be heading dies, in which case the machine is adapted to head both ends of the blank simultaneously. It is apparent however that the terminals 4—4—4 may be simply conical engaging terminals, for contacting with heads

already formed on one end of the rivet blanks. In this latter case only the dies connected to the transformer secondaries perform the heading function.

The operation is apparent. The circular seam of a cylinder, with rivet blanks passed through the holes therein, is inserted around the heading terminals 4—4—4 and is brought between them and the oppositely disposed heading dies 1—1ª, 2—2ª, 3—3ª. The rivet blanks are brought in line with and between the oppositely disposed dies. The conical sleeve 5 is slid forward on the shaft 6 so as to press the terminals or dies 4—4—4 radially outward against the inwardly projecting ends of the rivet blanks. Hydraulic or pneumatic pressure is admitted into cylinders 10—11—12 and the heading dies 1—2—3 are thrust radially inward against the outwardly projecting ends of the rivet blanks. The transformer primaries are excited and heavy heating secondary currents, in three-phase relation, flow from the secondaries 16—17—18, through the heading dies 1—2—3 and through the rivets to the terminals 4—4—4 where they are united. The heat, due to the passing currents, softens the rivet blanks and the mechanical pressure forces the metal downward at either end, thus forming heads on the rivets.

The primary current being now interrupted and the pressure on the heading dies 1—2—3 relieved, pressure is next admitted to cylinders 10ª—11ª—12ª, thus forcing heading dies 1ª—2ª—3ª radially inward against the ends of three other rivets, not shown, in the same manner as above described.

The primaries 19—20—21 being again excited, heating polyphase currents flow from secondaries 16—17—18 and three more rivets are headed, and so on.

What I claim is:

1. The method of fastening two pieces of metal together along a circular seam, consisting in placing uniting members through holes in said pieces of metal, in applying mechanical pressure upon the projecting ends of a plurality of the uniting members disposed about the circumference of the seam, and in conducting through these uniting members a plurality of currents in three-phase relation to a point of common union within the circular seam.

2. The method of forming a riveted circular seam in a cylinder by the use of heading dies, consisting in bringing the dies in contact with the projecting ends of uniting rivet blanks distributed along the seam, in applying mechanical pressure and in conducting through the rivet blanks a plurality of heating currents in three-phase relation to a point of common union within the cylinder.

3. The method of heading a plurality of rivet blanks inserted in holes through metal sheets around the circumference of a circular seam, consisting in applying mechanical pressure to the projecting ends of the rivet blanks, in conducting therethrough a plurality of heating currents of different phase relation and in uniting these currents within the circular seam.

4. The method of riveting a circular seam in a sheet metal cylinder, consisting in applying a plurality of heating currents in three-phase relation and mechanical pressure to the ends of rivet blanks projecting from holes through said seam and in conducting said currents through the rivets and uniting these currents at a point of neutral potential.

5. The method of fastening two pieces of metal together along a circular seam consisting in applying mechanical pressure and heating currents in three-phase relation to the projecting ends of uniting rivet blanks, disposed about the whole circumference, in conducting these currents through the rivet blanks to a point of neutral potential, in thereafter applying mechanical pressure and heating currents in three-phase relation to the ends of intermediate rivet blanks along the line of circular seam and in conducting these currents through the rivet blanks to a point of neutral potential.

6. In an apparatus for heading rivets in the circular seam of a cylinder, the combination of a set of three-phase transformers so disposed as to surround and be in close proximity to said cylinder, of a plurality of heading dies connected to the transformer secondaries and of a plurality of inter-connected engaging terminals disposed opposite to said dies.

7. In an electric metal working apparatus for riveting a circular seam the combination of a set of transformers three-phase connected and so disposed as to surround and be in close proximity to said circular seam, of a plurality of heading dies connected to the secondaries of the transformers and adapted to contact with the protruding ends of rivet blanks inserted in holes disposed in and along said seam, and of a plurality of engaging terminals inter-connected, disposed opposite to aforesaid heading dies and adapted to contact with the inside ends of said rivet blanks.

8. In an electric apparatus for riveting seams in a metal cylinder, the combination of a set of inter-connected polyphase transformers so disposed as to be in close proximity to said cylinder, of a plurality of heading dies connected to the secondaries of the polyphase transformers and adapted to engage with the projecting outside ends of inserted rivet blanks, and of a plurality of inter-connected dies, disposed opposite to

said heading dies and adapted to engage with the inner ends of said insert rivet blanks.

9. In an apparatus for riveting seams in a metal cylinder, the combination of a plurality of inter-connected polyphase transformer secondaries so disposed as to be about and in close proximity to said cylinder, of means for applying polyphase currents in different phase relations from the transformer secondaries to the projecting ends of inserted rivet blanks and of means for conducting said currents from the opposite ends of the rivet blanks to a point of common union.

10. An electric riveting apparatus, consisting of a circular yoke or conductor adapted to surround the work, of heading dies connected to said yoke at various points disposed along the circumference thereof, of means for maintaining three equal portions of the yoke at electric potentials having a three-phase relation and of another set of engaging terminals, electrically connected, disposed opposite to the said heading dies and adapted to be surrounded by the work.

In testimony whereof, I have hereunto signed my name, in the presence of two subscribing witnesses, at Macon, in the county of Bibb and State of Georgia, this 13th day of December, 1916.

CHARLES H. KICKLIGHTER.

Witnesses:
B. F. HALE,
R. F. FINCHER.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."