cause due to the high cost of krypton relatively small bulbs must be used for krypton lamps, so that they become blacker than is the case with the corresponding argon lamps. In agreement with this we found that the lamps on the market with krypton filling and coiled coil, compared with our corresponding coiled-coil argon lamps of the same luminous flux, exhibited an improvement of 3 per cent in the efficiency throughout life. To what degree it is in general justifiable to realize this improvement, considering the cost of the krypton filling, is an economic problem which we shall not discuss here.

In general that development will be preferable by which a technical advance can be attained without an intolerable increase in production costs, and with which, moreover, the new lamp can replace the existing type almost completely. A further requirement of the general utility of a new technical improvement is that it shall not have a retarding action on later possibilities of development. The coiled-coil lamp filled with argon and in normal dimensions satisfies these conditions. In recent years it has gained an absolutely dominating position with the result that the former lamp with single coil has practically become obsolete while it leaves the path open for further improvements in the future.

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**ON THE CONSTRUCTION OF VIBRATORS FOR RADIO SETS**

by J. KUPERUS.

A description has already been given in this periodical of a vibrator which serves for the connection of an A.C. receiving set to the D.C. mains. The study of these problems has led to the development of a new type of vibrator which is described.

Several problems are discussed, which are connected with the construction of vibrators for the connection of an A.C. receiving set to the D.C. mains. The study of these problems has led to the development of a new type of vibrator which is described.

A description has already been given in this periodical of a vibrator which serves for the connection of A.C. receiving sets to a D.C. main. In this article we shall discuss a number of problems connected with the construction of such vibrators and describe a new type of vibrator in which various improvements are incorporated.

A current thus flows through the primary winding of the transformer which continually changes its direction, so that in the secondary winding an A.C. voltage is induced whose magnitude depends upon the voltage of the D.C. mains, among other factors, and on the ratio of the number of windings of primary and secondary coils of the transformer.

Due to the self-induction of the transformer and the magnet coil, with connections like those of fig. 1, a high voltage would occur between the points of

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contact each time a contact was broken. The sparks thus caused would considerably diminish the life of the contacts. Because of this the contacts are shunted with condensers.

**Fig. 2. New construction of the vibrator.**

- **a** = magnet coil,
- **b** = armature,
- **c** = stop for the spring D (see fig. 5),
- **d** = contact for switching the current into the magnet coil,
- **e** = contact for changing the direction of the current in the external circuit,
- **f**, **g**, and **h** may be compared with 1, 2 and 3 in fig. 7.

In order to prevent the penetration into the mains or into the receiving set of the high-frequency oscillations which occur due to the sudden current variations in the vibrator, the connection to the mains as well as to the receiving set is via filters. The complete vibrator thus consists of two parts, namely:

1. the vibrator proper
2. the coil and condensers for the filters and shunts across the contacts, built together as a compact unit. This part will be called the anti-interference part.

Both parts are housed together in an acoustically and electrically shielding container.

**Fig. 2** shows a new construction of the vibrator.

We shall now discuss several problems whose solution led to the construction illustrated in this figure.

**The attachment of the vibrator to the anti-interference part**

Since the vibrator contains moving parts, if it were rigidly fastened to the other parts the latter, including the container, would also be set vibrating. The result would be that sound vibrations would be transmitted to the surrounding air. In order to prevent this, the attachment of the vibrator to the anti-interference part is made in such a way that no vibration is transmitted to the anti-interference part upon vibration of the springs. In order to illustrate this method of fastening, the centres of gravity of certain parts of the vibrator are indicated in fig. 3a. **A** is the centre of gravity of the whole vibrator. Since with the method of fastening to be described no external forces act upon the vibrator due to the motion executed by the latter, the centre of gravity **A** will not change its position during this motion. **B** indicates the centre of gravity of the moving parts (armature and springs) while **C** represents the centre of gravity of the remainder of the vibrator. This remainder consists of the electromagnet with coil (centre of gravity **D**), the frame and the attachment of the springs (centre of gravity **E**). If **B** moves in a certain direction as a result of a deviation of the armature and the springs, then, since **A** remains stationary, **C** will move in the opposite direction. In fig. 3b this motion of the centres of gravity is represented. Since the part whose centre of gravity is formed by **B** does not execute a pure translation, but a movement which may in general be described as a translation.

**Fig. 3.**

- **a)** Position of the centres of gravity of different parts of the vibrator.
- **b)** Relative displacement of these centres of gravity.
  - **A** = centre of gravity of the whole,
  - **B** = centre of gravity of armature + springs;
  - **C** = centre of gravity of **D** + **E**; where
  - **D** = centre of gravity of electromagnet with coil,
  - **E** = centre of gravity of frame + attachment of springs,
  - **F** = point of attachment of the vibrator to the anti-interference part.
of the centre of gravity $B$ and a rotation around the centre of gravity, the motion of the rest will also possess this general character, in which the rotation as well as the translation is in the opposite direction. This combined movement of the rest can be described as pure rotation around the point $F$ in fig. 3b. This point therefore does not change its position in the movement executed by the vibrator.

In the new construction of the vibrator the attachment of the vibrator to the anti-interference part takes place exclusively in the neighbourhood of point $F$, so that the motion of the vibrator can no longer be transmitted to the rest of the apparatus.

Since this fastening is flexible, upon fairly rough treatment in the transport of the vibrator it may easily be damaged. To prevent this the vibrator proper is so constructed that it can be fastened to the anti-interference part by means of a base which shows some similarity with a valve holder. The vibrator can therefore be taken out of the apparatus for transport and packed separately.

**Improved construction of the contact for sending the current through the magnet coil**

In older types of vibrators the contact $K$ is always so constructed that the stop for the spring $A$ (see fig. 1) also serves as contact point. While this gives simplicity of construction, the objections involved in this system have, nevertheless, led to an alteration.

In fig. 4 the older construction here referred to is shown diagrammatically. The fixed stop $C$ thus serves at the same time as contact point, and together with $D$ forms the contact $K$ of fig. 1. A clear insight into the objection to this construction is obtained by a comparison with a hammer which strikes a heavy anvil. After the first contact with the anvil the hammer will rebound and again fall on the anvil, and the process will be repeated several times until the hammer comes to rest. The same thing occurs in a construction like that of fig. 4; before the contact between $C$ and $D$ is "definitely" made it is broken several times by the rebound of $D$. The result is that the current through the magnet coil is interrupted a great many times more than is necessary, which has an unfavourable effect on the life of the contact.

The principle of the improved construction is sketched in fig. 5. $C$ is here again the stop for the spring $D$. Now, however, the spring $D$ is not driven by the electromagnet but by the spring $E$ to which the fork-shaped part $F$ is fastened. The contact $K$ is formed between this fork-shaped part and the spring $D$. The contact is closed when the spring $E$ and thus also $F$ moves upward, i.e. when $D$ does not touch $C$. This construction may be compared with a hammer which strikes against an easily movable object; no rebound of the hammer takes place. The dying out of the vibration of the contact is thus prevented by this construction and a much longer life of the contact is obtained.

**Improved construction of the contacts $K_{11}, K_{22}$**

In the case of the contacts which serve for the continual alternation of the direction of the current also (fig. 1: $K_{11}, K_{22}$) the above-mentioned undesired damped vibration often occurs. The principle of the method by which this phenomenon has been combated in these contacts is most clearly demonstrated by a comparison with billiard balls. If the ball 1 in fig. 6, moving in the direction of the arrow, strikes the stationary balls 2 and 3, 1 and 2 remain motionless or move together over a short distance, and the contact between 1 and 2 is not broken. The spring 3 moves away from 2 but this causes no breaking of the contact.

Fig. 6. When ball 2 is struck by ball 1, 1 and 2 remain stationary, while 3 rolls away alone.
Fig. 7. By the action of the spring 3 the contact between
1 and 2, when once made, is prevented from being broken
several times by the damped vibration. The distance between
the contacts is exaggerated in this figure.

Limitation of the current

During ordinary use the vibrator takes up a
current from the D.C. mains which is given by the
load on the A.C. end. Under certain circumstances,
however, this current may temporarily assume a
much too high value. This may take place for
example when a small particle of metal has fallen
between one of the contacts $K_{11}-K_{22}$. Since the
distance between the contact surfaces in the open
state is only 0.2 mm, a very small conducting
particle is enough to cause one of the contacts to
remain closed. The primary winding of the mains
transformer of the radio set is then connected to
the D.C. mains for too long a time and the current
takes on too high a value. In order to prevent
injury to the vibrator or the mains transformer,
a fuse is included in the connection between the
two. Since a defect of the nature described is
generally of a temporary nature, the melting of
this fuse is often not desired. For this reason a
maximum relay is included in the vibrator which
interrupts the connection with the contacts $K_{11}-K_{22}$
upon the occurrence of too large a current impulse.
The vibrator continues to function, but an un-
necessary melting of the fuse has been prevented.
Upon switching on the apparatus also a large cur-
rent surge may occur, whereupon the maximum
relay also goes into action.

Three coils are connected to the maximum
relay, indicated by $S_1$, $S_2$ and $S_3$ in fig. 8 in which
the diagram of the complete vibrator is drawn (for

Fig. 8. Complete diagram of the connections of the vibrator. The vibrator proper and the
anti-interference part are each placed in a separate shielded compartment, indicated by I
and II, respectively. Outside of these are the maximum relay and an arrangement for
switching over the vibrator for D.C. mains with different voltages. Around this whole
the second shielding, already referred to, is placed. The vibrator can be connected to D.C.
mains with a voltage of 220 volts as well as to those of 110 volts. For switching from 220 V
to 110 V, three components must be changed:
1) A resistance in series with the magnet coil ($R_2$, $R_3$). At the low mains voltage the
resistance $R_3$ is short-circuited.
2) The maximum relay. Since the vibrator takes up a larger current at a lower mains
voltage, the maximum relay must come into action at a higher current value. This
is achieved by connecting the coil $S_2$ at the low mains voltage, which coil is wound in an
opposite direction to $S_1$.
3) The resistance which is connected in series with the vibrator. Upon use of a low mains
voltage the resistance $R_1$ is connected in parallel with $R_4$.
The commutation arrangement is indicated by the double switch $S$. Actually this is a
contact block on the outside of the vibrator, which only needs to be reversed for switching
over to the other mains voltage.
the significance of $S_1$ and $S_2$ see the text under the figure). When the current exceeds a certain maximum the contact $K_1$ is broken. This contact is also shunted by a condenser as may be seen in the diagram. In order to limit possible current surges a small resistance $R_4$ is connected in series with the whole. This resistance is situated in the connection of the vibrator leading to the radio set.

**Complete shielding**

It is always very difficult to house an apparatus in which the heat development is fairly high in an entirely closed shielding container. This is, however, very desirable for the vibrator, in connection with the great interference which it may otherwise cause in the radio reception. We have succeeded in keeping the energy loss which occurs in the vibrator so low that the apparatus could be placed in a completely closed container, thus even without ventilation holes. In order to obtain the greatest possible security from interference the shielding is double. The energy loss was kept small, and thus the heat development also, by making the moving parts (springs and armature) as small as possible. By this means a small current, namely only 20 mA, in the coil of the electromagnet $M$ is sufficient to keep the vibrator in motion.

Keeping the energy loss small is of course also an advantage from the point of view of efficiency. In the case of this vibrator the efficiency amounts to about 90 per cent.

Finally in fig. 9 the complete vibrator is shown. The double shielding of the vibrator proper has here been removed in order to show the main parts more clearly.

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Fig. 9. The complete vibrator. Left, anti-interference part, right vibrator. Behind, slid partially into one another, are two cans with which the vibrator is doubly shielded.
ABSTRACTS OF RECENT SCIENTIFIC PUBLICATIONS OF THE
N.V. PHILIPS' GLOEILAMPENFABRIEKEN

An adequate number of reprints for the purpose of distribution is not available of those publications marked with an asterisk. Reprints of other publications may be obtained on application to the Natuurkundig Laboratorium, N.V. Philips' Gloeilampenfabrieken, Eindhoven (Holland), Kastanjelaan.


In this article a commonly neglected error in measurement is discussed which occurs in ferromagnetic measurements on bars or wires of magnetically soft material. In this case the external magnetic field is practically completely compensated by the demagnetizing field. If the external field is now changed so rapidly that the field in the interior of the bar can only follow with a large time lag due to eddy currents, the demagnetizing factor is temporarily very much reduced. This results in the fact that the interior of the rod is much too strongly magnetized for a short time. When the final state is once reached the inner part of the bar is thus on the descending branch of the magnetization curve instead of on the mounting branch. The area of the hysteresis curve thus appears smaller than it actually is. The coercive force measured is also too small. These errors in measurement occur when the time constant of the external field is small compared with the time constant of the material. The magnitude of the error in the change in induction observed also depends upon the ratio of the field change to the accompanying change in the demagnetization field. The error therefore does not occur in ring-shaped test pieces which have no poles. The shape and the magnetic properties of the material further determine the maximum error which can occur. With materials with not too small a coercive force the occurrence of this error need not be feared very much, since in this case the time constant of the external field will usually be much larger than that of the material.


The modulus of elasticity and the modulus of torsion are determined for polycrystalline molybdenum and for strips which have been cut with a chisel in different directions out of rolled plates of molybdenum, which clearly show a texture. The different elastic constants of molybdenum can now be calculated from these measurements and the compressibility determined by Bridgman. Molybdenum is the first metal for which it has been determined that the modulus of elasticity in the direction of the main diagonal is smaller than that along the edges of the elementary cube of the crystal.


This book is published as volume III, part II of the Handbuch der Metallphysik and offered the writer the opportunity of presenting his extensive knowledge of the subject of recrystallization in a comprehensive way. After an introduction in which, among other features, a nomenclature for the different phenomena of recrystallization is given and the methods of investigating them are dealt with, follow chapters on recrystallization in unworked substances, on the cold-worked state and its recrystallization. Furthermore the recrystallization temperature and the duration of recrystallization are discussed, as well as the influence of impurities and alloy components on the recrystallization of purer metals. In conclusion the significance is discussed of recrystallization on stiffening and plasticity.


In this lecture given before the Netherlands Radio Society (Nov. 1940) a survey was given of the noise phenomena which have in general already been dealt with in detail in the different articles devoted to "noise" in Philips techn. Rev. Equivalent circuit diagrams and a short derivation are given which constitute a considerable simplification in the treatment of noise phenomena.

1549: B. D. H. Tellegen: Meetkundige configuraties en dualiteit van elektrische netwerken (Geometrical configurations and duality...
This lecture given before the Netherlands Radio Society (Nov. 1940) is an elaboration of the article contributed by the author to Philips-techn. Rev., 5, 324, 1940. He took the opportunity of going somewhat more deeply into the proofs of the theorems dealt with and of illustrating them by means of a few examples.


The mutation-causing effect of different kinds of radiation is investigated as a function of the dosage and other external conditions. It is found that there is no question of a specific action of certain kinds of radiation, but that mutations occur when sufficient energy is transferred to a certain sensitive part of a gene. It is not possible to excite definite desired mutations in this way, but there is a good chance of encountering useful mutations among the many less vigorous ones which are obtained with a sufficiently intense radiation, so that in addition to theoretical significance for the general study of heredity, this method will also certainly have practical significance for the improvement of plants and animals.


The large fluctuations which occur in the development of artificially produced rickets in large numbers of rats, which are needed for instance for the standardization of vitamin D preparations, are ascribed by various investigators to the variability of different external factors. Even though great care is taken to secure constancy of the rachitogenic diet fed to the rats, the large fluctuations in the development of the rickets continue to occur. Dois and Jansen ascribed this to variations in the content of radium emanation in the air with the season of the year. By keeping different rats under otherwise similar conditions in cages with different contents of radium emanation the author has shown that this content has no effect on the development of experimental rickets in rats.