

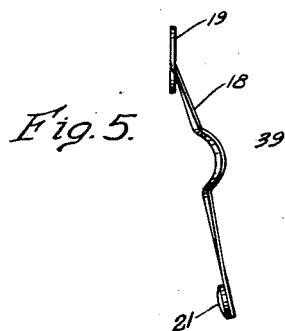
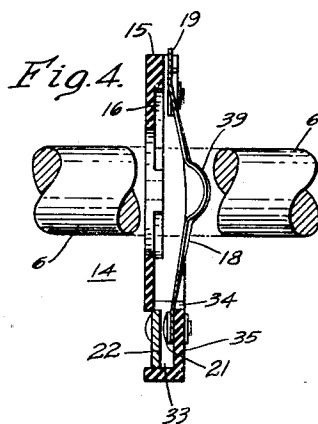
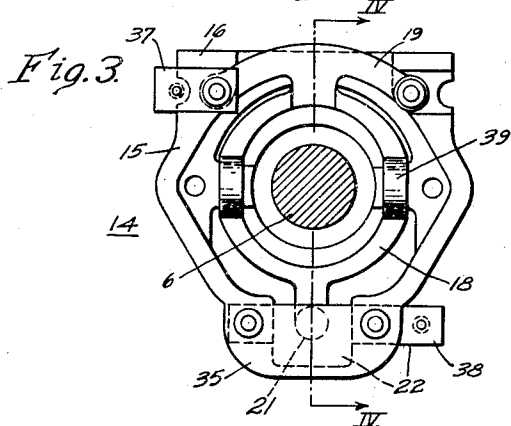
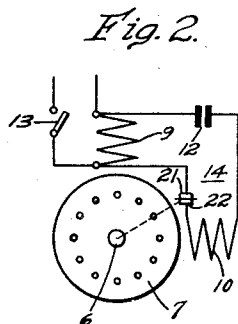
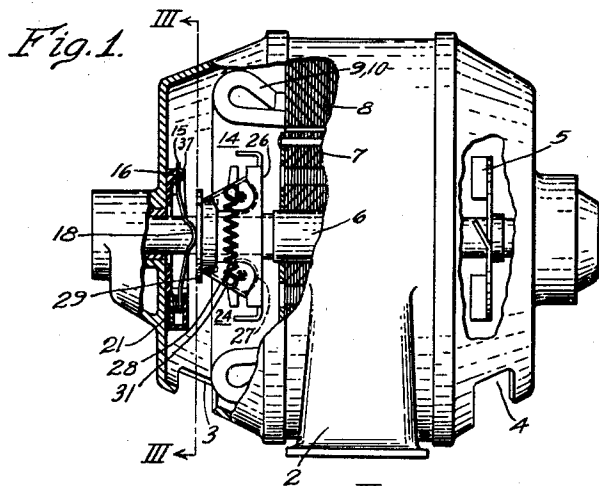
May 5, 1942.

W. SCHAELEHLIN

2,282,249

CENTRIFUGAL DEVICE

Filed March 21, 1939



WITNESSES:

*C. J. Weller.*

*Chas. C. Hoome*

INVENTOR

*Walter Schaelchlin.*

BY

*O. B. Buchanan*

ATTORNEY

## UNITED STATES PATENT OFFICE

2,282,249

## CENTRIFUGAL DEVICE

Walter Schaelchlin, Wilkinsburg, Pa., assignor to  
Westinghouse Electric & Manufacturing Com-  
pany, East Pittsburgh, Pa., a corporation of  
Pennsylvania

Application March 21, 1939, Serial No. 263,220

## 1 Claim. (Cl. 172-279)

My invention relates to centrifugal devices, and it has particular relation to the stationary element, or the electrical contact-mechanism, of a centrifugal switch such as is utilized on a relatively small, ventilated, self-starting, single-phase capacitor-motor.

Centrifugal switches of the class referred to have requirements which, in some senses, are rather exacting, but which, in other senses, are not so exacting. Since quantity-production methods are applied to the manufacture of such switches, the matter of cost is of paramount consideration, attention being paid to even very small fractions of a cent. In many instances, as in refrigerator motors and in many other small-motor applications, the matter of extreme silence of operation is also of paramount importance.

A peculiar characteristic of a capacitor motor, which is a type of motor finding more and more use in small, single-phase motor-applications, is that the centrifugal switch cannot be permitted to reclose its contacts, when the motor is decelerating, until the motor has decelerated to a rather low speed, as otherwise the motor is likely to self-excite itself, as a result of its residual magnetism and the capacitance which is in series with the capacitor-winding, causing the motor to rapidly stop with an objectionable growling noise.

Another requirement of centrifugal switches of the type under consideration is that the same basic parts, for economy in the manufacturing operation, will have to be utilizable over a wide range of speeds, as between 600 and 3600 revolutions per minute, by the simple expedient of changing weights and springs.

An example of such small items of expense is found in the contact points, which have heretofore been silver-to-silver contacts, each silver contact-tip costing in the neighborhood of a half of a cent, and involving a labor-charge of another half of a cent to weld it to the part which carries it. Silver-to-silver contacts have been utilized because this form of contact is the generally accepted form of contact which skilled workers of the art commonly utilize in order to provide good contacts which will stand up in service, with a relatively low contact-resistance-drop. As is well-known, silver, and other metals, particularly metals which are basically silver, have the property of maintaining a good conducting surface, without forming a poorly conducting oxide-coating under the operating-conditions of the mechanism. Such silver-to-silver contacts are objectionably costly, however, and are also subject to some danger of becoming welded together under

severe arcing conditions such as sometimes obtain when the current through the capacitor-winding is interrupted.

On the other hand, contact-tips of most other available materials are unsuitable, for one reason or another. Brass and bronze are notoriously poor contact-materials. Copper is suitable in other places where it is possible to obtain a sufficient wiping-action to remove the nearly non-conducting oxide-film which forms thereon. For small capacitor motors operating on ordinary commercial circuits, such as the 110-volt lighting circuit, there is only a voltage of 100 to 150 volts available across the contact-tips of the switching mechanism, and this voltage is insufficient to break down two copper-oxide films, at least with the rapidity required in the rapid starting of motors. Moreover, the copper-oxide films, even when broken down, have a certain amount of resistance, resulting in relatively high resistance in the switching contact, a feature which is commonly avoided in applications where long life and durability are required.

The result of the foregoing and other considerations is that silver-to-silver contacts have been utilized in the centrifugal switches of capacitor motors, notwithstanding the fact that each small item of expense becomes enormously magnified in the large mass-production methods which are utilized in the manufacture of these mechanisms.

According to one aspect of my present invention, I have discovered that I can obtain improved results, eliminating the danger of the contacts becoming welded to each other, and I can save something like one cent per motor, by utilizing a relatively inexpensive material such as copper or a copper-base metal for one of the contact surfaces, and a silver tip for the other contact surface. It is true that the copper forms a highly insulating oxide coating on itself, but this coating is practically instantaneously broken down at the operating voltages of the order of 100 volts more or less; and it is also true that this copper-oxide film, even when broken down, results in a contact of fairly high resistance, such as would produce serious overheating and burning if it were required to carry the rated current for any considerable length of time. I have found, however, that the starting-time of small capacitor-motors is so very small, ranging from  $\frac{1}{2}$  of a second to an extreme maximum of 5 seconds, that there is insufficient time for the contact to become dangerously overheated before the contact is opened by the operation of the centrifugal mechanism. I have further found that the resistance

of the copper-oxide contact is not deleterious to the performance of the motor, because it is included in the circuit of the capacitor-winding having an impedance which is predominantly capacitive, because of the serially connected capacitor, so that the contact-resistance is added vectorially at right angles to the capacitive impedance, producing a relatively small effect.

A further aspect of my invention relates to another difficulty which has heretofore been experienced in motors which have been equipped with centrifugal switches, including capacitor-motors. This difficulty arises from the fact that, throughout all of the time that the motor is running, with the exception of the very brief starting-period, the centrifugal switch-contacts are open, and the rotation of the motor is causing air-currents to flow over the open contact-points. Most motors of this type are partially enclosed, with air drawn into the frame at the same end as the centrifugal switch, and blown out by a blower which is necessarily placed at the other end of the motor, for lack of sufficient room for both the blower and the centrifugal switch at the same end of the motor, without making the motor-frame larger which is not to be tolerated. Experience has shown that the air-inlet end of the motor-frame becomes coated with grease and dust on the inside of the frame and on all of the exposed parts therein, whereas the other end of the motor remains cleaner because of the removal of the aforesaid grease and dust from the air. In spite of these conditions, the common forms of centrifugal switch-mechanisms which have heretofore been utilized have had open contacts which were exposed to all of the grease and dust, and which were designed to be operative, even under these adverse conditions.

It is an object of my invention to avoid the difficulties just mentioned by the provision of a dead-air pocket in which the contacting parts are placed, so that grease and dust is not carried to the make-and-break surfaces of the contact members.

With the foregoing and other objects in view, my invention relates to the parts, structures and combinations hereinafter described and claimed, and illustrated in the accompanying drawing, wherein:

Figure 1 is a longitudinal cross-sectional view through a capacitor-motor embodying my invention,

Fig. 2 is a diagrammatic view illustrating the electric circuit connections of the motor,

Fig. 3 is an end elevational view of an electrical contact-mechanism constituting the stationary part of a centrifugal switch in accordance with my invention, the section plane being indicated by the line III—III in Fig. 1,

Fig. 4 is a vertical cross sectional view of the switch-element or contact-mechanism shown in Fig. 3, the section plane being indicated by the line IV—IV in Fig. 3, and

Fig. 5 is a side elevation of the spring element of the contact-mechanism.

Fig. 1 shows a typical single-phase capacitor-motor embodying my invention. The motor is provided with a frame 2 having an air-inlet opening 3 at one end and an air-outlet opening 4 at the other end, the circulation of air for ventilating purposes being produced by a blower 5 mounted on the motor-shaft 6 adjacent to the air-outlet 4. A rotor-member 7, usually of the squirrel-cage type, is centrally disposed on the motor-shaft 6, in cooperative relation to a stator-mem-

ber 8 carrying main and auxiliary windings 9 and 10.

As indicated in Fig. 2, the main and auxiliary windings 9 and 10 are spatially displaced from each other, usually by 90 electrical degrees, and the auxiliary winding 10 is utilized as a capacitor winding in series with a capacitor 12.

The starting and stopping of the motor is usually controlled by a manually-operated starting-switch 13.

Referring again to Fig. 1, it will be seen that a centrifugal switch 14 is disposed within the motor frame, surrounding the motor-shaft 6, at the end of the motor adjacent to the air-inlet opening 3. The stationary part of the centrifugal switch 14 is an electrical contact-mechanism 15 essentially comprising a flat housing 16 which is stationarily mounted within the motor-frame 2 in a position surrounding the motor-shaft 6 out of contact therewith and at approximately right angles thereto, said stationary housing carrying a sheet-metal spring-member 18 which also surrounds the shaft without touching the same. The spring member 18 is secured, at its upper end 19, to the supporting housing 16, and at its lower end it carries a contact-tip 21 on the surface facing the supporting housing 16. The resiliency of the spring member 18 is such as to normally hold the contact-tip 21 away from the back of the housing 16, and the housing is provided, at this point, with a stationary contact member 22.

As indicated in Fig. 2, the electrical contact-members 21 and 22 of the centrifugal switch 14 are connected in series in the circuit of the capacitor winding 10 and the capacitor 12.

The rotor member of the centrifugal switch 14 is in the centrifugal device proper, which is designated by the numeral 24. Essentially, this rotor member of the centrifugal device comprises a flat guide-member 26 which is fixed to the motor-shaft 6 at approximately right angles thereto, supporting the inwardly and outwardly moving weight-members 27 which are linked, through finger-members 28, to a slider-member 29 which is slidably mounted on the motor-shaft 6. The finger-members 28 are normally drawn together, toward the shaft, by springs 31, as illustrated, in the stand-still position of the parts which is shown in Fig. 1. In this position of the parts, the slider-member 29 is pushed away from the guide-member 26, so that it engages the contact spring-member 18 of the contact-member 15, resulting in the closure of the electrical contact 21—22, so that the motor is in a condition ready to be started.

The contact-mechanism 15, which is the so-called stationary part of the centrifugal switch 14, constitutes the special subject of my present invention. One of the novel features consists in the provision of a housing or dead-air space 33 for enclosing the contact make-and-break members 21 and 22. This housing or dead-air space is provided by means of a side wall 34 and a spaced front wall 35, both of which are illustrated as being integral with each other and with the rest of the contact-housing 16, although other designs might obviously be used.

It will be noted, from Fig. 1, that the contact-mechanism 15 is placed within the motor frame at a point quite close to the air-inlet 3, as previously pointed out. Heretofore, the contacting portions proper, corresponding to my elements 21 and 22, have been entirely exposed, reliance being placed upon the air-blast action to blow the contacts clean, or else a sufficient contact-

closing pressure being utilized to, theoretically at least, force the contacts closed in spite of dirt thereon. By the simple expedient of providing a small inexpensive pocket or dead-air space 33, I have at one stroke overcome one of the serious handicaps which have been at the root of many centrifugal-switch troubles for quite a number of years.

A second feature of my invention relates to the choice of the materials of the contact make-and-break members 21 and 22. As previously intimated, the form of construction which was standard prior to my invention has been to utilize a silver tip on each of the members, so as to provide a silver-to-silver contact which is unquestionably good, particularly in its low contact-resistance, being subject, however, to some slight difficulty in regard to an occasional welding of the silver-to-silver contacts as a result of arcing conditions under heavy-current duty.

In accordance with my invention, as previously explained, I utilize contacting surfaces which are of dissimilar metals, so that the welding tendencies are effectively avoided. I prefer that one of the contacting metals shall be a metal such as silver or a metal which is basically silver, or other metal which does not form a poorly conducting oxide-coating under the operating-conditions of the mechanism. I prefer to utilize, as the other contacting metal, a much less costly metal, which may be one of a type which forms a poorly conducting-oxide coating, and which is preferably copper or a metal with a copper base, by which term I do not mean to include brass or bronze. Since the contacting spring 18 is necessarily of thin-gage material, usually steel, it is usually necessary to have some sort of thickened tip 21 thereon, at the point where the contact is made and broken, in order to provide enough metal to stand some pitting or wearing away, without material harm to the operation. I prefer, therefore, since it is necessary to go to the expense of adding some sort of tip 21 to the movable spring-contact members 18, to make this tip 21 the the silver tip, or its equivalent, and to make the other contact-member 22 out of the less-expensive material such as copper.

Among the advantages of the silver-to-copper contact, I may mention reducing the cost, which is important in devices where mass-production methods are employed, and securing non-welding properties and a contact-resistance which,

while somewhat high, is nevertheless quite unobjectionable because of the out-of-phase relation of the capacitive impedance, and because of the extremely short starting-time which is too short a time for overheated-switch difficulties to be developed.

In centrifugal switches for motors of the small ratings, it is quite feasible to let the switch-current pass through the switch-spring member 18, as shown in Fig. 3, wherein one of the switch-terminals is secured to the fixed upper end-portion 19 of the spring member 18, as indicated at 37, whereas the other switch-terminal is secured to the stationary contact-member 22, as indicated at 38.

As indicated in Fig. 4, the intermedoate portions of the spring-member 18, where said spring-member straddles the motor shaft 6, are preferably bowed outwardly in a hump 39, as is well known in the art, for the purpose of engaging the centrifugal member proper, or the slider member 28 of the centrifugal rotor-device 24.

While I have described my invention in a single preferred form of embodiment, it will be obvious that many changes by way of substitutions, additions or omissions may be made by those skilled in the art without sacrificing all of the essential features of the invention. I desire, therefore, that the appended claim shall be accorded the broadest construction consistent with its language and the prior art.

I claim as my invention:

The combination, with a relatively small, single-phase, approximately 110-volt motor of a type having an intermittent-duty, controlled circuit which has a highly reactive impedance and which is energized for only a very brief time at intermittent intervals, being deenergized at all other times, of an electrical contact-mechanism connected and operated so as to effect the aforesaid control over said intermittent-duty, controlled circuit, characterized by said electrical contact-mechanism having cooperating, substantially ineffectively wiping, contact-making parts of dissimilar materials, one of said contact-making parts being a metallic member which has a copper base, and the other contact-making part being a metallic member which is basically silver.

WALTER SCHAELEHLIN.