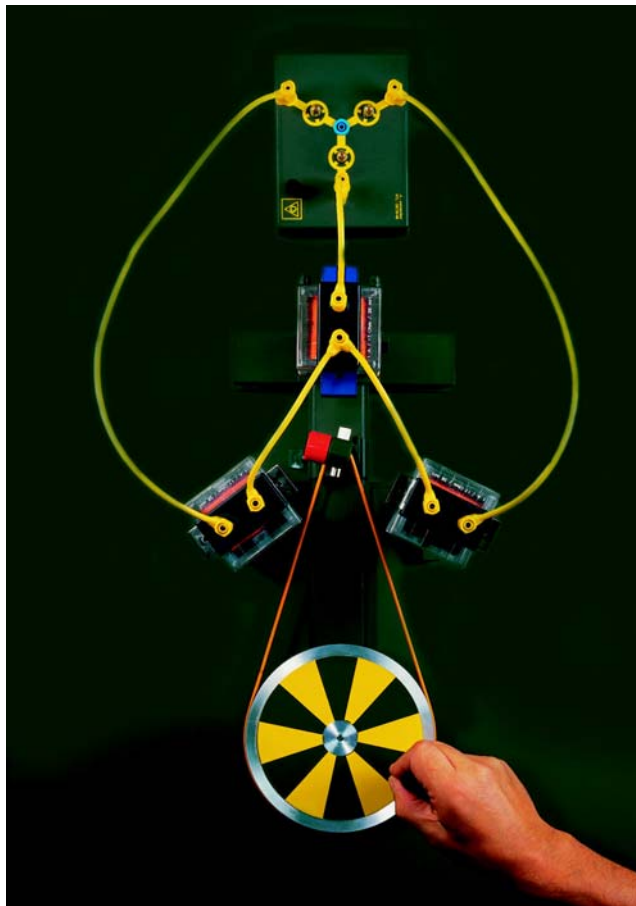


Háromfázisú generátor Háromfázisú áram előállítás

Szükséges eszközök:

	1	Komplett bemutató tábla	DS103-1A
S1	1	Tartósín, L=325 mm, mágneses	DS102-3G
S1	2	Futósín, h=70 mm	DS103-7G
S1	1	Csapágy, csúszótalpon keresztfurattal	DS402-3B
S1	2	Tekercstartó csappal	DS407-2G
S1	1	Tekercstartó horonnyal	DS407-3G
S2	1	Tartósín, L=500 mm	DS104-5G
S2	2	Állványtalp, mágneses, L=200 mm	DS102-1G
S2	1	Futósín, h=34 mm	DS103-3G
S2	1	Hajtókar	DS402-2N
S2	1	Hajtósíj, készlet	DS401-1A
S2	1	Hajtótárcsa, d=160 mm	DS402-3D
S2	1	Csapágy-egység, rövid	DS402-4B
E7	1	Lapos csatlakozó	DE454-1F
E7	2	Tömör vasmag, L=92 mm	DE452-1N
E7	1	Vasmag, rövid, lemezelt	DE452-3B
E7/8	3	1200-menetes tekercs	DE453-1E
E8	1	Mágnestartó, állványon	DE411-2M
D1	1	Lámpafoglalat 3-fázisú csillag-kapcsoláshoz, erősítővel	DE720-4S
EZ	1	4V/0.04A, E10 lámpa, 5db-os készlet	DE309-1S
EZ	1	20 db-os sárga mérővezeték készlet	DG507-1S

Three coils connected in a star or delta circuit are positioned in a rotating magnetic field at 120° to each other. The devices in the circuit consuming electricity (i.e. light bulbs) each display alternating currents of the same frequency but shifted by 120° with reference to each other, their timing differing by one-third of a period.



Kísérlet:

Three-phase generator and devices in a star circuit

A revolving field generator is symbolized with the aid of the magnet on a support. The magnet is made to rotate using the drive belt disc and the hand crank pin.

Set up the experiment according to the diagram.

The support stand rail, $l = 500$, is fitted with three support stand bases with the bottommost base mounted parallel to the support stand rail. To this end the clamp screw on the rail must be loosened, the clamp turned 90° and the screw tightened once more. The short pivot bearing with the drive belt disc fixed to it is mounted on the parallel support stand base.

Two support stand clamps, $h = 70$ mm, with two coil holders with plug pins are mounted on the middle base and two coils with 1200 turns and iron cores, $l = 92$ mm, are fixed in the stands. The two support stand clamps may simply be suspended from the rail (the fastening screw pointing downward). It is not necessary to tighten the screws, thus facilitating adjustment of the coils' position.

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The coils are to be positioned at 120° angles to each other. The third, topmost coil with 1200 turns is fixed in the coil holder with a slit and mounted in a support stand clamp, l = 34 mm, on a support stand rail.

The short, laminated iron core is fixed in the coil using a flat plug. The pivot bearing with a transverse hole with the magnet on a support are mounted in the middle of the coil assembly. The magnet should be about 15 – 20 mm from the iron cores.

Megjegyzés:

The box – light bulb socket - star connection is fitted with an amplifier to reinforce the weak current produced by the coils and the magnet rotating slowly. The amplifier should be turned on before the experiment begins (green LED must light up!) in order to ensure that the light bulbs blink brightly.

The gear-driven motor may be used on the vertical rail holders from support stand set S1 in order to drive the magnet on the support evenly.

Feszültségmérés háromfázisú rendszerben

Szükséges eszközök:

	1	Komplett bemutató tábla	DS103-1A
D1	1	3-fázisú átalakító, 3x13/23 V, mágneses	P3120-3D
E1	1	Lámpafoglat, E10	DE720-2A
E1	1	6V/10Ah akkumulátor, mágneses	P3120-1B
EZ	1	20 db-os sárga mérővezeték készlet	DG507-1S
EZ	1	Lámpa 24V/100mA, E10, 5db-os készlet	DE309-6S
EZ	1	Demonstrációs multiméter I, mágneses	DE710-00

Háromfázisú hálózatoknál a feszültség az egyes fázisok között (vonali feszültség) 400 V (delta), a fázis-feszültség (az egyes fázisok és a semleges pont /csillagpont/) között 230 V (csillag).

A kísérletekhez a véletlen áramütés elkerülése céljából a háromfázisú hálózat helyett a 23 V/13 V kimenőfeszültséggel rendelkező háromfázisú konvertert használjuk.

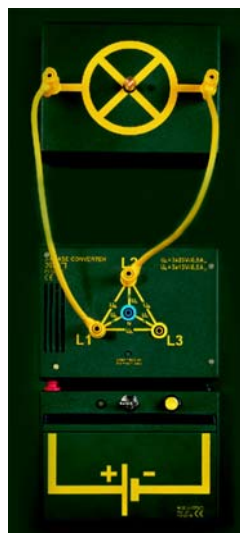
Kísérlet:



1. ábra



2. ábra



3. ábra



4. ábra

Állítsuk össze a kísérletet az ábra szerint.

By observing the brightness of the light bulbs (i.e. power consumption) the difference in potential between two of the phases (delta connection diagram 1) and between the individual phase leads and the neutral lead (star connection diagram 2) can be seen.

A measuring instrument, e.g. universal multimeter I DE710-00, can be used to measure the voltages accurately (diagrams 3 and 4).

Megjegyzés:

The amplifier in the box – light bulb socket – star connection should not be switched on.

Seeing that the three-phase converter consumes a lot of power, make sure that the box - rechargeable battery 6 V/10 Ah is charged completely, thus ensuring that the three-phase converter works reliably. The box - fixed voltage transformer can, of course, be used in its place.

A csillag-kapcsolás A nulla-vezetőn folyó áram

Szükséges eszközök:

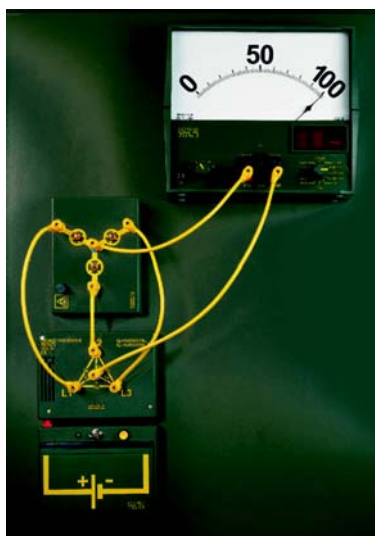
	1	Komplett bemutató tábla	DS103-1A
D1	1	Lámpafoglalat 3-fázisú csillag-kapcsoláshoz, erősítővel	DE720-4S
E1	1	6V/10Ah akkumulátor, mágneses	P3120-1B
D1	1	3 fázisú átalakító, 3x13/23 V, mágneses	P3120-3D
EZ	1	Lámpa 12V/100mA, E10, 5db-os készlet	DE309-5S
EZ	1	20 db-os sárga mérővezeték készlet	DG507-1S
EZ	1	Demonstrációs multiméter I, mágneses	DE710-00

When equally great amounts of current flow between any two of the phases and the central connector, the sum of these currents is the same as the individual currents between each of the phases and the central connector as long as the third phase is not connected. The currents do of course shift phases in this case but this does not affect the value displayed with only two power-consuming devices connected.

Kísérlet:



1. ábra



2. ábra



3. ábra

Állítsuk össze a kísérletet az ábra szerint.

The light bulbs 12 V/100 mA are screwed into the box with light bulb sockets and star connection to a certain extent without touching the contacts. The universal multimeter I (measuring scale 100 mA ~) connected to the central connector displays a current of 100 mA when only one light bulb is connected (screw in the first light bulb until it touches the contact, diagram 1). The value display does not change when the second light bulb is connected (diagram 2). The pointer of measuring instrument drops back to zero when the third phase is connected (screw in the third light bulb 12 V/100 mA, diagram 3) even though all three light bulbs glow. Thus, no current flows through the central connector when current of the equal magnitude flows through all three of the phase leads.

Megjegyzés:

The amplifier in the box – light bulb socket – star connection should not be switched on.

Seeing that the three-phase converter consumes a lot of power, make sure that the box - rechargeable battery 6 V/10 Ah is charged completely, thus ensuring that the three-phase converter works reliably. The box - fixed voltage transformer can, of course, be used in its place.

A delta-kapcsolás

Szükséges eszközök:

	1	Komplett bemutató tábla	DS103-1A
D1	1	Izzófoglalat 3-fázisú delta-kapcsoláshoz	DE720-3D
D1	1	3-fázisú átalakító, 3x13/23 V, mágneses	P3120-3D
E1	1	6V/10Ah akkumulátor, mágneses	P3120-1B
EZ	1	20 db-os sárga mérővezeték készlet	DG507-1S
EZ	1	Lámpa 24V/100mA, E10, 5db-os készlet	DE309-6S



1. ábra



2. ábra

Delta-kapcsolásban a háromfázisú tápegység fázisai közé kapcsoljuk a terheléseket, összesen hármat, a semleges vezető alkalmazása nélkül.

Kísérlet:

Állítsuk össze a kísérletet az ábrának megfelelően.

As compared to the star connection with a potential of 13 volts, the delta connection has a higher potential (23 volts), thus 24 V/100 mA light bulbs are to be used. The three light bulbs are screwed into the box – light bulb socket – delta connection one after the other and the brightness of each bulb is observed.

A háromfázisú szinkronmotor működési elve

Szükséges eszközök:

	1	Komplett bemutató tábla	DS103-1A
S1	1	Tartósín, L=325 mm	DS104-3G
S1	2	Állványtalp, mágneses, L=200 mm	DS102-1G
S1	1	Tartósín, függőleges, 101 mm	DS103-4G
S1	1	Futósín, h=34 mm	DS103-3G
S1	1	Csapágy-egység, rövid	DS402-4B
MAG	1	Lezáró U alakú mágneshez, rögzítővel	DE411-1S
MAG	1	Mágnesű	DE421-1N
E7	1	Rúd mágnes, 1 pár	DE412-1B

Kísérlet:



Ha az U-alakú mágneset kézzel forgatjuk, a mágnesű együtt forog a mágnessel. Másképpen ezt úgy nevezük, hogy **SZINKRONBAN** mozog a mágnessel.

Állítsuk össze a kísérletet az ábrának megfelelően.

The short pivot bearing is mounted on the support stand rail, $l = 325$ mm. The yoke on the support is fastened to the pivot bearing while the block magnets stick to the yoke by magnetic force, thus forming a rotatable magnet.

The rail holder is mounted vertically on the support stand rail over the pivot bearing and the support stand clamp, $h = 34$ mm, holding the inclination needle is fastened to the rail holder.

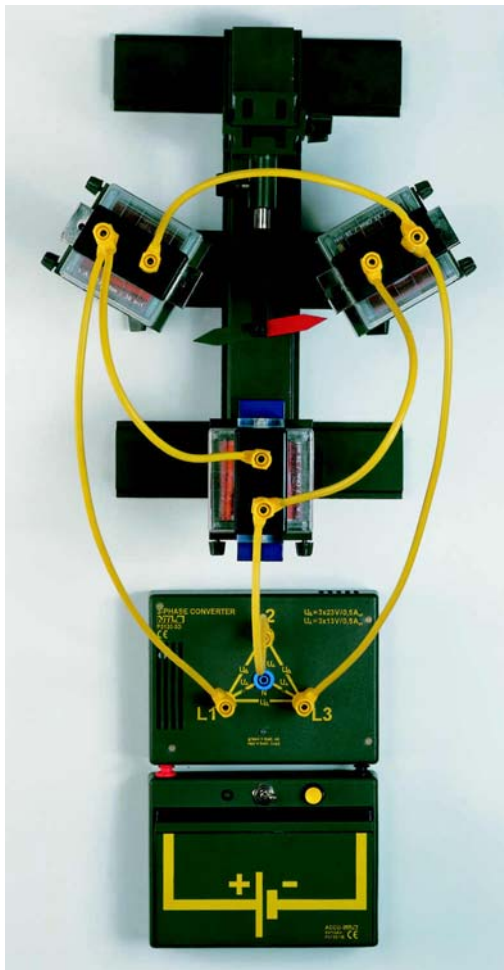
A mágnesűt a mágnesűl kb. 6 cm-re kell elhelyezni, és ügyelni kell, hogy a mágnessel párhuzamosan helyezkedjen el.

A háromfázisú szinkronmotor

Szükséges eszközök:

	1	Komplett bemutató tábla	DS103-1A
S1	1	Tartósín, L=325 mm	DS104-3G
S1	2	Állványtalp, mágneses, L=200 mm	DS102-1G
S1	2	Futósín, h=70 mm	DS103-7G
S1	1	Tartósín, L=325 mm	DS103-4G
S1	2	Tekerstartó csappal	DS407-2G
S1	1	Tekerstartó horonnyal	DS407-3G
S2	2	Futósín, h=34 mm	DS103-3G
S2	1	Állványtalp, mágneses, L=200 mm	DS102-1G
MAG	1	Mágnestű	DE421-1N
E7	1	Lapos csatlakozó	DE454-1F
E7	2	Tömör vasmag, L=92 mm	DE452-1N
E7	1	Vasmag, rövid, lemezelt	DE452-3B
E7/8	3	1200-menetes tekercs	DE453-1E
E1	1	6V/10Ah akkumulátor, mágneses	P3120-1B
D1	1	3-fázisú átalakító, 3x13/23 V, mágneses	P3120-3D
EZ	1	20 db-os sárga mérővezeték készlet	DG507-1S

A magnetic needle within a rotating magnetic field rotates synchronously with the field at the same speed. A magnetic needle at rest in a rotating magnetic field consisting of three coils does not begin to rotate by itself but must be started by hand. It is important to note the sequence of the coils with the corresponding phase leads L1 - L2 - L3.



Exchanging two of the phase leads (e.g. L2 and L3) causes the magnetic needle to stand still; it must be then started again by hand in the opposite direction.

Kísérlet:

Állítsuk össze a kísérletet az ábrának megfelelően.

The support stand rail, $l = 325$ mm, is fitted with three support stand bases. Two support stand clamps, $h = 70$ mm, holding two coil holders with plug pins and two coils with 1200 turns and iron cores, $l = 92$ mm, are mounted on the middle base.

The two support stand clamps may be simply suspended from the support stand base (fastening screws pointing downward). It is not necessary to screw them tight, thus allowing for adjustments (movement).

The third support stand clamp, $h = 34$ mm, is fitted with a coil holder with slit and mounted on the support stand rail. The third coil with 1200 turns is fastened into the coil holder and the laminated iron core with flat plug is inserted into this coil.

The three coils should be arranged at 120° angles to each other. A support stand clamp, $h = 34$ mm, holding the inclination needle is fastened to the vertical rail holder which in turn is mounted on the support stand rail.

The inclination needle should be positioned so that it rotates freely in the center of the three coils approx. 2 mm from the iron cores.

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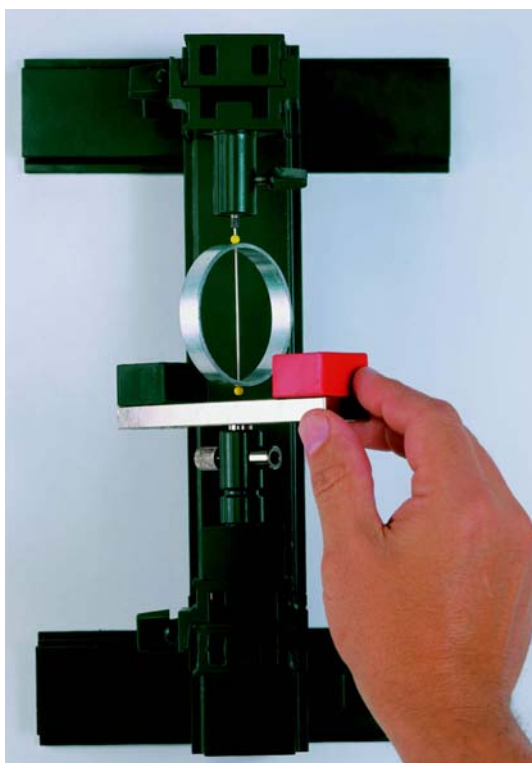
A háromfázisú aszinkron-motor működési elve

Szükséges eszközök:

	1	Komplett bemutató tábla	DS103-1A
S1	1	Tartósín, L=325 mm	DS104-3G
S1	2	Állványtalp, mágneses, L=200 mm	DS102-1G
S1	2	Tartósín, függőleges, 101 mm	DS103-4G
S1	1	Futósín, h=34 mm	DS103-3G
S1	1	Csapágy, csúszó talpon kereszt furattal	DS402-3B
MAG	1	Lezáró U alakú mágneshez, rögzítővel	DE411-1S
MAG	1	Alumínium tárcsa, d=60, rögzítővel	DE454-3A
E7	1	Rúd-mágnes, 1 pár	DE412-1B

Ha az U-alakú mágnezt kézzel forgatjuk, az alumínium-gyűrű együtt forog ugyan a mágnessel, de kisebb sebességgel. Azt mondjuk, hogy az alumínium-gyűrű mozgása nincs szinkronban a mágnes mozgásával, azaz aszinkron módon mozog, csúszás van a mágneses mezőben.

Kísérlet:



Állítsuk össze a kísérletet az ábrának megfelelően.

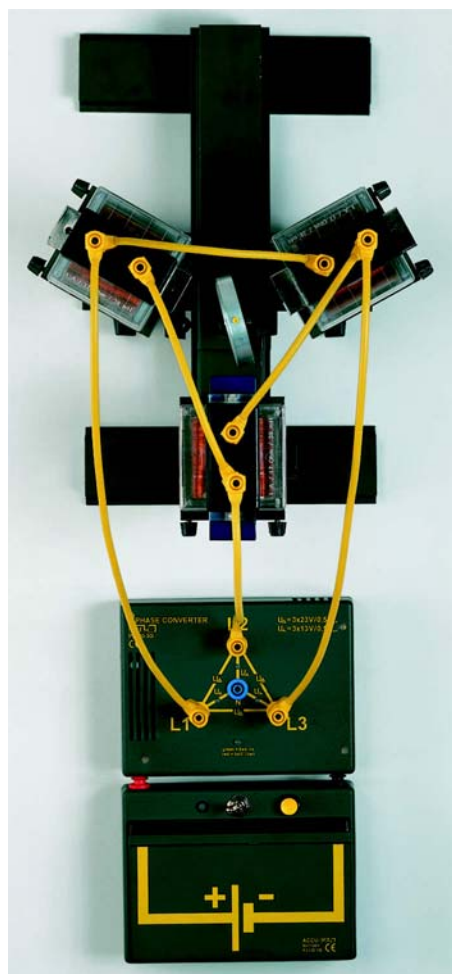
Two vertical rail holders are mounted onto the support stand rail, $l = 325$ mm. The pivot bearing holding the yoke on a support is fastened to the lower of the two rail holders. The pair of block magnets is stuck onto the yoke. The support stand clamp, $h = 34$ mm, holding the rotatable aluminum ring is mounted on the upper rail holder.

A háromfázisú aszinkron-motor

Szükséges eszközök:

	1	Komplett bemutató tábla	DS103-1A
S1	1	Tartósín, L=325 mm	DS104-3G
S1	2	Állványtalp, mágneses, L=200 mm	DS102-1G
S1	2	Futósín, h=70 mm	DS103-7G
S1	1	Tekercstartó horonnyal	DS407-3G
S1	2	Tekercstartó csappal	DS407-2G
S2	2	Futósín, h=34 mm	DS103-3G
S2	1	Állványtalp, mágneses, L=200 mm	DS102-1G
MAG	1	Alumínium tárcsa, d=60, rögzítővel	DE454-3A
E7	2	Tömör vasmag, L=92 mm	DE452-1N
E7	1	Vasmag, rövid, lemezelt	DE452-3B
E7	1	Lapos csatlakozó	DE454-1F
E7/8	3	1200-menetes tekercs	DE453-1E
D1	1	3-fázisú átalakító, 3x13/23 V, mágneses	P3120-3D
E1	1	6V/10Ah akkumulátor, mágneses	P3120-1B
EZ	1	20 db-os sárga mérővezeték készlet	DG507-1S

An aluminum ring (short-circuited rotor) in a rotating magnetic field created by three coils powered by three-phase current rotates. (Unlike the synchronous motor the aluminum ring starts rotating by itself.)



The rotational speed of the aluminum ring is less than the frequency of the rotating magnetic field (slip).

Exchanging two of the phase leads (e.g. L2 and L3) on the three-phase converter causes the ring to rotate in the other direction.

Kísérlet:

Állítsuk össze a kísérletet az ábrának megfelelően.

The support stand rail, $l = 325$ mm, is fitted with three support stand bases. Two support stand clamps, $h = 70$ mm, holding two coil holders with plug pins and two coils with 1200 turns and iron cores, $l = 92$ mm, are mounted on the middle base.

The two support stand clamps may be simply suspended from the support stand base (fastening screws pointing downward). It is not necessary to screw them tight, thus allowing for adjustments (movement).

The third support stand clamp, $h = 34$ mm, is fitted with a coil holder with slit and mounted on the support stand rail.

The third coil with 1200 turns is fastened into the coil holder and the laminated iron core with flat plug is inserted into this coil.

The three coils should be arranged at 120° angles to each other. A support stand clamp, $h = 34$ mm, holding the rotatable aluminum ring on a support is mounted in the middle of the coils.

The aluminum ring should not be more than 2 mm from the iron cores.

A lineáris motor

Szükséges eszközök:

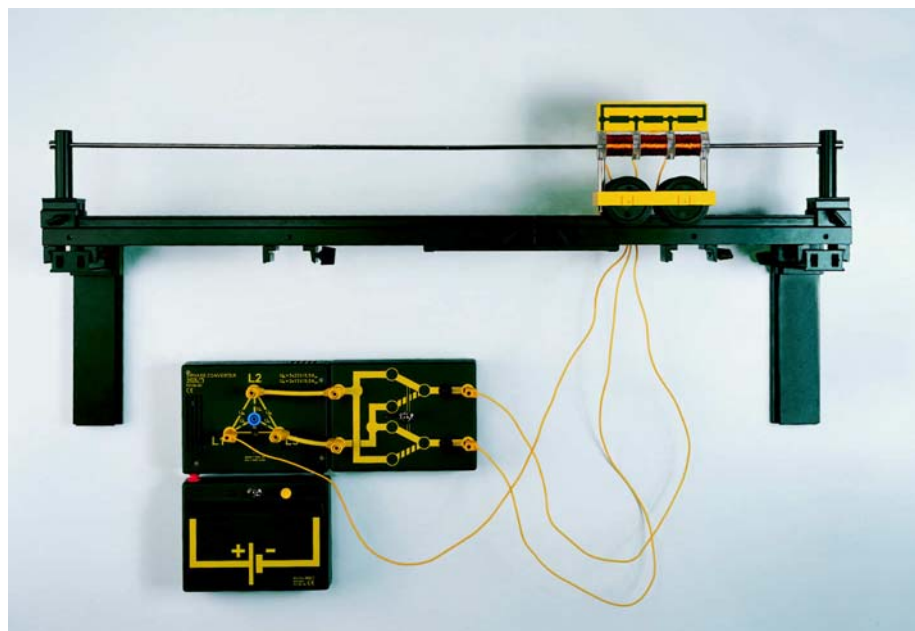
	1	Komplett bemutató tábla	DS103-1A
S1	1	Tartósín, L=325 mm	DS104-3G
S2	1	Tartósín, L=500 mm	DS104-5G
S1/2	3	Állványtalp, mágneses, L=200 mm	DS102-1G
S1	2	Tartósín, függőleges, 101 mm	DS103-4G
S1	2	Futósín, h=70 mm	DS103-7G
MAG	1	Demonstrációs kocsi	DM300-2A
D1	1	Tekerecs lineáris motor modellhez	DE453-4L
D1	1	Osztott acélrúd	DE453-5L
D1	1	3-fázisú átalakító, 3x13/23 V, mágneses	P3120-3D
E1	1	6V/10Ah akkumulátor, mágneses	P3120-1B
E3	1	Polaritás váltó kapcsoló	DE720-1K
EZ	1	20 db-os sárga mérővezeték készlet	DG507-1S

In the case of a three-phase current motor, a rotating field is created using three coils placed at 120° to each other. In the case of a linear motor, with the help of three-phase current and three coils arranged around the axis, a moving field is created which induces current in the iron bar at the center of the coils. The interaction of the magnetic field with the induction current causes a force to bear on the three coils (connected in a delta circuit), moving them along with the experimental wagon. When the phase leads are exchanged (exchange the poles using the two-way switch), the coils and the wagon move in the opposite direction.

Kísérlet:

Állítsuk össze a kísérletet az ábrának megfelelően.

The slider is removed from both support stand rails on the side where the tightening screw is found so that the support stand rail can be fastened to a support stand base.



This makes for a 825 mm long track at the ends of which a rail holder is mounted vertically in a slider.

The rail holder is fastened to two support stand bases serving as magnetic supports. A support stand clamp, h = 70 mm, is placed at each end of the track. The coil accessory for the linear motor is placed on the measuring wagon which in turn is placed on the track. The segmented iron bar, here screwed together, is passed through the hole in one of the support stand

clamps, then through the coil accessory and finally through the hole in the second support stand clamp, fixing it in place with the fastening screws in the clamps.

Megjegyzés:

The poles should be exchanged using the two-way switch before the experimental wagon reaches the end of the track in order to avoid a collision with the slider.