Enlarged view of movement

Lever movement
Automatic winding, sweep second

Technical and practical communication for the use of the watch repairer
1. Characteristics

ETA 2450 10½, oscillating weight with heavy-metal rim.
ETA 2451 11½, oscillating weight with heavy-metal rim.
ETA 2452 11½, oscillating weight with heavy metal rim, date mechanism.
ETA 2453 11½, brass oscillating weight.
ETA 2454 11½, brass oscillating weight, date mechanism.
ETA 2472 11½, oscillating weight with heavy-metal rim, instantaneous date mechanism.

2. Disassembling

2.1. Disassembling the automatic device

2.1.1. Loosen both screws 51.134 of framework of complete automatic device.
2.1.2. Disengage complete automatic device 1130 and turn it upside down on the bench.
2.1.3. Loosen screw 51.498 of bearing wheel.
2.1.4. Disengage complete automatic device from oscillating weight 1143/1.
2.1.5. Using a screwdriver, open bolt 1525 of reduction gear.

2.2. Disassembling the barrel bridge

2.2.1. Loosen screw 51.15 of ratchet wheel and remove ratchet wheel 415.

3. ETA 2474 11½, brass oscillating weight, instantaneous date mechanism.

Except for the oscillating weight, the automatic winding device is identical in all the calibers listed above.

3.1.6. Remove reduction gear 1481 and driving gear for ratchet wheel 1482 from their respective posts.
3.1.7. Turn framework of automatic device over.
3.1.8. Disengage bolt 1576 of pawl winding wheel so that its cut-away portion is opposite the post of one of the wheels, then remove that pawl winding wheel from its post.
3.1.9. Deal with the other pawl winding wheel in the same way.

3.2.2. Loosen screws 5105 of barrel bridge.
3.2.3. Remove barrel bridge 105 and take out barrel 180/2.
3. Replacing the mainspring

IMPORTANT: When mainspring 770 and its brake spring 775 are functioning normally, it is unnecessary to take them out of the barrel. The brake spring should slip only after 6 turns of wind, which corresponds to a power reserve of about 40 hours. If damage has occurred to the mainspring or brake spring, they must be replaced by high-grade springs only. The barrel is made in two different types, and therefore it is important to know whether:

3. 1. The barrel has a wide groove machined in the inside wall of the drum.
3. 2. The barrel has a plain inside wall.

Now select mainspring and bridge according to the following table:

<table>
<thead>
<tr>
<th>Mainspring</th>
<th>H. 1.33 mm</th>
<th>T. 0.105 mm</th>
<th>L. 33 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake spring version 3.1</td>
<td>H. 1.16 mm</td>
<td>T. 0.175 mm</td>
<td>L. 33 mm</td>
</tr>
<tr>
<td>Brake spring version 3.2</td>
<td>H. 1.29 mm</td>
<td>T. 0.16 mm</td>
<td>L. 32.5 mm</td>
</tr>
</tbody>
</table>

Lightly grease inside wall of barrel over its entire circumference. Grease mainspring and fit it into barrel by means of a suitable mainspring-winder. If fitted with any other tool, the spring would be damaged and would lose its propriety. Then oil barrel arbor 195 of its pivotal points and fit it in position, making sure that eye of mainspring is correctly shaped. Fit on lid to close barrel and check endshake of barrel arbor, as well as number of turns of wind as far as slipping limit of brake spring.

Slipping should be smooth and even, without jerks or jars.

4. 4. Oil both bridge and plate bearings.
4. 5. Fit ratchet wheel and screw it tight.

5. Assembling the automatic device

5. 1. Apply a small drop of fine oil to the four pawl pivots, i.e. two on each of top disks of pawl winding wheels.
5. 2. Fit pawl winding wheels on their respective posts, proceeding as follows:
5. 2. 1. Turn bolt so that its cut-away portion is opposite post of wheel that is being fitted.
5. 2. 2. Fit pawl winding wheel on to post.
5. 2. 3. Turn bolt towards post of the other pawl winding wheel.
5. 2. 4. Fit the other pawl winding wheel.
5. 2. 5. Turn bolt so that its cut-away portion is facing away from the two pawl winding wheels.
5. 3. Turn framework of automatic device over. Open bolt of reduction gear. Fit driving gear of ratchet wheel with its pinion upwards and reduction gear with its pinion downwards.
5. 4. Bring bolt back against wall of recess by turning it in reverse.
5. 5. Check endshake, using a suitable tool (small riveting tool with flat end drilled with a hole 0.32 to 0.33 mm in diameter) or a pair of tweezers. Train of automatic device must run freely in either direction.
5. 6. Oilings:
5. 6. 1. Oil bearings of pawl winding wheels with train oil.
5. 6. 2. Oil posts of the two lower wheels, preferably with barrel oil.
5. 7. To help oscillating weight to swing easily, clean the two cones inside tube of bearing with a piece of sharpened pegwood, to remove any galvanic deposit.
5. 8. Fit framework of automatic device in position on oscillating weight. Arbor of bearing wheel should turn inside tube driven into center of framework of automatic device.
5. 9. Fit screw of bearing wheel (60° taper head) in position.
5. 10. Adjust endshake of oscillating weight.

If there is too little shake, increase it by removing material from cone inside tube, using a 60° milling cutter.
If there is too much shake, reduce it by removing material from cone inside spindle (thrust point of screw), using a 60° milling cutter.

Once adjusted, there should be about 0.32 mm endshake at center of oscillating weight.
5. 11. Apply thick oil to bearing of oscillating weight.
5. 12. Drive screw of bearing home, using a screwdriver with a blade diameter ¼ that of the screw head.
5. 13. Fit framework of automatic device in position; to facilitate meshing of pinion of driving wheel of ratchet wheel with ratchet wheel, and before finally fitting the device, it is advisable to turn winding soon slightly in the winding direction.
5. 14. Drive both screw of automatic device home.
5. 15. Check oscillating weight for free running. Wind barrel by turning winding stem a few turns; holding the movement stationary, turn it slowly a few times. Repeat this process in various positions and in both directions of rotation, to make sure that winding by means of oscillating weight is proceeding normally.
6. Disassembling the date mechanism of calibers ETA 2472 and 2474

6. 1. Remove hour wheel 255.
6. 2. Unscrew and remove:
   minute work cock 462;
   minute wheel 260;
   setting wheel 450.
6. 3. Unscrew and remove:
   date indicator guard 2536;
   date jumper spring 2575;
   date jumper 2574;
   intermediate date wheel 2543;
   assembled cannon pinion with driving wheel 242.
6. 4. Turn assembled driving wheel and lever slide 2619/1 so that
   the two notches of the cover are facing rim of plate.
6. 5. Remove date indicator 2557/1.
6. 6. Push lever slide 2631 until it is disengaged from head of
   guide post; lift assembled driving wheel and lever slide off
   their post.
6. 7. Remove lever slide spring 2638.

7. Assembling the date mechanism

7. 1. Fit date indicator, check for free running and remove.
7. 2. Fit lever slide spring into recess located round driving
   wheel post.
7. 3. Fit assembled driving wheel and lever slide by pushing
   slide as far as possible towards center of wheel, so that
   notch of slide is under head of guide post. Pull visible
   portion of spring so as to make it press against end of lever
   slide.
7. 4. Lubricate friction point between lever slide spring and lever
   slide.
7. 5. Oil pivoting point of driving wheel.
7. 6. Oil friction point between guide post and lever slide.
7. 7. Oil end of release beam solid with driving wheel, through
   holes in driving wheel cover.
7. 8. Turn driving wheel so that the two notches are facing rim
   of plate.
7. 9. Fit date indicator.
7. 10. Oil friction of driving wheel on cannon pinion (fat oil).
7. 11. Oil center pipe. Fit cannon pinion and driving wheel on to
      center pipe and check for easy fit.
7. 12. Fit mounted intermediate date wheel on to its post, with
      tongue of bridge in opening provided in plate.
7. 13. Oil pivoting point of intermediate date wheel.
7. 15. Fit date jumper spring.
7. 16. Oil functional portions of date jumper (inclined faces).
7. 17. Fit and screw on date jumper guard.
7. 18. Fit minute wheel and setting wheel, and oil their pivoting
      points.
7. 19. Fit and screw on minute work cock.
7. 20. Fit hour wheel.
7. 21. Turn winding crown and check whether date indicator is
      shifted by beak of lever slide.
6. Disassembling the date mechanism of calibers ETA 2472 and 2474

6. 1. Remove hour wheel 255.
6. 2. Unscrew and remove:
        minute work cock 462;
        minute wheel 260;
        setting wheel 450.
6. 3. Unscrew and remove:
        date indicator guard 2535;
        date jumper spring 2575;
        date jumper 2576;
        intermediate date wheel 2543;
        assembled cannon pinion with driving wheel 242.
6. 4. Turn assembled driving wheel and lever slide 2619/1 so that
        the two notches of the cover are facing rim of plate.
6. 5. Remove date indicator 2557/1.
6. 6. Push lever slide 2631 until it is disengaged from head of
        guide post; lift assembled driving wheel and lever slide
        off their post.
6. 7. Remove lever slide spring 2638.

7. Assembling the date mechanism

7. 1. Fit date indicator, check for free running and remove.
7. 2. Fit lever slide spring into recess located round driving wheel post.
7. 3. Fit assembled driving wheel and lever slide by pushing
        slide as far as possible towards center of wheel, so that
        notch of slide is under head of guide post. Pull visible
        portion of spring so as to make it press against end of lever
        slide.
7. 4. Lubricate friction point between lever slide spring and lever slide.
7. 5. Oil pivoting point of driving wheel.
7. 6. Oil friction point between guide post and lever slide.
7. 7. Oil end of release hook solid with driving wheel, through
        hole in driving wheel cover.
7. 8. Turn driving wheel so that the two notches are facing rim
        of plate.
7. 9. Fit date indicator.
7. 10. Oil friction of driving wheel on cannon pinion (fat oil).
7. 11. Oil center pipe, fit cannon pinion and driving wheel on to
        center pipe and check for easy fit.
7. 12. Fit mounted intermediate date wheel on to its post, with
        tongue of bridge in opening provided in plate.
7. 13. Oil pivoting point of intermediate date wheel.
7. 15. Fit date jumper spring.
7. 16. Oil functional portions of date jumper (inclined faces).
7. 17. Fit and screw on date jumper guard.
7. 18. Fit minute wheel and setting wheel, and oil their pivoting
        points.
7. 19. Fit and screw on minute work cock.
7. 20. Fit hour wheel.
7. 21. Turn winding crown and check whether date indicator is
        shifted by hand of lever slide.
3. Replacing the mainspring

**IMPORTANT:** When mainspring 770 and its brake spring 775 are functioning normally, it is unnecessary to take them out of the barrel. The brake spring should slip only after 6 turns of wind, which corresponds to a power reserve of about 40 hours. If damage has occurred to the mainspring or brake spring, they must be replaced by high-grade springs only. The barrel is made in two different types, and therefore it is important to know whether:

3. 1. The barrel has a wide groove machined in the inside wall of the drum.
3. 2. The barrel has a plain inside wall.

Now select mainspring and bridle according to the following table:

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<td>H: 1.29 mm</td>
<td>T: 0.16 mm</td>
<td>L: 32.5 mm</td>
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Lightly grease inside wall of barrel over its entire circumference. Grease mainspring and fit it into barrel by means of a suitable mainspring-winder (if fitted with any other tool, the spring would be damaged and would lose its propriety). Then oil barrel arbor 195 at its pivoting points and fit it in position, making sure that eye of mainspring is correctly shaped. Fit on lid to close barrel and check endshake of barrel arbor, as well as number of turns of wind as far as slipping limit of brake spring.

Slipping should be smooth and even, without jerks or jams.

4. Assembling the barrel bridge

4. 1. Place barrel in its recess.
4. 2. Fit barrel bridge and screw it tight.
4. 3. Check endshake of barrel arbor.
4. 4. Oil both bridge and plate bearings.
4. 5. Fit ratchet wheel and screw it tight.

5. Assembling the automatic device

5. 1. Apply a small drop of fine oil to the four pawl pivots, i.e. on each of top disks of pawl winding wheels.
5. 2. Fit pawl winding wheels on their respective posts, proceeding as follows:
   5. 2. 1. Turn bolt so that its cut-away portion is opposite post of wheel that is being fitted.
   5. 2. 2. Fit pawl winding wheel on to post.
   5. 2. 3. Turn bolt towards post of the other pawl winding wheel.
   5. 2. 4. Fit the other pawl winding wheel.
   5. 2. 5. Turn bolt so that its cut-away portion is facing away from the two pawl winding wheels.
5. 3. Turn framework of automatic device over. Open bolt of reduction gear. Fit driving gear of ratchet wheel with its pinion upwards and reduction gear with its pinion downwards.
5. 4. Bring bolt back against wall of recess by turning it in reverse.
5. 5. Check endshake, using a suitable tool (small riveting tool with flat end drilled with a hole 0.32 to 0.33 mm in diameter) or a pair of tweezers. Train of automatic device must run freely in either direction.
5. 6. Oil bearings of pawl winding wheels with train oil.
5. 6. 2. Oil posts of the two lower wheels, preferably with barrel oil.
5. 7. To help oscillating weight to swing easily, clean the two cones inside tubes of bearing with a piece of sharpened pegwood, to remove any galvanic deposit.
5. 8. Fit framework of automatic device in position on oscillating weight. Arbor of bearing wheel should turn inside tube driven into center of framework of automatic device.
5. 9. Fit screw of bearing wheel (60° taper head) in position.
5. 10. Adjust endshake of oscillating weight.
   If there is too little shake, increase it by removing material from cone inside tube, using a 60° milling cutter.
   If there is too much shake, reduce it by removing material from cone inside spindle (thrust point of screw), using a 60° milling cutter.
   Once adjusted, there should be about 0.02 mm endshake at center of oscillating weight.
5. 11. Apply thick oil to bearing of oscillating weight.
5. 12. Drive screw of bearing home, using a screwdriver with a blade diameter ½ that of the screw head.
5. 13. Fit framework of automatic device in position; to facilitate meshing of pinion of driving wheel of ratchet wheel with ratchet wheel, and before finally fixing the device, it is advisable to turn winding stem slightly in the winding direction.
5. 14. Drive both screw of automatic device home.
5. 15. Check oscillating weight for free running. Wind barrel by turning winding stem a few turns; holding the movement standing, turn it slowly a few times. Repeat this process in various positions and in both directions of rotation, to make sure that winding by means of oscillating weight is proceeding normally.
The ETA Ebauche Factory Ltd has marketed a family of movements, all of them fitted with a automatic winding device of the "ETAROTOR" type, which has been found to give excellent performance.

These calibers are as follows:

2451 11-\(\frac{1}{2}\)" sweep second, automatic
2453 11-\(\frac{1}{2}\)" sweep second, automatic
2452 11-\(\frac{1}{2}\)" sweep second, automatic, date showing in dial aperture
2454 11-\(\frac{1}{2}\)" sweep second, automatic, date showing in dial aperture
2472 11-\(\frac{1}{2}\)" sweep second, automatic, instantaneous change of date showing in dial aperture
2474 11-\(\frac{3}{4}\)" sweep second, automatic, instantaneous change of date showing in dial aperture

This family of movements is based on calibers 10-\(\frac{1}{2}\)" 2390 and 11-\(\frac{1}{2}\" 2391 with instantaneous change of date but not automatic. Of the automatic calibers, caliber 10-\(\frac{1}{2}\" 2450, which is 23.30mm in diameter, has a direct sweep second and an oscillating weight with a heavy-metal rim.

By increasing the diameter of the plate and of the oscillating weight, the designers produced caliber 11-\(\frac{1}{2}\", 2451. Its diameter is 25.60 mm, with all parts corresponding to and interchangeable with, those of caliber 2450, with exceptions of the plate, oscillating weight and winding stem. Caliber 2453 is identical with caliber 2451, apart from the fact that its oscillating weight is made entirely of brass.

These last two calibers can be fitted with a calendar work recessed in the thickness of the plate, thus forming calibers 2452 and 2474.

Finally, these calendar mechanisms can be replaced by others of the instantaneous type, which are found in calibers 2472 and 2474.

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These seven calibers are all 5.20 mm in height, both types of calendar work being recessed in the plate.

In view of the interest in watches having date indicators, the following is a description of calibers 2452 – 2454 and 2472 – 2474.

**Automatic winding device**

In this device we find the characteristic features of the "ETAROTOR" system. The framework of the automatic device carries the oscillating weight, which is fixed by means of a screw, the two pawl winding wheels, the reduction gear and the gear driving the ratchet wheel. The automatic unit is independent of the movement, to which it is fixed by means of two screws.

Driven into the center of the oscillating weight is its bearing wheel, which transmits the motion to the automatic device. In calibers 2453 - 2454 - and 2474, the oscillating weight is made entirely of brass, in the other calibers, however, it has a heavy metal rim, which is set into the body of the weight, enabling it to be more heavily beveled.

The pipe of the bearing wheel, which is tapered at each end, enters a bushing or jewel driven into the framework. The end-shake of the oscillating weight is limited between the taper of the bearing wheel and that of the bearing-wheel screw, which is locked in the threaded pipe of the bearing wheel. As in all "ETAROTOR" calibers, this endshake can be corrected by milling either the bushing in the framework (which increases it) or the inner taper of the bearing-wheel pipe (which reduces it). This operation must be carried out carefully with a 60° milling cutter.

The two pawl winding wheels are accomodated in the two recesses in the upper side of the framework and turn round beryllium studs driven into the framework. One of the pawl winding wheels has a pinion, which transmits the motion to the reduction gear.

Each of these pawl winding wheels is composed of two toothed wheel disks. The upper disk meshes with the bearing wheel of the oscillating weight, while the lower one meshes with the corresponding disk of the other pawl winding wheel. The connection between the two superposed wheel disks is insured by two springless pawls. These are driven by the upper wheel disk and work with the profiles of a circular groove solid with the lower wheel disk.

In the pawl winding wheel which carries the pinion, the lower wheel disk is made of beryllium, the groove is cut in the "inter-disk" portion. In the other pawl winding wheel, it is cut in a beryllium disk solid with the lower wheel disk, which is made of steel.
The pawls of the two wheels are mounted in such a way that the wheel which has no pinion is locked if the oscillating weight turns "to the left", while the other wheel is locked when the oscillating weight turns "to the right".

These two pawl winding wheels are held in position by a bolt which, as it turns, penetrates between the two disks of the wheels.

The reduction gear and the gear driving the ratchet wheel are accommodated beneath the framework of the automatic device and turn on studs driven into the framework. These two gears are held in position by a bolt. The latter covers the reduction gear, which in its turn covers the gear driving the ratchet wheel. Their endshake is limited by holes which are drilled in the train-wheel bridge and can be fitted with bushings or jewels.

Operation

The operation of this "ETAROTOR" system is identical with that of the lady's caliber ETA 2458, which we have already described.

When it turns "to the right", the oscillating weight transmits a "left-hand" movement to the two upper disks of the pawl winding wheels and, as has just been explained, the whole wheel disk bearing the pinion will be locked and, by way of the lower wheel disk, will transmit a "right-hand" movement to the corresponding disk of the other pawl winding wheel and, by way of its pinion, a "right-hand" movement to the reduction gear.

When the oscillating weight turns "to the left", the other pawl winding wheel will be locked and will transmit a "left-hand" movement to the lower wheel disk, which is solid with the pinion of the first pawl winding wheel. Thus the reduction gear will again be given a "right-hand" movement, as in the first case.

By way of the gear driving the ratchet wheel, the necessary movement for winding the mainspring reaches the ratchet wheel.

When the watch is wound by hand, the gear train of the automatic winding system turns as far as the pawl winding wheels, which cannot be locked, and the oscillating weight remains motionless.

When automatic winding is interrupted, the pawl winding wheels act as a stop click by locking simultaneously.

During automatic winding, the crown wheel disengaged from the ratchet wheel by its rocker system. The click also acts on the crown wheel, and it is the click spring which keeps the crown wheel in contact with the ratchet wheel. The heel of the crown-wheel rocker defines the distance between the centers of the ratchet wheel and the crown wheel, by resting against a notch in the barrel bridge. This construction avoids the necessity of throwing the clutch wheel and the winding pinion out of gear.
The movement

The movement is of the direct drive sweep-second type, with the center wheel located off center, making it possible to achieve a thin construction.

The barrel

The barrel is of very traditional design for an automatic watch. As in most recent calibers, there is no notch in the cover.

It is to be noted that the upper barrel-arbor pivot turns in a bushing driven into the bridge.

The click is accommodated on an extension of the barrel bridge which penetrates into a recess in the seat of the balance cock. As has already been mentioned, this click acts on the crown wheel, and not on the ratchet wheel (rocker system).

The gear train

The gear train does not include the traditional center wheel which completes one revolution per hour. This wheel is replaced by an intermediate wheel, which is not set in the center of the movement. On the other hand, the remainder of the gear train is the same as in sweep-second watches of the usual type.

All the train pivots turn in jewel bearings with the exception of the lower second-wheel pivot, which turns in a beryllium pipe driven into the center of the plate. Thus the distance between the shoulders of the second-wheel pivots is very great, which helps to insure the perpendicularity of its arbor.

The escapement and balance

The standard lever escapement used in this caliber is easily accessible.

The balance is of large diameter, enabling excellent timing results to be obtained.

The hand winding and setting mechanism

As in most recent calibers, this mechanism is built on two different levels.

The lower level includes the traditional parts of the hand winding stem, the clutch wheel, the winding pinion, the yoke, the yoke spring, the setting lever with its screw, the setting-lever spring which covers this mechanism.

The yoke spring is identical with that used in the non-automatic calibers.
The minute work is of a peculiar type. As there is no ordinary center wheel, the motion is brought back to the center by a driving wheel which meshes with the third-wheel pinion. This driving wheel is fitted friction-tight on the cannon pinion, which turns freely round the center pipe.

The minute wheel and the setting wheel are held in position by the minute-work cock.

The calendar devices

The device used in calibers 2452 and 2454: This device consists of an hour wheel, an intermediate date wheel with two sets of teeth, a date-indicator driving wheel with a mobile finger, a date jumper with its spring, a date-indicator and a date-jumper guard which penetrates between the two sets of teeth of the intermediate wheel.

This guard and the minute-work cock also cover part of the teeth of the date-indicator.

The device is entirely recessed in the thickness of the plate.

The motion of the hour wheel is reduced and transmitted by the intermediate date wheel to the driving wheel, which completes one revolution per day. Once daily, the unlocking finger comes into contact with a tooth of the date-indicator and pushes it forward one step.

To make it offer the least possible resistance, the date jumper is fitted with a polished roller, which turns at the end of the jumper. When the date-indicator is driven forward, this roller runs up one of the teeth and, on reaching the top, quickly pushes the indicator forward. It is then brought back by its spring to its position of rest.

The unlocking finger slips beneath the central disk of the date-indicator driving wheel when the hands are turned backwards, so that this can be done without causing the indicator to jump. In this way, quick date-setting is possible by turning the winding crown to and for several times in succession.

The device used in calibers 2472 and 2474: This device differs from the one just described by the fact that the date changes instantaneously.

It consists of the hour wheel, an intermediate date wheel with two sets of teeth and a driving wheel, which are fitted to the operating slide. Beneath the driving wheel is the slide spring, which pushes the slide into its position of rest. The date jumper and its spring are covered by a guard, which also covers part of the indicator teeth.
1. We wish however to remind the reader that it is possible to adjust the endshake of the oscillating weight by milling either the taper of the pipe driven into the framework (to increase the shake) or the inner taper of the pipe of the bearing wheel (to reduce it).

2. It is obvious, too, that the pawl winding wheels should not be disassembled for cleaning and that they must not be dried in sawdust.

3. As for the calendar device (cal. 2452 and 2454), it is important not to lubricate the driving finger or the date-indicator teeth.

4. The instantaneous calendar device (cal. 2472 and 2474) can be assembled more easily if certain precautions are taken. It is advisable to carry out the assembly operations in the following order:
   a) Place the slide spring in its fitting, beneath the driving wheel.
   b) Push the slide towards the center of the driving wheel as far as it will go, so as to engage it under the head of the guide stud. Fit the driving wheel on the stud.
   c) Bring the beak of the slide spring into contact with that of the slide and lubricate the point of contact.
   d) Turn the driving wheel so that two notches in its upper disk are pointing towards the outside of the movement, thus permitting the indicator teeth to pass. Then fit the indicator, the jumper and its spring, the jumper guard and the minute-work cock.

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