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W. P. PLACE

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ELECTRICAL RECTIFIER

Filed Sept. 25, 1931

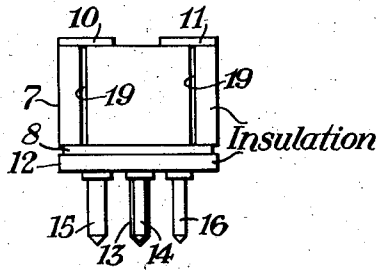


Fig. 1.

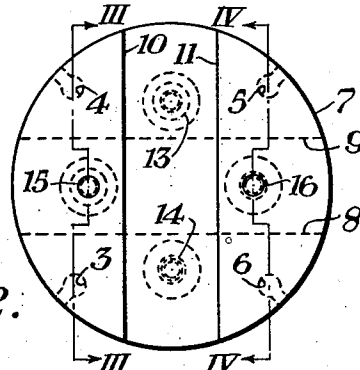


Fig. 2.

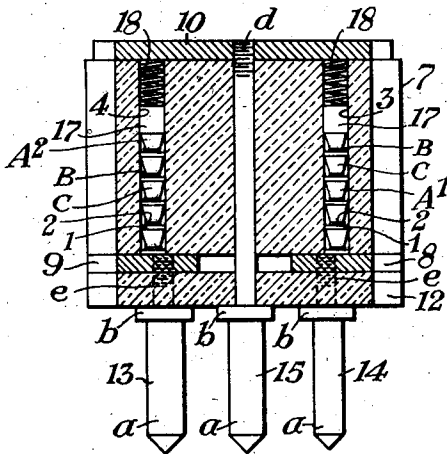


Fig. 3.

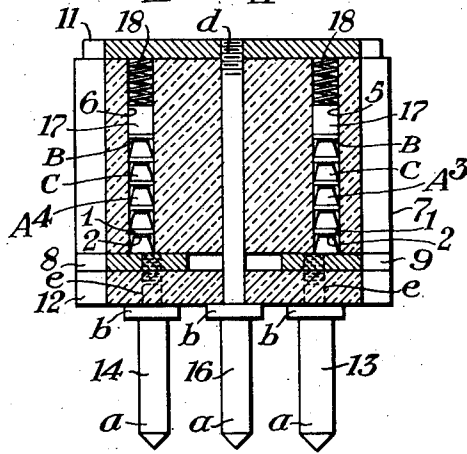


Fig. 4.



Fig. 5.

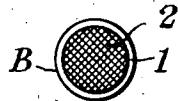


Fig. 6.



Fig. 7.



Fig. 8.

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UNITED STATES PATENT OFFICE

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ELECTRICAL RECTIFIER

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My invention relates to electrical rectifiers, and particularly to rectifiers employing asymmetric units of the metal oxide type.

It has been proposed to utilize rectifiers of this type in various kinds of radio circuits as detectors of high frequency waves and for other purposes. When utilized in this manner, it is usually desirable that the rectifier should have a high resistance as well as a good rectifying ratio, and that the rectifier should take up as little space as possible. One way in which the rectifier can be constructed to have these desirable characteristics is to make the asymmetric units small in physical size. For example, units one-twelfth of an inch in diameter have been found to be very satisfactory. When the units are made small in physical size, however, and several units are assembled together into a stack, considerable difficulty has been experienced in securing good electrical contact between the units, and in making external electrical connections with the units. One object of my invention is to provide a rectifier of the type described in which these difficulties are completely eliminated.

Another object of my invention is to provide a rectifier of the four-legged bridge type which can be plugged into any of the well-known forms of vacuum tube sockets, and which will utilize a minimum amount of space.

I will describe one form of rectifier embodying my invention, and will then point out the novel features thereof in claims.

In the accompanying drawing, Fig. 1 is a view showing in side elevation one form of rectifier embodying my invention. Fig. 2 is a top plan view, on an enlarged scale, of the rectifier shown in Fig. 1. Figs. 3 and 4 are vertical sectional views taken on the lines III—III and IV—IV, respectively, of Fig. 2. Fig. 5 is a side view showing, on an enlarged scale, one of the asymmetric units B forming part of the rectifier shown in Figs. 1 to 4, inclusive, and Fig. 6 is a top plan view of the asymmetric unit B shown in Fig. 5. Fig. 7 is a side view

showing, on an enlarged scale, one of the impressionable conducting elements C forming part of the rectifier shown in Figs. 1 to 4, inclusive; and Fig. 8 is a top plan view of the element C shown in Fig. 7.

Similar reference characters refer to similar parts in each of the several views.

Referring first to Figs. 1 to 4, inclusive, the rectifier here shown is of the four-legged bridge type, and comprises four stacks A¹, A², A³ and A⁴ of asymmetric units B assembled in four holes 3, 4, 5 and 6, respectively, formed in a block 7 of suitable insulating material, such as a condensation product of phenol. The block 7 may have any desired shape and size, but in the embodiment illustrated, the block 7 is cylindrical, and is of suitable size to permit the rectifier to be plugged into any of the well-known push types of vacuum tube sockets, as will be explained more fully hereinafter. The holes 3, 4, 5 and 6 extend vertically downward, through the block 7, and are spaced apart the same distance as the contact holes in a vacuum tube socket of the type previously referred to. The lower ends of the holes 3 and 6 are closed by a semicircular metal contact plate 8, and the lower ends of the holes 4 and 5 are closed by a semicircular metal contact plate 9. Likewise, the upper ends of the holes 3 and 4 are closed by a semicircular metal contact plate 10, and the upper ends of the holes 5 and 6 are closed by a semicircular metal contact plate 11. The semicircular metal contact plates 8 and 9 are fastened to the upper side of a circular insulating plate 12, by means of terminal members 14 and 13, respectively, and the insulating plate 12, in turn, is fastened to the block 7 by means of terminal members 15 and 16, which also fasten the semicircular metal plates 10 and 11 to the block 7. The terminal members 13 and 14 are similar, and are each provided with an annular shoulder b which engages the underside of the circular insulating plate 12, and with a threaded portion e which extends upwardly through the insulating plate 12, and is screwed into a suitable threaded hole in the associated semicircular

plate 8 or 9. The terminal members 15 and 16 are likewise similar, and are each provided with an annular shoulder *b* which engages the underside of the plate 12, and with a threaded portion *d* which extends upwardly through the insulating plate 12 and through the block 7, and is screwed into a suitable threaded hole in the associated plate 10 or 11. The lower ends of the terminal members 13, 14, 15 and 16, as here shown, are each provided with a prong *a*, these prongs being so spaced and so proportioned as to enable the rectifier to be plugged into a vacuum tube socket of the type referred to hereinbefore, in only one position. It should be distinctively understood, however, that my invention is not limited to the particular type of terminal members shown, and that these terminal members may, if desired, assume the form of binding posts so constructed that the conductors of any circuit in which the rectifier is to be utilized may be connected directly to the terminal members in the most convenient manner.

The asymmetric units B may be of any suitable type, and as most clearly shown in Figs. 5 and 6, each unit, in the form here shown, comprises a flat disk 1 of metal, such as copper, having a coating 2 of a compound of the metal, such as cuprous oxide, formed on one side thereof. Asymmetric units of the type described exhibit the characteristic of offering a higher resistance to current which tends to flow through the unit from the copper to the oxide than to current tending to flow in the opposite direction through the unit. The coating 2 may, if desired, cover the whole side of the unit, but in the preferred form, the coating only covers a circular central portion, leaving an annular uncoated portion adjacent the outer edge of the unit, as clearly shown in the drawing. One reason for constructing the units in the manner shown and described is that with a given load on a unit, the smaller the area of the coating is, the higher the resistance and rectifying ratio of the unit will be. Another reason for constructing the units in the manner described is that, when the whole face of a unit of the size contemplated in rectifiers embodying my invention is coated, it is difficult to prevent some of the oxide from extending over the side of the unit, in which event the unit is rendered unfit for use.

Adjacent the coating 2 of each unit is placed an impressionable conducting member C of suitable material such as lead. It is desirable that each conducting member C should engage as large an area of the coating 2 of the adjacent unit as possible, but it will be readily understood that it is essential that the conducting member should not extend

past the edge of the coating into contact with the metal part of the unit, because, if this should occur, the asymmetric unit would be short circuited, and the rectified would therefore fail to operate in the manner intended. In order to enable each conducting member C to engage as large an area of the coating 2 of the adjacent unit as possible, and yet prevent the conducting members from short circuiting the units, I prefer to construct each conducting member in the form of a frustum of a cone (see Figs. 7 and 8), the larger base of which has a diameter which is only slightly smaller than the diameter of the holes in which the units are assembled, and the smaller base of which has the same, or a slightly smaller diameter than the outer surface of the coating 2 of the units. With this construction it will be seen that the shape of the conducting members keeps these members properly centered on the coating of the adjacent units and provides the maximum contact area between the members and the units. It should be pointed out, however, that a frustum of a cone is not the only shape that the conducting member C may assume in order to provide the desired contact between the units, the only essential requirement being that the conducting member have a large end for centering the members and a small end for making contact with the coated side of the units.

Interposed between the upper end of each stack A of asymmetric units and the plate which closes the hole in which such stack is mounted, is a conducting plunger 17 and a compressed coil spring 18. The function of the springs 18 and conducting plungers 17 is to subject the asymmetric units B and the associated conducting members C to a comparatively high pressure, thus insuring good electrical contact between the units, the conducting members, and the contact plates which close the holes in which the units and conducting members are mounted.

As shown in the drawing, each stack A of asymmetric units comprises five asymmetric units in series, the units of the stacks A¹ and A² being assembled with their coating 2 up, so that these stacks will offer the lowest resistance to current tending to flow downwardly through the stacks, and the units of the stacks A³ and A⁴ being assembled with their coating 2 down so that these stacks will offer the lowest resistance to current tending to flow upwardly through the stacks. It should be understood, however, that the particular arrangement shown is chosen merely for convenience in illustrating my invention, and not by way of limitation, the number of stacks and arrangement of units in each stack being determined by the manner in which the rectifier is to be utilized.

In utilizing the rectifier, a source of alter-

nating current may be connected with the terminal members 13 and 14 and the load may be connected with the terminal members 15 and 16. With this arrangement, the terminal member 15 will be negative and the terminal member 16 will be positive.

In order to facilitate inspection and assembly of the units, the block 7 may, if desired, be provided with a plurality of vertically disposed slots 19, one of which extends through the side of the block into each hole 3, 4, 5 and 6, as shown in Figs. 1 and 2.

Although I have herein shown and described only one form of electrical rectifier embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. A rectifier comprising an asymmetric unit consisting of a flat metal member having a coating of a compound of the metal formed on one side thereof, an insulating member provided with a hole which receives said unit with slight clearance, an impressionable conducting member in said hole having one end which fits into said hole with only slight clearance and another end which is somewhat smaller in size than the coating of said unit and which engages said coating, and means for subjecting said member and said unit to a comparatively high pressure.

2. A rectifier comprising an asymmetric unit consisting of a flat metal member having a coating of a compound of the metal formed on one side thereof, an insulating member provided with a hole which receives said unit with slight clearance, an impressionable conducting member in said hole having one end which fits into said hole with only slight clearance and another end which is somewhat smaller in size than the coating of said unit and which engages said coating, a coiled spring in said hole, and means including said spring for subjecting said member and said unit to a comparatively high pressure.

3. A rectifier comprising a block of insulating material provided with a hole, an asymmetric unit in said hole, said asymmetric unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, an impressionable conducting member in said hole, said member being in the form of a frustum of a cone and having its smaller end engaging the coating of said unit, and means for subjecting said member and said unit to a comparatively high pressure.

4. A rectifier comprising a block of insulating material provided with a hole, an asymmetric unit in said hole, said asymmetric unit comprising a metal disk having

a coating of a compound of the metal formed on one side thereof, an impressionable conducting member in said hole, said member being in the form of a frustum of a cone and having its smaller end engaging the coating of said unit, a spring in said hole, and means including said spring for subjecting said unit and said member to a comparatively high pressure.

5. A rectifier comprising a block of insulating material provided with a hole, an asymmetric unit in said hole, said asymmetric unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, an impressionable conducting member in said hole, said member being in the form of a frustum of a cone the one base of which fits into said hole with a small amount of clearance and the other base of which has a diameter which is smaller than the diameter of the coating of said unit, said smaller base being in engagement with the coating of said unit, and means for subjecting said member and said unit to a comparatively high pressure.

6. A rectifier comprising a block of insulating material provided with a hole, an asymmetric unit in said hole, said asymmetric unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, an impressionable conducting member in said hole, said member being in the form of a frustum of a cone the one base of which fits into said hole with a small amount of clearance and the other base of which has a diameter which is smaller than the diameter of the coating of said unit, said smaller base being in engagement with the coating of said unit, a spring in said hole, and means including said spring for subjecting said member and said unit to a comparatively high pressure.

7. A rectifier comprising a block of insulating material provided with a hole which extends through said block, an asymmetric unit in said hole, said asymmetric unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, an impressionable conducting member in said hole, said member being in the form of a frustum of a cone and having its smaller end engaging the coating of said unit, two metal plates secured to said block and closing each end of said hole, and a compressed spring in said hole for subjecting said unit and said member to a comparatively high pressure.

8. A rectifier comprising a block of insulating material provided with a hole, a plurality of asymmetric units in said hole each said unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, a plurality of impressionable conducting members in said hole each said member being in the form of

a frustum of a cone and each having its smaller base engaging the coating of a different one of said units, a compressed spring in said hole, and means including said spring for subjecting said units and said members to a comparatively high pressure.

9. A rectifier comprising a block of insulating material provided with a hole, a plurality of asymmetric units in said hole each said unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, a plurality of impressionable conducting members in said hole each said member being in the form of a frustum of a cone and each having its smaller base engaging the coating of a different one of said units, a spring in said hole, and means for compressing said spring to subject said units and said members to a comparatively high pressure.

10. A rectifier comprising a block of insulating material provided with a hole which extends through said block, an asymmetric unit in said hole, said asymmetric unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, an impressionable conducting member in said hole, said member being in the form of a frustum of a cone and having its smaller end engaging the coating of said unit, two metal contact plates secured to said block one closing each end of said hole and a compressed spring in said hole for subjecting said unit and said member to a comparatively high pressure, and means for making electric connections with said plates.

11. As a new article of manufacture, an impressionable electrical conducting member for improving the contact between a second conducting member and an asymmetric unit of the dry disk type, said impressionable conducting member being in the form of a frustum of a cone the larger base of which has substantially the same diameter as the second conducting member, and the smaller base of which has a diameter which is somewhat smaller than the diameter of the unit.

12. As a new article of manufacture, an impressionable electrical conducting member for improving the contact between a second conducting member and an asymmetric unit of the type comprising a flat metal member having a coating of a compound of the metal formed on a portion of one side thereof, said impressionable conducting member being in the form of a frustum of a solid the larger base of which has substantially the same shape and area as the metal side of the unit, and the smaller base of which has the same shape but a slightly smaller area than the coating of the unit.

13. As a new article of manufacture, an

impressionable electrical conducting member for improving the contact between a second conducting member and an asymmetric unit of the type comprising a metal disk having a centrally located circular coating of a compound of the metal formed on one side thereof and covering only a portion of such side, said impressionable conducting member being in the form of a frustum of a cone the larger base of which has the same diameter as the disk, and the smaller base of which has a diameter which is somewhat smaller than the diameter of the coating.

14. An electrical rectifier comprising a block of insulating material having a first, a second, a third, and a fourth hole extending therethrough in spaced relation, a first metal plate secured to said block and closing one end of said first and second holes, a second metal plate secured to said block and closing the one end of said third and fourth holes, a third metal plate secured to said block and closing the other end of said second and third holes, a fourth metal plate secured to said block and closing the other end of said first and fourth holes, four stacks of asymmetric units one located in each of said holes and each comprising one leg of the rectifier, and a compressed spring in each of said holes for subjecting the units of the associated stack to a relatively high pressure.

15. An electrical rectifier comprising a block of insulating material having a first, a second, a third, and a fourth hole extending therethrough in spaced relation, a first metal plate secured to said block and closing one end of said first and second holes, a second metal plate secured to said block and closing the one end of said third and fourth holes, a third metal plate secured to said block and closing the other end of said second and third holes, a fourth metal plate secured to said block and closing the other end of said first and fourth holes, four stacks of asymmetric units one located in each of said holes and each comprising one leg of the rectifier, each said asymmetric unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, a plurality of impressionable conducting members each being in the form of a frustum of a cone the larger base of which has a diameter only slightly smaller than the diameter of the holes in said block, one said conducting member being disposed in each of said holes adjacent each unit and each having its smaller base engaging the coating of the adjacent unit, and four springs one compressed in each of said holes for subjecting the units and the conducting members to a comparatively high pressure.

16. An electrical rectifier comprising a block of insulating material having a first,

a second, a third, and a fourth hole extending therethrough in spaced relation, a first metal plate secured to said block and closing one end of said first and second holes, a second metal plate secured to said block and closing the one end of said third and fourth holes, a third metal plate secured to said block and closing the other end of said second and third holes, a fourth metal plate secured to said block and closing the other end of said first and fourth holes, four stacks of asymmetric units one located in each of said holes and each comprising one leg of the rectifier, each said asymmetric unit comprising a metal disk having a coating of a compound of the metal formed on one side thereof, a plurality of impressionable conducting members each being in the form of a frustum of a cone the larger base of which has a diameter only slightly smaller than the diameter of the holes in said block, one said conducting member being disposed in each of said holes adjacent each unit and each having its smaller base engaging the coating of the adjacent unit, four metal plungers one located in each of said holes between one end of the associated stack and the plate which closes the adjacent end of the hole, and four compressed coil springs one interposed between each plunger and the plate which closes the adjacent end of the hole for subjecting the units of the associated stack to a relatively high pressure.

end screwed into said third plate and the other having one end screwed into said fourth plate, each said terminal member being provided with a prong, said terminal member being so spaced and said prongs being so proportioned as to enable the rectifier to be plugged into a vacuum tube socket. four stacks of asymmetric units one located in each of said holes, the asymmetric units of each stack each comprising a metal disk having a coating of a compound of the metal formed on one side thereof, the units of the stacks in said first and second holes being disposed with their metal sides facing in one direction and the units of the stacks in said second and third holes being disposed with their metal sides facing in the opposite direction, a plurality of impressionable conducting members each being in the form of a frustum of a cone the larger base of which has a diameter only slightly smaller than the diameter of the holes in said block, one said conducting member being disposed in each of said holes adjacent each unit and each having its smaller base engaging the coating of the adjacent unit, four plungers, and four compressed springs, one said plunger and one said spring being located in each of said holes between one end of the associated stack and the plate which closed the adjacent end of the hole, said springs serving to subject the units and the impressionable conducting members in the associated stack to a relatively high pressure.

17. An electrical rectifier comprising a block of insulating material having a first, a second, a third, and a fourth hole extending therethrough from one end to the other in spaced relation, a first metal plate engaging one end of said block and closing one end of said first and second holes, a second metal plate engaging said one end of said block and closing one end of said third and fourth holes, a third metal plate engaging the other end of said block and closing the other end of said second and third holes, a fourth metal plate engaging said other end of said block and closing the other end of said first and fourth holes, an insulating plate engaging the outer side of said third and fourth metal plates, two terminal members for fastening said first and second metal plates and said insulating plate to said block each said terminal member being provided with a shoulder which engages the outer side of said block and each extending through said insulating plate and one having one end screwed into said first plate and the other having one end screwed into said second plate, two other terminal members for fastening said third and fourth plates to said insulating plate, each said other terminal member being provided with a shoulder which engages the outer side of said insulating plate and each extending through said insulating plate and one having one

18. As a new article of manufacture, an impressionable electrical conducting member for improving the contact between a second conducting member and an asymmetric unit of the type comprising a flat metal member having a coating of a compound of the metal formed on a portion of one side thereof, said impressionable conducting member having one base which has substantially the same shape and area as the metal side of said unit, and another base which has the same shape and an area which is equal to, or smaller than, the coating of the unit.

In testimony whereof I affix my signature.
WILLARD P. PLACE.