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CLOCK MOVEMENT.

1 This invention relates to clock movements in
accordance with the preamble of Claim 1.

 Such clock movements are known from US Patent
3 945 192. This clock movement has been proved to be
5 successful, more especially on account of the technical
advantages concerned with production, these advantages
consisting in the avoidance of the conventional
mechanism construction between plates which are spaced
apart by means of posts; instead of this arrangement,
10 the mechanism is now formed on both sides of a single
support plate. However, what is disadvantageous is the
considerable constructional depth in the axial direction
of the hand arbors and gearwheel shafts and the use of a
conductor plate for the establishment of an electrical
15 drive-control circuit, at the same time as a functional
constructional part for the mounting of the gearing
mechanism, which imposes high standards as regards both
the material and the fitting of the conductor plate.

 In connection with a clock movement of a similar
20 type, it is known from US Patent 4 263 667 to employ, as
an electromechanical converter, a stepping motor of
which the stator is fixed on the conductor plate in the
same manner as the other structural elements or
components of the time-maintaining, quartz-stabilised
25 driving circuit, namely, it is soldered with connecting
pins passing through the said plate on that side of the
plate which is lined or backed to form conductor paths
or tracks. The stepping motor rotor fits into the rotor
opening between the stator plate pole shoes and is, on
30 the contrary, mounted on a pin, which, in turn, is
anchored parallel to the conductor plate in the front
shell of the two-shell clock movement casing. The wheel
train and indicating or hand mechanism is established on
both sides of an intermediate plate positioned on posts
35 in this front housing shell and is mounted on this
intermediate plate, and also between the front wall of

1 the front casing shell and rear wall of the rear casing
shell. This clock movement has been proved satisfactory
in millions of cases. However, what is a disadvantage
in respect of certain factors as regards the
5 establishment of such clock movements is the relatively
large constructional depth which is caused more
especially by the conductor plate extending parallel to
the clock movement axis and the high standard as regards
production accuracy, on account of the distribution of
10 the mounting positions of the units of the movement on
different constructional parts which are to be connected
in form-locking manner to one another, which may have a
detrimental influence on the efficiency of the stepping
motor, and on the gearing formation, and also on the
15 noise which is produced.

A clock movement of a similar type is known from
US Patent 3 943 695, in which the wheel train and hand
mechanism are assembled in a conventional manner between
two plates spaced apart by posts, in which arrangement
20 one of these plates is at the same time formed with pins
for the positioning of a stepping motor stator which is
rivetted on, a conductor plate for the establishment of
an electronic driving circuit being fixed in spaced
relation on extension of the plate posts parallel to the
25 stepping motor stator. For the connection of coils to
the conductor plate, this distance or spacing is bridged
by a coil-connecting pin, which is anchored in a coil
body carried by the stator plate. The mounting of the
stepping motor rotor is carried out at the bottom of a
30 pot-shaped recess in the plate, onto which the stepping
motor stator is rivetted, while a separate bridge is
established as a second mounting position for the rotor
shaft, which bridge is fixed thereto between the
conductor plate and the mounting plate. This clock
35 movement once again also has the disadvantage of
considerable constructional depth parallel to the
mechanism axis and the disadvantages already mentioned

1 as regards the technical assembly of the gearing wheels
between several plates.

Furthermore, the construction of the mechanism
which is known from US Patent 4 175 374, and which has a
5 mounting in an intermediate plate and in the rear casing
shell, with positioning of the stepping motor stator,
both on the intermediate plate and on the rear casing
shell, and fitting of a circuit conductor plate parallel
to the axes of the wheels, once again produces an
10 undesirably large depth of construction in the direction
of the mechanism axis and with considerable expense
technically as regards assembly for putting the
mechanism together.

In recognition of these disadvantages, the
15 present invention seeks to develop a clock movement of
the type as initially indicated, while retaining its
advantages as regards its function and technical
production arising from the single-plate conception, by
the fact that it provides a wheel train construction and
20 hand mechanism capable of being driven by a stepping
motor and having high functional reliability and a small
degree of noise generation, while being particularly
shallow and capable of being easily mounted, and also
capable of being easily inspected and repaired in the
25 event of a defect.

According to the invention, there is provided a
clock movement with electrical conductors for an
electronic drive-control circuit, the movement having a
support plate for an electromechanical converter which
30 drives a gear wheel train for the movement of an
indicating or hand mechanism in a two-shell mechanism
casing whose arrangement is such that the indicating or
hand mechanism is situated in front of the support plate
and facing the front shell of the casing whilst behind
35 the support plate and facing the rear shell of the
casing, the wheel train is mounted on the support plate
as far as its third wheel which passes with its arbor
through the support plate to engage drivingly in the

indicating or hand mechanism, characterised in that the plane of the substantially flat support plate is traversed by coil connection pins secured in a stator-coil body which is borne by a stepping-motor
5 stator-plate that is retainingly positioned in the region of a rotor opening behind the support plate to bear flat against the latter, whereby the components of said electronic drive-control circuit are arranged in front of the rear shell of the casing adjacent to,
10 and/or beneath the wheels of, said gear wheel train and are fastened onto conductor tracks, and whereby, behind the support plate, the rotor of the stepping motor and the intermediate wheel of said wheel train are taper bore mounted onto pins fixed into the support plate with
15 a restriction of their axial play on the pins due to the rear shell of the casing extending parallel to the support plate, said rear shell having shallow lubricant-collecting holes formed therein in coaxial relationship with said mounting pins.

20 The mounting of a conductor plate can thus be carried out approximately in the plane of the substantially flat support plate and, in fact, directly on said plate, embracing in U-formation the area for the arrangement of the minute and hour wheels of the
25 indicating or hand mechanism and also a pot-shaped, sunken, rotor mounting, so that the casing space in the rear casing shell is available for the components of the electronic circuit to be arranged on the conductor plate, in or above the plane of the support plate, which
30 space is, in any case, present to receive gearing from the stepping motor rotor by way of the seconds wheel to the third wheel. As a consequence, electronic components of relatively small thickness can be arranged beneath gear wheels of larger diameter, in order to have
35 available the fitting space inside the rear casing shell alongside the wheel train for components to be fitted further forwardly at the movement, without it being

1 necessary for the total overall height of the mechanism
to be increased for this purpose. With this
arrangement, the conductor plate no longer has to assume
any mounting functions and is able, as a consequence, to
5 be optimised as regards its electromechanical
requirements. The coil-connecting pins of the stepping
motor stator positioned against the support plate serve
at the same time for the fixed connection of a conductor
plate on that side of the support plate which is
10 opposite the stator, together with the support plate,
during the soldering of the structural elements or
components arranged on the conductor plate.

The establishment of exclusively overhung
bearings for the wheel train on the side of the support
15 plate which is remote from the conductor plate and is
facing the rear wall of the mechanism casing facilitates
functional control of the assembly, since a driving
assembly which can be tested as regards its operation,
and which consists of a conductor plate with an
20 electronic circuit and a support plate with a stepping
motor and a wheel train, can be completely checked
before being assembled and, after this quality check,
can be fitted as a complete unit into the mechanism
housing or casing. On the other hand, as regards
25 automated assembly, it is possible, and it is to be
preferred, that the wheel train is only to be fitted
after the fitting of the driving unit consisting of the
support plate and the conductor plate with its
drive-control circuit.

30 In a manner which is known as regards this
driving assembly, it is expedient to form, on that side
of the support plate remote from the wheel train, a
rigid mounting for sleeves enclosing the hand or
indicating mechanism, which is, at the same time, formed
35 as a hollow elongate cylinder that has an increasing
internal diameter in one piece with the support plate;
it is possible, in this case, for the smallest internal

1 diameter of the hollow cylinder to serve as a mounting
 which has a short axial length and which is thus subject
 to small frictional torques for the seconds hand arbor
 and thus for the seconds wheel arranged on the wheel
 5 train side of the support plate. Since the minutes
 sleeve or tube and the hours tube are rotated
 comparatively slowly, it is of no critical significance
 as regards technical gearing that these long cylindrical
 surfaces rest on one another or on the wall surface of
 10 each hand mechanism mounting beneath the support plate.

In principle, it is also possible to provide for
 the third wheel of the hand mechanism, namely, the
 change wheel, to be mounted in a known manner beneath
 the support plate. In the interest of possibilities as
 15 regards inexpensive production, by the use of automatic
 fitting arrangements and similar auxiliary assembly
 devices, the third or change wheel is, however, mounted
 on a pin formed parallel to the mechanism axis in the
 front casing shell and thus as a single gearing
 20 component by itself in the mechanism casing. This is of
 no critical significance as regards technical gearing
 procedure, since, in any case, a coarse involute
 toothing transmission is possible from the minutes wheel
 pinion, by way of the third or change gear and its
 25 pinion, to the hours wheel, as the slowest running wheels
 of the wheel train, this arrangement being critical as
 regards its noise generation in the event of any
 variations in the depth of tooth engagement (as a result
 of stresses between the casing shells and the support
 30 plate, caused by external strains or loads). On the
 other hand, this mounting procedure provides the
 advantage that, for the assembly of the clock movement,
 with the front casing shell opened upwardly, it is only
 necessary for the hours wheel to be inserted in the
 35 front wall opening and the third or change wheel to be
 on the front wall pin and also thereafter the minutes
 tube to be inserted into the hours tube; with this

1 arrangement, these tubes lying one within the other,
upon insertion of the already mentioned driving
assembly, are centred by the engagement of the hollow
cylindrical support plate attachment (for a seconds hand
5 arbor to be guided therein). After the wheel train has
also been fitted, the clockwork casing only has to be
closed by fitting of the rear casing shell in, once
again, the same assembly direction, the establishment of
the driving unit being effected through its support
10 plate, by contact of the conductor plate with battery
contact springs on the battery chamber formed in the
front casing shell.

So that this fixing of the support plate in the
clock movement casing may be readily accessible, perhaps
15 in the plane of the separation joint of the casing
shells, for example, for inspection purposes, bearing or
pressure shoulders are formed on the side walls of the
casing shells, between which shoulders is tightened the
adjoining marginal region of the support plate in an
20 axially parallel position, when the two casing shells
are screwed tight with one another from the back of the
rear casing shell by anchoring bolts extending in the
aforementioned assembly direction. The screwing
together of the two casing shells has the advantage in
25 this case of providing, when using a torque-type
screwdriver, substantially more definite assembly
factors, and thus fitting conditions for the driving
assembly, than conventionally was the case for the
fitting together of snap-type latching closures which
30 have been used for casings consisting of casing shells;
such snap-type connections are frequently damaged in the
course of an inspection for defects and then are no
longer capable of being used, because it is not apparent
from outside, at least not easily, which snap-closure
35 mechanism holding the casing shells together has to be
operated for opening the casing. Furthermore, the
respect of an expert, such as perhaps a clockmaker or

1 an expert clock dealer, for such a clock movement, is
improved if the expert is able quickly and easily to
open such a timepiece entrusted to him without any
danger of damage, and without experimentation in the
5 presence of the customer.

The production of an electrically conducting
connection of battery terminals in a battery chamber to
a conductor track formation on the lined side of the
conductor plate is already known from the previously
10 mentioned U.S. Patent 4 175 374 and U.S. Patent 3 911
663 where one-part battery contact bridges are used with
initially formed bearing regions on the conductor plate
backing and initially formed battery contact springs
projecting into the terminal end of the battery chamber.
15 However, it is a disadvantage with the known solutions
that the bending stress on the contact bridge at the
time of replacing the battery has the result that the
bearing region over the conductor plate backing becomes
chaffed or worn and damages the said backing, or that
20 contact bearing pressure of the bearing region against
the conductor plate backing is reduced; in each case,
this results in disruptions during operation as a
consequence of the contact action becoming increasingly
less certain. By contrast herewith, it is desirable, in
25 accordance with a further development of the invention,
with a conductor plate sustained by the support plate
and having a lining or backing, to establish a support
shoulder in the vicinity of the bearing shoulders in the
front casing shell for each contact bridge, on which
30 shoulder is supported the resiliently formed bearing
zone, when the conductor plate backing is forced, in
this region, into the front casing shell by the
tightening of the support plate when the casing shells
are screwed together. The elastic deformation thereby
35 occurring of the bearing region which, in other respects,
is fixed, ensures a high contact quality and more
especially avoids contact defects due to bending

1 stresses on the contact bridge when the battery is changed.

While the positioning and supporting of the driving assembly, as such, takes place when the two casing shells are screwed together, it is expedient also for the stepping motor, namely, that end of its stator plate which is remote from the rotor opening, to be gripped between projections formed on the casing shells. What is hereby guaranteed is that, firstly, the stator only has to be accurately positioned in the region of the rotor opening and thus in the region of the gearing connection of the wheel train, while secondly, due to the gripping action between the casing shells, any possible distortion of the stator position, because of the counteracting torque to be taken up by the stator, with the long lever arm of the reach of the stator plate from the rotor opening, can be reliably prevented.

This particular geometry of the stepping motor stator also makes possible the provision of a stepping motor which is economical as regards material and which is highly efficient; this is because a one-layer stator plate whose U-shaped arms are connected by the pole-shoes of narrow pole-shoe bridges which, when magnetised, quickly reach their magnetic saturation point and then act as air gaps, is sufficient (as is known per se for such clock stepping motors) always to achieve the optimum rotor opening geometry without any requirements as regards adjustment; in addition, the long U-shaped arms of the stator plate make possible the use of two or, preferably, even only one axially elongated coil with a thin layer of windings. Because now also the outer coil windings contribute more strongly to the magnetisation of the stator plate than is the case with axially shorter coils with a thicker winding layer, this extended or elongated stepping motor stator produces a particularly high efficiency with an exceptionally small overall height in the direction of

1 the rotor axis, that is to say, transversely of the
direction of length of the stator plate, and of the
housing separation joint, respectively.

5 The magnetic return by way of the free ends of
the U-shaped arms of the stator plate is expediently
effected by a yoke-like plate which is welded on at this
point, as a result of which a low magnetic resistance in
the stator plate magnetic circuit and high dimensional
10 stability of the stator plate are assured, in spite of
very thin pole shoe bridges which, as a consequence, are
sensitive to mechanical deformation.

In accordance with a further development of the
invention, for a stepping motor having a single-layer
stator plate, there is advantageously used a rotor which
15 is, for example, supported in a hollow cylindrical
mounting or frame that is injection-moulded onto the hub
or boss of the stepping motor rotor pinion; this
assembly is also capable of being automated, but is less
liable to error than is a direct moulding of the rotor
20 pinion together with its boss into a fracture-sensitive
hollow rotor cylinder.

Having regard to practical requirements, it is
desirable to be able to switch off the driving means of
the wheel train. This is because it is thereby possible
25 for the hands indicating hours and minutes to be set to
a certain time - by directly engaging the hands in front
of the dial or from the rear of the mechanism, by means
of a setting spindle - and to release the hand-driving
means again when this set time is reached. Within the
30 scope of the present invention, provision is made for
this purpose to dispense with the hitherto usual
construction of an electromechanical circuit-breaking
contact in the train for triggering the stepping motor
from the drive-control circuit; this is because the
35 construction of such a switch usually requires two
additional connecting pins in the electronic
clock-switching circuit and consequently larger

1 dimensions of that circuit; in addition, the ohmic or
resistant contact path to be developed for this purpose
on the conductor plate is sensitive to disruption and is
expensive as regards fitting of the conductor plate into
5 the timepiece casing, having regard to the requirement
concerning the positioning and accessibility of the
switch-operating member. Instead of this arrangement,
provision is made for a latching means to be provided on
the support plate, which means serves at the same time
10 as a mounting and as a position detent for a locking
latch which - manually accessible through the rear wall
of the casing by means of a handle - positively engages
in one locking position of the latch in the teeth of one
wheel train, advantageously of the seconds wheel, so
15 that, despite any further triggering of the stepping
motor from the drive-control circuit, there is no longer
any advance of the hand mechanism. In this connection,
it is not important that it is no longer possible for
the stepping motor to be switched off electrically,
20 because in any case no driving battery is used during
the storage of such large clockwork mechanisms of the
type referred to - in contrast to the usual procedures
with small clockwork mechanisms. The current
consumption with the hand or indicator mechanism blocked
25 is approximately equal to the current consumption during
normal operation and thus has no deleterious influence
on the effective life of the battery.

Since the driving assembly consists of a
substantially flat support plate and of a flat conductor
30 plate which adjoins the latter and is possibly slightly
offset with respect to the plane thereof, it is also
possible, according to a further development of the
invention, for the function of the conductor plate (as a
carrier of components and as an electrical connecting
35 means between the connections of said components) to be
combined with the support plate. For this purpose, and
in a manner which is known per se, a metallic conductor

1 frame network serving for the electrical component
connection and also for mechanical rigidity can be
injection-moulded with the moulding of the support
plate; alternatively, an enlarged support plate is used,
5 which support plate is provided with suitably extending
printed conductor tracks. In both cases, the production
and fixing of a separate conductor plate becomes
completely superfluous. With the injection moulding of
a conductor frame zone adjoining, or connected to, the
10 support plate bearing zone, or with the formation of a
printed support plate, it is possible at the same time
to establish shapes, bulges and the like and also
recesses for the electromechanical connections, which
are also of assistance for the positioning of the
15 components to be welded thereon together with their
electrical connections and with an even more greatly
reduced overall height (thickness) of the clock
movement.

Further features and advantages of the invention
20 will be apparent from the following description of two
preferred constructional examples for solving the
problem according to the invention, these being shown to
an enlarged scale in the drawings, wherein:-

Figure 1 is a rear view of a clock movement with
25 its rear casing shell removed,

Figure 2 is a section, to an enlarged scale,
taken on the line II-II in Figure 1, but with the rear
casing shell fitted,

Figure 3 is a partial section to a further
30 enlarged scale, taken on the line III-III in Figure 1,

Figure 4 is a section to the same scale as Figure
3, taken on the line IV-IV in Figure 1, in this case
with the rear casing shell fitted, and

Figure 5 is an elevational view of a driving
35 assembly, which here is only equipped with a motor
stator and with electronic structural elements, but as a
modification of what is represented according to Figure

1, in a construction having conductor tracks which are printed or sprayed on, for a conductor plate moulded onto the support plate.

Throughout this document, that side of the clock movement which, in the use of a timepiece in which it is employed, has its dial facing a user of the timepiece, is considered as being the "front" or "top" of the movement and the document should be interpreted accordingly.

Referring to the drawings, a clock movement 1 comprises a two-shell casing, of which, in Figure 1, only the front casing shell 2 - fitted with the components of the functional mechanism - is illustrated in elevation, facing its separation gap end surface 3.

Fitted into the front casing shell 2 is a driving assembly 4. This assembly 4 comprises, essentially, a support plate 5, behind which is fixed a conductor plate 7 that is, in fact, disposed parallel to a casing front wall 6 and facing the latter. The support plate 5 is disposed approximately in the parting line 8 of the casing shells (see Figure 2) and carries above it, i.e. facing the rearward casing shell 9, an extended stepping motor stator 10 projecting beyond one edge of the support plate 5 and a stepping motor rotor 11, as well as a complete wheel mechanism 12, consisting of an intermediate wheel or idler 13 driven by the rotor 11, a seconds wheel 14 driven by the wheel 13 and a so-called third wheel 15a, which is driven by the seconds wheel 14.

Arranged on the conductor plate 7, that is to say, also in the direction of the rear casing shell 9, are electronic components 15 for an electronic drive-control circuit for the time-proportional driving of the wheel mechanism 12, as regards which components 15 there may be an integrated circuit and a vibrating quartz and, possibly, also an adjustment member for adjustment of the time-maintaining vibration frequency of said quartz.

Provided at the bottom in the arrangement as shown in the drawings, i.e. towards the inside of the casing front wall 6 and in front of the support plate 5, and as will be more particularly apparent from Figure 3 in association with Figure 4, is the hand mechanism 16.

1 This mechanism 16 consists of a minutes wheel 17, which
is driven by a third wheel drive 18 extending through
the support plate 5 and which, in its turn, drives a
change gear 19, which drives an hour wheel 20, this
5 being known per se for the driving or gearing chain of a
clockwork mechanism. The hour wheel 20 is, for example,
formed in one piece with an hour sleeve or tube 21 as a
shaft for accomodating an hour hand, whereas the minutes
wheel 17 has formed thereon a minutes tube 22, with
10 formation of a friction coupling, the said tube 22
preferably carrying at its free end a profiled bushing
23 for the fixing of the minutes hand (see Figure 4).

The conductor plate is made flat and
substantially rectangular, but is provided with a wide
15 marginal recess 24, towards a battery chamber 25 formed
in the front casing shell 2, which latter the conductor
plate 7 embraces in U-form in that region behind which
is the support plate 5 on which are mounted the wheel
mechanism 12 and the rotor 11 of the stepping motor
20 serving as an electromechanical converter for the
driving of the wheel mechanism 12. The conductor plate
7 is supported non-positively on that side of the plate
5 facing the casing front wall 6 by means of clamping
pins 26 which are formed on the plate and onto which the
25 conducting plate 7 is pressed by means of positioning
bores 27 until it bears against a stop 28 formed on a
clamping pin 26 (Figure 2). An additional, tight
connection is also provided by pins 29, which serve at
the same time as coil-connecting pins for the winding
30 ends of a stator coil 30 of the stepping motor. These
pins 29 are injected into the synthetic plastics coil
body 31 and project, as do the components 15 fixed on
the conducting plate 7, through conductor plate bores
32, so as to be soldered onto the conductor track
35 backing or lining (see Figures 1 and 4).

The stator coil 30 is held by a stator plate 34,
without the coil 30 or its coil body 31 bearing on the

1 conductor plate 7. What is hereby assured is that the
dimensional tolerances of the conductor plate 7 itself,
or assembly tolerances at the time of being pressed onto
the clamping pins 26, have no influence on the size
5 accuracy between a rotor opening 35 of simple circular
geometry (in that end of the extended stator plate 34
carried by the support plate 5) provided with recesses
84, determining the direction of rotation and a rotor
mounting 36 in a recess in the support plate 5, and that
10 therefore, despite mechanised mass production, an
identical and reproducible torque of the stepping motor
is assured as a consequence of the reproducible torque
of the stepping motor, due to a fixedly established
spacing between the rotor mounting 36 and the rotor
15 opening 35. Furthermore, those pole shoes 37 of the
stator plate 34 which encompass and thus partially
define the rotor opening 35 are firmly connected
together by continuous pole shoe bridge 38 and a split
pole shoe bridge 38', the bridge 38 being so thin that
20 it consequently quickly reaches the stage of magnetic
saturation. A positioning stud 39 formed axially
parallel with the rotor mounting 36 on the supporting
plate 5 positively engages in a positioning eye 40,
which is formed adjacent the rotor opening 35 at the
25 front end of that region of the stator plate 34 which
bears flat on the support plate 5. Furthermore, for the
positioning of the stator plate 34 on the support plate
5, a slot 41 is formed in that region of the stator 10
which is diametrically opposite with respect to the
30 positioning eye 40 and the rotor opening 35, in which
region is non-fixedly engaged an additional positioning
bolt or pin 42 formed on the support plate 5.

By means of the two pole-shoe bridges 38 and 38',
which are surrounded by the rotor opening 35 and by
35 lateral, arcuate rimming cut-outs 43 between the pole
shoes 37, two relatively long arms or sides 44 of the
single-layer stator plate 34 are connected in one piece

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1 (integrally) to one another and are, in fact, stamped
out from a single metal sheet. Adjoining that inwardly
disposed one of the two recesses or cut-outs 43, i.e.
lengthwise of the U-shaped arms 44, is a rectangular
5 field-deflecting recess 45 of a narrow arm interstice
46, which recess 45 reduces the arm width for a short
distance, as a result of which any return of the
magnetic field lines at the adjacent end of the stator
coil 30 is here effectively prevented, without passage
10 through the corresponding pole shoe 37 and by way of the
rotor opening 35. The diameter of the coil body 31 and
hence also of the winding of the stator coil 30 is
approximately as large as the internal width of the
stator arm interstice 46. Consequently, the winding or
15 coil layer 47 of the stator coil 30 on the long coil
body 31 is small in relation to the length 48 of the
coil, which in total provides a good electromagnetic
efficiency, because of a small spacing of the individual
turns of the coil relatively to the coil core in the
20 form of the U-shaped arms 44 passing therethrough and
hence an efficient stepping motor.

Serving for the magnetic return of the magnetic
lines of force passing through the stator plate 34, and
also the mechanical stability in order to maintain the
25 accuracy to size of the stator 10 in the region of the
rotor opening 35, is a yoke-shaped plate 49, which is
arranged above the two rearward, free arm or leg ends 50
- for example, in the form of a Laser welded connection.

Used for the permanent magnet rotor 11 of the
30 stepping motor is a thick-walled hollow cylinder. To
avoid the conventional construction of a rotor, there is
advantageously no injection of a synthetic plastics boss
with a pinion into the hollow cylindrical rotor
permanent magnet, since connected with this was
35 considerable mechanical radial stressing of the hollow
cylinder at the time of injection and with the cooling
of the synthetic plastics member. Instead, the rotor 11

1 consists of a plastics pinion 51 with a hub or boss 52
moulded thereon and a dish-shaped or plate-shaped
fitting or holder 53 formed coaxially thereof, in the
form of a projecting and encircling collar flange with
5 an encircling fitting wall on the rim. In this fitting
or holder 53, a hollow cylindrical permanent magnet 54
is fixed, for example, stuck coaxially with one end
face or is, for example, advantageously simply pressed
in, as will be apparent from the section view in Figure
10 2.

The positioning of the stepping motor in the
clockwork mechanism 1 is effected, firstly, by way of
the support plate 5 and, secondly, between the two
casing shells 2/9, approximately in the plane of the
15 casing parting line or joint 8 and parallel thereto.
For this purpose, those arm ends 50 which are connected
to one another by means of the yoke-shaped plate 49 and
which form part of that region of the stator plate 34
projecting through the support plate 5 are gripped, as
20 will be apparent from Figure 1, when the front and rear
casing shells 2/9 are assembled, between a support
projection 55 on the adjacent inside wall of the front
casing shell 2 and support projections 56 (indicated in
broken lines in Figure 1) on the corresponding inside
25 wall of the rear casing shell 9; the support plate 5, on
which is secured the opposite end region of the stator
plate arm 44 with the pole shoes 37 embracing the rotor
11, lies parallel to this supporting direction and thus
in axially parallel relationship with the mechanism axis
30 between supporting shoulders 57 and pressure-applying
shoulders 58. These shoulders 57/58 (Figure 4) are
tightened in relation to one another by anchoring screws
or bolts 59, which serve at the same time for screwing
the rear casing shell 9 onto the front casing shell 2.
35 For a distortion-free installation of the support plate
5 with a stepping motor fixed thereon, slots 60 are
formed in the margin of the support plate, which slots

1 engage in U-shaped form around a collar 61 projecting
outwardly from the supporting shoulders 57 and, in this
collar, at the time of assembling the casing shells 2/9,
the anchoring bolts 59 formed with self-tapping threads
5 are guided (Figure 1 and Figure 4).

During this tightening of the support plate 5,
together with the stepping motor, between the casing
shells 2/9, there is also effected the elecomechanical
contacting of the backing beneath the conductor plate 7
10 with battery contact springs 62 projecting into the
battery chamber 25, which chamber extends in the front
casing shell 2 alongside the support plate 5. These
springs 62 are formed in one piece with a contact bridge
63 and a bearing zone 64, the one end of the contact
15 bridge 63 being arranged along one side wall of the
front casing shell 2 and projecting into the battery
chamber 25 serving as the actual battery contact spring
62, while the opposite end of the contact bridge 63 is
bent over and extends at an angle to it and is fitted
20 with a positioning lug 65, by means of which the contact
bridge 63 is positioned on a post 66 formed in the front
casing shell 2 on its front wall parallel to the
mechanism axis of the clock movement. Formed on this
post 66 are the collar 61 for the positioning of the
25 support plate 5, behind it the supporting shoulder 57
for the tightening of the support plate 5 and
therebehind an additional supporting shoulder 67, on
which bears the positioning lug 65 of the contact bridge
63. The annular marginal region surrounding the
30 positioning lug 65 is arched upwardly, in order to serve
as a resilient bearing zone 64 for the backing beneath
the conductor plate 7, which is pressed by means of a
support projection 68a, formed beneath the support plate
5, with the clamping of the said plate between the
35 casing shells 2/9, against the bearing zone 64, in order
to produce the electrical connection from the associated
battery terminal to the conductor track formation on the

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1 conductor plate backing.

5 As is shown from the foregoing description of the fitting of the support plate 5 between the casing shells 2/9 with contacting of the conductor plate backing or lining, the clock movement 1 is designed for the purpose of being completed by insertion of the hand mechanism 16 into the forwardly opened front casing shell 2 and also insertion of the driving assembly 4, which can be equipped beforehand, between the casing shells 2/9 during the assembly thereof - with a uniform fitting and mounting direction, also as regards the insertion of the gear wheel train 12 into the driving assembly 4 which has already been previously inserted. In this connection, the front casing shell 2 has exclusively the function of a mounting for the third or change wheel or gear 19, by the latter being fitted on to a pin, stud or arbor (see Figure 4), which is formed on the inside of the front wall 6. all other bearings of the gear wheel train 12 and of the hand mechanism 16 are formed directly (or indirectly, as regards the hour wheel 20) on the support plate 5. As a consequence, since the casing shells 2/9 for the mechanism do not have any functions for mounting purposes - with the exception of the third or change wheel 19, which does however have a coarse involute toothing which is non-critical as regards its function between wheels which, in any case, rotate non-critically slowly, the result is that, independently of the actual fitting factors concerning the clock movement 1, which has to serve, for example, as a support of a heavy dial or plate and is thereby mechanically stressed, there is always ensured an exact gear-tooth engagement of the stepping motor rotor pinion 51 by way of the gearing wheels and thus an operation insensitive to disruption without fluctuating factors as regards the exerted torque or the generation of noise.

35 The drive assembly 4, which can be functionally assembled in advance, independently of the completion of

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1 the mechanical movement 1, is equipped with pins 68 (see
Figure 2) serving as stub shafts for the rotor 11 and
for the gear wheel train 12 which pins 68 are forced
into that surface of the support plate 5 which faces the
5 rear casing shell 9 and is formed with sockets and
recesses, onto which plate 5 are fitted, for axial
displacement, the rotor boss 52 with the permanent
magnet 54 and the intermediate or idler wheel 13. The
seconds wheel 14, injection-moulded onto a seconds hand
10 arbor 69, is held by the said arbor 69, which is, in its
turn, guided radially in an extended hollow cylindrical
member 70, which is formed on that side of the support
plate 5 that faces the front casing wall 6 and that is
extended into a passage 71 for the hand arbors in the
15 casing front wall 6. This cylindrical member or sleeve
70 has an internal diameter which is slightly conically
enlarged in the direction of the casing front wall, the
radial mounting of the seconds hand arbor 69 being
effected in the region of the support plate 5, where the
20 internal diameter is constant and approximately
cylindrical. Since the third wheel 15a on the end of a
stub shaft 72 has its pinion 18 engaging on the opposite
side of the support plate 5 in the hand mechanism 16,
said wheel 15a is radially mounted in a sleeve 73 formed
25 on the support plate 5 with the bore extending through
that plate 5. The axial support of the rotor 11 and of
the hand mechanism 16 on the side opposite to that of
the support plate 5 is effected by the inside surface 74
of the housing rear wall 75. Shallow cylindrical blind
30 holes are provided on the inside in the rear wall 75
opposite the arbors of the fast-running gearing parts,
namely, opposite the pins 68 of the rotor 11 and of the
intermediate gear 13 and also opposite the rearward end
of the seconds hand arbor 69, the holes serving as oil
35 traps and preventing any migration of the gearing oil
from the fast-running gearing parts along the rear
inside wall 74.

1 The cylindrical external surface of the long,
hollow, cylindrical member or sleeve 70 which is behind
the front side of the support plate 5 serves in that
region which is offset axially in relation to the
5 bearing position of the seconds hand arbor 69 as a
radial bearing for the minutes tube or sleeve 22 which,
in its turn, carries, as a radial bearing the hour tube
or sleeve 21, which both extend from the front casing
shell 2 through the opening 71 in the front wall. The
10 forward end of the seconds hand arbor 69 is once again
radially mounted in the shaped seating 23 in the minute
tube or sleeve in known manner. The axial fixing of the
hand mechanism 16 is effected, with axial support
relatively to one another, between the inside of the
15 casing front wall 6 and the adjoining surface of the
support plate 5.

As will be seen in Figure 1, a latch holder 77 is
also formed on the support plate 5 and is preferably
moulded as a profiled rib, this serving as the support
20 and guideway of a stop latch 78, which projects with a
movable handle through a guide slot 82 in the casing
rear wall 75. Formed on the latch 78 is an arm 80 which
ends with a latching claw 79. In that one of the two
latching positions which is shown in Figure 1, the claw
25 79 engages in the tothing of the seconds wheel 14, as a
result of which the movement of the wheel train and hand
mechanism, that is to say, the drive means for the
hands, is prevented, despite the stepping motor still
receiving driving pulses. By displacement of the latch
30 78 into the other position, this engagement and thus the
mechanical stoppage of the mechanism is cancelled, for
example, in order once again to allow movement of the
hands, for example, after manual rotation of a setting
shaft 83, when a prescribed moment in time is reached.

35 As a modification of the features which have been
dealt with in Figure 1, the drive assembly 4' according
to Figure 5 does not consist of a support plate 5 and an

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1 initially separate conductor plate 7 for the mounting of
the electric circuit. Rather is a support plate 5' now
extended also substantially over that surface within the
clock movement 1 which was previously occupied by the
5 conductor plate 7 (Figure 1); the plastics material of
the support plate 5' is, for example, moulded around a
previously formed conductor frame network 81, which
serves both for the mechanical stiffening of the support
plate 5' and also more particularly for the formation of
10 the electrical connections between the individual
components 15 of the switching circuit. These
components are arranged in the same manner as also
represented in Figure 1. However, it is also possible;
instead, to provide for the support plate to be equipped
15 with receiving channels which extend transversely of the
conductor plate plane and as a result make possible a
tighter packing of thicker components in the regions
bridged by the wheel train 12. In addition, it may be
expedient to insert a module instead of the separate
20 components 15, in which module the vibrating quartz and
the integrated switching circuit for the electronic
drive control circuit, possibly, with separable
conductors for a digital frequency adjustment as a
substitute of a trimmer condenser, are combined
25 electrically and mechanically. The conductor frame
network 81 is thus reduced to some insignificant
conductor channels between the battery contact support
regions 64 (see Figure 1), the stator coil connecting
pins 29 and such a module.

30 In the drawing, it has been considered to be
sufficient if one of the two pole-shoe bridges 38 is
closed, while the other, advantageously the pole-shoe
bridge 38' further from the coil, has a slot 85 in the
longitudinal axis of the stator. It has in fact
35 surprisingly been found that such a very narrow slot can
also still be provided after the heat treatment of the
stator plate 34 (by stamping or sawing), namely, after

1 mechanical stiffening of the stator frame by application
to the back of the previously stamped-out yoke plate 49,
without thereby - even with an unchanged position of the
recesses 43 with respect to two closed pole-shoe bridges
5 38 - the efficiency of the stator being impaired. On
the other hand, the provision of such a narrow slot 85
gives the advantage of making possible, by this removal
of material, a fine balancing of the electromagnetic
effects in the region of the pole-shoe 37.

10 The invention thus produces an extremely reliably
functioning clock movement which is, at the same time,
extremely thin and flat. The main element determining
the function thereof is the assembly which can be
pre-mounted externally and which consists of the support
15 plate 5 for the mounting of the hands and wheel train
and the stepping motor 10-11 and also of the conductor
plate 7, equipped with the electronic components 15.
This constructional group is so assembled and placed in
the casing shells 2/9 of the clock movement 1 that a
20 central fixing between the front casing shell 2 and a
dial plate support is still possible, despite the small
total depth of the mechanism. Even with the tight
screwing on of heavy dial plate supports (fittings)
which are then to be supported by the mechanism, there
25 is no longer any danger of this loading of the front
casing shell 2 leading to disadvantageous effects as
regards the functioning of the mechanism, more
especially the engagement of teeth and the positioning
of the rotor on the stator, because these forces are
30 absorbed by the casing shells themselves, that is, are
conducted around the functionally critical components on
the support plate 5. These functionally critical parts
of the mechanism 1 are, in addition, enclosed in a
dust-tight manner by the two casing shells, so that any
35 functional disruptions due to penetration of foreign
bodies, such as dust particles, are prevented. The
powerful tightening operation by means of the anchor

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1 bolts 59 between the two casing shells 2-9 not only ensures resistance to distortion of the clock movement as a whole but, in addition, more especially also ensures a reliable and strong bearing pressure of the
5 battery contact springs 62 against the contacting support regions 64 of the conductor plate 7.

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1 CLAIMS.

1. A clock movement with electrical conductors for an electronic drive-control circuit, the movement having a support plate for an electromechanical
5 convertor which drives a gear wheel train for the movement of an indicating or hand mechanism in a two-shell mechanism casing whose arrangement is such that the indicating or hand mechanism is situated in front of the support plate and facing the front shell of
10 the casing whilst, behind the support plate and facing the rear shell of the casing, the wheel train is mounted on the support plate as far as its third wheel which passes with its arbor through the support plate to engage drivingly in the indicating or hand mechanism,
15 characterised in that the plane of the substantially flat support plate is traversed by coil connection pins secured in a stator-coil body which is borne by a stepping-motor stator-plate that is retainingly positioned in the region of a rotor opening behind the
20 support plate to bear flat against the latter, whereby the components of said electronic drive-control circuit are arranged in front of the rear shell of the casing adjacent to, and/or beneath the wheels of, said gear wheel train and are fastened onto conductor tracks, and
25 whereby, behind the support plate, the rotor of the stepping motor and the intermediate wheel of said wheel train are taper bore mounted onto pins fixed into the support plate with a restriction of their axial play on the pins due to the rear shell of the casing extending
30 parallel to the support plate, said rear shell having shallow lubricant-collecting holes formed therein in coaxial relationship with said mounting pins.

2. A clock movement according to Claim 1, wherein, behind the support plate, the stepping-motor
35 rotor is taper bore mounted in front of the rotor opening on a rotor mounting secured in an indentation in the support plate.



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1 3. A clock movement according to Claim 1 or 2,
characterised in that a hollow cylindrical member or
sleeve is formed in front of the support plate for the
mounting of the hour and minute tubes or sleeves, guided
5 one within the other, the internal diameter of the
sleeve being tapered in a conical form and, in the
region of its smallest diameter, extending somewhat over
the thickness of the support plate, where it merges into
a hollow cylinder which radially supports the seconds
10 hand arbor, against which, and behind the support plate,
the seconds wheel is axially supported.

4. A clock movement according to Claim 3,
characterised in that a bearing journal for the radial
mounting of a third or change wheel is formed in the
15 front casing shell on the casing front wall, which third
or change wheel is coupled fast in rotation, by way of
coarse involute toothing, with the driven pinion of the
minute tube, with the hours wheel and with the pinion of
a setting shaft or arbor similarly supported by the
20 front casing shell.

5. A clock movement according to any preceding
claim, characterised in that, in the region of posts for
receiving anchor bolts for the connection of the casing
shells to one another axially of the gearing, relatively
25 facing supporting or pressure shoulders are formed on
the two shells approximately in the plane of the
separation joint thereof, between which shoulders is
engaged, by means of said anchor bolts, an adjacent
marginal region of the support plate of the complete
30 driving assembly, which support plate is fitted in
advance with the gear wheel train.

6. A clock movement according to Claim 5,
characterised in that each supporting post has formed
thereon a supporting shoulder on which is fixed a
35 contact bridge projecting as a battery contact spring
into a battery chamber in the front casing shell, the
bridge having a bearing region arched resiliently in a

(A)



1 direction towards the support plate and transversely of
its springing direction, which bearing region is pressed
against conductor tracks formed on a lining of the
conductor plate by the support plate fitted between said
5 shoulders of the casing shells.

7. A clock movement according to any preceding
claim, characterised in that the stator plate of the
stepping motor is gripped axially of the gearing between
bearing and supporting projections at the end thereof
10 opposite the rotor opening, which projections are formed
in the casing shells so as to face one another
approximately in the plane of the surface of the
separation joints.

8. A clock movement according to any preceding
15 claim, characterised in that the stepping motor
comprises a single-layer stator plate, which consists of
two arms that are connected to one another in U-shaped
form through a pole-shoe and are of relatively great
length in relation to their breadth, the rotor opening
20 being defined by two relatively narrow pole shoe bridges
connecting the pole shoes to one another and one of the
arms being fitted with a stator coil of relatively large
coil length having a winding layer which is thin in
comparison therewith.

25 9. A clock movement according to Claim 8,
characterised in that the rotor opening in the stator
plate is partially defined by two relatively thin pole
shoe bridges connecting the pole shoes to one another,
and in that the stator plate arms, equipped with at
30 least one stator coil, are rigidly connected to one
another at their ends opposite the pole shoes by a
yoke-like plate.

10. A clock movement according to Claim 7, 8 or
9, characterised in that indentations determining the
35 direction of rotation are formed in the rotor opening
and field-deflecting indentations are formed adjacent
the pole shoes in an arm interstice.



1 11. A clock movement according to any preceding
claim, characterised in that the rotor mounting is
anchored in an indentation of the support plate and
comprises, in the rotor opening of the stepping motor
5 stator plate, a hollow cylindrical permanent magnet
which is fixed in a plate-shaped frame or mounting that
is formed in a boss or hub of the rotor pinion.

 12. A clock movement according to any preceding
claim, characterised in that a latch support for a
10 stopping latch which is displaceable between two
positions and which projects through the rear wall of
the casing is provided behind the support plate and on
the latter, which latch is provided with a latching claw
that can be moved into engagement with the teeth of the
15 seconds wheel.

 13. A clock movement according to any preceding
claim, characterised in that said conductor tracks for
connection of the components of the electronic
drive-control circuit line a conductor plate, which
20 conductor plate is maintained at a small distance in
front of the substantially flat support plate by the
latter, and is connected with said support plate by
means of pins, these pins being soldered onto the
conductor track lining of the conductor plate, whereby
25 the conductor plate arcuately encompasses the area
occupied in front of the support plate by the minutes
wheel and the hours wheel of the indicating or hand
mechanism and supports the components in front of the
rear casing wall.

30 14. A clock movement according to any of Claims
1 to 12, characterised in that the conductor tracks for
connection of the components are formed as a network
which is arranged on a widened support plate.

 15. A clock movement according to any preceding
35 claim, characterised in that its stator plate comprises
a slotted pole-shoe bridge.

 16. A clock movement substantially as



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1 hereinbefore described with reference to Figure 1 to 4
or Figures 1 to 4 as modified by Figure 5 of the
accompanying drawings.

17. A clock or other timepiece having a movement
5 as claimed in any preceding claim.

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