572

Patents Form—No. 1. 5730 **No Charge for the Form.**

ONE POUND OFFICE 21 2 34

PATENTS & DESIGNS ACTS, 1907 to 1932.

(To be accompanied by two copies of Patents Form No. 2 or of Patents Form No. 3.)

APPLICATION FOR PATENT.

(a) Here insert (*in full*) name, address, and nationality of applicant or applicants (including the actual inventor).

(a) I (or We) Leo Szilard, citizen of Germany and subject of Hungary, 6 Halliwick Rd Muswell Hill, London N.10. ~~and Strand Palace Hotel, Strand, London~~ do hereby

5730

21 FEB 1934

declare that I am (or we are) in possession of an invention the title of which is (b) Asynchronous and Synchronous Transformers for Particles

(b) Here insert title of invention.

that (c) I (Leo Szilard)

(c) State here who is or are the inventor or inventors.

claime to be the true and first inventor......thereof, and that the same is not in use by any other person or persons to the best of my (or our) knowledge and belief; and I ~~(or we)~~ humbly pray that a Patent may be granted to me ~~(or us)~~ for the said invention.

Dated the 20 day of February, 1934

(d) Leo Szilard

(d) To be signed by applicant or applicants and, in the case of a Firm, by each partner.

NOTE.—One of the two forms on the back hereof, or a separate authorisation of agent, should be signed by the applicant or applicants.

To the Comptroller,
The Patent Office, 25, Southampton Buildings,
Chancery Lane, London, W.C.2.

(Y9430) Wt 13359/4327 30,000(2) 7/33 H & Sp Gp 102

over

(1) *Where application is made through a Solicitor, Patent Agent, or other authorised representative.*

I (or We) hereby appoint..

of ....

to act for me (or us) in respect of the within application for a Patent, and request that all notices, requisitions, and communications relating thereto may be sent to him (or them) at the above address.

Dated the..................day of.., 193 ....

* To be signed by applicant or applicants.

* ....

....

....

....

(2) *Where application is made without an Agent* (*Rule* 7).

I (or We) hereby request that all notices, requisitions, and communications in respect of the within application may be sent to

Miss Simpson 6. Halliwick Rd Muswell Hill at* London N.10.

* The address must be in the United Kingdom.

....

Dated the 20 day of February, 1934

† Leo Szilard

† To be signed by applicant or applicants.

....

....

....

Asynchronous and Synchronous Transformers for Particles.

The invention concerns methods and apparatus for the production of fast charged particles, e.g. electrons or protons. All these methods, described below, are based on multiple acceleration, i.e. the velocity of the particle is exceeding the maximum voltage which arises between any two parts of the apparatus. We shall have to deal with two different methods - the method of the asynchronous transformer, and the method of the synchronous transformer. In the first case we shall deal with single action and multiple action transformers, and we shall start by dealing with the asynchronous transformer method which is based on the acceleration of a charged particle in the electric field induced around the changing magnetic flux.

Fig. 1 shows the principle of a method in which a magnetic flux is produced in an iron core 1, and the flux is rapidly changing its magnitude. This flux is produced through the coil 2, this coil being built so as to consist of one or two windings only, and a rapidly changing electric current being sent through the coil 2. If an electron encircles in its path several times the iron core while the flux in the core is changing its value the energy of the electron will increase at each revolution. The value of this increase in energy is determined by the voltage induced by the changing flux in a single winding round the core. In order to compel the electron to encircle the core 1 a magnetic field 3 can be sustained round this core which will bend the path of the electron round it. If one uses a stationary field for this purpose one has the advantage of being able to build up the magnet 4 out of thick sheets or a block and is not compelled to use thin sheets. Another advantage of a stationary field is the lowxx voltage which can be used in generating the field. The field ~~xxxxx~~ 3 is generated by means of the coils 5 and 6. SIC. SIC.

However, if one uses a stationary magnetic field as described in figure 1 the radius of curvature of the path of the electron necessarily increases as the momentum of the electron increases, For instance if the momentum of the electron increases in the ratio 1 to 10 this radius also increases in the ratio 1 to 10. It is not possible to remedy this disadvantage ~~by~~ using a field the strength of which increases with increasing r. Such a field would render the plane of the revolving electron unstable. Fig. 2 will show what remedy can be employed to prevent a large increase in radius.

The maxiumu energy which can be transmitted to the revolving electron with this arrangement is only determined by the maximum value of the induction in the core, the cross section of the core and (for large energies where the velocity of the electron approaches the velocity of light) the mean circumference of the path of the revolving electron. It is therefore important to keep this circumference as small as possible and an increase of the radius of the path of the revolving electron ought therefore to be avoided.

Fig. 2 shows a magnet system which will bring about a slight variation of the radius only, when the momentum of the electron increases. In this magnetic field the revolving electron emerges intermittently from a strong field into a gap in which the field is weaker or nil and enters again into the next section of the strong field. 10 is the centre of the arrangement. 11 and 12 are poles of magnets which generate a magnetic field perpendicular to the surface of the pole (and perpendicular to the plane of the diagram). The angles α 11, α 12 and α 10 are equal, and the adjacent sides of the magnets 11 and 12 are parallel. There are further magnets not shown in the diagram, which form together a symmetrical figure round the centre 10; this is indicated in Fig. 2b. An electron of a given momentum will encircle the centre 10 at a definite distance r from the centre in such a way that the path enters at right angles the left side of the magnet 11 , is bent round in the field of the magnet 11 by the angle α, leaves the other side of the magnet 11 at right angles, goes through the gap 30, enters at right angles the left side of the magnet 12, is bent round by the angle α in the magnetic field of the magnet 12, and leaves the right side of the magnet 12 at right angles again, and so on. 13 is a coil energised by an electric current, that generates a magnetic field across the air gaps of the individual magnets 11, 12 and so on. One coil 13 can serve several magnets, but the coil must not surround the iron core 1. In most cases it will have advantages to use at least two coils (1 coil for each half of the magnet system.)

If a practically uniform magnetic field were to be used in the gaps of the individual magnets 11, 12 and so on, the radius r of the electron path would only vary slightly with increasing momentum of the electron i.e. according to the equation $\frac{r_2 - R}{r_1 - R} = \frac{p_2}{p_1}$

In this equation R is the radius of the ~~circle/circular path~~ circle SIC. having its centre at point 10, at the periphery of which circle the corners of the magnets 11, 12 etc. are arranged. p_1 and p_2 represent the momentum of the electron at the beginning and at the end ($p = \frac{mv}{\sqrt{1 - v^2/c^2}}$). In practice instead of a uniform magnetic field one will use a field, the strength of which will slightly decrease with increasing r, and therefore, a slightly modified equation will be used.

Fig. 3 shows the magnet 11. 15 is the air gap across which a stationary magnetic field is maintained by means of the coil 13. This coil 13 is formed by an upper coil 16 and a lower coil 17, leaving the neighbourhood of the plane of symmetry AB in which the electron revolves unobstructed, thereby leaving a free space for the path of the electron emerging from the magnet system at the end of the accelerating process.

The magnetic field in the area 15 is not uniform, but decreases with increasing r. Such a field stabilises the path of the electron in the neighbourhood of the plane of symmetry AB. In order to indicate such a decreasing field the width of the area 15 is shown to be increasing with increasing r in Fig. 3.

45 indicates a glowing filament that may be used as a source of electrons, the electrons ejected by the filaments to be accelerated subsequently in the magnet system.

The outer part of the air gap indicated by the number 18 shows a rapidly increasing width of the gap with increasing r in such a way that the magnetic field across the gap should decrease in this area stronger than $\frac{1}{r-R}$. The purpose of this is to draw the circular path of the electron into a spiral, thereby making it easier to lead the electron beam at a definite spot out of the magnet system, An electric condensor 19 or other suitable means may serve for the purpose. This will be more fully explained with the help of Fig. 5.

The path of the electron in the space 20 between the metal plates 21 and 22 is protected from xx the electric field induced by the changing flux in the core. Therefore the electron is only accelerated when emerging from between the plates 21 and 22, and about to enter the space between two similar plates 23 and 24. This is shown in Fig. 4.

In Fig. 4 one half of the circular path 27 of the electron lies between the metal plates 21 and 22, and the other half between the metal plates 23 and 24. All these plates constitute equipotential surfaces and the electron is accelerated by a strong electric field in the gaps 28 and 29 between the two pairs of plates 21/22 and 23/24. This electric field is induced by a changing flux in the transformer core 26. This core is laminated as shown in Fig. 4a, and the two pairs of plates are both connected to the middle sheet of the core. The electric lines of force generated between the two pairs of plates are shown in Fig. 4b. Such a field has the effect that any electron which has deviated out of the plane of symmetry AB is bent back towards that plane so that the path of the electron is stabilised in the neighbourhood of that plane.

In Fig. 6. the effect of a strongly decreasing magnetic field at the outer edge of the system is described. Between the two circles 30 and 31 the magnetic field decreasing stronger than $\frac{1}{\rho}$ whereas within the circle 30 the magnetic field, though it may decrease with increasing ρ it does not decrease as strongly as that. The path of the electron within the circle 30 deviates from a closed circular path round the centre 10 only insofar as the electron is accelerated by the electric field which leads to a steady increase of the radius of curvature of the path. However, as the electron passes beyond the circle 30 and enters into the region between the circles 30 and 31 no closed circular path is any longer possible, and the path of the electron will be drawn out into a spiral 32, as shown in Fig. 6. Accordingly it is possible to have an electric condensor built of a thin plate 33 and another plate 34 and compel thereby the electron to leave the magnet system at a definite spot after passing through this condensor, without losing most of the electrons through collisions with the condensor plate 33. If the path 32 of the electron 32 were not drawn out into a spiral by means of the strongly decreasing magnetic field in the region between the circles 30 and 31 many electrons would get lost by striking the plate 33. Even if the path is drawn out into a spiral the plate 33 must be thin or else a large number of electrons get lost by striking the plate. Of course the electric acceleration of the electron has also the effect of drawing out the path into a spiral and this effect can in certain cases be sufficient in itself i.e. if the voltage induced by the changing flux of the core 26 is extremely large. Fig. 6b shows a cross section of the magnet 36 indicating an increasing width of the gap with increasing ρ; increasing strongly between the circles 30 and 31.

Fig. 7 shows another feature of the same type of magnetic field. If a multiple action transformer is to be used, as will be described later on, it is essential to bring the electron from the periphery into the magnet system, and keep it within the magnet system for many revolutions during which it is accelerated by electric fields. The magnet system in Fig. 6 and 7 on the one hand differs from the magnet system in Fig. 3 on the other hand insofar as the electric coils 40 and 41 and the magnet cores 42 and 43 are inside the magnet gap area in Fig. 6 and 7 and not outside of that area as in Fig. 3.

Fig. 7 also shows the metal plates 21 and 23, and the gaps 28 and 29 between the pairs of plates 21/22 and 23/24 as described in Fig. 4. If an electron is shot into the air gap of the magnet system from the periphery it is drawn into the magnet field as indicated by the curved path 44. However, the electron would leave the magnet system again if it were not for the accelerating action of the electric field in the gaps 28 and 29. This accelerating action will have the effect of bringing the path of the electron to approximate a circle having its centre near point 10. This circle will, according to the initial energy of the electron, be situated within the circle 30. As the energy of the electron gradually increases owing to the electric acceleration, the radius of the path gradually increases and the electron emerges from within the circle 30, as described previously in Fig. 6a.

In Fig. 8 another aspect of the arrangement is described. It is necessary that the path of the electron within the magnet system should lie in vacuum and a simple method of achieving this is shown in Fig. 8. Fig. 8a shows a flat metal box (a flat tube) composed of two pieces 50 and 51 which are joined, having a piece of insulating material 52 and 53 at each of the two junctures. An unobstructed annular space 54 is formed within the box, and the box is evacuated. The top wall of the ~~fat~~ flat box or tube 50 corresponds to the metal plate 21 and the bottom of it corresponds to the metal plate 22 in Fig. 4.

The top wall of the flat box or tube 51 corresponds to 23, and the bottom wall of it corresponds to 24 in Fig. 4. Fig. 8b shows that the magnet system also consists of two insulated halves 55 and 56, and this is indicated by electric lines of force being drawn in the gap 57 between the halves 55 and 56.

If an alternating magnetic flux within an iron core is used as described in Fig. 1 for the acceleration of electrons, and one wishes to increase the total energy transmitted to the electron one has to increase the cross section of the iron core. However, if the cross section is multiplied by four the circumference is doubled and therefore the maximum energy of the electron is only doubled. The weight of the apparatus would accordingly increase with the square of the transmitted energy. (This rule holds for fast electrons the velocity of which is practically not changing any longer with increasing energy).

One can obtain a less heavy apparatus by utilising several half cycles of the changing flux. In order to do that the electron has to encircle different iron cores during subsequent half cycles of the changing flux or if it encircles several times ~~the~~ (during several subsequent cycles) the same core it must do so in the proper sense of revolution. An example for this is shown in Fig. 9 which indicates an apparatus subsequently referred to as a single phase multiple action transformer. 60 and 61 are two iron cores forming a transformer frame. This frame is magnetised by means of alternating current which is passed through a coil 62 consisting of only one winding. A circular magnet system indicated by 63 (the magnet systems are not drawn in Fig. 9c) surrounds the core 60. An electron is shot into the magnet 63 in a manner described in Fig. 7. The electron enters the magnet about the time when the voltage induced by the changing flux of the core 60 passes through zero (i.e. about the time when the flux passes its maximum) and this electron encircles the core 60 many times, gradually gaining energy as the flux decreases, while the induced voltage has a positive value. About the time when the flux in the core 60 reaches its minimum value and the induced voltage again approaches zero the electron leaves the magnet 63 and passes into the magnet 64 which encircles the core 61. The strength of the magnetic field in the gap of the magnet 63 determines at what energy value the electron will leave 63. It is therefore possible to adjust the strength of the magnet so that this should happen at the proper time. The electron is in a similar manner accelerated within the magnet 64 and so on within other magnets which alternately surround the cores 60 and 61. The number of magnets to be used is only limited by the length of the transformer frame which can be made so as to suit the purpose.

Fig. 10a and b illsutrate a certain appect of such a single phase multiple action transformer. The two curves shown in Fig. 10 give the voltage round the cores 60 and 61 plotted against time. At the point 1 the electron enters the first magnet surrounding core 1 and at point 2 the electron has accumulated sufficient energy to leave the first magnet and to enter the second magnet in which it is further accelerated. At point 3 the electron leaves in a similar manner the second magnet in order to enter into the third magnet and so on.

Whether Fig. 10a or b is the more appropriate illustration of the multiple action depends on the strength of the magnetic fields generated in the magnets, since the strength of ~~that the~~ those fields determin SIC: at what energy level the electron leaves the respective magnet.

Fig. 11 shows a two-phase multiple action transformer. 70 and 71 are two transformer frames magnetised at 90° phase difference. 72 is a magnet system surrounding the core 73 of the transformer 70.

The electron after encircling the core 73 in the magnet 72 leaves the magnet 72 and enters the magnet 74 which encircles the core 75 of the transformer 71. After this the electron enters the magnet 76 which encircles the core 77 of the transformer 70. The next magnet 78 encircles the core 79, then follows 80 encircling the core 73 once more, then follows the magnet 81 encircling the core 75. The position of the planes in which the electrons revolve is indicated in Fig. 11a and b by marking the slope by arrows.

Fig. 12 illustrates the action of such a two-phase transformer. The four curves represent the voltage induced around the four cores (having 90° phase difference in relation to eachother) as a function of time. An electron enters at point 1 the magnet 1) and leaves it at point 2. It enters the magnet 2) at point 2 and leaves it at point 3 . It enters the magnet 3) at point 3 and leaves it at point 4. It enters magnet 4) at point 4 and leaves it at point 5 and so on. Magnet 1), ~~and~~ magnet 4) and so on surround the first iron core. Magnet 2), magnet 5) and so on surround the second iron core etc. etc. The multiple action illustrated in Fig. 12 has a remarkable stabilising effect on the phase at which the passing of the electron from one magnet into the next magnet occurs.

Should an electron for instance enter the magnet 1) at the point 1′ the time required to reach the energy level at w ich it can leave the magnet) 1) will be shorter than a quarter part of a cycle and it will therefore leave the magnet 1) at a point 2′ which is nearer to point 2 than 1′ was to point 1. Therefore the magnet 2) will already be entered with a smaller phase difference than it has been the case with magnet 1). In this way the phase ~~difference~~ SIC. will gradually readh its normal value.

The two-phase transformer has a certain advantage over the single-phase transformer insofar as when the electron enters the magnet of the two-phase transformer it is at once strongly accelerated by the electric field in the gaps 28 and 29. This is of importance as described in Fig. 7 in preventing the electron from leaving the magnet immediately after its enterance.

Fig. 13 shows an iron core to be used for the acceleration of electrons. This core is wound from a thin iron sheet. If one uses iron sheets below 1/10th mm. e.g. .03 mm., it is quite possible to obtain 1,000 volts per revolution using an induction of B = 10,000 Gauss and a cross section of about 10 cm X 10 cm. Using very thin sheets an iron core built up of these sheets by winding the sheets is preferable to an iron core built up in the usual way.

The methods described hereafter are based on synchronous acceleration. Instead of using an iron core in Fig. 4 it is also possible to use an extremely high frequent electric oscillator, and connect 21/22 to one pole and 23/24 to the other pole of the oscillator. If the frequency of the oscillator corresponds to the time of revolution of the electron the electron will be accelerated in the gaps 28 and 29. It is essential to keep the electric capacity of the plates 21/22 and 23/24 small, otherwise very heavy currents would flow into these plates and it would be difficult to maintain a sufficiently high potential in the plates. It is therefore essential that the magnet system as shown in Fig. 8b should be built of two insulated parts, 55 and 56, and that the part 55 should be kept at the same alternating potential as the plates 21/22 (tube 50), and similarly that the part 56 should be kept at the same alternating potential as the plates 23/24 (tube 51). On the other hand an alternating potential will appear between the two halves of the magnet system 55 and 56, and this is indicated by the lines of electric force drawn in the gap 57. If an arrangement as shown in Fig. 2 is used and if R has a value of two metres, an oscillation of about six metres wave-length has to be used for the acceleration of the electrons (this holds when the initial velocity of the electron is already close to the velocity of light. During the accelerating process the time of revolution will increase as the momentum of the electron increases (again we assume that the initial energy is sufficiently high, otherwise the time of revolution would decrease in the beginning). Therefore the wave-length of the applied high frequency oscillation should not be constant but should increase during a period of time which is required for the acceleration of the electron within the magnet. If for example the magnetic field is so adjusted that for the initial revolutions of the electron r - R is equal to one cm. and if the initial momentum of the electron is increased 10 times during the acceleration of the electron, then for the last revolutions of the electron within the magnet r - R will be equal to 10 cm. Accordingly the time of revolution (R being equal 100 cm.) will gradually increase by about 10% and therefore the wave-length should gradually increase by 10%.

The change of the wave-length is very small for a single revolution. It is important to note that the time required for the acceleration of the electron so as to bring the momentum up to a certain value depends on the phase relation which characterises the passage of the electron through the gaps 28 and 29 in Fig. 4a. This fact leads to a considerable freedom in the rate at which the high frequency oscillation may change its frequency within wide limits within which it is effective in accelerating the electron. The oscillation having a changing frequency will stabilise the phase of the passage of the electron across the gaps 28 and 29.

Fig. 14 shows the potential difference between the two pairs of plates 21/22 and 23/24 as a function of time. The increase in energy which the electron gets at each revolution when passing through the gaps 28 and 29 is not determined by the maximum value of the oscillating voltage alone, but also determined by the phase of the passage across the gap. If the increase of energy per revolution is too large then the time of revolution increases too rapidly and the passage of the electron across the gaps 28 and 29 is shifted nearer and nearer to the maxima of the oscillation. (This holds when the initial energy of the electron is sufficiently large so that its velocity practically does not change any longer.) Fig. 14b illustrates how the passage of the electron across the gaps 28 and 29 moves nearer to the maxima of the oscillation if the energy of the electron lags behind so that the time of revolution is too short. Fig. 14a illustrates how the passage of the electron across the gaps lags behind the maxima if the electron has an access of energy and accordingly a too long period of revolution.

If one has to accelerate protons or electrons the initial velocity of which is small as compared to the velocity of light an electric oscillation with an increasing frequency has to be used. Whereas in Fig. 14 the electron

590

passage across the gaps followed the maxima of the oscillation it will now preceed those maxima.

If the initial velocity of the particle is small the velocity reached towards the end of the accelerating process however is approaching the velocity of light an oscillation has to be used, the frequency of which first increases and later deminishes. The voltage must be so adjusted that about the time when the frequency reaches its maximum the passage of the particle should coincide with the maxima (i.e. the passage should first follow and later on preceed the maxima).

One way of producing an oscillation, the frequency of which changes slowly is to insert into the oscillating ~~xixcuix~~ circuit a condenser the capacity of SIC. which is changing periodically. Such a changing condensor is shown in Fig. 15. It is built in the following way. Two discs facing eachother rotate very rapidly in the opposite sense round acommon axis. The two rotating surfaces which face eachother are equipped with teeth and therefore the capacity of the two discs towards eachother varies rapidly. A quartz plate 71 is inserted between the two discs 70 and 72.

The same effect on the frequency which can be brought about by a condensor periodically changing its capacity can also be brought about by a condensor in series with a changing resistance. If one uses two valves one can build up with these a changing resistance of a suitable nature. The valves can be controlled by applying a periodically changing voltage to their grids.

The following are essential features of the invention, relating to the asynchron transformer method:-

1. The use of ~~the~~ a stationary magnetic field for bending round the path of the charged particle encircling the changing flux.

2. The insertion of gaps in the field of the magnet system which encircles the changing flux.

3. The use of equipotential surfaces around the changing flux which limit the accelerating electric field to a few gaps, thereby stabilising the path of the revolving charged particle in the neighbourhood of the plane of symetry.

4. The use of a magnet system, having the magnetic field decreasing with increasing radius.

5. Having part of the magnetic field decreasing stronger than $\frac{1}{r-R} = \frac{1}{\rho}$ so as to make circular paths of the charged particle in stable and to draw them out into a spiral.

6. Electric or magnetic fields to lead the particle at a definite spot out of this unstable region.

7. Multiple acceleration having the particle revolving around a different flux in subsequent half ~~[illegible]~~ cycles.

8. The use of ~~polyfase~~ polyphase multiple accelerators.

9. Bringing the charged particle from the periphery into the magnet system at a point which is about 90° removed from the accelerating ~~spot~~ gaps, and removing the charged particle at the periphery after having increased its energy within the magnet system.

10. Building up the iron core by winding up a thin iron sheet.

11. Coils producing the stationary field <u>not</u> surrounding the changing flux.

12. These coils being built of two parts leaving free the neighbourhood the plane of revolution.

13. The magnet system built of two halves insulated from eachother, each of these halves being at the same potential as the corresponding ~~paths~~ pairs of plates 21-22 and 22-23. The two halves of the magnet system having an electric field between them.

The following are essential features of the invention, relating to the synchronous transformer method:

1. A circular magnetic system with gaps in the field.

2. A magnetic field decreasing with increasing r so as to stabilise the path of the charged particle in the neighbourhood of the plane of symetry.

3. The application of a high-frequency oscilation the frequency of which is slowly changing.

4. The voltage of this oscillation adjusted in such a way that there should be a time lag between the passage of the particle through the accelerating gap and the maxima of the oscilation.

5. The circular magnetic system built of two halves oscilating against each other and not oscilating against the respective pairs of plates 21-22 or 23-24.

Dated the day of 20th of February 1934

Leo Szilard

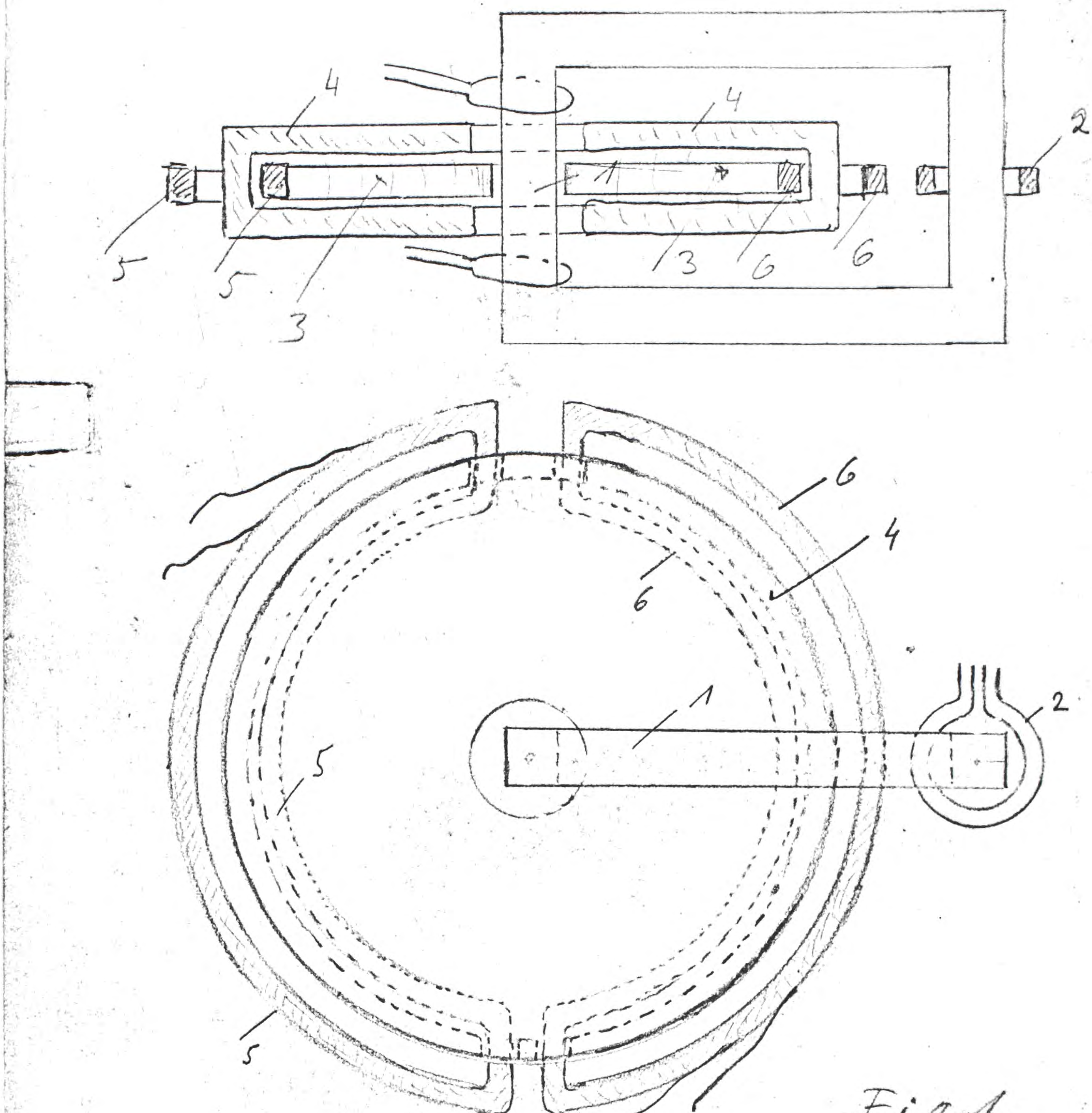


Fig. 1.

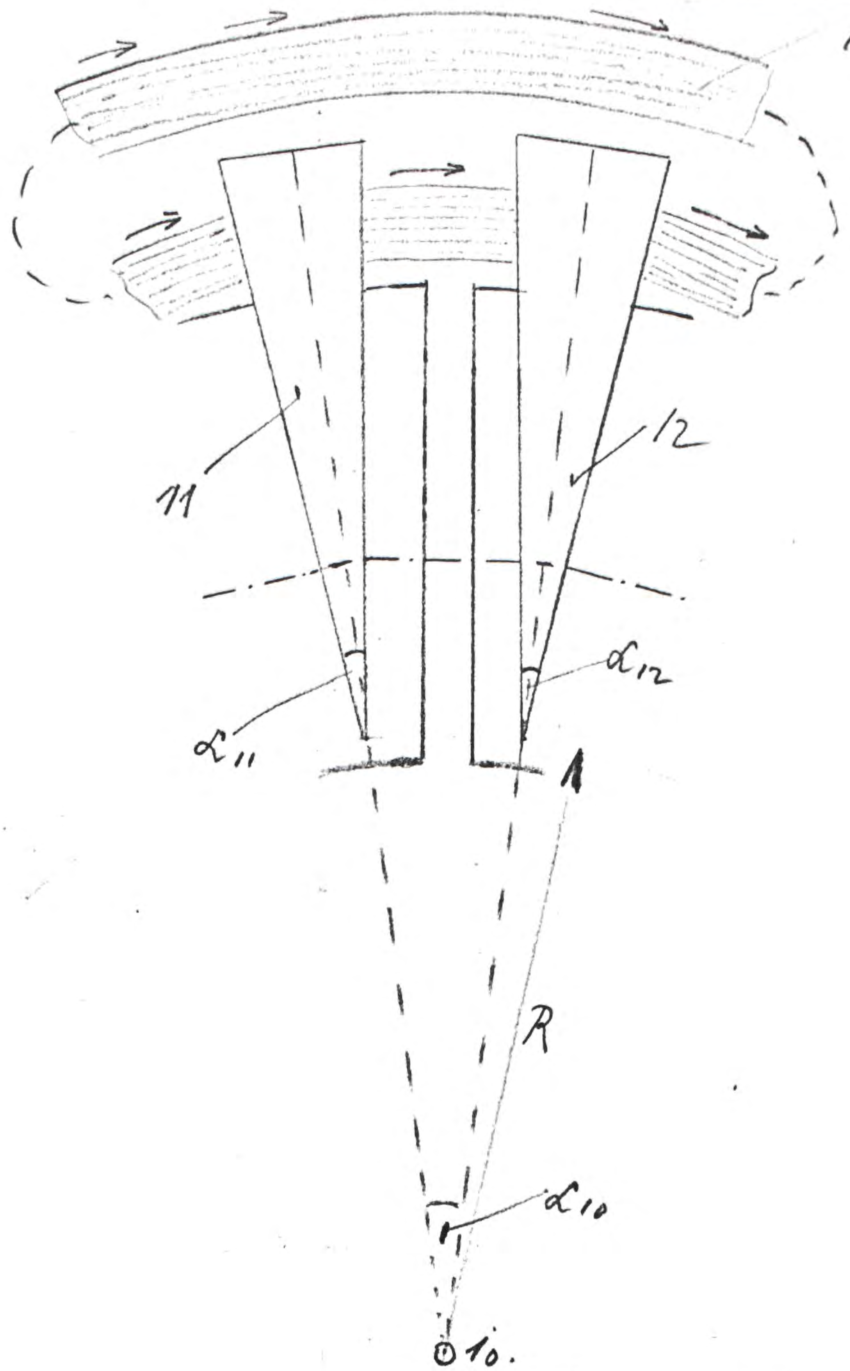


Fig 2.

597

2

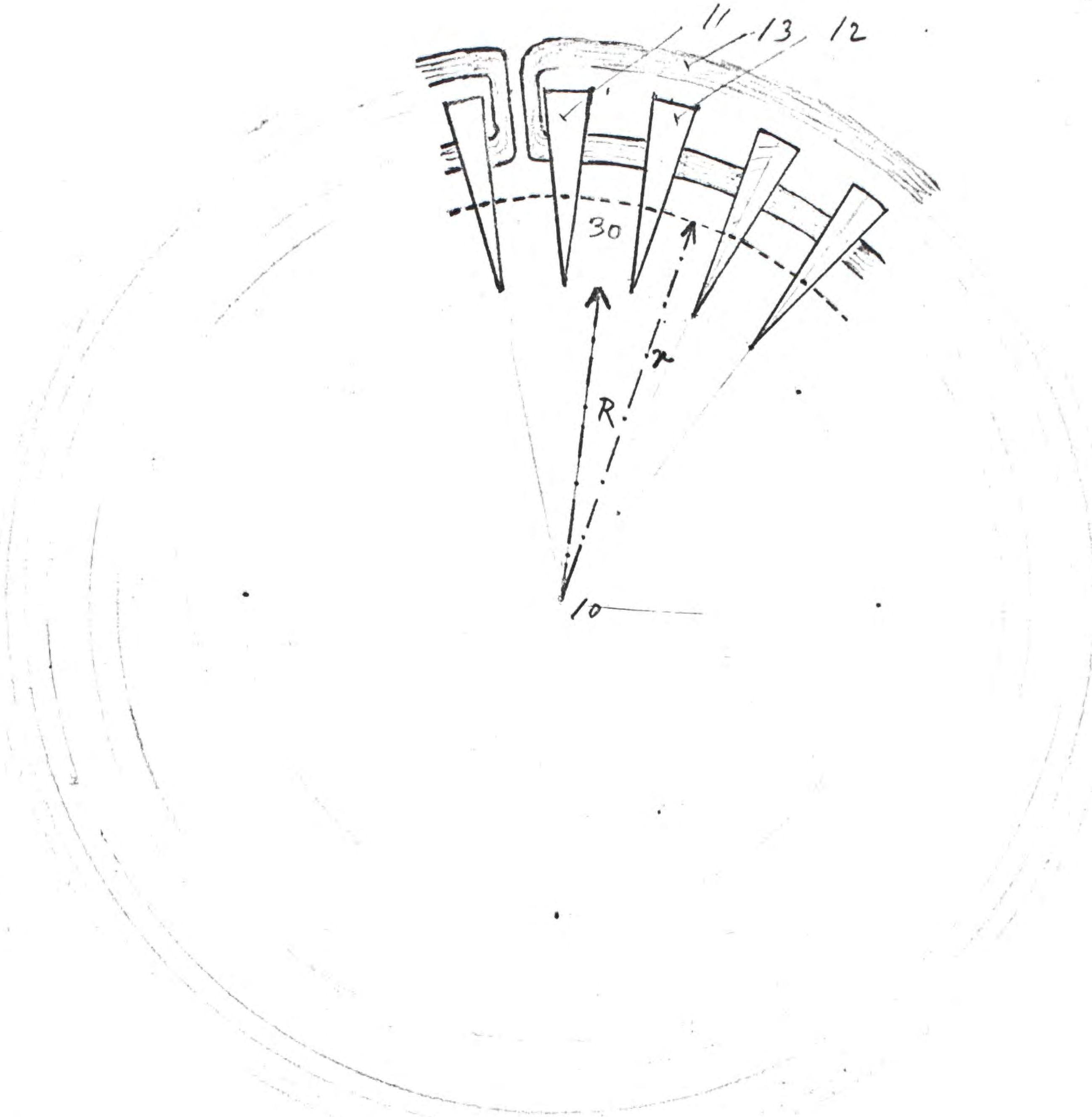


Fig 2b

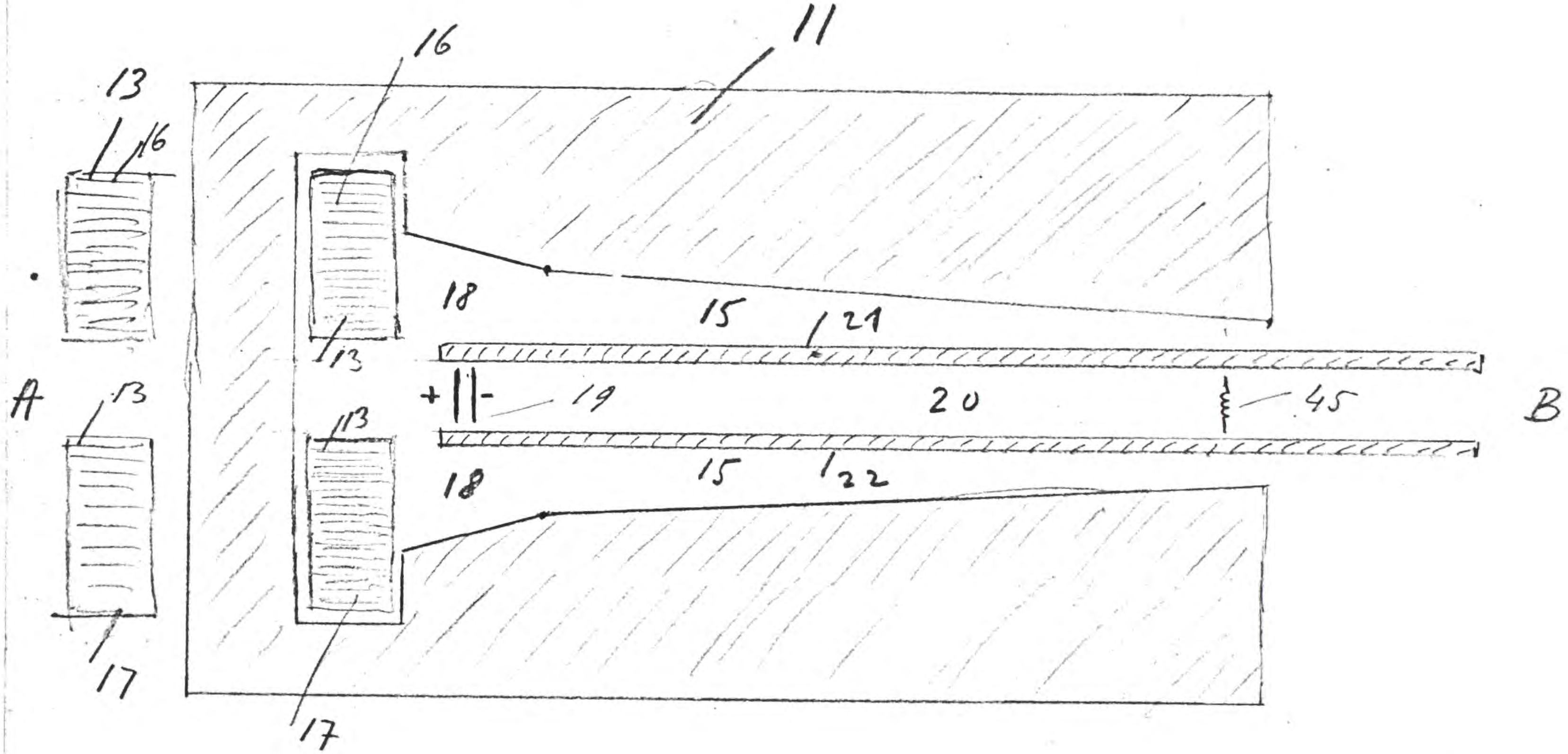
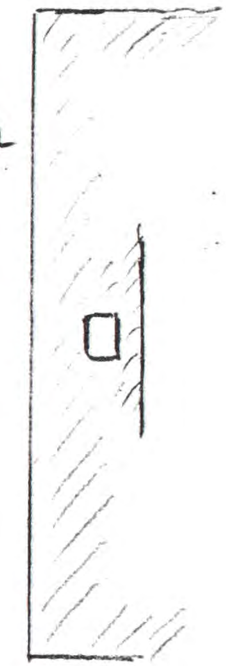


Fig 3

Fig 3a



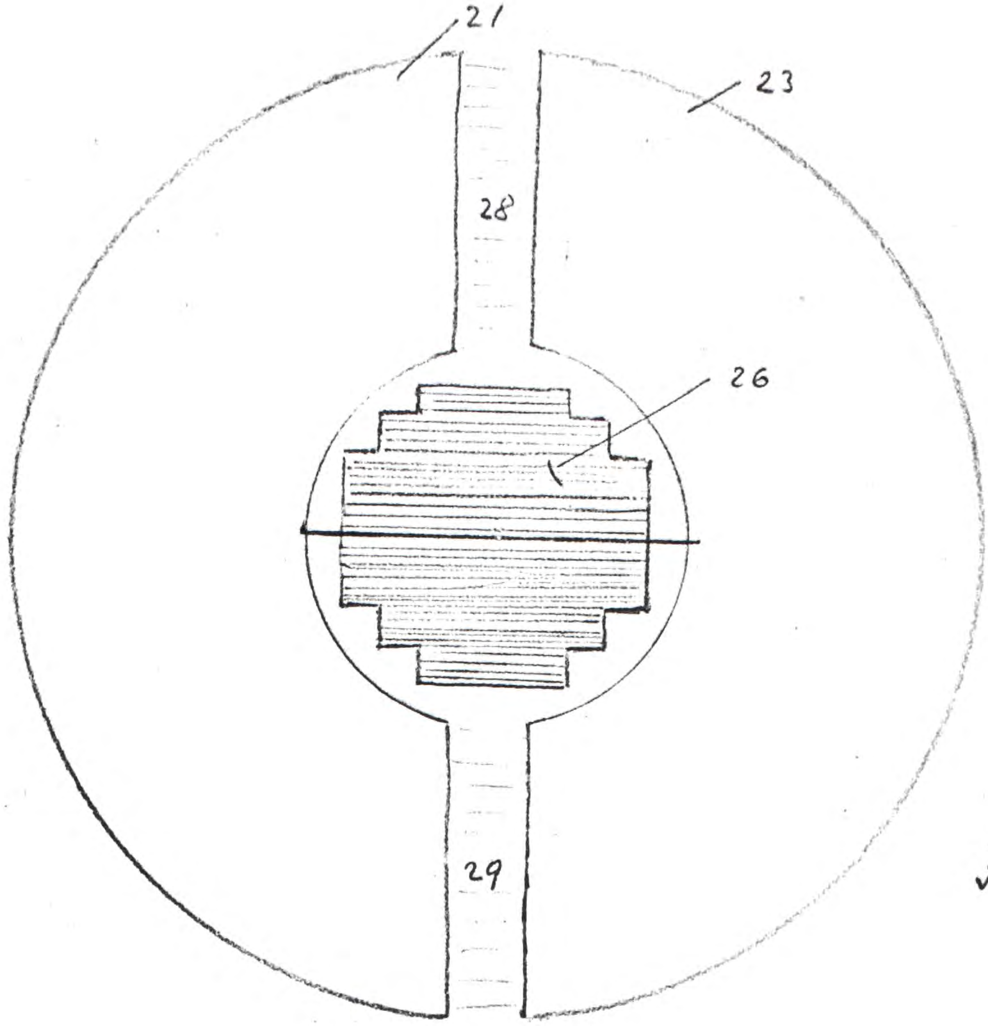


Fig 4a

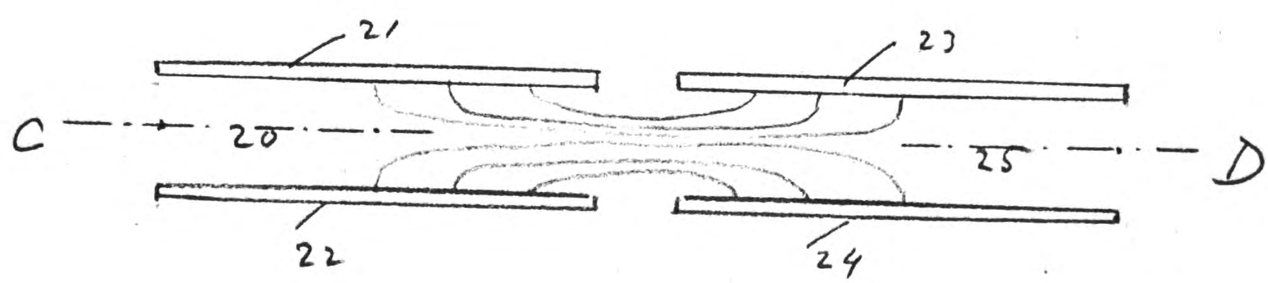


Fig 4b

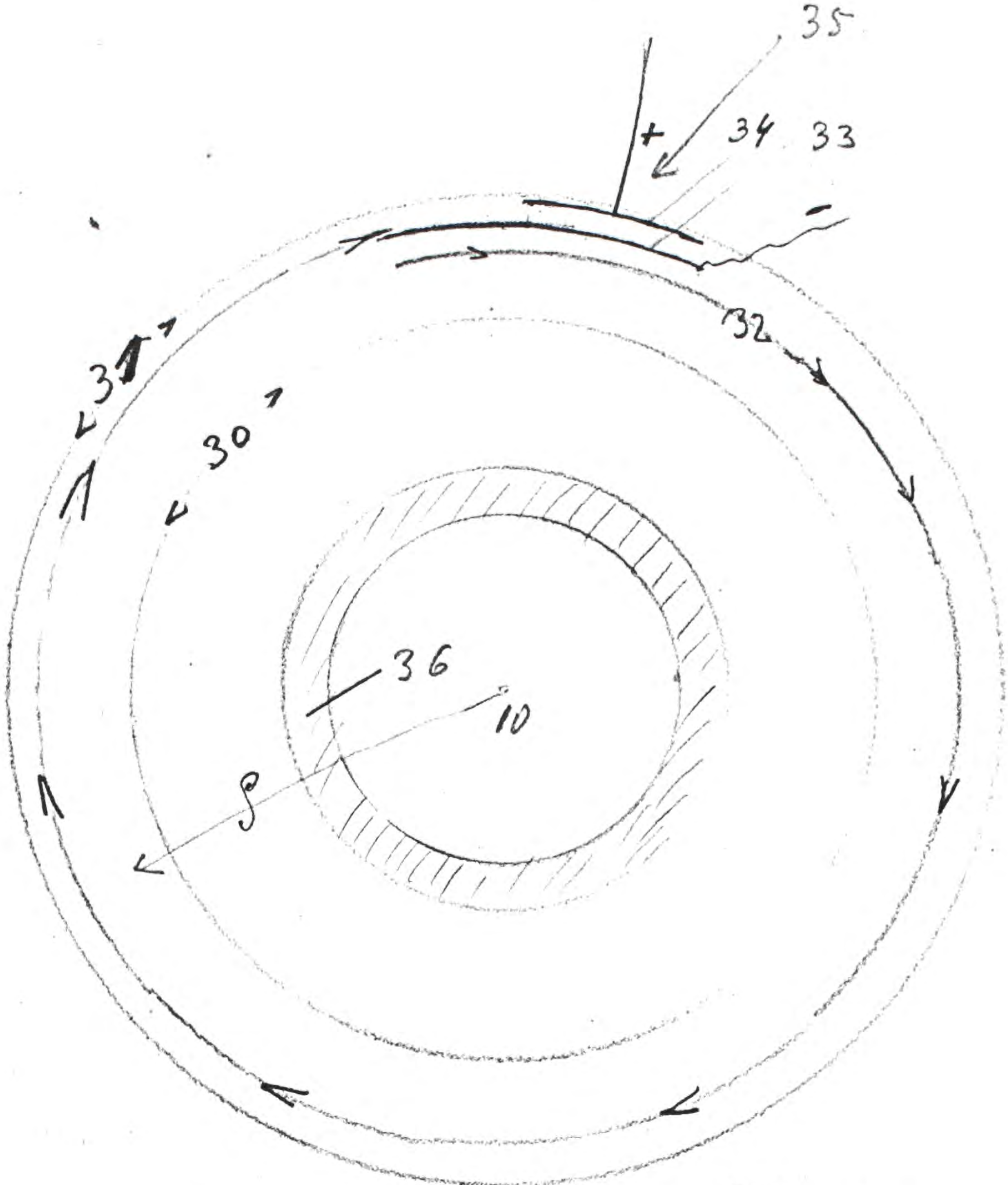


Fig 6a

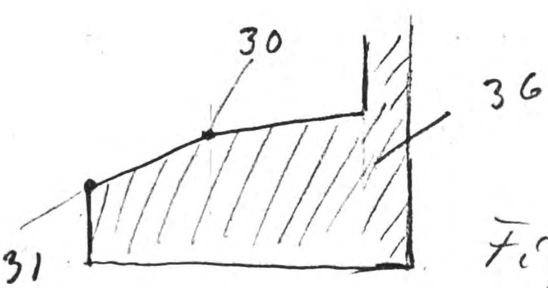


Fig 6b

Fig 6

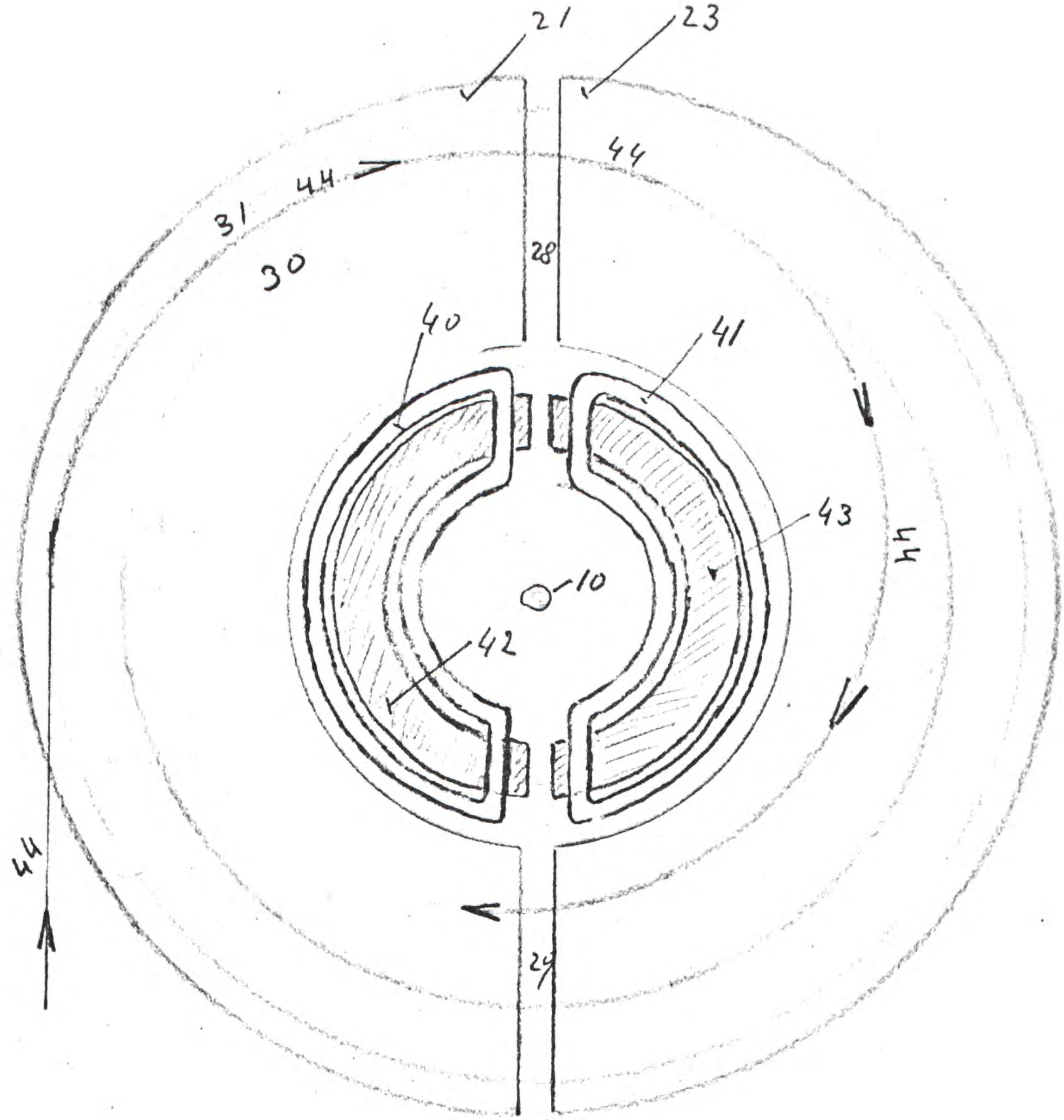


Fig 7.

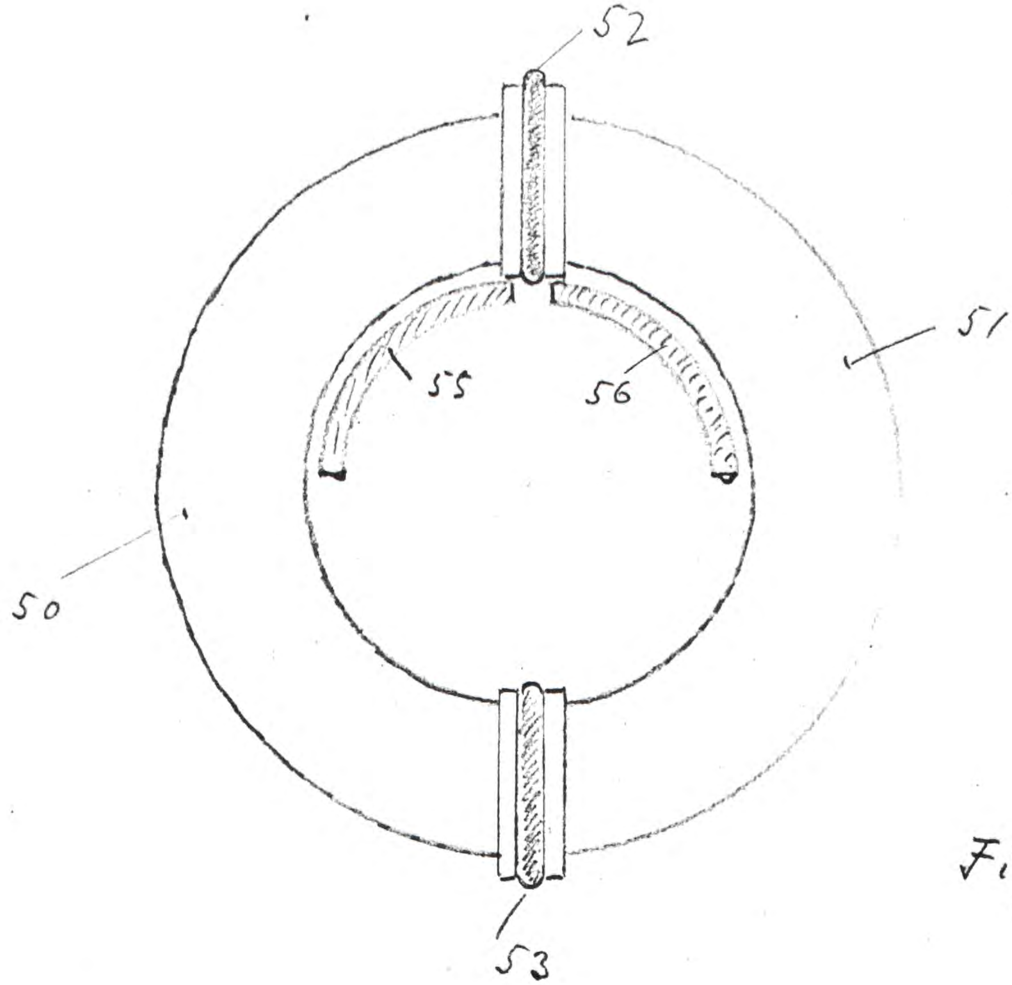


Fig 8a.

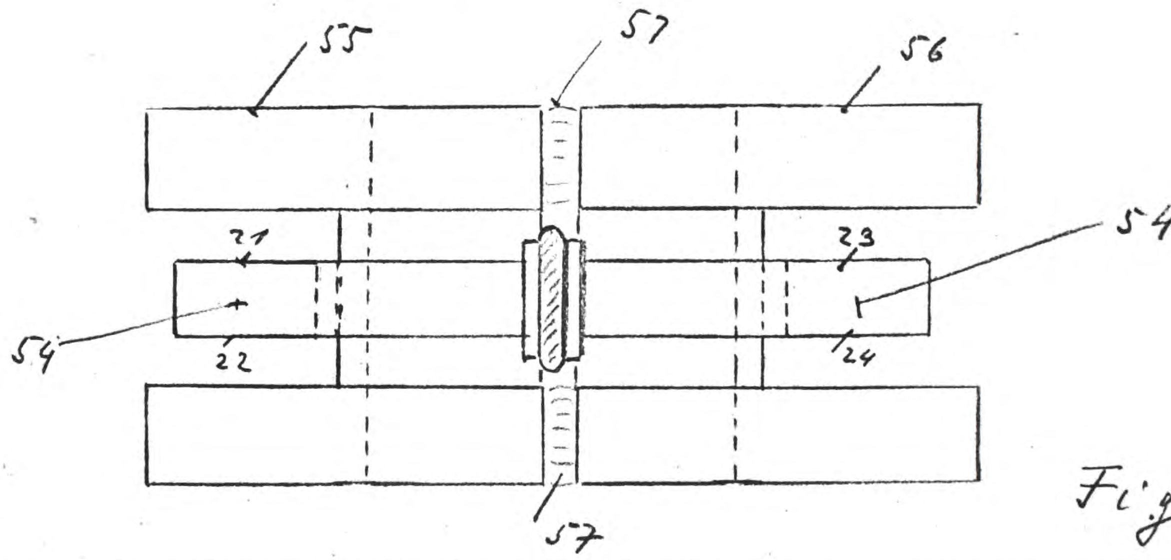


Fig 8b.

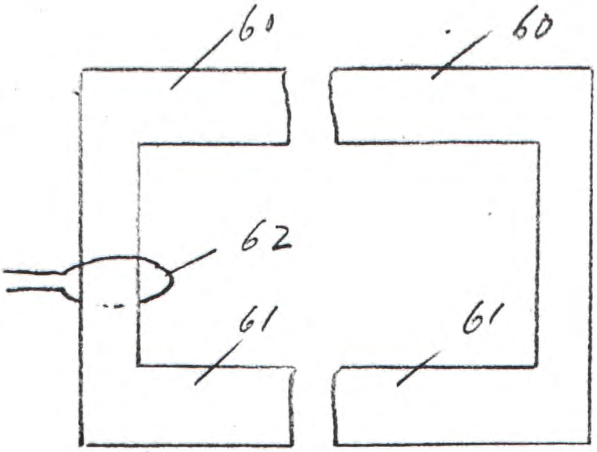


Fig 9c.

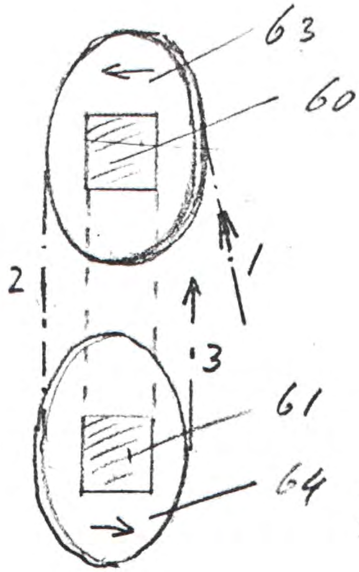


Fig 9a

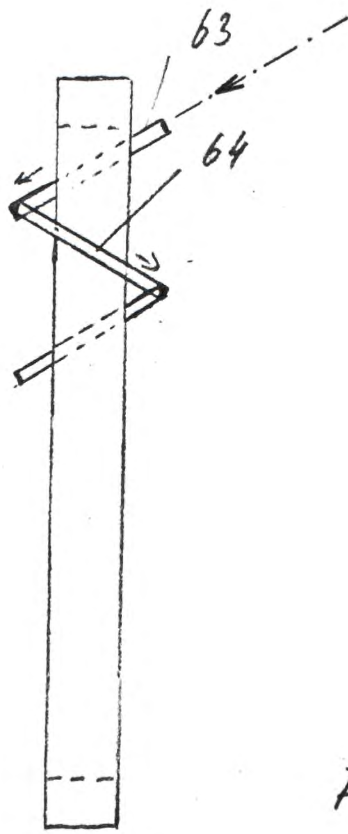


Fig 9b.

10 u 12.

Fig 10 and 12

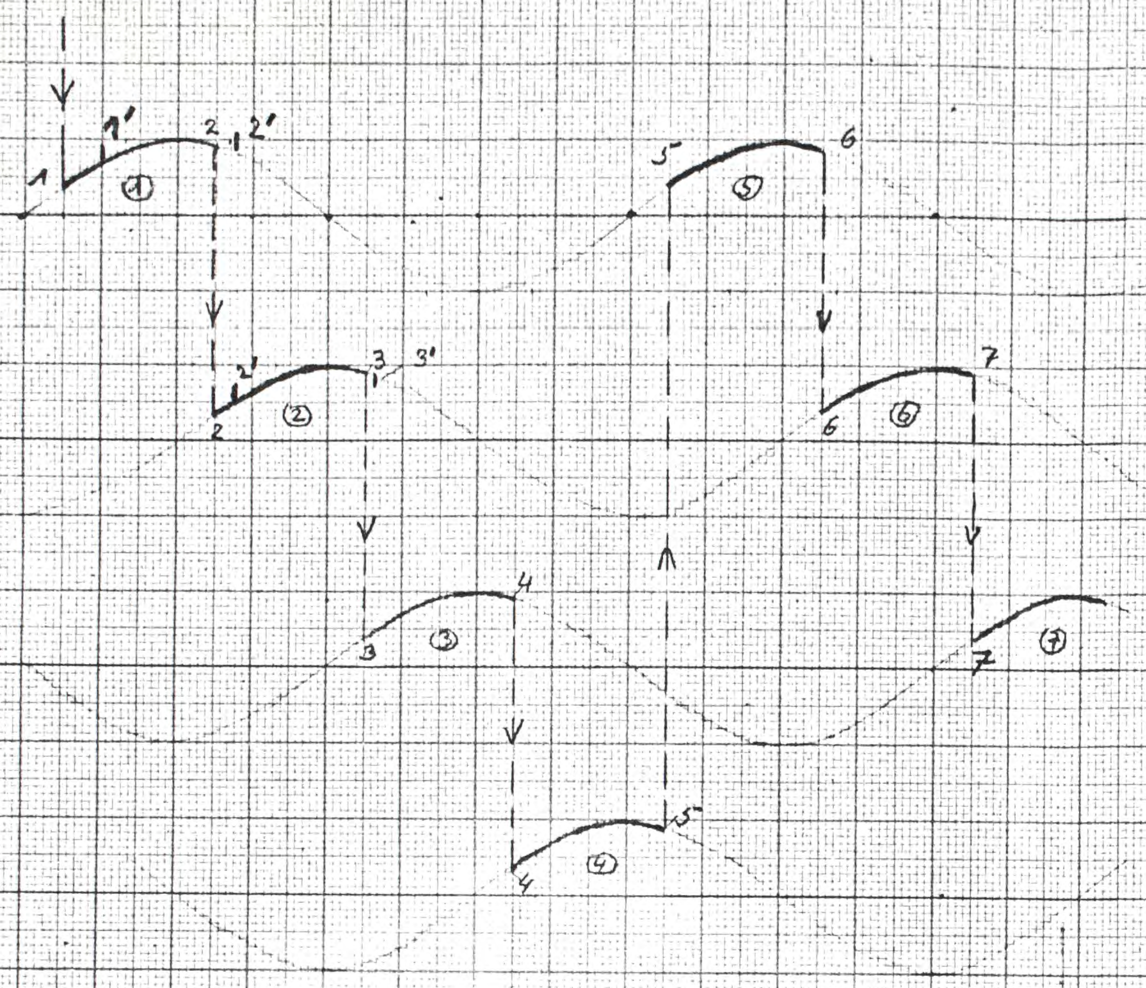


Fig. 12.

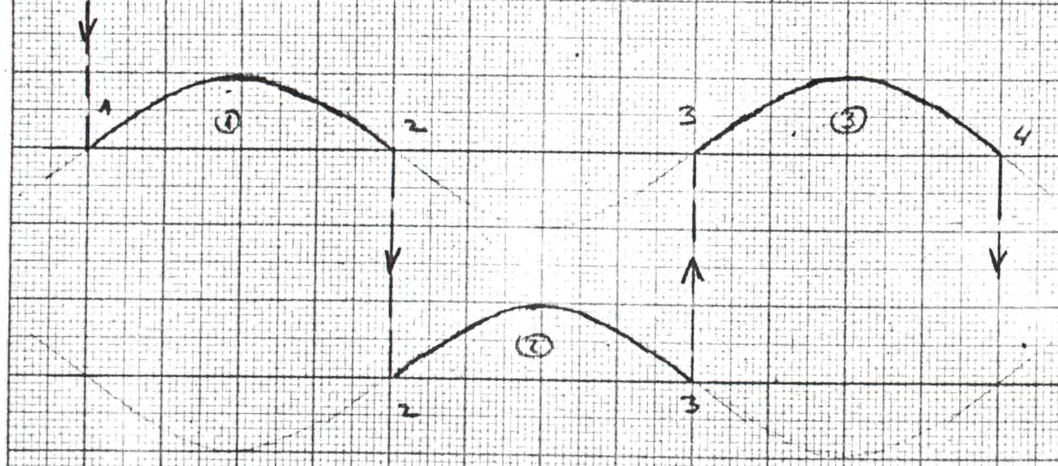


Fig. 10a.

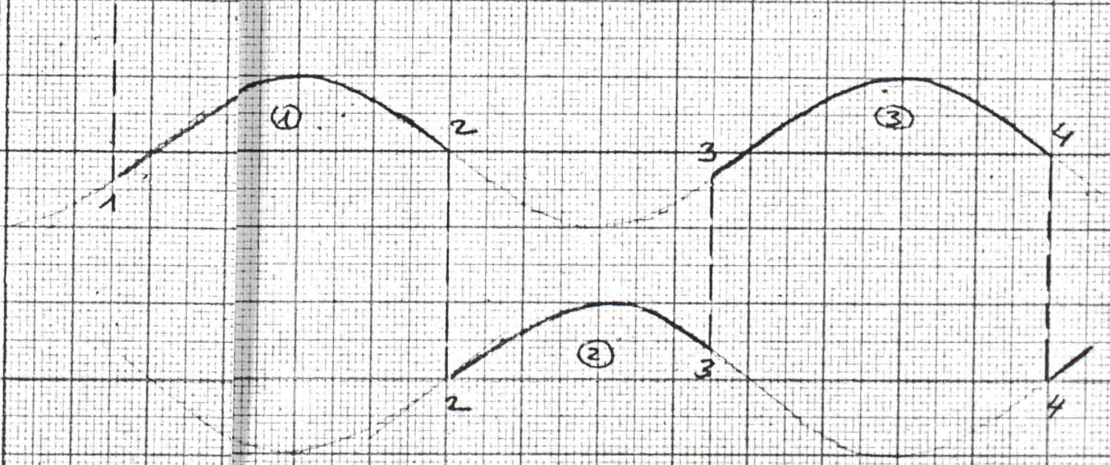


Fig. 10b.

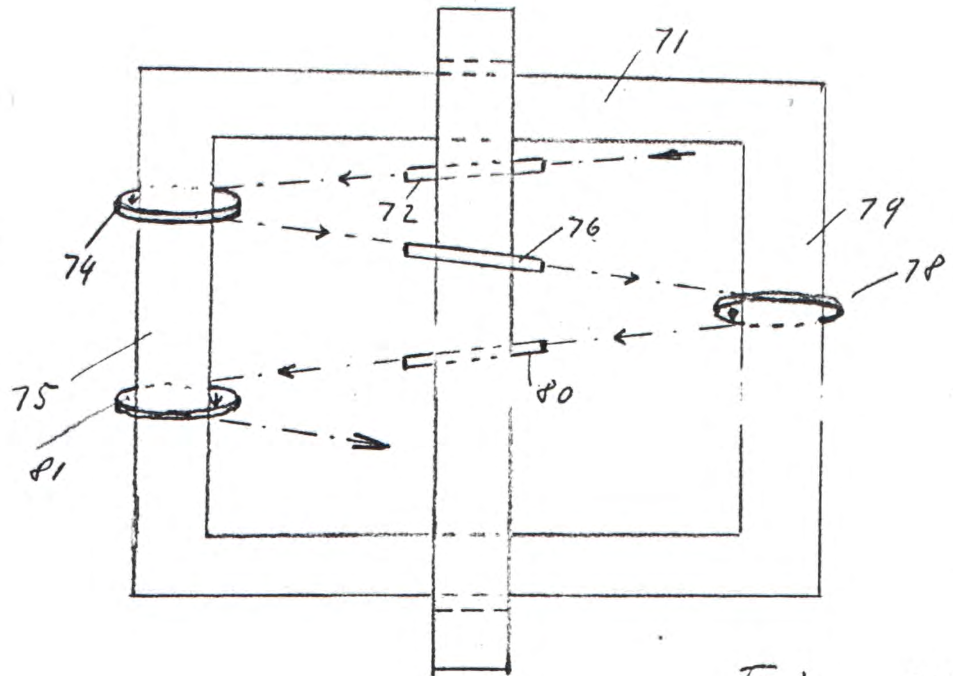


Fig 11a

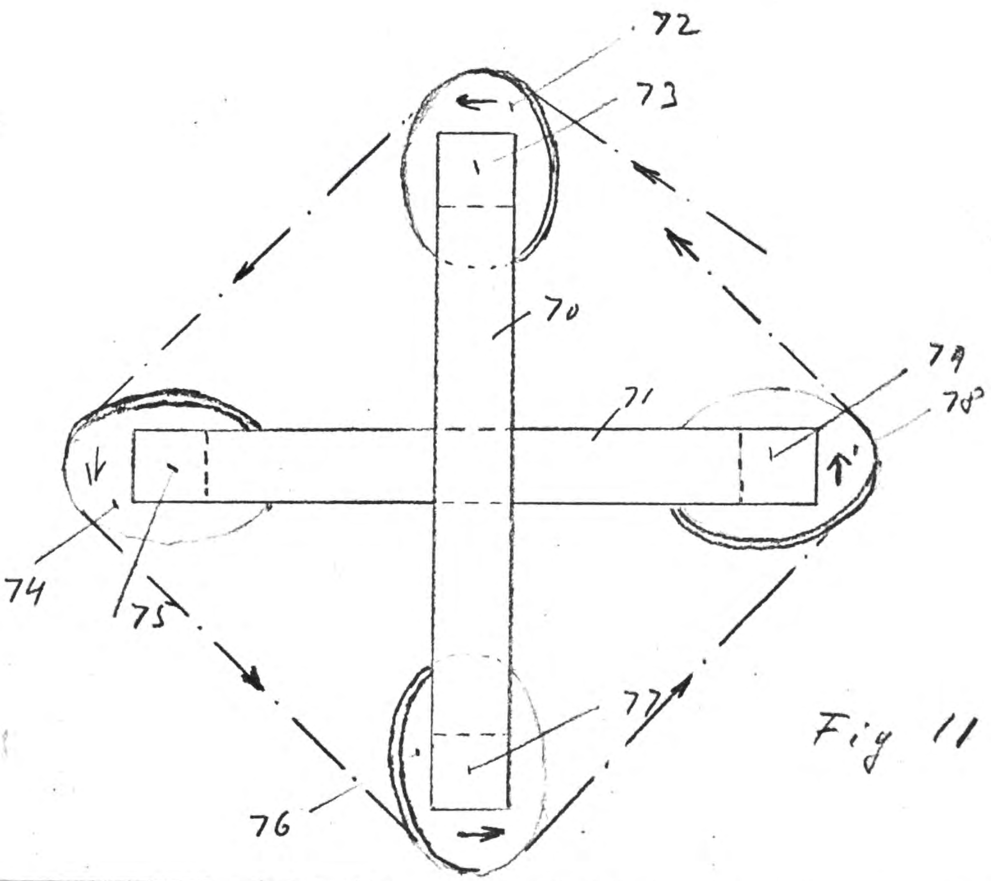


Fig 11 b.

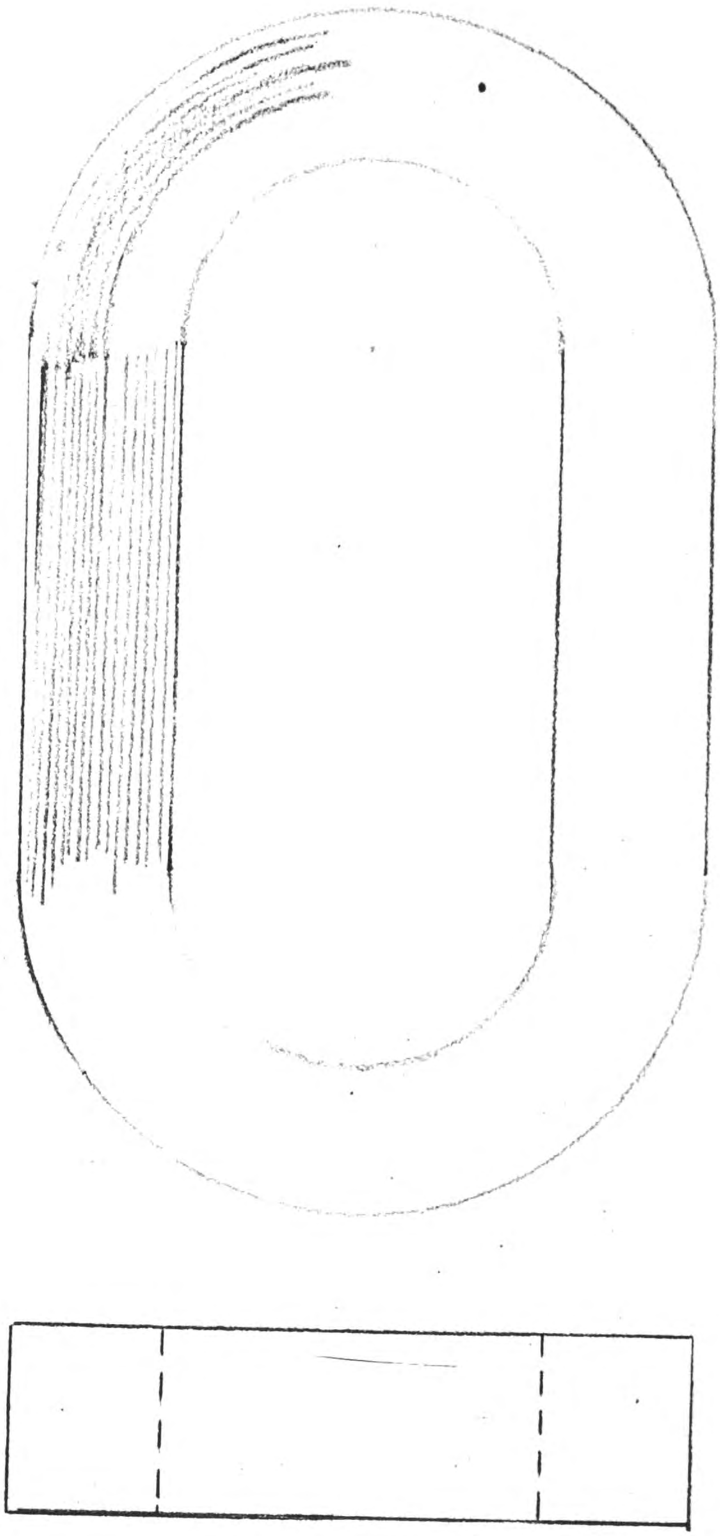
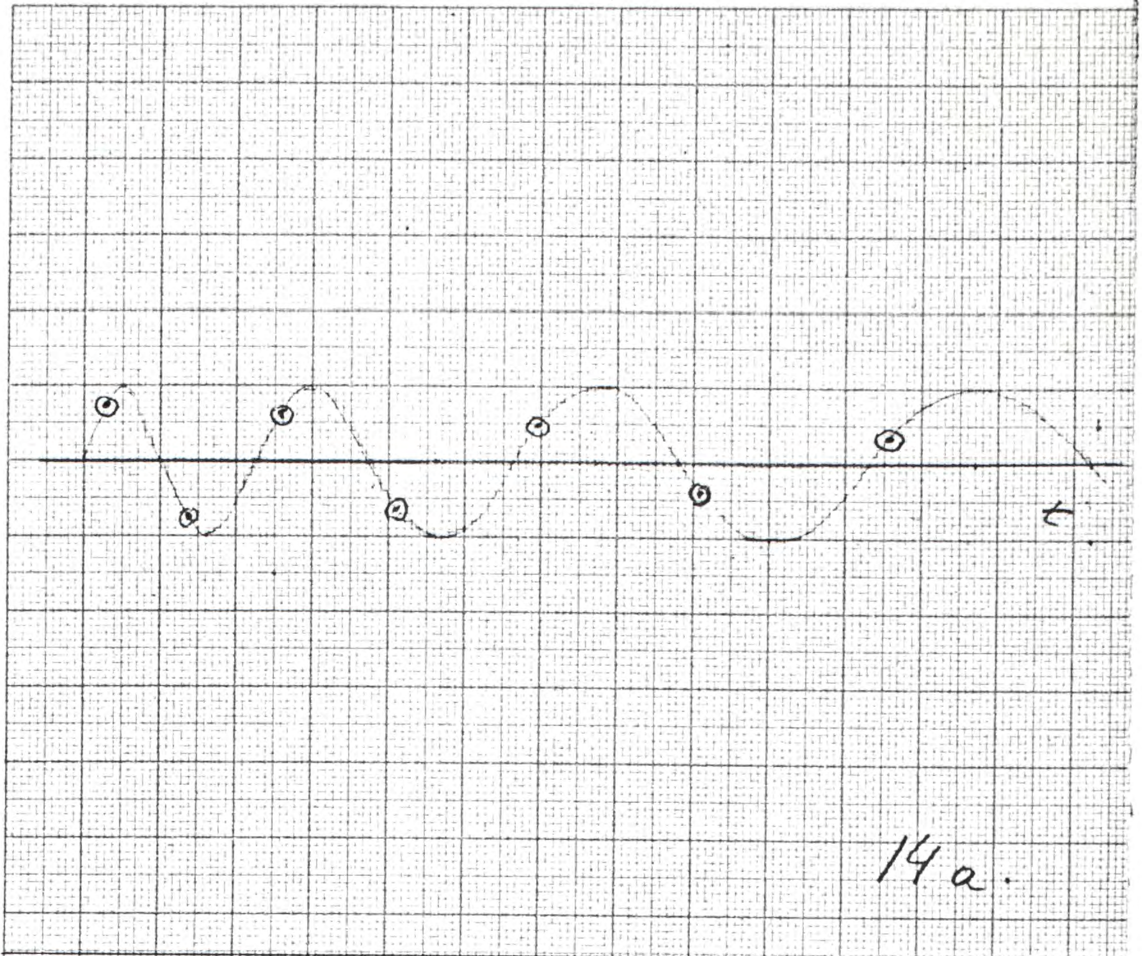
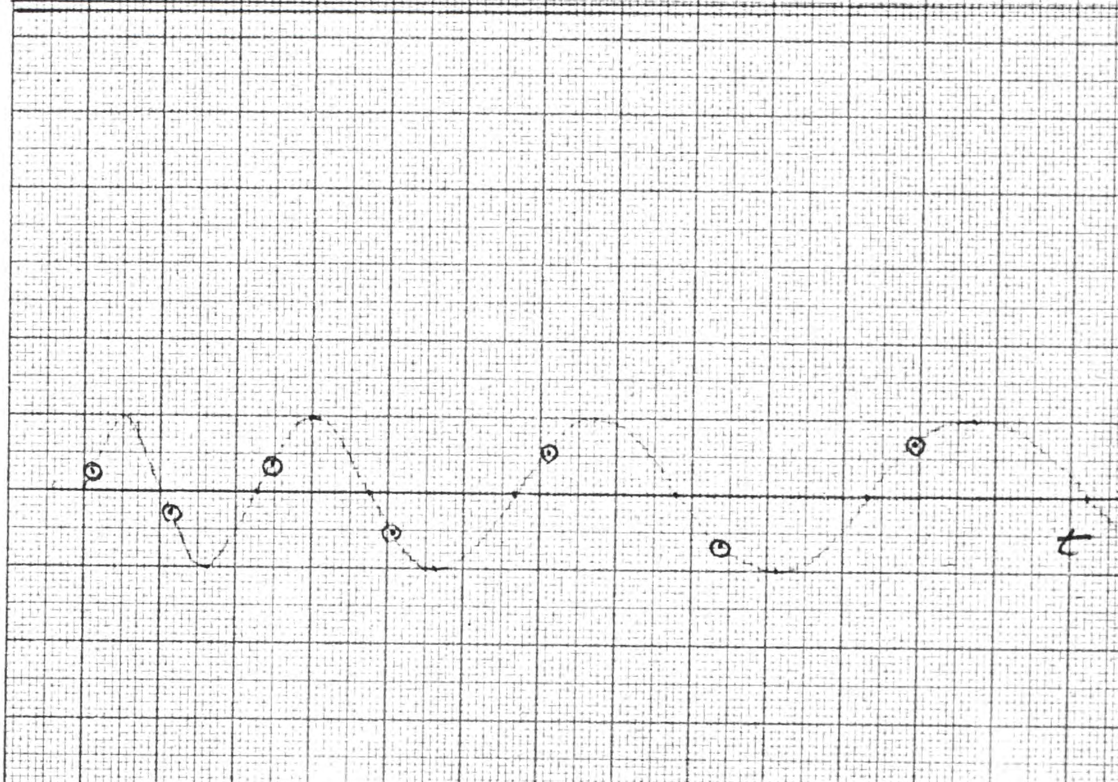


Fig 13.



14a.



14b

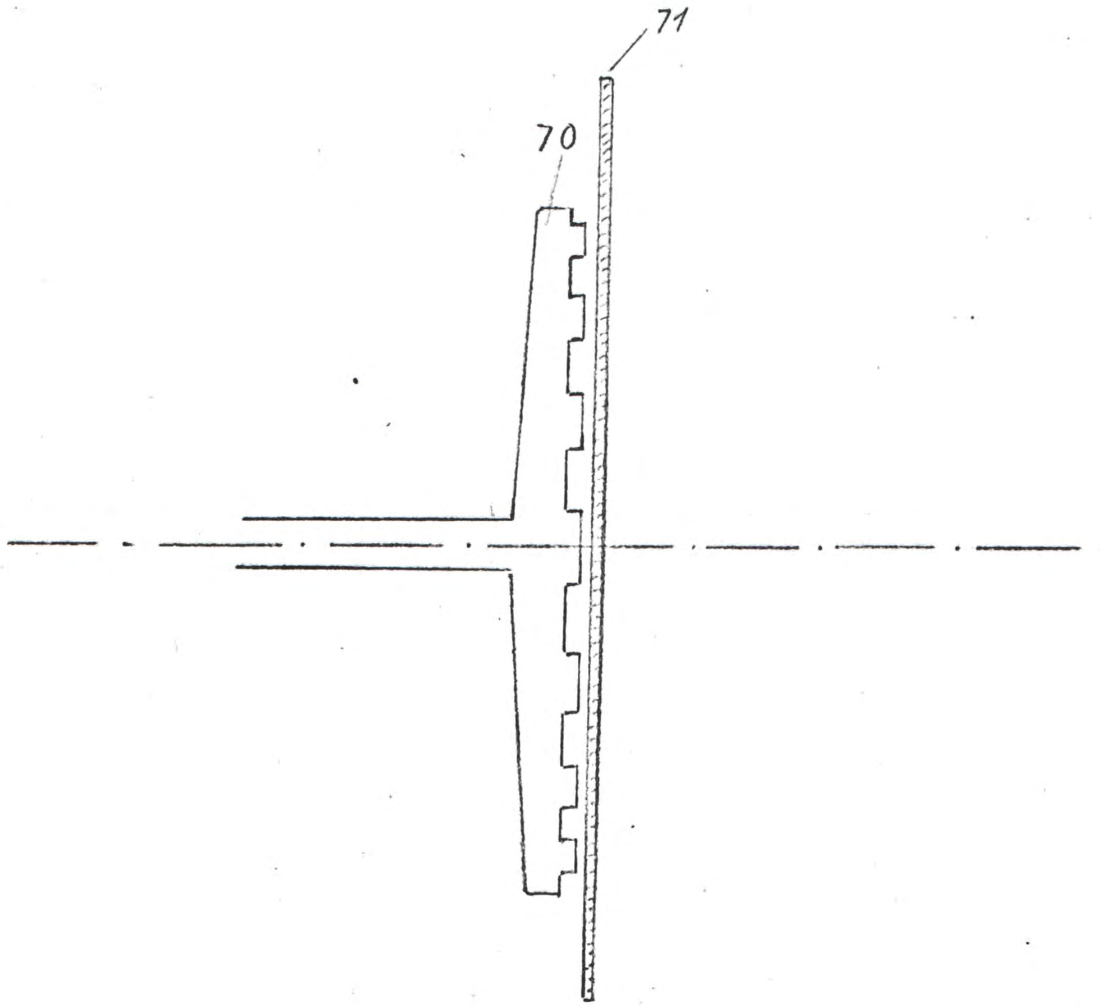


Fig. 15.

Form P. Ack. 4.

THE PATENT OFFICE,

25, SOUTHAMPTON BUILDINGS,
CHANCERY LANE, LONDON, W.C. 2.

No. 5730

Date 21 FEB. 1934

Received documents purporting to be the Application and Provisional Specification of *L. Szilard*

which have been numbered and dated as above.

M. F. LINDLEY,
Comptroller-General.

N.B.—Unless a Complete Specification is left on an Application for a Patent within TWELVE MONTHS from the date of application (or with extension fee, 13 months), the Application is deemed to be abandoned. The investigation as to novelty prescribed by the Patents Acts, 1907 and 1932, is made only when a Complete Specification has been left.
The number and date of this Application must be quoted on the Complete Specification and Drawings (if any), as well as in any correspondence relative thereto.

Wt 2952 144 Bks/8/33 Wt & Sons Ltd 431f/1385—4

Patents Form—No. 1. 5730 **No Charge for the Form.**

PATENTS & DESIGNS ACTS, 1907 to 1932.

(To be accompanied by two copies of Patents Form No. 2 or of Patents Form No. 3.)

ONE POUND 21 2 34

APPLICATION FOR PATENT.

(a) Here insert (*in full*) name, address, and nationality of applicant or applicants (including the actual inventor).

(a) I (or We) Leo Szilard, citizen of Germany and subject of Hungary, 6 Halliwick Rd Muswell Hill, London N.10. ~~and Strand Palace Hotel, Strand, London~~ do hereby declare that I am (or we are) in possession of an invention the title of which is (b) Asynchronous and Synchronous Transformers for Particles

5730

21 FEB 1934

(b) Here insert title of invention.

(c) State here who is or are the inventor or inventors.

that (c) I (Leo Szilard)

claime to be the true and first inventor.....thereof, and that the same is not in use by any other person or persons to the best of my (or our) knowledge and belief; and I ~~(or we)~~ humbly pray that a Patent may be granted to me ~~(or us)~~ for the said invention.

Dated the 20 day of February, 1934

(d) To be signed by applicant or applicants and, in the case of a Firm, by each partner.

(d) Leo Szilard

NOTE.—One of the two forms on the back hereof, or a separate authorisation of agent, should be signed by the applicant or applicants.

To the Comptroller,
The Patent Office, 25, Southampton Buildings,
Chancery Lane, London, W.C.2.

(Y9430) Wt 13359/4327 30,000(2) 7/33 H & Sp Gp 102

7406

Patents Form No. 2. No Charge for the Form.

To be issued with Patents Forms Nos. 1, 1_A, 1_C, 1_C**, 1_C*** or 1_D.

PATENTS & DESIGNS ACTS, 1907 to 1932.

PROVISIONAL SPECIFICATION.

(To be furnished in Duplicate.)

15. Informal Sgd.

(a) Here insert title verbally agreeing with that in the application form

5730

21 FEB 1934

(a) Asynchronous and Synchronous Transformers for Particles

(b) Here insert (in full) name, address and nationality of applicant or applicants as in application form.

(b) I ~~(or We)~~ Leo Szilard a citizen of Germany and a subject of Hungary
6. Halliwick Rd ~~and Strand Palace Hotel, Strand London~~
Muswell Hill
London N. 10.

do hereby declare the nature of this invention to be as follows :—

(c) Here begin description of the nature of the invention. The continuation of the specification should be upon wide-ruled paper of the same size as this form, on one side only, with a margin of one inch and a half on the left-hand part of the paper. The specification and the duplicate thereof must be signed at the end and dated (thus): "Dated the day of 19 ."

(c)

(*Y8885) Wt 15367/3534 60,000(4) 11/32 H & Sp Gp 102

(1) *Where application is made through a Solicitor, Patent Agent, or other authorised representative.*

I (or We) hereby appoint..

of ....

to act for me (or us) in respect of the within application for a Patent, and request that all notices, requisitions, and communications relating thereto may be sent to him (or them) at the above address.

Dated the..................day of.., 193 .....

* To be signed by applicant or applicants.

* ....

....

....

....

(2) *Where application is made without an Agent (Rule 7).*

I (or We) hereby request that all notices, requisitions, and communications in respect of the within application may be sent to

Miss Simpson 6. Halliwick Rd

Muswell Hill at* London N.10.

* The address must be in the United Kingdom.

....

Dated the 20 day of February, 1934

† To be signed by applicant or applicants.

† Leo Szilard

....

....

....