Then adjust the nose iron to correct the ratio error.

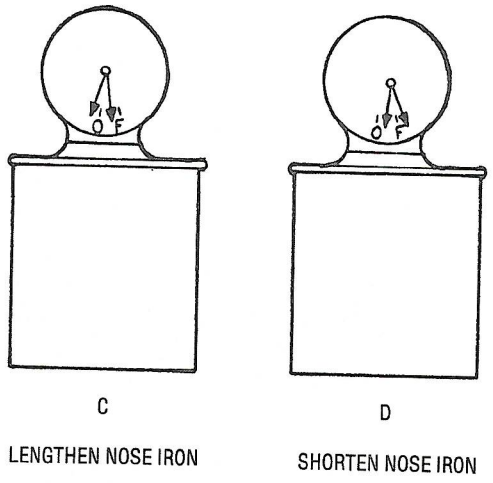

Figure 1.2.42. Cabinet Dial Adjustment

The next step is to test the range of the tare lever. With 1000 lbs. on the platform, and the unit weight lifted, the indicator should point to 1000 lbs. Assuming that there is a 1 lb. minus error, note, but do not adjust. Place 1000 lbs. more on the platform and drop one unit weight. The reading should be one minus again. If it is indicating two minus or more, the unit weight pivot should be raised slightly if the pivot is vertically adjustable. If it is not adjustable, the pivot will have to be replaced with a higher one. If the pivot line is neutral, that is to say, all the pivots are perfectly in line, then the above discrepancy indicates that the pivot line and the steelyard rod (the rod connecting the understructure with the tare lever) form an obtuse angle. This should be corrected by shifting the cabinet. An obtuse angle is broader than 90°. An acute angle is sharper than 90°. The pivot line and the steelyard should form a 90° angle when the indicator points to half capacity. Any such error is more pronounced and easier to detect at the third or fourth revolution; and for this reason, it is advisable to test these higher ranges by using the same procedures. Re-zero the scale after each adjustment and recheck.

The next step is to test and adjust the parallel condition of the tare and capacity bars with the pivot line, and the weight of the poises. Example: Value of the capacity bar is 1000 lbs., and the tare bar has a value of 200 lbs. The adjusting procedure is the same as described in the section dealing with cabinet Weightographs, or in the section dealing with the floating pendulum type dial scales, or the procedure can be reversed as follows.

Zero the scale. Place 1000 lbs. on the platform and move the capacity poise to the 1000 lb. graduation. The reading should be zero. If the reading is plus, lead should be added to the poise. Remove the weights and zero the scale. Reload the scale and move the poise to the capacity position again. If the reading now is minus, cut off a piece of lead. Repeat previous procedure until the reading is correct. Remove the poise from the bar. Open it and punch a hole in the existing lead. Place the correcting piece of lead in the hole and swage it over. Make sure that the lead is tight and in the poise. Shifting lead will cause inconsistencies. Had the error been minus, lead should have been removed from the poise, by using the same method. Check and adjust the tare poise in the same manner.

Check and adjust parallel condition. Zero the scale. Place 1,200 lbs. on the platform. Read the indication exactly, but make no corrections. Move both poises to their capacity. The reading should be zero now because the poises have already been adjusted. Now add 1,200 lbs. more on the platform. The reading should be exactly the same as the previous one. If the second reading indicates more, then the tare bar bracket on the capacity end will have to be lowered, or the zero end raised. If the reading is minus compared to the first reading, then the capacity end will have to be raised or the zero end lowered. Repeat testing and adjusting until both readings are equal.

This procedure can be also used on cabinet "Weightographs" or substituted for the procedure described for the floating pendulum type scales. It is really the better method, but it is good to know both. The above explained procedure is basic, and can be used in all makes, types, or systems of dial scales. It will not be repeated again.

1.2.32 NEW STYLE TOLEDO DIAL SCALE

Repair or replace worn bearings and pivots. Clean and check every part thoroughly before assembly. After the scale has been assembled, check it for consistency. Adjustments to the understructure are similar to any other scale.

Check tare lever fulcrum plate for distortion and the proper setting. Clearance between the plate retainer and the horizontal bar should be .002 of an inch. To adjust, loosen the plate set screws.

The pendulum rails should run parallel when the indicator points to zero. To parallel the rails, a rail gauge should be used. If unable to obtain such a gauge, it can be made fairly easily.

To parallel the rails place a load on the platform that would equal to about half capacity. Pull the rails together and place the gauge flush with the lower end of the rails. If the pendulums are too low, raise them for the duration of this adjustment.

Disengage the rack by turning the rack guide until the pinion turns freely. Re-engage teeth in a position where the indicator is nearest to the empty space between zero and full capacity. Reset the rack guide so that the clearance between the rack and the rack guide is .010". Zero the indicator with the rack adjusting screw, which is located on the top of the rack. This procedure is necessary in order to set the cams in their calibrated starting position.

Adjust the indicator travel by turning the nuts on the top of the tape connecting rod, where it is attached to the tape yoke. The indicator should point to the center of the empty space between zero and full capacity when the scale is locked or when the tare lever is depressed to the limit. Adjust the pendulum bumpers so that the pendulums rest against them when the scale is locked. The bumper on the tare lever may have to be reset.

On dial scales that do not have a tare lever, the oil seal cup is used as a travel limiting agent. In this case the platform should be raised slightly so that the pendulums rest against the bumpers. Adjust them until the indicator points to the center of the open space.

Zero the scale with the balance ball, which is located on the pendulum activating lever, between the dial head and the tare lever. It has a wide adjusting range. If balance cannot be accomplished in this manner, lead should be added or removed from the back balance weight at the end of the tare lever. Care should be taken to see that the lead is held rigidly in place.

1.2.33 THE OUT OF LEVEL TEST

Make sure that the pendulum weights are equally spaced. Zero the indicator with the balance ball. Facing the scale so that the back balance weight is on the right hand side, tip the scale to the right and place a half inch board under the left hand wheels of the base and note the indication. If the scale is indicating minus, the back balance weight of the tare lever should be lowered with the aid of the height adjusting screw, after the lock screw has been loosened. Tighten the lock screw after the adjustment. If the indication is plus, do the opposite. Remove the board and check zero. Repeat the adjustments until scale reads zero both in a level and out of level condition.

Check and adjust for swivel errors in the same manner as described for the other floating pendulum type scales. This is also a floating pendulum scale. Check and adjust poises and beam parallel as described for the previous scales.

1.2.34 FULL CAPACITY

Load the scale to the capacity of the dial. If there is a minus error, both pendulums will have to be raised an equal amount. Loosen the pendulum lock nuts first. Raise the pendulums, with the aid of the hexagon headed height adjusting screws which are located on the top of the pendulum rails. Tighten the lock screw after the adjustment. If the indication is plus, do the opposite. Remove the weights and check zero. Repeat the adjustments until correct.

1.2.35 ADJUST HALF CAPACITY

Load the scale to the half capacity of the dial. If there is a plus error move the top portion of the pendulum which can be adjusted horizontally, away from the pendulum rail. Both of these weights will have to be moved equally.

For one graduation error on the plus side, move one of the weights until the reading is 4 graduations minus. Move the second weight until the reading is 8 graduations minus. Remove the weights and adjust zero. Test again. Repeat adjustments to full and half capacities until both are correct.

1.2.36 ADJUST FIRST QUARTER

If there is a minus error at the first quarter, move the indicator tail weight which can be adjusted in parallel with the indicator, toward the shaft of the indicator. Adjust this weight until the reading at the first quarter is correct. This adjustment will not affect the half and full capacities. Do the opposite for a plus error.

1.2.37 ADJUST THIRD QUARTER

Should there be an error at the third quarter, weights equivalent to the quarter capacity should be removed from the platform. With half capacity on the platform, adjust the indicator weights (which can be moved at right angles to the indicator) until an error is created at half capacity that is equal to the error found at 3/4 capacity. The error created should be in the same direction and the same amount as was found at the third quarter. In other words, if there was a one graduation minus error at 3/4 capacity, then a one graduation minus error must be created at half capacity with the indicator balance weights. Remove the load and zero the indicator. Check and adjust half and full capacities as previously described. Repeat procedure until all four quarters are correct. If there is an error between the quarters, check the scale for friction or dirt under the tapes. Readjust the pendulum bumpers so that they hit the pendulums when the indicator points to the center of the empty space between zero and full capacity. Tighten the lock nuts.

1.2.38 NEW TOLEDO CABINET DIALS

Load the platform with weights equal to the dial capacity. Drop one unit weight. The reading should be zero. If not, the nose iron of the understructure should be adjusted. The next step is to adjust the second, third, and fourth revolutions in the same manner as described on the section dealing with cabinet dials. This should be followed by the dial adjustments as previously described for new style Toledo dials.

1.2.39 REPLACING FULCRUM PLATES

If the lever is not centered in the trip loop, loosen all the set screws that hold the horizontal and the vertical plates. Center lever and retighten set screws. Adjust restrainer plate to correct gap (.002").

To replace the plates, disconnect the tare lever from the head assembly and the understructure. Remove the pendulum lever by lifting the bracket, in order to disengage from suspension pin. Move bracket to the right after the tension coil sleeve has been removed. Remove damaged plates and install new ones. Align the horizontal plates by moving the pendulum lever fulcrum bracket. Tighten all plate set screws and reassemble pendulum lever. Adjust tension coil sleeve until the nuts are snug against the bracket. Adjust the indicator travel.

1.2.40 OLD STYLE FAIRBANKS-MORSE DIAL SCALE

The old stype Fairbanks dial is easy to repair, but it also requires careful workmanship. The pendulum pivots must be straight and finely honed. The edge should have no shoulders. The pivot casing is pressed in the pendulum hub and, of course, it should be removed and replaced in the same manner. A slit open piece of pipe of slightly smaller diameter than the casing should be very helpful. The slot accommodates the pivot. For the other side of the sector, use another piece of pipe with an inside diameter slightly larger than the pivot casing.

Before the casing is removed, its position should be distinctly marked. A vise should be opened far enough to accommodate the two lengths of pipe and the sector. By closing the jaws of the vise, the slotted pipe will force the pivot casing into the larger pipe on the opposite side of the sector. The casing should never be driven out with a hammer. It is apt to break. The same pipes can be used to press the casing back into the sectors.

The pendulum bearings are made of either agate or steel. The bottoms should be sharp, but must not have any cuts. They are self-aligning, but should not rock on the steel ball.

The sector surfaces should be clean and unmarred. The same applies to the one and only cam and steel tapes. The ball bearings, the rack, and the pinion should be cleaned, or if necessary, replaced.

The cam is locked in position by two set screws and is adjusted by one height and adjusting screw, which is located on the underside of the cam. The adjusting procedure is the same

as on the scales described previously with the exception that there is only one cam to adjust.

If there is no error at half capacity, but a minus error is found at full capacity, it can be corrected by raising the cam. This scale, like the others, can be adjusted for out of level operation. The tare lever load pivot is adjustable. In some models, the fulcrum pivot is also adjustable.

1.2.41 NEW STYLE FAIRBANKS-MORSE DIAL SCALE

The new style F-M dial scale is an inverted floating pendulum system. It is called the "Floaxial" system. Basically it is similar to the Triner and Toledo systems. The understructure adjustments are the same as on any other scale. The object is to equalize the four corners.

1.2.42 SWIVEL ADJUSTMENTS

If the head of the dial swivels, turn the head halfway around and check the reading. If there is an error, split it in half by shifting the tare lever fulcrum stand parallel with the dial and the poise run. Zero the indicator, turn the head and check again. If the reading in both positons is correct, turn the head at right angles and check again. Split any error in half by shifting the tare lever fulcrum stand crosswise at right angle to the poise run. Zero the scale, turn the head and check again.

1.2.43 ADJUSTMENTS FOR OUT OF LEVEL CONDITION

This scale also should weight correctly when not level. Zero the scale. Place a half inch board under the right hand side wheels while facing the dial from the back. If there is a plus error, then the right hand pendulum should be lowered and the left side pendulum raised an equal amount. Remove the board and zero the scale. Repeat this procedure until the indicator remains at zero both while at level or not at level.

1.2.44 TARE AND CAPACITY BAR PARALLEL ADJUSTMENTS

Assumed dial capacity is 500 lbs., the capacity bar has a 200 lb. capacity and the tare bar 100 lbs. Set both poises to the zero position and zero the indicator. Place 300 lbs. on the platform. Read the indication exactly, but do not make any corrections. Move both poises to their capacity graduations. Zero the indicator again. Add 300 lbs. more to the platform. The reading should be exactly the same as the previous one. If the second reading indicates more, then the bar bracket on the capacity end will have to be lowered, or the zero end raised. If the reading is minus compared to the first reading, then the capacity end will have to be raised or the zero end lowered.

Adjust capacity and tare poise. Place 200 lbs. on the platform. Move capacity poise to the 200 lb. graduation. The dial should now read zero. Should the indicator point beyond zero into the empty space, it is a minus error and lead should be removed from the poise. Remove the load and zero the indicator after each adjustment and repeat procedure until correct. Add lead to the poise for a plus error. Test and adjust the tare poise in the same manner.

Adjust the dial. Check half capacity. Lift pendulums for a minus error, lower them to correct a plus error. A three graduation error requires about one full turn on the pendulum.

Check full capacity. Adjust any errors on the cam sectors by doubling the error. In other words, the error should be increased. Adjust both cams equally. To correct a minus error loosen the bottom and tighten the top adjusting screws. Remove the weights and zero the indicator. Test again. Repeat previous procedure until both half and full capacities are correct.

Adjust quarter and third quarter capacities. Place 125 lbs. on the platform. If there is an error, correct it by moving the tail weight on the end of the indicator. Next, place an additional 250 lbs. on the platform. The reading should be 375 lbs. If there is a plus or minus error, a similar error will have to be created at half capacity with the aid of the indicator balancing weights. This error in turn will have to be corrected with the aid of the cams and pendulums as previously described. Check and repeat until all positions are correct.

1.2.45 HOWE TAPE DRIVE DIAL

The pendulum shafts should have about 1/32" end play. The hubs should have 1/8" clearance between the front frame. The front side is where the chart is located. The multiplying wheel hub should have a clearance of 1/16" between the front frame and the same amount of end play as the pendulum shafts.

The indicator drum should be balanced with the tape clips attached. It should be possible to stop the indicator in any position of its 360 degree travel. The balancing should be done while the drum is disconnected from the rest of the mechanism.

The purpose of the two spring arms on the multiplying wheel is to keep the tapes taut. They should move freely. The multiplying wheel should be balanced.

Ball bearings should be checked as described in the section dealing with friction in general.

Poises and balance balls should be checked for loose lead. Loose lead should be tightened. End play in the balance ball shaft should be eliminated.

The tapes should be installed with slightly loose clips. This, in order, to permit the tapes to align themselves. Depress and release tare lever a number of times for this alignment. Tighten clips after this. Check to see that the crossing tapes do not rub each other, or that the tapes do not contact any of the clips at certain positions.

1.2.46 ADJUSTMENTS

Adjust the corners of the understructure in the same manner as on a beam scale, using the poises to obtain a zero reading on the chart, or by reading the chart directly. A 100 lb. load does not necessarily have to read 100 lbs. The object is to equalize the four corners.

Adjust indicator travel limits. Indicator should point to the center of open space, or if it is a fully graduated chart, there should be an equal over-lap when the scale is locked and when the tare lever depressed to the capacity limit. To do this, use tare lever limiting bolts and lengthen or shorten tape connecting rod.

Adjust scale for out of level condition by placing a 1/2" board under the right hand side wheels while facing the dial from the back. If there is a plus error, the right hand pendulum should be lowered and the left one raised an equal amount. Remove board and zero. Repeat procedure until indicator will stay at zero with and without the board. This is a good feature in a dial scale, but should not be abused, because, although the pendulums compensate one another, there are other detrimental effects caused by the out of level condition. When a scale is out of level, every connecting rod and loop will be out of plumb. The platform will swing to one side and possibly cause friction. The dashpot plunger will lean heavily against one side of the dashpot wall, with the same result. For these reasons, the ideal way to operate a dial scale is in a level position.

If the head of the dial swivels, turn head half way around and check reading. If there is an error, split it in half by moving tare lever fulcrum stand parallel with chart. Zero the indicator and check again. Check the 90 and 270 degree angles. To correct error, move stand at right angle to the chart.

Let us assume that the scale we are working on has a 500 lb. chart capacity with a 200 lb. capacity, and a 100 lb. tare bar. In order to eliminate any variable sensitivity factors, the tare and capacity bars will have to be paralleled with the pivot line. An upgrade toward the capacity end will create a plus error. A downgrade will create a minus error. Set both poises on zero position and zero indicator. Place 300 lbs. on the platform. The dial has not been adjusted yet, and as a result there may be an error. Let us say that the indication is 297 lbs. Make note of it, but do not adjust. Move both poises to their capacity positions. The scale should now read zero, but it is possible that it will not, because the poises have not been adjusted yet. With 300 lbs. on the platform and both poises on capacity position, zero the indicator and place an additional 300 lbs on the platform. The reading should be again 297 lbs. Should the indicator point to 299, or anything above 297, it indicates that the bars are high at their capacity end. To correct this, loosen the two set screws on the front side of the back balance weight and turn the two height adjusting screws on top of the back balance weight, to the right about two full turns and retighten set screws. Remove load, zero

indicator and test again. Repeat procedure if necessary.

Move poise to the 200 lb. graduation. Next, zero the scale with empty platform. Place 200 lbs. on the platform. Move the poise to the 200 lb. notch. The indication should be zero. Should there be a plus error, a piece of lead should be placed on the poise. Move the poise back to zero, taking care that the piece of lead does not change its position. Remove the weights from the platform and zero the scale. Load the platform again with 200 lbs., taking care that the load piece does not shift. The added lead may be too much or not enough. Increase or decrease size, using the above testing procedure until correct. Secure the lead in the poise and check again. Remove lead to correct a minus error. Use the same method to adjust the tare poise.

Adjust the dial head by first placing 250 and then 500 lbs. on the platform. If there is a one pound plus error at 250 and two pounds plus error at 500, lowering both pendulums an equal amount will correct the errors. Remove the load and zero indicator. Test again. Repeat procedure until correct. If the errors are minus and are multiplying, raise pendulums.

Should it happen that the scale is correct at half capacity, but there is a 1 lb. minus error at full capacity, a cam adjustment will be necessary. Loosen both cam set screws and raise both cams equally with the height adjusting screws and retighten set screws. The scale should now read approximately 3 lbs. plus. Remove load and zero indicator. Check half capacity. As a result of the cam adjustment, there will be a plus error and the pendulums will have to be lowered. Remove load and zero indicator. Check half and full capacities. Repeat procedure if necessary. An experienced mechanic can make short cuts by adjusting the cams and pendulums simultaneously if so required. Multiplying errors (plus or minus) require only pendulum adjustment. Non-multiplying errors (plus or minus) require cam and pendulum adjustments.

Adjust 1/4 and 3/4 capacities by placing 125 lbs. on the platform. If there is an error, correct it by moving the tail weight on the indicator. Now place an additional 250 lbs on the platform. The reading should be 375 lbs. If the reading is 376 for instance, further adjustments will be necessary. Remove 125 lbs. from the platform and create a 1 lb. plus error at half capacity with the aid of the indicator balance weights. In other words, create an error at half capacity, equaling the error found at 3/4 capacity. Remove load and zero indicator. Correct errors at half and full capacities with cams and pendulums. Repeat procedure until all four quarters are correct. Should there be any errors between the four quarters, they may be due to dirt under the tapes or possible kinks on some faulty surfaces on cams, etc., faulty ball bearings, or other obstructions in the understructure.

1.2.47 TAPE DRIVE CABINET DIALS

The tare lever of a cabinet dial is similar to that of the cabinet Weightograph (Figure 1.2.39).

The first step is to eliminate all variable sensitivity factors. The sensitivity factor of the tare lever pivot line must be neutral, indifferent. In other words, the edges of all tare lever pivots must be perfectly in line.

For example, let us assume that we have a scale with a 1000 lb. chart capacity and three drop weights. Zero the indicator. Place 1000 lbs. on the platform and drop one drop weight. The reading should be zero. If not, adjust nose iron of understructure. Remove load and zero indicator. Test again. Repeat adjustments until correct. Lift drop weight and note indicator reading. To save extra work, do not adjust the dial yet.

Let's assume that the dial reads 999 lbs. Place 2000 lbs. on the platform and drop two drop weights. If the nose iron adjustment was accurately made and the drop weights were accurately adjusted, the reading will be zero. Now lift one drop weight and check the second revolution of the indicator. If the pivot line of the tare lever is neutral, the reading on the chart will be 999 lbs. again. In other words, both the first and second revolutions of the indicator will give identical readings. If the second revolution reads 1000, the drop weight pivot has to be lowered. If the reading is 998 lbs., it has to be raised. Remove load and zero indicators. Repeat testing and adjusting until correct. Test third drop weight the same way.

The high capacity cabinet dials should be tested and adjusted in the same manner as prescribed for the cabinet Weightographs, up to

this point. After the drop weights have been adjusted the tare and capacity bars should be adjusted in the same manner as prescribed for low capacity dials. The dial adjustments are also the same.

1.2.48 DETECTO DIALS

The Detecto dial mechanism is a departure from the orthodox methods of obtaining an evenly multiplying indicator movement. It has no cams for the purpose of producing a multiplying pendulum travel on the arc.

The system is based on the geometric theory that angles are similar, if their corresponding sides are at right angles with each other, and as a result, the vertical movement of the rack is proportional to the pull of the draft tape.

The repair procedure is similar to any other dial scale and so is the adjustment of the understructure, the drop weights, the capacity and tare bars.

The dial head itself is adjusted by raising or lowering the pendulums to correct any full capacity errors on the dial. For fine adjustment there is a plug screw in a vertically bored hole on the back side of the pendulum weights. These plugs are locked in position by a socket head screw.

Any intermediate errors, that is to say, errors found at 1/4, 1/2, and 3/4 capacities, should be adjusted with the aid of the indicator balance weights and the tail weight.

The indicator balance weights are located behind the indicator proper, on the indicator supporting flange. The indicator is fastened onto the flange by four screws. Two of these screws, namely the ones that fall in line with the pointer and the tail, serve two purposes. One purpose is to help fasten the indicator, and the other is to tighten the splined flange that holds the indicator balance weights. These balance weights are headless screws, slotted on one end to accommodate a screw driver.

1.2.49 DRUM TYPE COMPUTING SCALES

Drum type computing scales can be classified in two basic categories. Some are spring scales and others are gravity (pendulum scales).

The adjustments to the gravity type are similar to that of the dial scales. There are cam and pendulum adjustments to correct half and full capacities, and drum balance weights to correct the 1/4 and 3/4 capacities. The drum balance weights are located on the spokes of the drum.

The spring type drum scales are adjusted the same way as any other spring scale, plus the drum balance weights to correct errors found between zero and full capacity.

1.2.50 SPRING SCALES

The spring dial mechanism is about the simplest of all. When repairing such scales, every effort should be made to minimize friction as much as possible. For correct operation, the coils of the active portion of the spring should be fully separated. Some coils are closely wound. In such cases there should be sufficient initial pull created by the produce pan, or platform, to separate all the coils of the active portion before the indicator points to zero. In other words, when the indicator points to zero, all the coils should be separated.

The earlier, and also the present day, cheaper models are not legal for commercial purposes, because the strength of the spring varies with the change in temperature. The better quality present day models are legal for trade in most states because the springs used are made out of a special steel alloy that is affected very little by temperature variations.

There is still a great variety of types of scales not mentioned in this handbook. Some of these are the fully automatic grain dump scales, conveyor belt scales, hopper and batching scales. There are also the newest developments in automation; whereby a scale combined with a series of electronic devices, will automatically feed, weigh, and discharge a number of various ingredients, completing a full batching cycle by pressing one button. There are ordinary dial scales equipped with printing mechanisms.

The actual weighing mechanism of all the above mentioned scales is constructed according to the basic principles described in this book.