The Drexler Simplified System of Clock and Watch Repairing

A Thorough and Practical Extension Course

Book No. 11

Conducted By
The Drexler School of Watch Repairing
Milwaukee
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JOHN DREXLER.
PALLET SETTING PLIER.

Pallet jewels can be set with stubby brass tweezers, but more satisfactory work can be done with the aid of a plier shaped like the one in Fig. 325. To make a pallet jewel plier, draw the temper from a small flat plier (about three inch) and file the jaws to about 3 m.m. in thickness at the end, and taper toward the base to a thickness of about 4 m.m. Saw a slot about 10 m.m. deep in the ends of both jaws, to receive the pallet arbor and guard pin. Drill, and thread a hole in one jaw about 20 m.m. from the end and fit into it a shoulder screw (S), with the shoulder about 1 m.m. long. File out a strip of steel (A) about 40 m.m. long, 1 m.m. thick and 4 m.m. wide. Drill a hole in one end of this strip to fit the shouldered screw, and two smaller holes (R) in the other end for riveting on the copper plate (C) which should be about 6 m.m. in diameter with a slot as shown to receive the guard pin of a right angle fork. File the steel strip a little thinner near the screw hole to form a spring. Harden it and temper to blue. Rivet on the copper plate, take off the corner that comes towards the jaws and with the shouldered screw, fasten the spring strip friction tight. If you wish, make a wing for the other side although one is sufficient.

PALLET JEWELS.

In modern lever watches, the pallet jewels are exposed and fastened in the pallet frame with shellac, making it easy to adjust or replace them. When duplicating a pallet jewel, select one with a correct angle and the same width as the old one, so that when set with the proper lock and drop, the face of the pallet will come flat on the face of the tooth when they are opposite each other as in Fig. 327. The angles of the receiving and discharging pallets are a little different, and are not interchangeable. If a receiving pallet is put in place of a discharging pallet, the heel of the tooth will slide on the lifting face of the pallet as in Fig. 328. If a discharging pallet is put in place of a receiving pallet, the locking
corner of the tooth will slide on the lifting face of the pallet, as in Fig. 329. When a pallet stone is broken, or the corners of the lifting face are chipped, send for a new one. State the size, make, and whether receiving or discharging pallet.

SETTING PALLET JEWELS.

When a pallet jewel has been selected the proper width with the correct angle, place the fork in the plier as shown in Fig. 325, raise the wing to touch the pallet frame near the pallet, apply a little heat to the copper, and when the shellac melts, remove the old jewel. Then hold the pallet frame between the fingers and clean off all the old shellac. Dip in benzine and dry. Hold the pallet frame, top downward, firmly in the plier as in Fig. 326. Insert the new jewel, heat slightly and touch the pallet jewel with a shellac thread, using only enough to melt around the jewel in the slot. Before the shellac cools, pull the wing sidewise and downward to prevent the jewel sticking to it. When the jewel is set, try the fork in the movement, and if necessary, take it out and move the pallet in or out as explained in adjusting the pallet action. When properly adjusted, with a chisel shaped brass wire, scrape the surplus shellac, especially from the acting part of the pallet, and clean with a pegwood soaked in alcohol.

THE CYLINDER ESCAPEMENT—CONSTRUCTION.

Necessity often compels the watch repairer to repair cylinder watches, and hence you must understand their construction, which differs from the lever watch only in the escapement, that is composed of a cylinder or shell, half of the lower part being cut away and the remainder slotted to allow the peculiarly shaped escape or cylinder wheel teeth to pass through. A brass hub is pressed on the upper part of the cylinder to receive the balance and hairspring, and plugs on which the pivots are turned are pressed into each end of the cylinder. In the side view Fig. 330 the plugs are removed, to show the construction.
In the front view, Fig. 331, X is a section of the body of the wheel, Y the tooth and Z the arm that supports the tooth. The escape wheel has fifteen teeth, so spaced that when the cylinder is of correct size and thickness, the same amount of freedom is allowed between the teeth and the cylinder, when the cylinder is between two teeth, as when one tooth is in the cylinder. This freedom is the drop and must be the same on the inside of the cylinder as on the outside.

When the escapement is in the movement, the plugs are in the cylinder shell, the balance is riveted to the balance seat and the pivots are held between the balance bridge and lower bridge or chariot, which can be shifted in the plate to move the cylinder toward the escape wheel to make the lock deeper, or away from the escape wheel, to make the lock shallower. The drop will take care of itself if the cylinder is of the correct diameter and thickness.

**ACTION OF THE CYLINDER ESCAPEMENT.**

The cylinder escapement has lock, lift and drop, there being neither draw nor recoil. In Fig. 332 the tooth X is locked on the discharging lip; in Fig. 333 it is lifting on the discharging lip, in the direction of the arrow; and in Fig. 334 it has dropped from the discharging lip and a second tooth Y has locked on the receiving lip, which it will lift in the direction of the arrow. After locking on the receiving lip, the hairspring moves the cylinder a little into the escape wheel, when, if it is jarred, the banking pin (A) on the *balance* will strike on the banking pin (B) of the *bridge*, the tooth being near the discharging lip as at X in Fig. 335. If the banking (B) of the bridge is bent away or the pin (A) on the balance is too short, the balance will move farther, and allow the tooth to drop into the cylinder over the discharging lip (X) as in Fig. 336. The cylinder is then overbanked and stopped. Thus you will see that the pin on the bridge must be moved up to allow the banking pin of the balance to strike it on either side.

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CYLINDER REPAIRING.

When a cylinder is broken, replace it with a new one; but if only a pivot is broken, insert a new plug. Cylinders are sold in various lengths, diameters and thickness and when selecting one, remember this. When ordering a new cylinder, screw the upper cylinder bridge to the lower bridge (or chariot), and send the cylinder escape wheel with them.

REMOVING A PLUG.

To remove a plug from which the pivot has been broken, take off the hairspring, place the cylinder in the staking tool, on a stump with a tapered hole, to hold the shell and allow the plug to pass through, and with a cylinder knee punch, tap out the plug (as in Fig. 337). If a plug is tight or rusted in, rest the end of the cylinder on a brass block and tap it gently to loosen the plug.

MAKING NEW PLUG.

After removing the old plug, turn a steel wire, tempered blue, without tapering it, until it enters the cylinder friction tight (as at X in Fig. 338), and polish the end flat. Remove the cylinder, mark the length of the plug (as at A B) and turn the pivot, cutting away as shown by the black. Fasten the plug in the chuck, finish the pivot to fit the jewel, and underturn to make the shoulder and oil chamfer as shown by the dotted lines at Y. Place the cylinder on a special stump in the staking tool as in Fig. 339 and press the plug into place. If the stump is too large, hold the plug and cylinder in the staking tool and press the cylinder on the plug with a knee punch like the one in Fig. 340. Try the cylinder between the bridges for height and if necessary to remove a little from a pivot or shoulder, center the cylinder in cement as in Fig. 341. Turn off the required amount, grind and polish the pivot and its end. Remove from the cement and boil it out in alcohol and then true the balance. For small changes in the height of the cylinder, you may press the upper plug in or out, but not the lower one, as it might interfere with the passing of the escape wheel.
CEMENTING THE CYLINDER.

Turn a V in a cement brass with a hole deep enough to receive the upper part of the cylinder; or make a tube (T) to press over the cement brass (as in Fig. 341) that will fit any length of cylinder. Fill the tube with cement as shown by the black, place in the cylinder allowing only the part to be turned to project from the cement as at X and true the cylinder with a pegwood.

SELECTING A CYLINDER.

When the cylinder is broken, turn off the riveting and remove the balance. Unscrew the chariot and cap jewels and screw the balance bridge to the chariot as in Fig. 342. Select a cylinder to fit between two teeth of the escape wheel with the same freedom as one tooth has in the cylinder. (Too large a cylinder makes the inside drop greater than the outside drop and vice versa.) Try the cylinder on one side of the chariot and balance bridge, for length as in Fig. 342, which shows the correct length of shell and shoulders. (A cylinder shell of correct diameter, if too long, may be shortened a trifle when turning the unfinished shoulders to make the pivots.)

SHORTENING LOWER SHOULDER.

Screw the chariot and its cap jewel in place. Try the new cylinder on the lower hole jewel to see where the lower part of the passage comes on the escape wheel rim. Grasp the lower plug between a rounded cutting edge of a cutting plier, as in Fig. 343, and file off from the lower shoulder enough, to allow the escape wheel to come to the lower part of the passage of the cylinder as shown by the dotted lines in Fig. 344. Cement the cylinder and turn, grind and polish the pivot to fit the lower hole jewel as in Fig. 345. The pivot entering into the jewel will allow the cylinder wheel to come in the center of the passage as shown by the dotted lines.

FINISHING UPPER SHOULDERS.

Remove the cylinder from the cement, boil in alcohol, try in the hole jewel, note how high the escape wheel
bridge comes, and mark the brass hub for the balance seat, so that the balance when riveted in place will clear the bridge as at X in Fig. 345. Measure over both the hole jewels without the cap jewels for the total height, and file off from the upper unfinished shoulder, allowing it to be about .05 m.m. longer to be taken off when adjusting the endshake. Again cement the cylinder, turn the upper shoulder and pivot and polish it. Then turn the hairspring collet shoulder, and balance seat. Underturn it for riveting over the balance. Remove the cylinder from the cement and boil it in alcohol.

PLACING THE CYLINDER.

Press the balance on its shoulder, hold the cylinder with a tweezer on its lips, as in Fig. 346, and turn the balance so that the banking pin is half way between the lips as shown by the dotted line (X) that is perpendicular to the line (YY) that passes the lips. Partly rivet on the balance, partly true it, fasten the upper cap jewel and try for end shake. If there is not enough end shake, hold the cylinder by the lower part of the brass hub in a wire chuck or cement it, to take off a little from the upper pivot. (Holding by the cylinder would break it.) If there is too much end shake, press out the upper plug a trifle.

Place the balance in the movement and adjust the banking pin in the bridge, so that it will not overbank. Lead the banking (A) in the balance to the banking (B) in the bridge as in Fig. 335 and notice if the tooth drops into the cylinder over the discharging lip (X) as in Fig. 336. If it does, remove the balance, and turn the cylinder until the tooth will rest near the discharging lip as at X in Fig. 335. Rivet the balance tight and true it the same as a wheel. If there is no dot on the balance over which to place the hairspring stud, observe where the hole for the hairspring stud in the bridge comes on the balance when a tooth locks on the receiving lip and on the discharging lip. Remove the cylinder, and place the stud half way between these two points and press the
stud into the bridge. Wind the mainspring and if the cylinder and cylinder wheel are adapted to each other, the locking will be correct, and the balance will make about three-quarters of a turn. If necessary to move the chariot, and if its steady pins do not allow it to be moved, broach out the steady pin holes in the plate until the chariot can be moved the required amount.

**STRAIGHTENING A CYLINDER WHEEL.**

Test the cylinder wheel in the truing caliper, to see if it is true in the flat. If it is not, turn a recess in a brass disk to receive the teeth and hub as shown in Fig. 347. Lay the cylinder wheel on this disk as in Fig. 348 and with a rounded face chisel shape brass wire tap lightly on the cross arms, to straighten the wheel. If you tap too much on one arm, invert the wheel and tap on the other side.

**REPLACING A CYLINDER WHEEL.**

Should the cylinder wheel have a broken tooth, the watch will gain about three minutes an hour, as the escape wheel is allowed to revolve more rapidly, and must be replaced with a new one, of the same diameter and the same height and size of teeth. When a new cylinder wheel is desired, send in the old one, or the whole movement, if the wheel is lost.

To replace a broken escape wheel, stake out the pinion. Insert a copper wire in the new wheel and heat it until the hub is blue as shown by the black in Fig. 349 and remove the wire. Press the old wheel, hub downward, on a broach, and broach the hole in the new wheel until it meets the old one as in Fig. 350. If the pinion shoulder will not enter into the hub, enlarge the hole a little more, press it on a true wire, fastened in a chuck, and turn off the upper part of the hub until it is low enough to rivet on the pinion. Rivet lightly, so as not to spread the pinion, remove the blue with dilute muriatic acid on a pegwood, place it on the cleaning wire, wash with soap and water and dry well. Now hold the escape wheel between the thumb and forefinger, and, with a
small half round burnisher, burnish the long way of the
tooth, as shown by the arrow in Fig. 351 to remove the
burrs from the teeth. Try the teeth in the cylinder, and
if there is no drop, take off a little with an oil stone slip,
from the back part of each tooth until there is sufficient
drop. Again remove the sharp edges and test the wheel
in the caliper to see if true in the flat.

DIAL REPAIRING.

Dials are made of brass gold plated, silver or gold
with the numbers enameled or painted on; but most
commonly of copper and enameled, then lettered and
fired. They are held to the plate with two, or three,
copper posts. The dial for the second hand, called the
second bit, is soldered with bismuth solder.

SECOND BIT.

When examining the dial, if the second bit is loose,
remove it and scrape off the dirt around it with a graver
or round file. Make a spring with a tapered button on
one end (as in Fig. 352), and place the second bit in with
the thirty and sixty mark in line with the twelve and six
mark on the dial (as in Fig. 353). With a pegwood
apply soldering fluid and place a few small pieces of bis­
muth solder along the edge of the dial bit (as in Fig. 354).
Lay the dial on a bluing pan held over a flame and when
the solder melts, follow around with the pegwood and
the solder will form in a ball. Move the ball until the
crevise is evenly filled and then push it off the dial and
allow the dial to cool.

DIAL POSTS.

If a post is broken, grind off the remainder of the
post and the enamel around it, on an emery wheel as at
X in Fig. 355. Place the dial on the plate, so that the
center hole is over the center of the bottom plate, and the
hole in the second bit is over the center of the fourth
wheel jewel, and with a needle mark through the hole of
the plate where the post should be. Turn a post from a
copper wire, cutting in close to the bottom with a round
graver (as at X in Fig. 356) to allow it to be easily bent after soldering. Clean the dial and post in benzine, place on a little soldering fluid, melt a little solder on the post and allow it to cool. Fasten the post centrally over the place marked on the dial, with a flat spring as in Fig. 357. Lay it on a bluing pan and heat it until the solder melts. When cool, lightly grind off the surplus solder, place the dial on the plate and if it is not central, bend the post a trifle until it is. If too much bending is required, again heat, shift the post while the solder is soft and allow to cool. Do not bend the dial as it may crack.

CHIPPED DIALS.

If the dial is chipped, clean it with benzine, lay it on a bluing pan, place a piece of dial enamel on the chipped place and heat gently until it melts. When cool, scrape off the surplus enamel with a sharp knife and again heat to give it a gloss. (Contact with a flame and too much heat turns the enamel yellow.)

CRACKED DIALS.

If the dial is cracked, hold it between the thumb and second finger, using the first finger to press the crack open, and with a brush dipped in the cleaning solution, wash the cracks lengthwise, being careful not to crack it further. Place it in alcohol and dry with a clean cloth.

CASE REPAIRING.

When a watch case is out of shape, send it to the factory or to a case maker. The charge is small and the work more satisfactory, for case making is a trade distinct from watch repairing. There are a few minor repairs, however, that the watch repairer may make, especially if the customer is in a hurry and is not particular about the appearance of the case. Among these are, fitting a lock and lift spring, a crown, a stem and sleeve, pendant bow and glass, inserting a new joint pin and removing dents. Some of the material for these repairs you may keep on hand, while for others it is best to send in the case to have the part fitted.
FITTING A LIFTING SPRING.

The purpose of the lifting spring in a hunting case is to raise the cover, when it is released by pressing on the crown. They can be bought for any make and size of case, but must be fitted by filing off a little wherever it is necessary. A spring made from a thin steel band is the best, because it is easily fitted. Some are held in place with a screw, or pin, in the case rim, or center, while others are held by a rim that serves as a dust band.

To fit a lifting spring, take out the pin screw or band that holds the old one, and with a flat end hook, enter from the wide end of the lifting spring and lift it out. Select a spring about the same width, thickness, length and curve as the old one and if necessary, file it a little narrower until it enters the case. Both sides of the wide part of the spring must fit the inside of the case center as at X in Fig. 358, and not be tapered as shown by the dotted line R in Fig. 359, as a spring narrower on either end will not lift the cover evenly. The spring must be left wide enough so that it will press against the screw, pin, or band, that is to hold it. After fitting the body of the spring, notice how the curved tongue fits around the joint. If it stands away from the joint (J) as at S in Fig. 360, file the tongue shorter and bend it to conform with the joint as at W in Fig. 358. Hold the spring in place, press down the cover and allow it to raise. If the action of the cover is not smooth and uniform, the spring does not fit properly around the joint and must be shaped with a file or by bending. If it does not raise the cover far enough, bend the spring up a little as shown by the dotted line B in Fig. 359. Should the spring be too strong, gradually file the acting part narrower (as from Y to Y). When it fits properly, polish and finish off the sharp corners from the tongue, and, on a circular felt buff, polish the exposed part of the tongue and its end that acts on the joint. Place the tongue on the joint, press the spring in place and fasten it the same as the old one. Inserting a lifting spring is not difficult, but fitting one properly, requires practice and it is advisable for the
beginner to practice on an old case to prevent spoiling a good one.

FITTING A LOCK SPRING.

The lock spring is to hold the case cover tight against the center. If well made and fitted, it will seldom need replacing, but if it is broken, fit a new one. Remove the old one the same as the lifting spring and shape the body of the new one to fit the center of the case. Try it in the case and if the stem rubs in the hole, remove the spring and correct the hole with a round file to allow the stem to move freely. Again fasten the spring and try the cover to see if the catch of the spring holds the cover lip tight against the case center or rim (as at T in Fig. 361) and does not allow space between the two (as at Y in Fig. 362). If the spring does not hold the cover tight, remove it from the case, soften it and bend down the catch a little. Again try it in the case, and, if necessary, remove it and bend the catch up or down a trifle as is required to make the cover close tight to the center. Allow a little freedom between the top of the catch and cover (as at C in Fig. 361). When the spring holds the cover properly, harden, temper to blue, polish the catch and with an emery stick grain the rest of the spring. Fasten the spring in the case and wash the case without removing the springs. Be sure and burn the alcohol out from behind the springs.

REPAIRING JOINTS.

When joints are out of order so that the cover is loose, send the case for repairs. Sometimes you can make a joint tighter by inserting a new brass joint pin. If the cover does not close tight to the center, bend in the fingers or hold the center of the cover, and press its outside edge against the bench until it does fit. Be careful not to break the joint.

To remove a joint pin, hold the case in the left hand with the back of the case towards you and press out the plug (G) with the round graver, as in Fig. 363. Turn the case over and press out the joint pin (J P) with a tem-
pered steel wire flat on its end, that fits in the joint easily (as in Fig. 364). Sometimes a few light taps on the length of the joint with a chisel shape flat punch are necessary to loosen the pin. Since the pin has a slight taper, it can be driven out only one way, but it may be necessary to start it a trifle from the large end.

If the middle joint is too loose, broach out the end joints a trifle and fit a thicker pin. If the end joints are loose, broach the center joint. Taper the pin slightly, stick it in beeswax and insert it from the side from which the broach entered. Then replace the plugs, file them smooth and polish them on a felt buff.

DENTS.

Small dents in the covers may be rubbed out from the inside with a smooth piece of bone by holding the case on a leather pad. Larger ones must be removed by tapping with a wooden mallet, from the inside, while the case is rested on the leather pad. If the dents still show, go over the outside with a very fine file and then polish with Tripoli on a rotary brush. (Do not file a filled case.)

If you follow these suggestions about case repairing, you can help yourself in case of necessity, but whenever it is practicable, it will be to your advantage and that of your customer, to send the case in for repairs, as you can earn more doing watch work and the case will appear better when repaired.

RECORDING THE WORK.

Although you begin with only a few watches for repairs, do not trust your memory, but keep a record of every one you handle. Enter your private number in a book and also the make, size and number of movement and case; repairs made, date, charges and the customer's name and address. Then lightly scratch your private number in the back cover of the case. If the watch is returned, the record will show the amount and date of repairs and whether the time of guaranty has expired. (Time of guaranty is generally one year.)
TAKING IN WORK.

Having explained how to repair a watch, we expect that you have profited by our instructions and have prepared yourself to take in watches from customers. No matter how competent a workman you are, you cannot profit without estimating accurately the repairs needed to put a watch in running order. The main thing is to get the work to do and a reasonable price for doing it. This requires tact, to avoid displeasing the customer and judgment to readily make a price without hesitating. You will acquire both through experience. Be civil, prompt, and above all, honest with your customer to win his confidence. Do not advertise your competitors by talking about them, but inquire as to their prices and make yours accordingly.

When you receive a watch for repairs, look in the case for your private number. If it is there, refer to your record and see the date and amount of work done, to avoid saying at once that the watch needs cleaning. If you have not handled the watch before, ask the customer when it was repaired and what was done to it. If the watch has not been cleaned within two years, tell the customer that it needs cleaning and fresh oil, but if clean, tell him that you must examine it to find the cause of stoppage. If he is willing to leave the watch, write his name and address on a watch tag, with two corresponding numbers. Hand him the number of the lower part of tag, fasten the other part to the pendant bow and mark "examine." Ask the customer to step in again to get the price or tell him that you will notify him before making repairs. Should the customer be unwilling to leave the watch without a definite estimate, take out the balance, examine the best you can and set a price to protect yourself and satisfy the customer.

Sometimes, trusting to your honesty, the customer will leave the watch to be repaired, without a price being set. This is the most desirable way, as you can then make all necessary repairs and charge accordingly. Explain to
the customer that you will make only the necessary repairs and charge no more than you must.

EXAMINING A WATCH.

Hold the watch without shaking it. See if the hands are free from each other, the dial and the glass. Open the back cover, with a tweezer, grasp an arm of the center wheel to see if it is free. If it has no power, try to wind the spring. Should the stem turn continuously without giving power to the center wheel, the mainspring is broken or unhooked. A stop work or a broken tooth in the winding may prevent the crown being turned.

See if the balance swings freely and whether the fork moves with it. A broken or loose roller jewel will allow the balance to move without moving the fork. If the balance is not free, it may be overbanked, a loose balance screw may be touching the balance bridge, a staff pivot may be rusted in, due to a lack of good oil, bent or broken, allowing the balance to lean to one side. The jewels may be broken. The hairspring may have jumped upon the center wheel, the stud or regulator pins. Examine the pallet action. If these parts are found right, the trouble is in the train. There may be a bad depthing or a worn pinion; also a worn pivot or pivot hole where there is no jewel. Dirt between a wheel and pinion may cause stoppage.

As only a partial examination can be made with the movement in the case, it is better to entirely dissemble the movement and make a thorough examination for two reasons. First, because you can then give an accurate estimate and second, the customer will generally leave the watch for repairs once it is apart.
Escapement Overbanked

Cementing A Cylinder

Pressing Plug In Cylinder

Trying Cylinder For Height

Upper Bridge

Turning A Cylinder Plug

Driving Out Plug

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Proper Position Of Cylinder And Escape Wheel

Placing Cylinder In Relation To Bankings

Holding Cylinder Plug With Plier

Section Of Wheel And Disk

Plug Shortened Before Turning Pivot

Cylinder Wheel Truing Disk

Removing Temper From Wheel Hub
Fig. 350
Broaching Hub To Size

Fig. 351
Burnishing Cylinder Wheel Teeth

Fig. 352
Spring For Holding Dial Bit

Fig. 353
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Fig. 354
Soldering Dial Bit

Fig. 355
Enamel Removed For Dial Post

Fig. 356
Dial Post Weakened For Bending

Fig. 357
Spring For Holding Dial Post
Fig. 358
Proper Shape Of Lifting Lip On Case Joint

Fig. 359
Shaping A Lifting Spring

Fig. 360
Lifting Spring Lip Too Long

Fig. 361
Locking Spring Catch Holding Cover Properly

Fig. 362
Locking Spring Catch Too Long

Fig. 363
Removing Joint Plug

Fig. 364
Removing Joint Pin