GENERAL REPAIR INFORMATION

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BULOVA SCHOOL *of* WATCHMAKING

EXAMINATION OF THE WATCH PRIOR TO DISASSEMBLY AND REPAIR

THE BAND

1. Does it need repairing or replacement?
2. If the old strap has a gold buckle use it on the new strap.
3. If the band is a piece of jewelry, check the stone settings and band links. Inform the customer of any defects.
4. Be sure the spring bars are right for the case and check their spring tension.

THE CASE

1. Is the case in proper condition to protect the movement? Is it free of holes and does it close properly? If not, can it be repaired by you or must it be sent to a case expert?
2. Are the case loops or lugs in good condition?
3. Does the bezel hold the crystal properly? Does it fit tightly on to the frame or back of the case?
4. Is a new crystal necessary? Since there are many kinds and qualities of crystals available, get the customer to agree to the type recommended.
5. If the case is jeweled, check the stones and their settings. Inform the customer if any stones are missing or broken.
6. Check the fit of the movement in the case.
7. Be sure that the right style of crown is on and properly fitted.

DIAL, HAND, WINDING AND SETTING MECHANISM

Does the dial need to be refinished? Are the hands mismatched, loose, bent, rusty, worn or in need of refinishing?

REMOVE MOVEMENT FROM THE CASE

Since there are several types of cases in use to-day, care must be taken to use the proper approach and opener appropriate to the type on hand. Be sure the opening is done over the skin drawer so that any loose parts will not be lost.

When watches are fitted with male and female stem and crown combinations, the crown may be snapped off by using cutting pliers or tweezers as a wedge. Always be sure of the proper procedure before attempting to pry or to press the case apart when opening it.

There are several types of case-locking devices in use today and it cannot be too strongly urged upon the student that he avail himself of all the literature that he can that will help him understand the various structural features that are used in case work. Special tools are used in

opening some cases and if this is not known or the proper procedure followed, then damage may be done to the case and movement.

If it is an automatic watch, check for marks on inside of the back and on outside of the oscillating weight or movement which will indicate that the weight was rubbing these places.

When the stem must be removed in order to remove the movement from the case, first pull the stem into the setting position, then loosen the setting lever screw. Remove the stem. After removing the movement from the case, replace the stem in the movement and then check the fit of the stem bearing in the movement.

BALANCE WHEEL ASSEMBLY

1. If the Balance Assembly is free, check the wheel for truth in the flat and round. Are there any screws missing or loose?
2. Is the hairspring centered and level?

A general observation of the movement at this stage may save a lot of valuable time as some movements are beyond repair and often no further disassembly is needed to determine this.

DISASSEMBLY

Before proceeding with the disassembly, it is well to demagnetize the watch. This will prevent small screws from clinging to the tweezers and screw drivers.

1. Remove the hands, taking due precautions not to scratch the dial. Then remove the dial, dial washer, hour wheel and canon pinion. If free, remove minute wheel.

    a. Check the fit of the stem bearing in the movement.
    b. Check the meshing of the clutch wheel with the winding pinion, and the winding pinion with the crown wheel. Look out for broken, rusty or worn teeth.
    c. Pull the stem into the setting position and check the meshing of the clutch wheel with the setting wheel. Some setting wheels have a beveled end, which end is placed on the post facing down. Check the setting lever spring. Is it strong enough to hold the clutch wheel and setting wheel together tightly when in the setting position?
    d. Check for freedom of the setting wheel and minute wheel.
    e. Check the clutch lever spring.
    f. Check the setting mechanism as a whole, for any signs of rust. Remove the rust if there is not too much or else replace the part.

2. Let the mainspring down gradually. If it is an automatic, remove as much of the automatic mechanism as is necessary to permit the letting down of the mainspring.
3. Loosen the stud screw. Note the position of the regulator index because it may be located at the correct regulation point.
4. Remove the balance bridge screw and bridge.

    a. If there is no boot on the regulator, the balance assembly will drop free from the bridge.
    b. When there is a boot, the balance bridge and assembly must be turned upside down on the bench and the boot turned away to free the hairspring.
    c. Check for bent, broken or rusty pivots. Check the roller to see if it is loose. Check the roller jewel for looseness and to see if it is broken. Is there excess cement on the active side of the jewel?

5. If the watch has an indirect drive sweep-second mechanism, it should be removed at this time.
6. Check the pallet end shake. Remove the pallet bridge with great care by not tilting it too much as this may break or bend the pallet arbor pivots.
7. Check the end shakes of all train wheels. Spin the train and check the truth of the wheels in the flat. If the fourth wheel has a long pivot for the second hand, check the pivot to see if it spins true. Also check the center wheel post to see if it spins true. A fault in either of these two places could stop the watch and definitely cause the hands to wobble.

    Remove the remaining bridge screws together with the ratchet and crown wheel screws. After removing the ratchet and crown wheel, take care to remove the steel center around which the crown wheel turns. This center is a reinforcement for the brass boss which is part of the barrel bridge.

    Nearly all crown wheel screws have left hand threads and some, but not all, ratchet wheelscrews have left hand threads.

    Take particular note of the length of the barrel bridge screws. Later it will be necessary to replace the shorter ones in their proper place or else damage to some of the winding and setting parts will take place.

    Take special note of the particular characteristics that the screws may have. There are left and right hand screws, screws with shoulders under the screw head, screws of different diameters and lengths. When reassembling the watch it will be necessary to return screws to their proper place or else damage to female threads or to other watch parts will take place.

8. Remove the barrel bridge.
9. Remove the train wheel bridge or bridges.
    When removing the train wheel bridge be sure that it is not tilted too much in any one direction and that no pivots are sticking in their holes. A rusty or bent pivot will stick in a hole jewel.

10. Remove the train wheels.
    a. Check their teeth and pinion leaves for rust, burrs, bends or breakage.
    b. Check the condition of the pivots. Are any broken, bent or rusty?
11. Remove the barrel.
12. Remove the barrel cover. Take note of the direction that the mainspring is wound around the barrel arbor.
13. Remove the mainspring.
14. Remove the cap jewels.
    a. Peg all hole jewels. Check to see if the jewels are cracked and whether or not they are loose or out of upright.
    b. If the watch is provided with shock resisting jewels, they must be disassembled and assembled according to their manufacturer's specifications. Their hole jewels should be pegged. All of the shock-resisting jewel units can be disassembled by picking off the cap jewel by the use of scotch tape in case the cap jewel is stuck on so tight that it will not separate in the cleaning process.
15. Disassemble all winding and setting parts.
16. Repair or replace all parts that have been discovered to be defective.
17. Before removing the hairspring observe the location of the stud as it may be exactly on or near the in-beat point.
18. Check the balance wheel in the truing calipers for truth in the flat and round.
19. Check to see if the balance wheel is poised.

CLEANING THE WATCH

Cleaning always follows disassembly and repair. If the job is done by use of the cleaning machine, then care must be exercised by placing small, delicate parts together and away from heavier parts to avoid damage to the more fragile ones.

There is something to be said for grouping related parts in the same compartment of the basket which will help out in the assembly procedure. Be sure that the parts having long pivots are so placed in the basket that the pivots do not protrude through the wire mesh.

The cleaning time in the machine may be reduced if the plates, bridges, and other parts have been brushed and the jewels pegged. Two or three minutes in each solution should be sufficient.

It is recommended that the balance wheel assembly and pallet be left out of the basket and hand-cleaned.

If the watch is to be cleaned by hand, then brush the parts and peg and jewels first. Follow this by stringing the bridges on a wire, which is then immersed in the cleaning solution and allowed to stand for a few moments and then gently moved back and forth until clean. Next place the wire and parts in the first rinsing solution and proceed as before A

second rinsing solution treatment should follow for the best results. After this, a gentle movement of the parts while still on the wire, through a good grade of heated boxwood sawdust, will dry them. Blow the parts free of dust particles with a hand blower. A thorough examination should be made to be sure that all particles have been removed.

There is on the market a tiny, fine-meshed basket suitable for holding any and all screws found in watches. This provides an efficient and effective means of cleaning screws.

Do not put water-proof crowns in the cleaning solutions, which may have a detrimental chemical effect on the crown gaskets.

Watch bands, excepting leather ones, or those having leather inserts, should be given a preliminary cleaning to remove heavy, loose dirt. Follow this with buffing, then cleaning in a good jewelry cleaning solution. A solution of ammonia, soap and water is very good. This should be followed by using a stiff brush with soap and water. Rinse in alcohol and thoroughly dry.

Follow the same cleaning procedure outlined for the band when cleaning the case. If the case has an unbreakable crystal then it should be removed to avoid possible damage from the cleaning solution. Do not remove the crystal if it is of the permo, seal type and do not use cleaning solutions. Soap and water should be sufficient.

In all cases where the case gaskets are other than metal, they should be kept away from cleaning solutions.

Enameled dials are the only ones that can safely be washed in any cleaning solution. Appropriate precautions must be taken with all other types of dial finishes.

ASSEMBLY

1. Replace all cap jewels.
   All cap jewels, excepting those for the pallet, should be oiled before assembling the train. Check for the oil ring in all cap jewel places.
2. In some watches the winding pinion can be inserted only from the barrel bridge side. In that case put the winding pinion in now. In all other cases it can be inserted from the dial side when assembling the winding and setting mechanism.
3. Oil the mainspring before putting it into the barrel. After the main spring is inserted, put the barrel arbor in place and oil. Be sure it hooks on to the inner terminal of the mainspring and with a good snug grip. Put the cap on.
4. Place the setting lever screw in place, then the setting lever in the pillar plate.
5. Insert the barrel first if it is a direct drive sweep second watch. Put the center wheel in place, then its bridge, followed by its screws and then oil the upper pivot before putting on the center second bearing plate.

6. Insert the train wheels.
7. Put on the train wheel bridge or bridges and their screws.
8. Put on the barrel bridge and its screws, being careful not to place a long screw where a short one should go.
9. The click and its screw, click spring, crown wheel, ratchet wheel and their screws may now be placed.
10. Install the winding and setting mechanism and lubricate.
11. Oil the train wheel pivots. Oil the center wheel post.
12. Try the train reversal test. Place the cannon pinion on the center wheel and again try the train reversal test.
13. Assemble the sweep second mechanism if there is one.
14. Oil the pallet stones on their impulse faces. Place the pallet in the pillar plate followed by its bridge and screws.
15. Check for draw by moving the pallet away from the banking pin, not sufficient to unlock, and see if it pulls back again to the banking pin. Check the pallet end shake, lock and slide.
16. Put the balance wheel assembly and its bridge and screws in place.
17. Check the hairspring for levelness and centeredness. Check the regulator arc to see it it is concentric with the regulator. Does the hairspring vibrate evenly between the regulator pins as the regulator is moved from fast to slow?
18. Put the watch in beat.
19. Wind the watch and check the motion of the balance wheel.
20. Check the rate in the timing machine if one is available.
21. Place the hands in position.

FAULTS

The following list of things to be checked as a matter of routine in disassembly and assembly on general repair work should be learned early and well. The failure to do so could set the stage for poor time keeping by the watch and inevitable comeback work:

Hands touching the dial.
Hands touching the crystal.
Hands touching hands.
Hour hand with sloppy and excessive end shake, indicating need for a dial washer.
Hour hand having no end shake due possibly to its not needing a dial washer or to a bent dial.
Dial feet loose or too long. Dial screws not holding. When cam-locking screws are present be sure they hold firmly.
Case should be checked for dents, burrs, failure to close evenly or whether or not it presses on the watch movement, which might stop it.
Hour wheel binding on the cannon pinion.
Hour wheel tooth bent or missing.
Cannon pinion loose.
Cannon pinion burred and binding in the hour wheel.

Cannon pinion too tight, which will bend or break minute wheel teeth or the minute wheel post when attempting to set the watch.

Minute wheel post loose or missing. Teeth bent or missing.

Setting wheel binding too tight on its post.

Setting wheel not meshing properly with the clutch wheel.

Stem poorly fitted or worn. Loose crown.

Stem bearing does not fit case opening.

Stem pilot loose in its hole or too short or long.

Stem slot too wide or too narrow.

Winding pinion loose or worn and does not wind or set properly.

Clutch wheel slips on stem square when winding or setting.

Clutch spring broken.

Yoke or setting bridge rusty. Setting lever spring broken.

Setting lever broken or rusty.

Crown wheel loose, slipping, teeth binding worn or missing. Not meshing with the ratchet wheel.

Ratchet wheel loose, screw broken, not turning true, missing the click or crown wheel.

Mainspring broken, too strong, too weak or slipping.

Barrel cover on wrong, not turning true. Bent, burred or missing teeth. Binding on the arbor. Excessive end shake of the arbor ir the barrel or no end shake. Barrel rubbing pillar plate, barrel bridge or center wheel.

Click or click spring broken or loose. Circular click spring leg too long will barrel and stop the watch.

Center wheel post bent causing hands to bind. Wheel out of flat and rubbing the barrel or bridges. Safety pinion loose will act like a broken mainspring. Teeth or pinion leaves missing. Not enough or too much end shake.

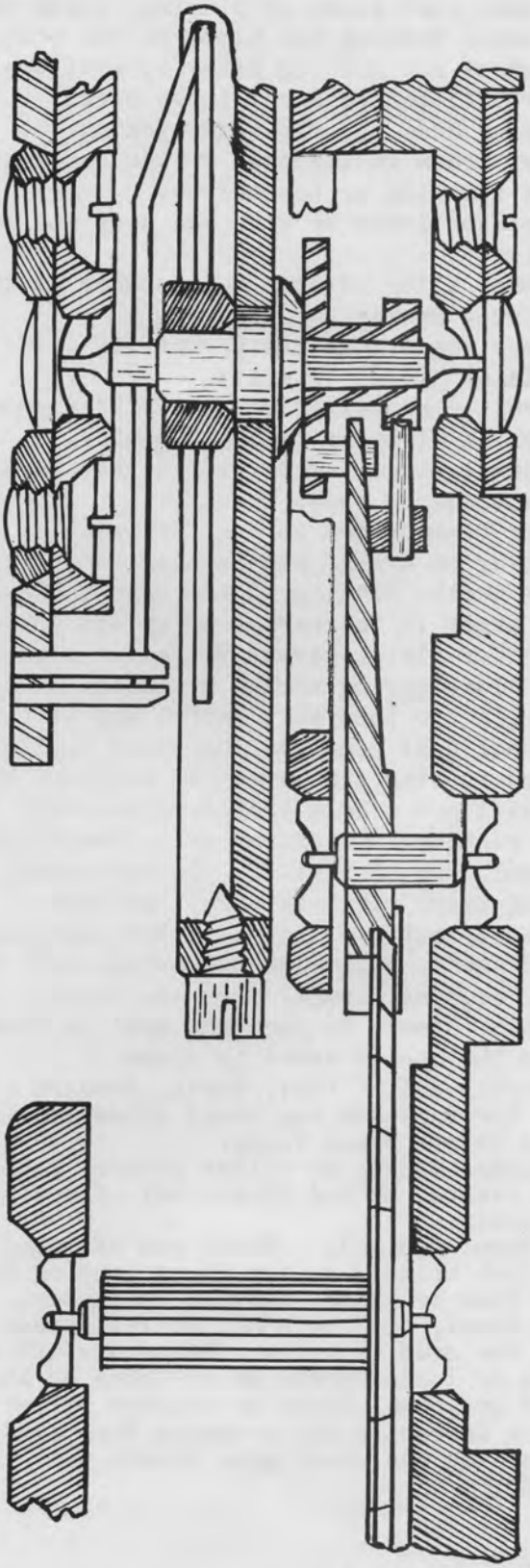
Third wheel, out of flat. On indirect sweep second watches, the long upper pivot is sometimes bent.

Fourth wheel, out of flat. Look for bent pivots or a cracked jewel. Sometimes the second hand is put on carelessly, causing damage. When the fourth wheel is also the center wheel, be sure the post is true and that the hole in the center wheel is clean.

Escape wheel, out of flat, rusty, damaged teeth or magnetized. Lower escape cap jewel screw too long. Broken or bent pivot. Wheel loose.

Pallet loose, broken or tilted stones. Bent fork, guard pin or pivots. No end shake. Out of upright or cracked hole jewels.

Balance Wheel Assembly - Wheel out of round or flat. Touching pallet bridge, center wheel stud or boot. Hairspring out of flat or round, rubbing the bridge, balance arms, center wheel, stud or pins. Collet spread or loose. Loose pin at the stud or collet. Balance staff hub cracked. Damaged or loose rivet. Wheel loose on staff. Roller crushed or loose. Loose or cracked roller jewel. Jewel not long enough to fully engage fork slot. Jewel too long and touching the guard pin. Pivots bent, broken, worn or mushroomed.



SIDE VIEW OF BALANCE AND ESCAPEMENT

ESCAPEMENT

A. ENDSHAKE

1. Endshake of escape wheel should be from .02 to .04 mm.
2. Endshake of pallet should be from .02 to .04 mm.
3. Endshake of balance staff should be from .02 to .04 mm.
4. Endshake adjustments are, as a general rule, made at the upper end. However, before making any changes it is advisable to check the height relationships of the escape wheel, pallet and roller. (See Section B below). This will help to determine whether or not to make the adjustment at the lower end instead.
5. Be very careful in making adjustments at the pallet upper end for greater endshake. Make sure that sufficient clearance is left between the top of the pallet and the under side of the cock; and if the jewel should project slightly above the cock make sure that it does not interfere with the balance wheel.

B. HEIGHT RELATIONSHIPS

1. Check for adequate clearance between escape wheel and pillar plate.
2. If the lower escape pivot is capped, make sure that the cap screw does not extend up to the escape wheel.
3. Raise escape wheel and check to see that top surface does not come above top side of pallet stones.
4. Raise pallet and check to see that bottom edge of escape wheel impulse faces is not below bottom side of pallet stone.
5. Raise pallet and check for clearance between top of pallet and under side of pallet cock or bridge. Check for this clearance especially at the "L" stone end of the pallet.
6. Check from "R" stone side to "L" stone side to make sure that pallet is level with escape wheel.
7. With pallet down (resting on lower jewel) check to see that guard pin has clearance with pillar plate and balance hole jewel setting (if such a setting is used).
8. Raise pallet and check to see that guard pin does not come above top of safety roller and has clearance with bottom end of jewel pin.
9. Raise pallet and check to see that top face of fork does not rub on under side of impulse roller.
10. Raise balance staff and check to see that safety roller does not come above guard pin, and that bottom end of jewel pin extends adequately below pallet fork.

C. JEWELS AND JEWELING

1. Check to see that all hole jewels and cap jewels are free of cracks.
2. Check to see that cap jewels are not pitted.
3. Check to see that each cap jewel is tight and flush with the side of the cap facing the pivot.
4. Check to see that hole jewels are not tilted.
5. Check for presence of foreign matter or burrs on cap seats or under side of caps.
6. Check to see that crowns of hole jewels are 0.02 mm below cap seats to allow proper space for oil.
7. Make sure that cap screws are tight and that caps are firmly and flatly seated.
8. Check to see that cap jewels are concentric with their hole jewels.

D. PALLET

1. Check to see that pallet stones are free of cracks or chips on the locking faces, locking corners, impulse faces or let-off corners.
2. Check to see that pallet stones are flush with top of pallet and are properly cemented at inner end and under side.
3. Check to see that all working surfaces and top of pallet stones are clean and free of cement.
4. Check to see that pallet arbor is tight in its hole.
5. Check to see if guard pin is tight in its hole.
6. Check to see if pallet fork arm is bent up or down. (This is undesirable, but sometimes is a necessity. Generally, the fork is considerably longer than the pallet arbor and, consequently, is very sensitive to any error in alignment of the pallet upper and lower jewels. Therefore, it is sometimes necessary to resort to bending the fork slightly to achieve proper height relationship with the roller).

E. ROLLER

1. Check to see if roller is seated against the hub of the balance staff and tight.
2. Check to see that roller jewel is upright and free of cracks and chips.
3. Check to see that roller jewel is tightly cemented and that cement is free of cracks.
4. Check to see that working surfaces of roller jewel are clean and free of cement.