TRAINING UNIT
NUMBER 2

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TRUING BALANCE WHEELS

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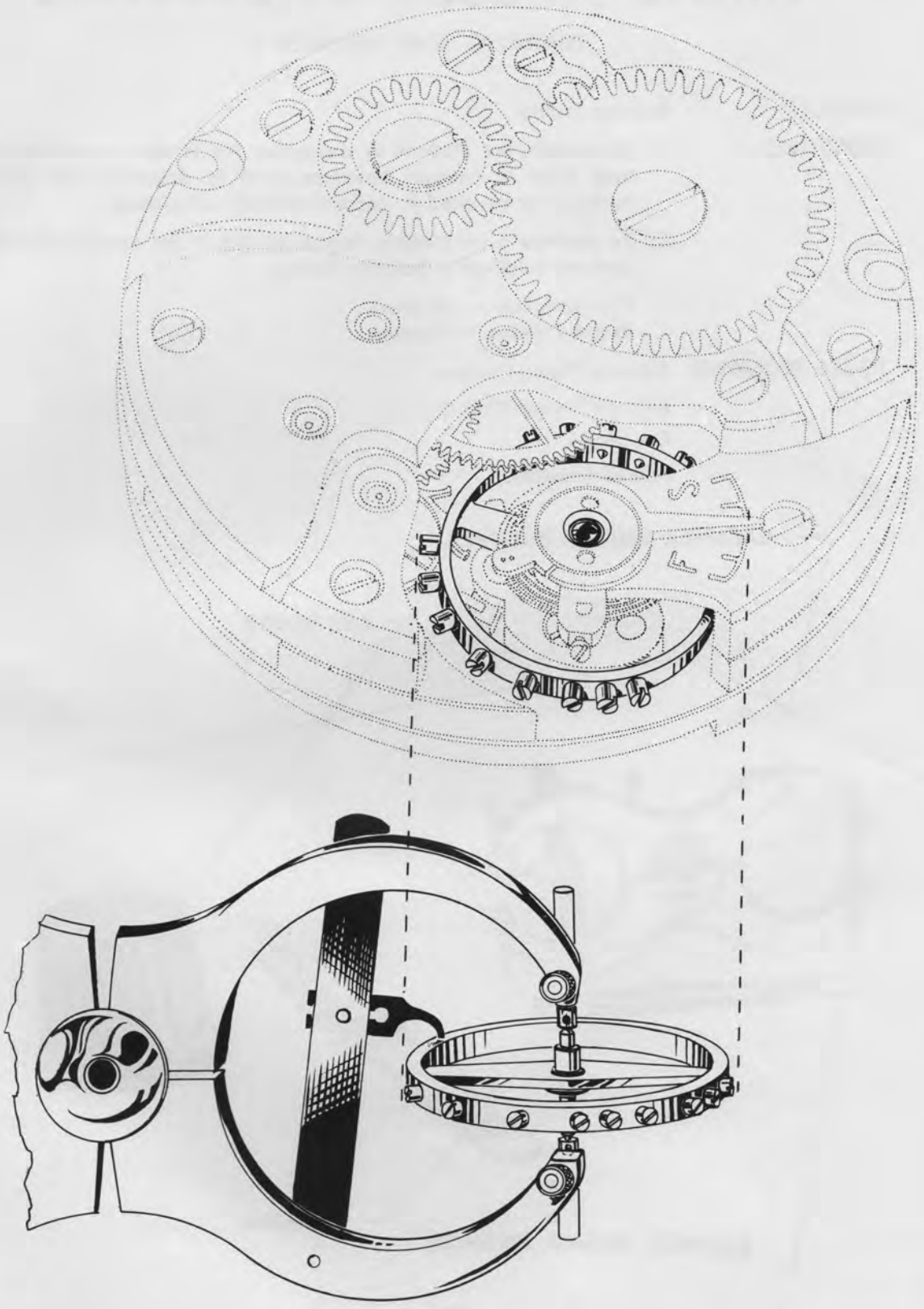
The balance staff and balance wheel form an integral part of the timekeeping unit of the watch.

The function of the staff is to support the balance wheel and the function of the balance wheel is to serve as an accurately oscillating member of the timekeeping unit under the control of the hairspring.

If this function of the balance wheel is to be fulfilled it is necessary that it be mounted on the staff in such a manner that:

1. The entire rim lies in one plane.
2. The plane in which the rim lies must be perpendicular to the staff axis.
3. The entire rim must be concentric with the staff axis.

The operation designed to establish this condition is known as BALANCE TRUING.



BULOVA SCHOOL of WATCHMAKING

TRAINING UNIT NUMBER 2

SUBJECT: Balance Truing

OBJECTIVES:

1. To enable the student to recognize the various conditions that may exist in untrued balances, and to determine the proper methods to be used in correcting these conditions.
2. To develop a reasonable degree of skill in the manipulative procedures involved in Balance Truing.

Practical work — 40 hours
Related theory — 8 hours

TOOLS REQUIRED: Balance Truing Calipers
Balance Truing Wrench
Eye Loupe
Pair of Tweezers

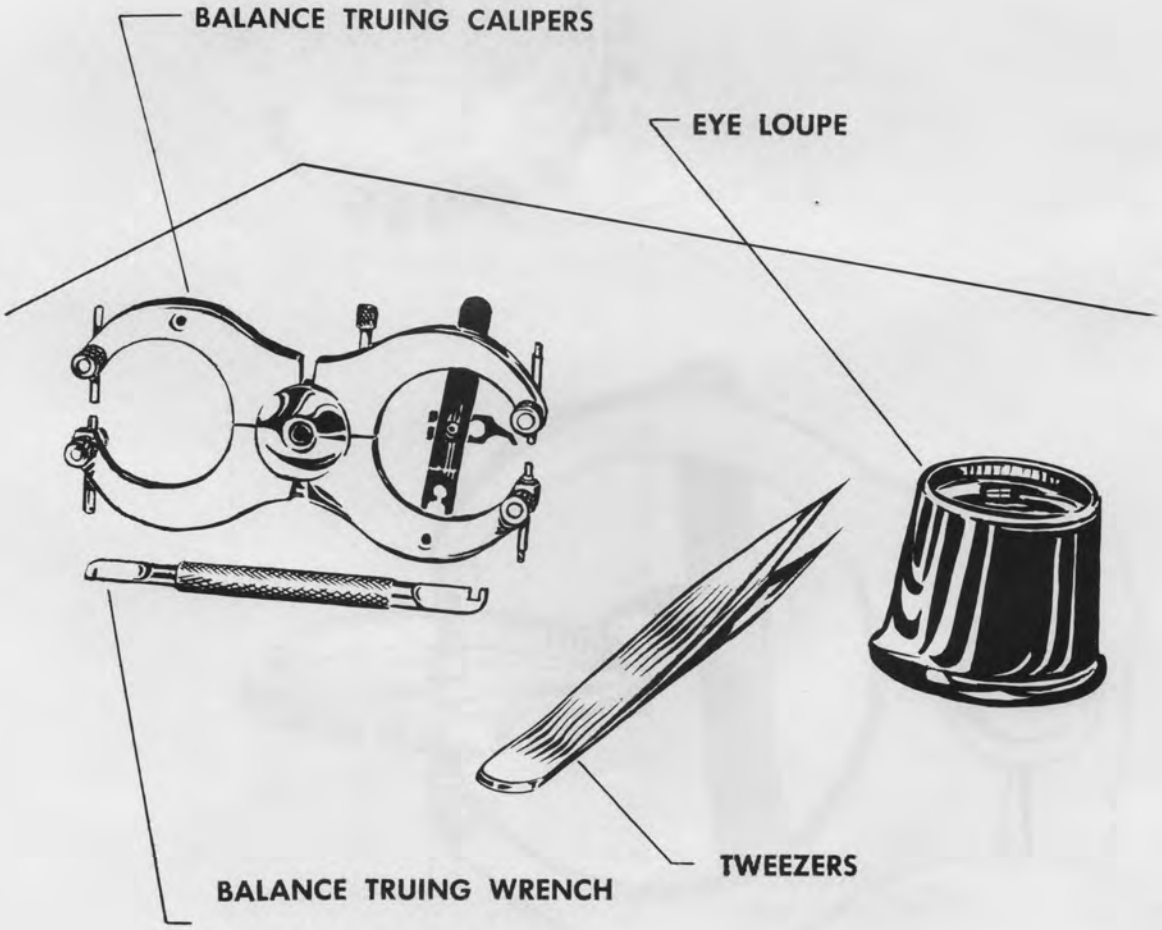


Fig. 1

PRACTICAL MANIPULATIVE OPERATIONS FOR BALANCE WHEEL TRUING

I. USE OF BALANCE TRUING CALIPERS

Throughout the truing operation the balance is held in the balance truing caliper. These calipers are so constructed that the balance is supported on the conical portion of the pivots. Fig. 2. Care must be taken that the pivot holes in the stumps are kept clean to prevent damaged or broken pivots.

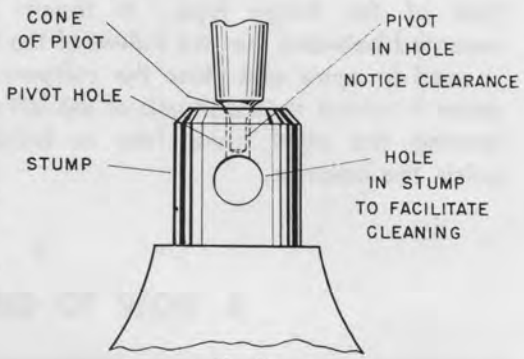


Fig. 2

HINGE TYPE CALIPERS

A further consideration when mounting the balance in the hinge type calipers is the alignment of the stumps with the staff.

In order to achieve this condition the stumps themselves must first be aligned. This alignment is present when, and only when the bows of the calipers are completely closed. Therefore, when mounting a balance for truing in these calipers, make certain that the bows are closed, then, by using the individual stump adjusting nuts, set the stumps so that the distance between them will be *slightly* less than the distance from cone to cone on the staff.

With these adjustments properly set the balance may be inserted and trued with no danger of damage to the pivots and with full confidence that indicated errors are due to the condition of the balance wheel and not to faulty mounting.

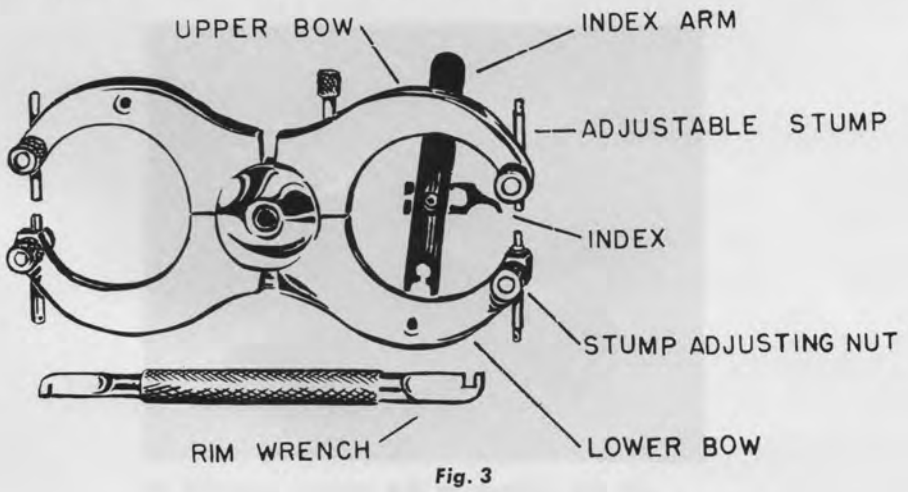


Fig. 3

SCREW-TYPE CALIPER

The screw type calipers are equipped with an adjustable index mounted on a sliding bar fastened to the frame. Fig. 4. The calipers are held in the left hand in a position similar to that of the hinge type. A thumb screw mounted between the two halves of the frame is used to open and close the calipers. This screw is turned by the thumb of the left hand, leaving the right hand free to hold and guide the balance.

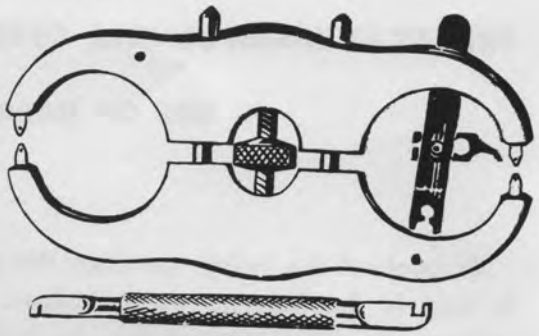


Fig. 4

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2. HOW TO GRASP AND HOLD CALIPERS

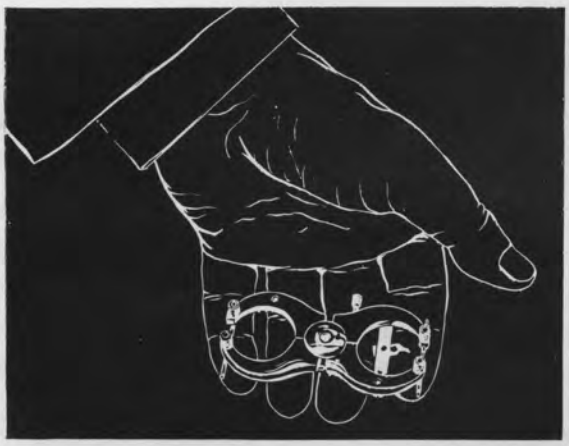

Fig. 5

Lay the calipers across the four fingers of the left hand as shown in Fig. 5.

Fig. 6

Bring the thumb down over the calipers so as to rest on the lower bow. Fig. 6.

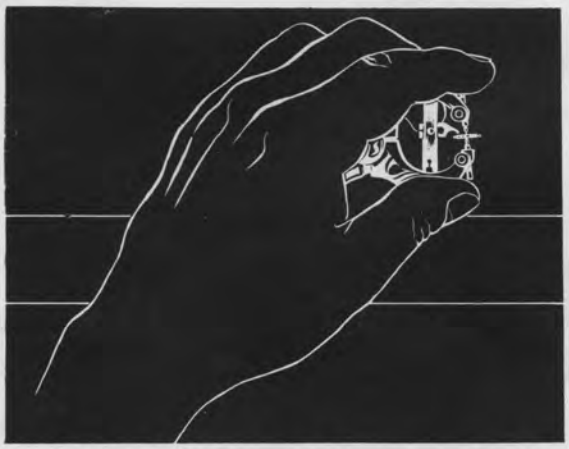

Fig. 7

Lift the caliper to the correct position at the bench. Fig. 7.

In the proper working position the forefinger is used to adjust the index arm and also provides leverage for the thumb when opening and closing the jaws. With practice, the moving of the index arm as well as the adjustment of the jaws can be performed with one hand.

Fig. 8

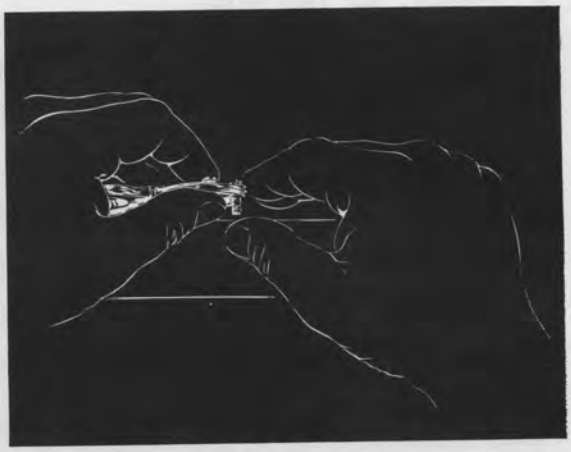

Fig. 9

Fig. 8 shows the proper position of the calipers for truing in the flat.

When truing a wheel in the round the calipers are tipped forward as shown in Fig. 9.

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SPECIFICATIONS FOR A TRUE BALANCE WHEEL

Balance Truing is an important part of the watchmaker's trade. The operation involves the bending of the balance wheel rim until it conforms to the following requirements of a true balance.

1. All parts of the rim must lie in the same plane. Fig. 10A.
2. The plane in which the rim lies must be perpendicular to the staff axis. Fig. 10A.
3. The entire rim must be concentric with the staff axis. Fig. 10B.

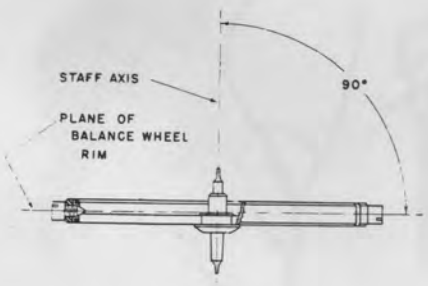

Fig. 10A

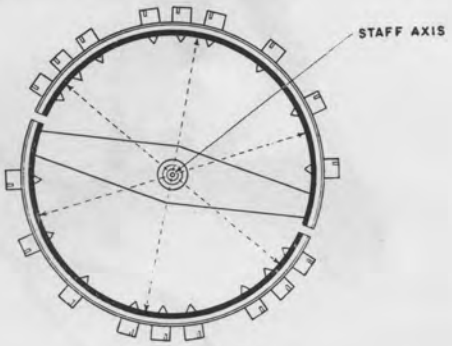

Fig. 10B

II. TRUING BI-METALLIC BALANCE WHEELS

A. TRUING IN THE FLAT

The operation known as truing in the Flat consists of bending the balance wheel rim until it conforms to the first two requirements of a true balance as illustrated in Fig. 10A, namely

1. The entire rim must lay in a single plane.
2. The plane in which the rim lies must be perpendicular to the staff axis.

To perform this operation, place the balance wheel in the calipers in such a manner that the conical portion of the pivots support the balance staff. See Fig. 2.

Adjust the index to a position just above the balance arm and as close to the end of the arm as possible. Fix the space between the index and arm accurately in mind and turn the balance wheel until the other arm is directly under the index. The space between the index and either arm must be exactly the same. If any variation is noted the arms must be adjusted until they are equal in height. This adjustment is accomplished by grasping the rim with the thumb and forefinger and gently forcing the arm up, Fig. 11A, or down, Fig. 11B as required.

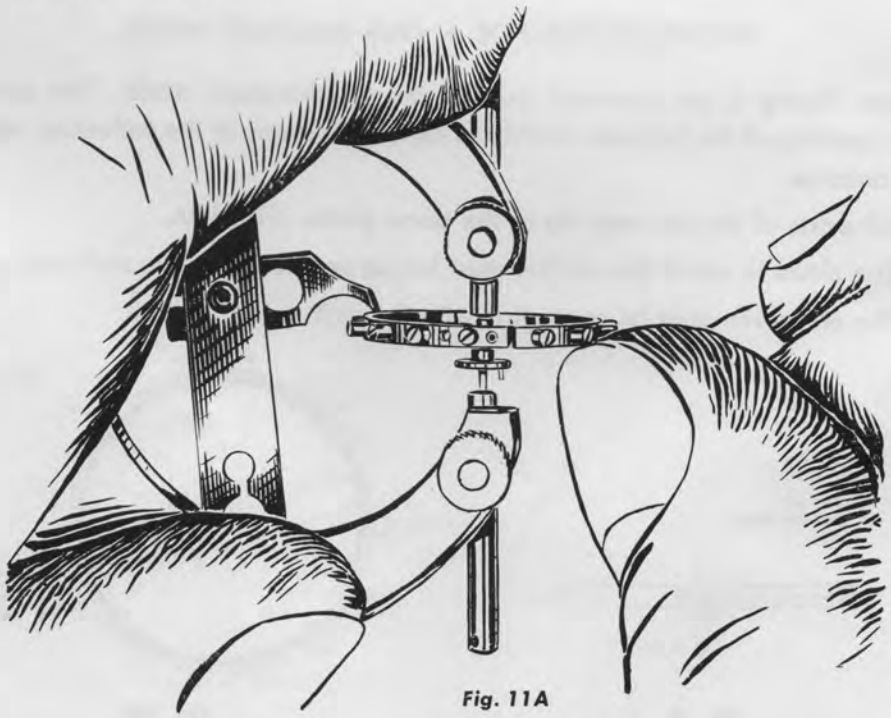

Fig. 11A

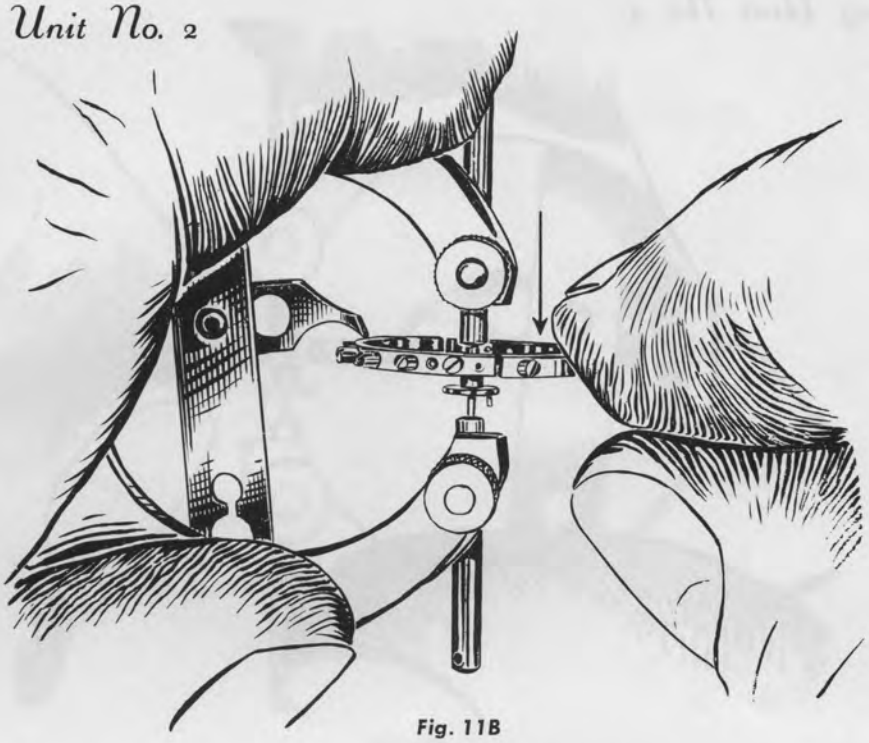

Fig. 11B

Readjust the index to a position directly over the rim at the end of an arm so that a narrow slit of light is visible between the index and rim when the calipers are held in the proper truing position. Fig. 12. Rotate the balance with the side of the right forefinger noting any variation in the width of the slit of light. Since the index serves as a fixed reference point, any increase in the light space indicates a downward bend in the rim. Likewise, any decrease in the light indicates an upward bend.

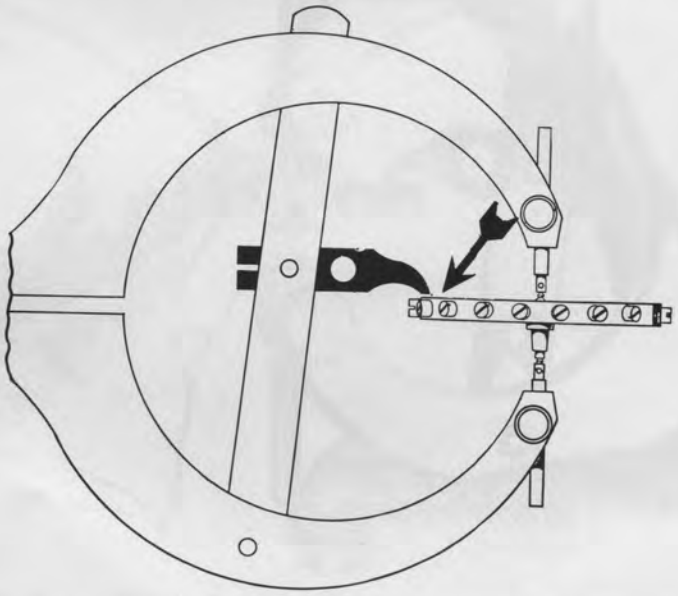

Fig. 12

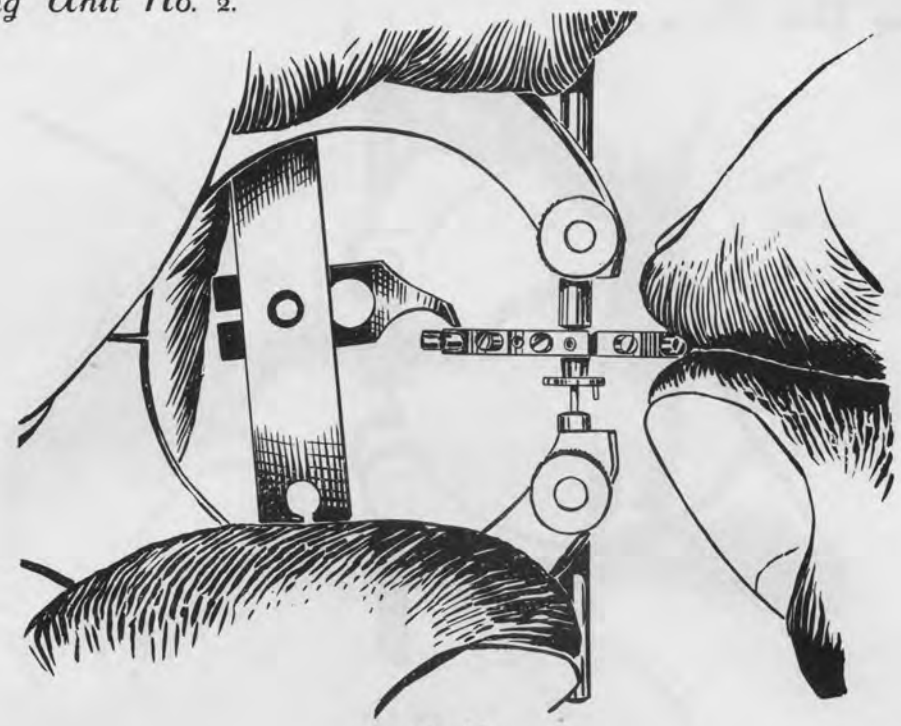

Fig. 13

If a gradual bend is encountered in the rim it may be eliminated by pressing the rim between the soft parts of the thumb and forefinger as shown in Fig. 13.

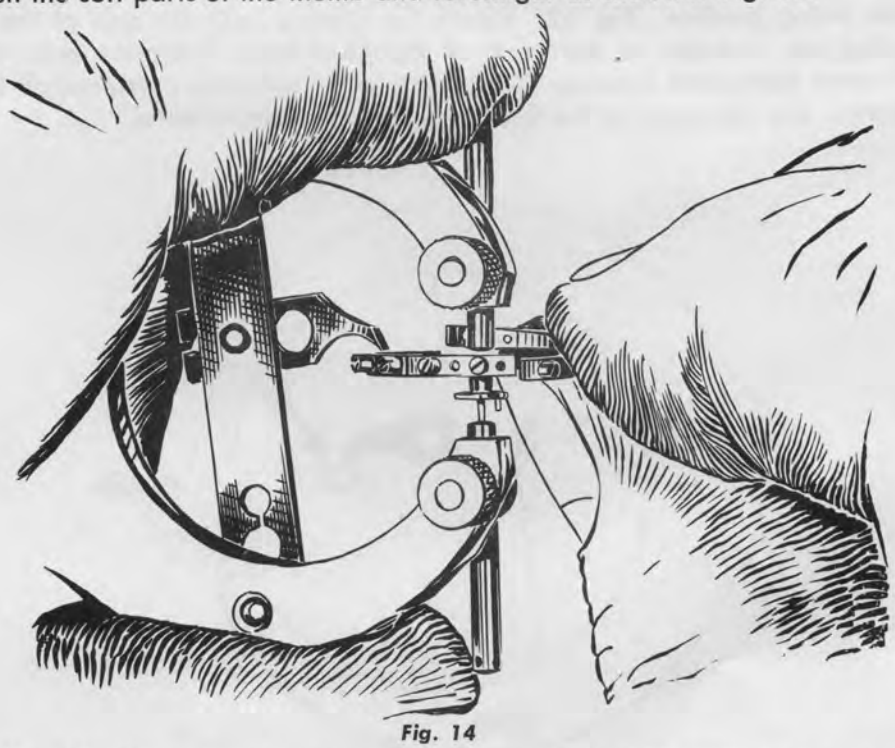

Fig. 14

If the bend is abrupt more pressure must be applied within a limited area of the rim in order to eliminate it. This is best accomplished by using the very ends of the fingers instead of the soft parts to exert pressure on the rim. Fig. 14.

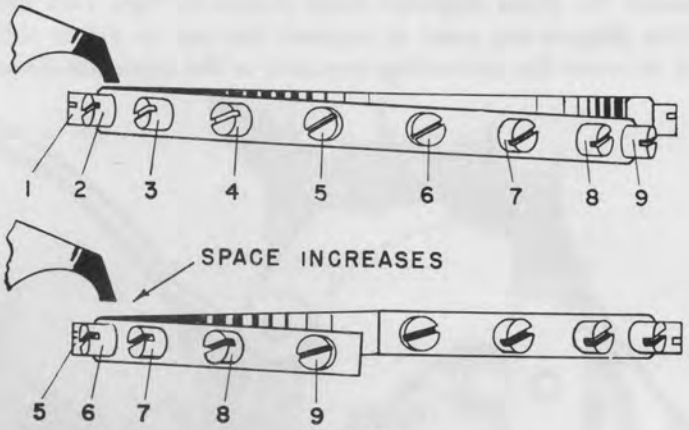

Fig. 15A

In Fig. 15A a downward bend from the arm to the cut is indicated, and in Fig. 15B a similar bend in the opposite direction is shown.

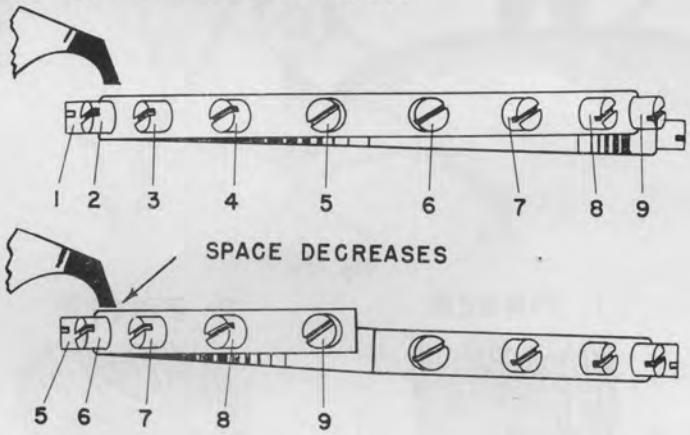

Fig. 15B

If a rim is found to be bent as in Fig. 16A, first straighten the bend nearest the arm, Fig. 16B, using the soft part of the fingers. The remaining bend is straightened by rolling the forefinger over the thumb from the bend to the cut, thus eliminating all bends. Fig. 16C.

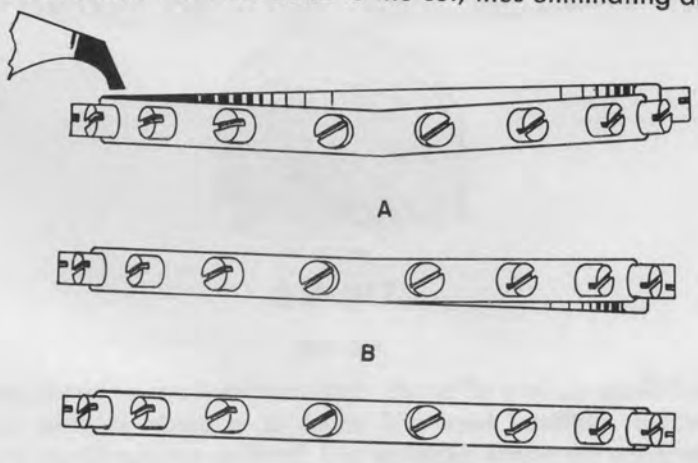

Fig. 16

When a more pronounced bend than that shown in Fig. 16 is encountered it will be necessary to develop the three fingered bend shown in Figs. 17A and 17B. In this bend the first and second fingers are used to support the rim on either side of the bend while the thumb is used to exert the correcting pressure in the opposite direction.

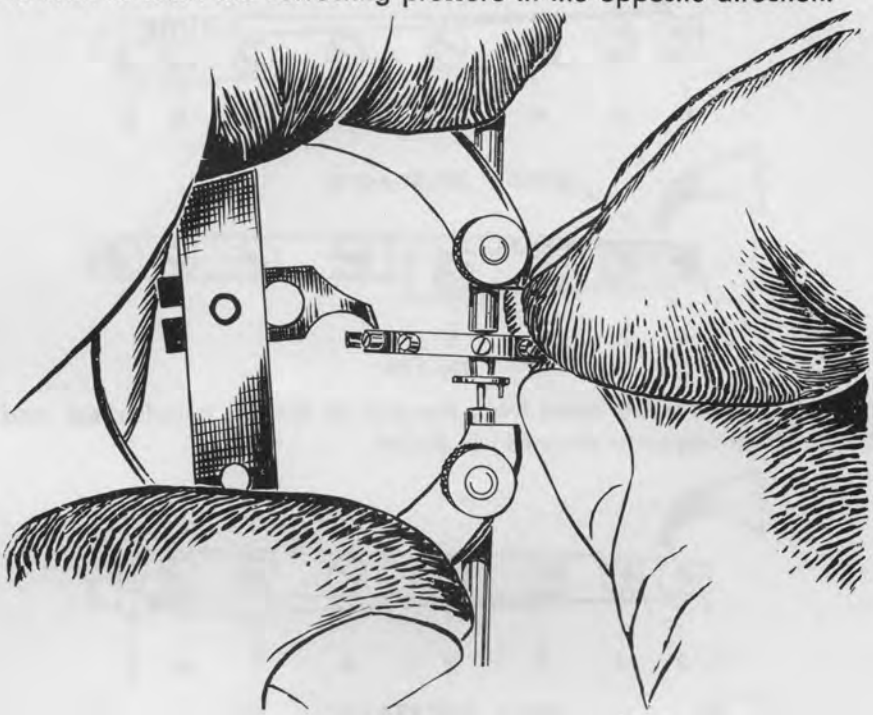

Fig. 17A

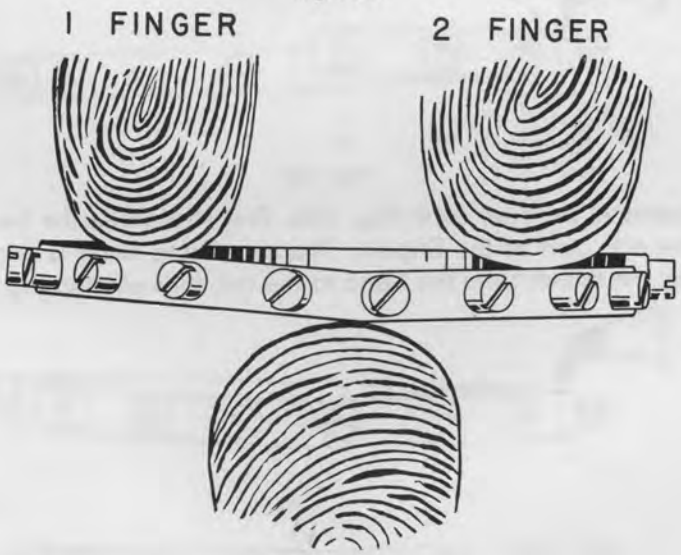

Fig. 17B

There are an infinite variety of bends, and combinations of bends possible in a balance rim, but the principles outlined here will serve as a guide in their correction. Through practice and experience the watch repairer will develop various finger movements to correct any bends that may be encountered.

B. TRUING IN THE ROUND

The operation known as "truing in the round" consists of bending the rim of a balance wheel until it conforms to the third requirement of a true balance as given at the beginning of this training unit. Namely: The entire rim must be concentric with the staff axis.

To perform this operation, readjust the index to lay just above the outside surface of the rim as shown in Fig. 16.

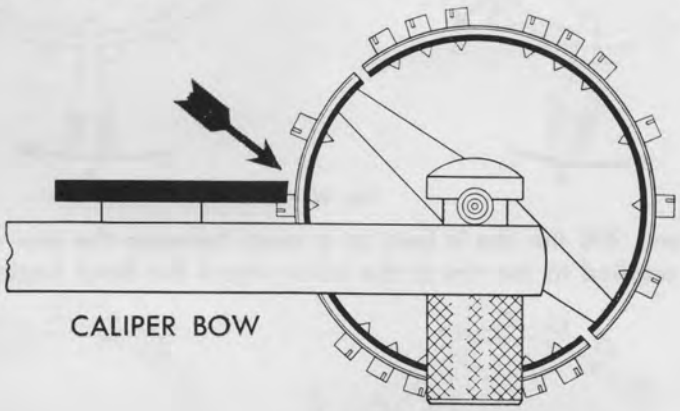

Fig. 18

Slowly rotate the balance, working from an arm to the cut. Any change in the index clearance indicates a bend in the rim. Eliminate all bends as they appear, using a rim wrench to achieve best result.

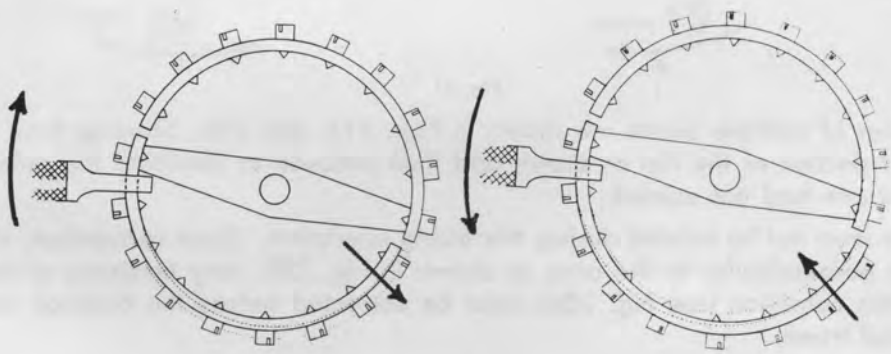

Fig. 19

In Figs. 19A and 19B the rim is bent out of true from the arm to the cut. To correct the bend place the wrench on the rim as close to the arm as possible and bend the rim outward for A and inward for B. The arrow on the wrench indicates the direction of force applied and the arrow at the arm indicates the direction the rim is to be bent.

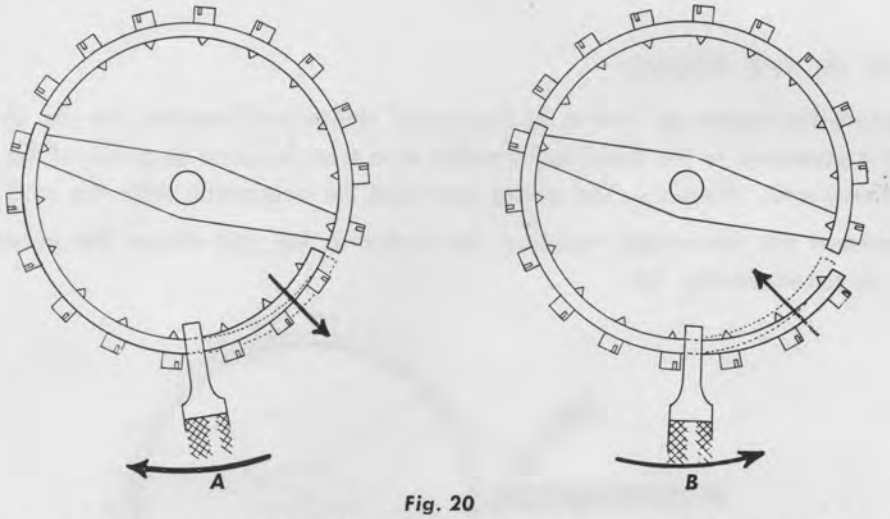

Fig. 20

In Figs. 20A and 20B the rim is bent at a point between the arm and the cut. Note that the wrench is applied to the rim at the point where the bend begins.

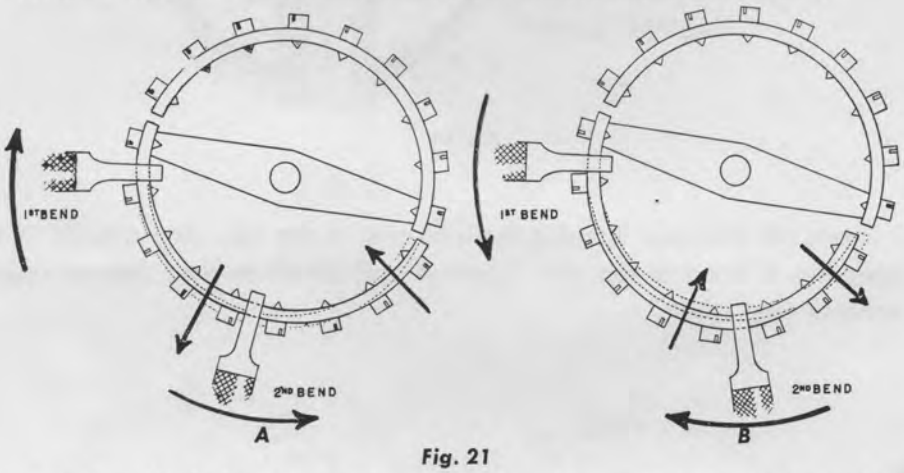

Fig. 21

Examples of multiple bends are shown in Figs. 21A and 21B. Starting from the arm, true the first portion of the rim as shown and then procede to eliminate the second bend as if the first one had not existed.

The rim must not be twisted during this truing operation. Upon completion, the entire rim must be perpendicular to the arms as shown in Fig. 22B. Any tendency of the rim to vary from this condition (see Fig. 22A) must be corrected before the balance wheel can be considered trued.

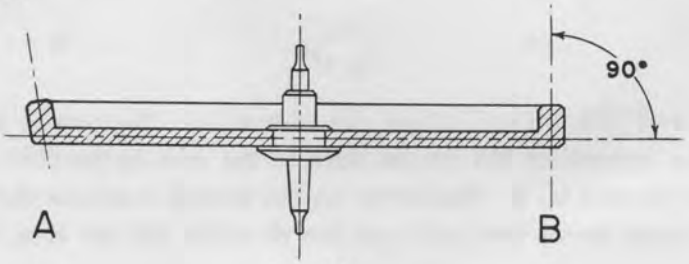

Fig. 22

III. TRUING MONO-METALLIC BALANCE WHEELS

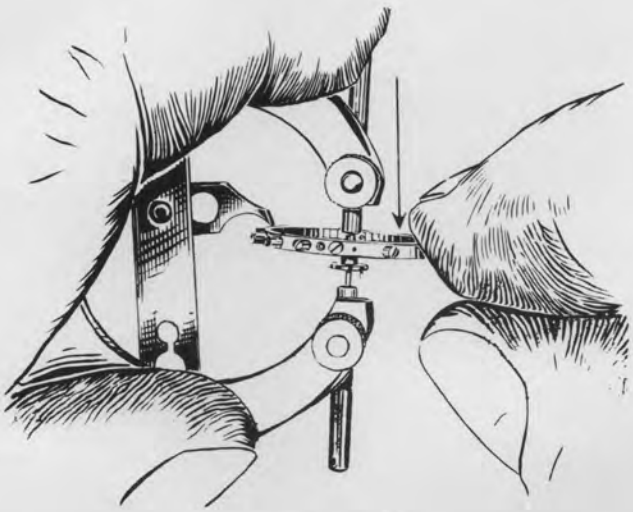

Fig. 23A

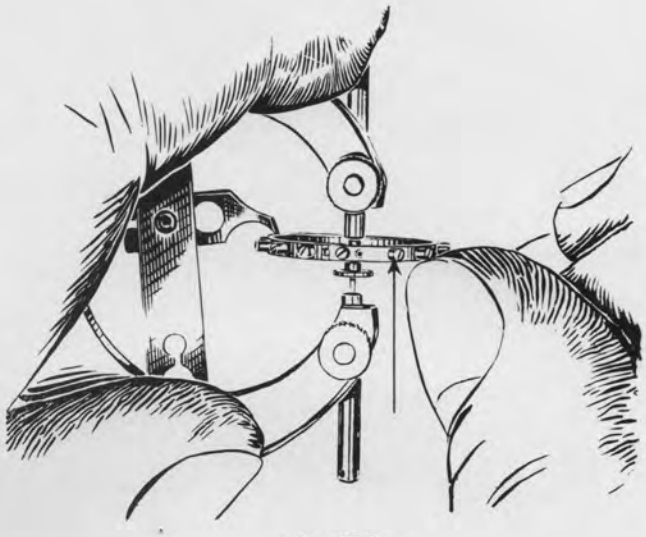

Fig. 23B

TRUING IN THE FLAT

A. Because of the solid rim, the mono-metallic wheel can best be trued in the flat using the three fingered bend discussed under "Truing of Bi-Metallic Balance Wheels" on page 7. See also Figs. 23A and 23B above. If a rim of this type is found to be bent to any appreciable extent it should be replaced.

B. TRUING IN THE ROUND

It is very difficult to correct any errors in the round on a mono-metallic balance wheel. If the wheel is found to be out of true it should be replaced.