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METHOD OF MAKING CONTACT BODIES OF TUNGSTEN.

APPLICATION FILED NOV. 20, 1914.

1,155,426. Patented Oct. 5, 1915.

Fig. 1. Fig. 3. Fig. 5 Fig. 7 Fig. 9. Fig. 11 Fig. 13

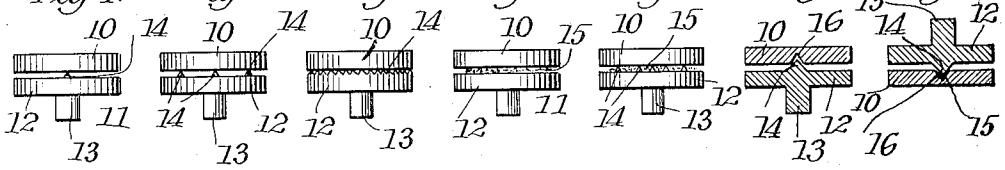


Fig. 2. Fig. 4 Fig. 6. Fig 8. Fig. 10. Fig. 12 Fig. 14.

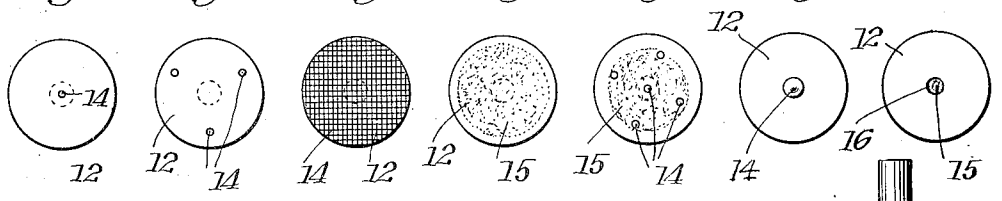
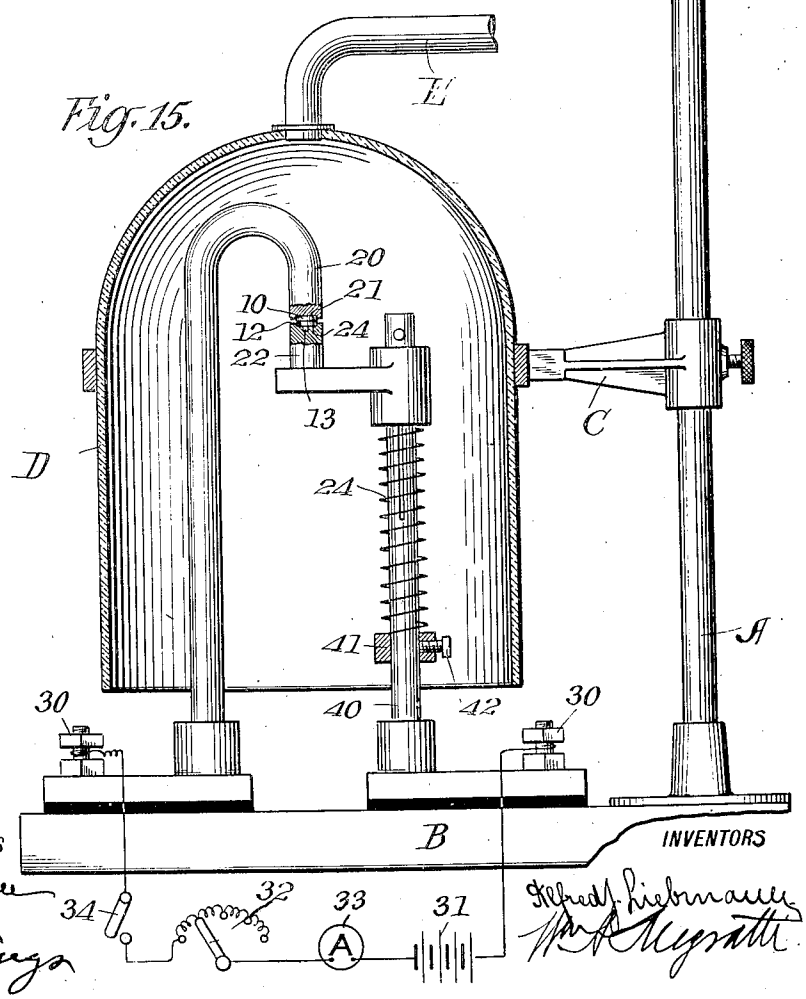


Fig. 15.



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METHOD OF MAKING CONTACT BODIES OF TUNGSTEN.

1,155,426. Specification of Letters Patent. Patented Oct. 5, 1915.

Application filed November 20, 1914. Serial No. 873,087.

To all whom it may concern:

Be it known that we, ALFRED J. LIEBMANN and WILLIAM A. MEGRATH, respectively of the borough of Manhattan, city, county, and State of New York, and of the borough of Brooklyn, county of Kings, city and State of New York, have jointly invented certain new and useful Improvements in Methods of Making Contact Bodies of Tungsten, of which the following is a specification.

This invention relates to improved electrical contacts for the use as contacts for gas engines, for circuit controllers and other like purposes.

As set forth in the Patent No. 1,111,698 granted September 22nd, 1914, to Alfred J. Liebmann, the metal obtained by the invention covered thereby is suitable to be used for contacts for magnetos and similar devices where there is a frequent making and breaking of an electric current.

In the present application the claims are directed to the process and the claims to the product are contained in our co-pending application Serial No. 29,777, filed May 22nd, 1915, as a division of the present application in compliance with a requirement of the Patent Office.

In order to make the tungsten contact plate or disk suitable for such purposes, it is desirable and in some cases even necessary to fasten or secure it to another metal, which other metal is so shaped that it can be easily attached to the apparatus in which the contact element is to be used. The tungsten plate or disk may be formed in any suitable way, for instance, it may be cut either from a plate of rolled tungsten or in cross sections from a rod or ingot of tungsten. The second metal as a rule is in the form and shape of a tack and suitably shaped to fit into some part which can be designed as the receptacle for the actual tungsten contact element.

It has heretofore been considered impossible to join tungsten contacts or other bodies of tungsten to a backing of other metal without using a third kind of metal to join the two together. It has been the practice to join the tungsten contact plate or disk to the tack by means of an auxiliary third metal different from the metals of the contact and support.

We have invented a process whereby we can join the tungsten plate or disk to the tack without the aid of such an auxiliary third metal. That is, we fuse or weld the tungsten contact plate or disk directly to the holder or carrier or backing material, which is to be set into the apparatus and which as a whole can be described as a contact breaker.

By means of our invention an article is produced which is commercially superior to the articles used heretofore which latter necessitate a third kind of metal being interposed between the tungsten and carrier or supporting material, for it has the advantage of overcoming the objection thereto due to the presence of a third kind of metal of lower fusing point between the tungsten and the carrier metal, which might during the operation of the circuit breaker become hot, get soft and thereby make the tungsten contact lose connection from the carrier metal and thereby fall off. This danger is avoided by means of our invention in which the tungsten contact disk or plate is directly joined to the carrier metal which may be for instance iron or steel. The resulting element is, therefore, homogeneous, and can almost be said to consist of one solid piece, the two pieces of metal being joined directly together and forming one undivided unit. Furthermore our device is easier and less expensive to manufacture.

In the practice of our invention we place between the two metals a point or a multitude of points of the same material, either steel or tungsten which will oppose when a current of electricity is passed through the two metals, a higher resistance to the passing electric current, and therefore reach a very high temperature locally. This temperature will be highest where the surfaces of the two metals to be joined contact with the points or projections between them and thus cause the two metals to soften and weld together when the proper pressure is applied. We have also found that we can still heighten this effect by placing between the two metals, a chemical, which when the current is being passed and a high temperature is being reached, by its own chemical action, will intensify the heat, and at the same time polish and clean the surfaces of the two metals in such a way that they stick to each other much better or much more intimately

and form a composite body much easier than when simply joined without this auxiliary chemical, which cleans the surfaces of any film of oxide or other foreign material which might be present. This chemical is so selected that it at the same time has a de-oxidizing action for both metals, and we have found as most suitable for this purpose, alkali or alkaline compounds, especially potassium nitrite.

The reaction between potassium nitrite and tungsten, which is the example given, is very highly exothermic, once started. This can easily be shown by a very simple experiment. If a cold piece of tungsten is dipped into a fusion of potassium nitrite, the reaction begins slowly, but after a very short time the piece of tungsten becomes red hot. even if no outside heat is applied. The fusion does not freeze, which it would do if the action were endothermic; on the contrary, it becomes even hotter by the reaction.

Referring to the drawings: Figure 1 is an elevation showing a single point or projection for welding the tungsten contact to the iron or steel base. Fig. 2, is a plan view of the supporting tack shown in Fig. 1. Fig. 3, is a side elevation similar to Fig. 1 with a plurality of welding points or projections as shown. Fig. 4, is a plan of the supporting tack shown in Fig. 3. Fig. 5, is a side elevation of the supporting tack and tungsten plate having a multitude of welding projections on the head of the tack. Fig. 6, is a plan view of the supporting tack shown in Fig. 5. Fig. 7, is a side elevation of the supporting tack and tungsten contact plate with powdered tungsten metal therebetween. Fig. 8, is a plan view of the supporting tack shown in Fig. 7, having thereupon powdered tungsten metal. Fig. 9, is a side elevation of the supporting tack and contact plate showing both the welding points and the powdered tungsten metal therebetween. Fig. 10, is a plan view of the supporting tack with both the welding points or projections and the powdered metal tungsten thereupon shown in Fig. 9. Fig. 11, is a sectional view through the center of the supporting tack and contact plate showing a recess in the center of the contact plate and a projection in the upper surface of the tack. Fig. 12, is a plan of the upper surface of the supporting tack shown in Fig. 11. Fig. 13, is a section of a supporting tack and contact plate in a position inverted from that shown in Fig. 11, with powdered tungsten metal shown in the recess. Fig. 14, is a plan of the under surface of the tungsten plate or disk shown in Fig. 13. Fig. 15, is a conventional apparatus used in the carrying out of my process.

In the drawings, similar reference characters indicate like parts.

10 represents the tungsten contact plate or disk, 11 an iron or steel supporting tack or base having a head 12 and a shank 13 depending therefrom; 14 represents welding points and 15 powdered tungsten metal; 16 is a cavity or recess in the tungsten contact plates or disks.

Referring to Fig. 15, 20 represents the upper electrode consisting of a rod of conducting material which is bent in a half circle and positioned in such a way as to come in contact with the center of the lower electrode 22, the two being pressed together by a suitable spring 24 or other suitable means. The upper electrode has a slight recess 21 in its center to hold the tungsten plate or disk 10 and thereby prevent it from sliding sidewise, and the lower electrode also has a slight recess 24 in its center to hold the iron or steel supporting tack in place. Both electrodes are connected in circuit through the terminals 30 which also connect in circuit with a source of power 31 a rheostat 32, a measuring instrument 33 and a switch 34. The lower electrode is slidably mounted upon a fixed rod 40 and is supported in its upper position by a spring 24 situated between the electrode and a collar 41 mounted upon the rod 40 and held in place by a set screw 42 to adjust its position upon the rod.

A represents the main support, B the base, C an adjustable supporting arm, D the bell, and E a tube through which hydrogen is passed into the bell.

We find that while we can carry out our process in the open air, that it is of advantage to carry it out either in a neutral atmosphere or vacuum, or even better, in an atmosphere which has a de-oxidizing action. We find hydrogen of special advantage, which is almost obvious because it helps to keep the two surfaces of the metal plates, which are to be joined together, clean, and prevents them from oxidizing.

We have found, however, that we can carry out our process not only in vacuum or neutral atmosphere, but when using a de-oxidizing chemical, as described above, we have succeeded in making a perfect weld in the open air, an operation which heretofore has never been performed and has been considered impossible. It is of advantage from several points of view to do this. First the operations can be carried out much easier than under the bells or other vessels, as it is necessary when the work is carried out in a neutral atmosphere or vacuum, and second the electric current used can be moderated quite considerably as compared for instance with an atmosphere of hydrogen, which gas has a very high thermal conductivity and carries away a good deal of the heat which is produced by the passage of the current.

To make our invention more clearly

understood and adaptable to persons skilled in the art, we will hereafter describe several ways how it can be performed. For example we shall speak of tungsten as the one metal which will serve as the actual contact making substance, while the tack or carrier in this example will be assumed to be of iron or steel. We wish it clearly understood, however, that instead of tungsten any other high fusible metal can be used, for instance, molybdenum, titanium or others, and instead of steel, another metal easily workable and of suitable physical properties can be used such as nickel, nickel alloys or others. In our example we take for instance, a contact plate or disk of tungsten of a diameter of approximately .13″ and the height of which is .05″.

We have found several different ways to carry out the invention and according to these different ways, the tack to which the tungsten plate or disk will be attached, has to be shaped differently. In the first case, this tack has a small protruding point or projection preferably in the center of the disk. This point is preferably of conical shape and its point is naturally directly over the center of the tack. While welding the point the tungsten plate is brought down on to this point in such a way that its center is touched by the point of the projection. The tack and the tungsten plate in this position are brought between two electrodes which are suitably shaped as herein described. We now pass an electric current through the tack and the projection and the tungsten plate which brings the projection and that portion of the metal of the tack and tungsten plate adjacent thereto to a fusing or welding temperature, and the welding is completed upon compressing the two metals together. The iron or steel projection must be made of sufficient size to furnish enough fused material to fasten the tungsten plate to the tack. Care should be exercised not to make the projection too high, because in that case complete fusion would not take place and the two surfaces could not be pressed tightly together. In the proportionate junction, that is when using a tungsten plate of about 0.139″ diameter and .05″ in height, and a tack, the supporting head of which is of the same height, the height of the iron or steel projection on the tack should be about .1″ and its diameter about .08″.

Instead of using one point in the center of the tack, two or more of these points may be used. The projections should be smaller the larger their number, and it is an advantage to use very many of these points so that the surface of the tack has the appearance of a very rough file or rasp. In the two cases mentioned, the medium which furnishes the high resistance for the current and by its fusing joins and welds the two materials together, is iron or steel. In the third case we use tungsten or other similar material to that of the contact plate or disk. We could produce tungsten plates with a point the same as in the first case or a multitude of points the same as in the second case, but we have found that in some cases instead of fusing these points to the tungsten plate it is practical to use a comparatively smooth tungsten plate, a comparatively smooth steel tack and place between the two some powdered tungsten which provides a multitude of points or projections which create a very high resistance. For such purpose we have selected a coarse grain tungsten powder. When the current is passed through the tungsten plate, powder and tack in an arrangement of this kind, the tungsten powder between the two is fused and unites the two plates into a uniform piece.

It is of great advantage to combine the second and third cases in such a way as to use the steel plate with a multitude of projecting points as described, and place on this plate the tungsten powder as mentioned. We then get a combined action and a uniform combined piece results. We have also found that in some instances it is of advantage to make a recess for the projections to set in. This recess if shaped at a less angle than that of the point has the further advantage to provide two points of contact where the projection is placed. An additional high resistance therefore will exist and consequently a high temperature will result when the current passes which causes the metal to fuse and flow into the recess filling it and causing the best binding in the center of the tack, or at the point where it is most desirable. In the case of a multitude of projections, a multitude of recesses is desirable, and while one of the plates, preferably the iron, has the projections, the other plate, that is the tungsten, should have the recesses. It can, however, be arranged the opposite way, but because of the different physical properties of the metals, the recess is preferably formed in the harder metal namely the tungsten, because it is easier to form a recess than to form a point of suitable length.

We have found it of advantage to use a chemical of the properties described heretofore, for instance, powdered potassium nitrite, which we find to be most suitable for this purpose. The powdered material, in the case of the fixed point or fixed points, is simply strewn on the flat plate, upon which the other plate, which is provided with the projection, is lowered. The moment the current is passed, the projection begins to glow, the chemical around it starts its action, and while developing local heat

through this chemical action, it is cleaning and softening the surfaces, thereby preparing it for the intimate junction which results the moment the metal, which is of high resistance, fuses.

When using tungsten metal powder, we mix the tungsten powder with the potassium nitrite powder and place this mixture between the tungsten plate and iron or steel tack. In the last case, that is when the welding is carried out in the air, we find the use of our chemical very useful. If it is not used, the two plates have a tendency to break apart, although we have succeeded in a good many instances to join them without the use of the chemical.

When working in hydrogen a current of about 1400 amperes is needed to thoroughly weld the two pieces together, in the first case, that is when a single projection is used. When tungsten powder is only used, a current of about 1200 amperes is needed. When in addition to the tungsten powder the chemical is used, it is sufficient to use a current of about 1000 amperes and in the case when the process was carried out in the open air, a current of about 700 amperes is sufficient to cause an intimate junction of the two metallic plates.

What we claim as new and desire to obtain by Letters Patent, is:—

1. The method of making electric contacts of tungsten which consists in securing a tungsten plate to a supporting base by electrically welding with a resistance increasing material between the tungsten plate and the supporting base.

2. The method of making electric contacts of tungsten which consists in securing a tungsten plate to a supporting base by electrical resistance welding with metal powder between the tungsten plate and the supporting base.

3. The method of making electric contacts of tungsten by electrically heating the tungsten contact plate and the supporting back, having powdered tungsten metal between the same.

4. The method of making electric contacts of tungsten by simultaneously treating tungsten and the supporting metal with an exothermically reacting compound and electrically welding the two metals together.

5. The method of making electric contacts of tungsten by simultaneously treating the tungsten and the other metal with potassium nitrite and welding the two metals together.

6. The method of making electric contacts of tungsten by simultaneously treating a tungsten plate and a supporting tack with potassium nitrite and welding the plate and tack together.

7. The method of making electric contacts of tungsten which consists in placing powdered tungsten between the head of the tack and a plate or disk of tungsten metal simultaneously treating the powdered tungsten and the adjacent surfaces of the tack and plate with potassium nitrite and welding the parts together.

8. The method of making electric contacts of tungsten by welding the tungsten contact plate to a supporting back, first strewing between the two, powdered tungsten metal mixed with powdered potassium nitrite.

9. The method of making an electric contact, which consists in preparing two surfaces, one a tungsten face plate and the other a support therefor, placing upon one of said surfaces one or more points of the same character of metal as the surface, pressing the whole together and passing an electric current therethrough.

10. The method of making electric contacts of tungsten by heating the tungsten contact plate and the supporting back, having a mixture of powdered tungsten metal and a powdered alkali between the same, and holding the parts together under pressure.

11. The method of making electric contacts of tungsten by electrically heating the tungsten contact plate and the supporting back, having a mixture of powdered metal tungsten and an alkaline compound between the same, and pressing the one upon the other.

In witness whereof we have hereunto set our hands at the borough of Manhattan, city and State of New York, this 19th day of November, 1914.

ALFRED J. LIEBMANN.
WM. A. MEGRATH.

In presence of—
GEORGE P. SCHOLL,
C. C. BILLINGS.