symmetry in the indicator travel is excessive. Unless the chart is graduated for weighing purposes, the absolute symmetry in travel is not essential because the reading will always be at the one and only zero line.

The scale illustrated by Figure 1.2.37 is also used for weighing purposes. When such is the case, the counting levers are omitted and the chart is fully graduated. Some scales are made to serve both purposes.

The shift adjustment for the load plate is similar to that of the counting scale. The chart capacity adjustments are the same as on the even arm scales.

1.2.22 WEIGHTOGRAPH TYPE SCALES

The indicator movement of the weightograph type scales is 45 to maximum 47 degrees. For this reason, they can be classified as fan type scales. The indicator is stationary and the chart is a microfilm rigidly mounted on the cam and pendulum assembly.

The light of a 100 watt clear electric bulb (on the latest models of a projection lamp), is condensed behind the chart with a condensing lens. This light passes through the microfilm chart and is projected through focusing lenses in front of the chart onto a ground glass screen with the aid of intermediate mirrors arranged in periscope fashion.

The indicator is behind the ground glass screen and throws a shadow on it. The figures and graduations are brightly illuminated.

The pendulum and the chart travel 45 degrees. This 45 degree travel represents the total capacity of the chart and is divided into the required number of graduations.

The movement of the pendulum, which is actually the final stage of the scale mechanism, is optically magnified; thus, producing an absolutely friction free enlargement of its travel. In comparison, the pendulum travel of a round faced dial scale is mechanically amplified to 350-360 degrees with the aid of a rack and a pinion, or steel tape transmission, with the resultant additional friction caused by this mechanism and its bearings.

An additional advantage is the lack of paralax. The weight can be read accurately from any angle or position. When reading a round faced dial scale, the operator must stand squarely in front of the indicator and his eye must be level, in order to get the correct weight.

Unconscious squinting may also cause an incorrect reading.

These scales are not portable, because they are equipped with only one pendulum. If the scale is moved and is not placed on exactly the same level position, as when it was adjusted, the scale will not operate accurately.

When it is necessary to move one of the semi-portable models, the scale should be first accurately zeroed on the old location. The scale will be most likely off zero on the new location. The zeroing of the scale should not be attempted by using the balance ball. It should be zeroed by the adjustable legs of the scale. This same rule applies when a new scale of this type is assembled. Zero, with the adjustable legs, to avoid cam adjustments. They are made as self-contined scales; that is to say, they are an integral part of a complete scale unit, and are also used as auxiliary attachments on beam scales.

1.2.23 REPAIR/ADJUST WEIGHTOGRAPHS

Dismantle completely. Clean and paint parts. Remove lenses and clean thoroughly. Wash ball bearings in naptha, benzine, or carbon tetrachloride. If necessary, replace them. Lubricate these bearings with a drop of watchmakers oil. On the latest models the pendulum assembly revolves on a pivot and "V" bearings. Clean cam with same as above. Do not buff cam. Clean mirrors or replace them if necessary. Wash ground glass screen with soap and water.

Start assembling by lining up the electric bulb. The filament must line up with the center of the condensing lens aperture. Mount focusing and condensing lens assembly. Clean chart. If badly scorched by over exposure, it should be replaced. Assemble cam, pendulum, and chart, and mount the whole unit. Clean and mount dashpot. Use method explained in section dealing with friction. Connect and line up. Fill with oil. Adjust cam shaft clearance. There should be a very slight end play to ensure free movement. Excessive end play will cause an intermittent change in the focus of the chart. Line up cam with connecting rod and attach steel tape.

Mount mirrors and ground glass screen. When mirrors are replaced, care should be taken not to depress the mirrors in any way, because a concavity or convexity of the mirror will cause a distorted reflection. Mount the mirror plates on the periscope housing and finally mount the periscope itself.

If it is an auxiliary Weightograph, it is now time to connect it to the weight beam. Turn on the switch. Focus the chart at zero position by turning the focusing lens holder in or out until the image on the frosted glass is sharp and clear. Move the chart to full capacity and check the focus. If it is out of focus, loosen chart clamp screws and move away or toward the focusing lens until the image is clear. Check the zero position again. Adjust the mirror until the image on the ground glass is straight, undistorted, and centered. Loosen the focusing lens stem set screw slightly and move the lens horizontally in or out until the shadow of the indicator covers half of the short graduations.

Lift the pendulum slowly to full capacity while watching the image on the screen. If the image creeps to the right, toward the cam shaft, and then starts to creep back to correct position at full capacity, then the chart stem will have to be pushed in slightly toward the cam shaft. The chart frame also has two set screws working against each other. The bottom screw pushes the frame out, away from the bracket and the other one pulls it in. After the stem has been pushed in, the above mentioned top screw will have to be loosened slightly, and the bottom screw tightened. If the zero position overlaps the indicator more than the full capacity position, then the bottom set screw will have to be loosened up some more and the top screw tightened. Repeat the adjustments until the image moves straight up and down without a waver. Should the chart creep in the opposite direction, then the procedure should be reversed. After every adjustment, the focusing lens stem will have to be moved along too, in order to keep the image in its proper position. After the image is fully focused and aligned, make sure that all the set screws are tight.

The next step is to level the beam. When the beam is level, the indicator should be at half capacity. If it is not, the connecting rod should be lengthened or shortened. This accomplished, the beam should be pressed down to the bottom of the trig loop. The indicator should now point to approximately the center of the trade mark, for proper clearance at zero. If it does not, the trig loop will have to be lowered, and the pendulum bumper set to this point.

Next, the beam should lifted until the travel limiting nut on the connecting rod hits the top of the housing. This nut is located directly above the tape connecting shackle. At this point the indicator should point slightly above the word "Limit". Adjust nut until it does and lock it with a lock nut. The top of the chart must not hit the top of the housing. On the new models the lever bumpers will have to be regulated to this end.

The Weightograph is now ready to be adjusted. If the Weightograph is adjusted in the shop and the beam is not connected to its understructure, a weight pan will have to be hung on the load loop. Load pan until indicator points to zero. To test the Weightograph it is necessary to know the multiple of the understructure and the capacity of the chart. Example: Understructure multiple 300. Chart capacity 20,000 lbs. Divide the 20,000 lbs. by 300. The result will be 66.666, which is the required load at 20,000 lbs. For half capacity the required load will be 33.333. Place 33.333 lbs. on the load pan. The reading should be 10,000 lbs. Correct any possible errors with the pendulum. Raise the pendulum for minus (below) and lower for plus (fast) errors. Remove weights and check zero. Repeat testing and adjusting until half capacity is correct.

Place 66.666 lbs. on the load pan. The reading should be 20,000 lbs. Adjust any possible errors with the cam. For plus errors loosen bottom and tighten top cam set screws. Do the opposite for minus errors. On cabinet and self-contained Weightographs a plus error is corrected by loosening the top set screw and tightening the bottom. The idea is to turn the cam in the direction that will tend to decrease the acting load arm of the cam at capacity. The opposite stands for a minus error.

A cam adjustment will affect half capacity also. Further pendulum adjustments will be necessary. Repeat testing and adjusting half and full capacity until correct. Do not forget to zero scale after each adjustment. With a little experience and luck, cam and pendulum adjustments may be made simultaneously as a short cut.

The simplest method is to use the capacity poise of the beam for load. Move poise to the 20, 000 lb. graduation. Load weight pan, (disregarding actual weight) until Weightograph indicates zero. The multiple of the understructure is not important in this case. That has been taken care of already when the beam was adjusted. We are simply adjusting the Weightograph to correspond to the already accurate beam.

Move the poise to the 10, 000 lb. graduation. The indication should be 10, 000. Next, move the poise to zero. The Weightograph should now read 20, 000 lbs. Should there be any error at either position, the same adjusting procedure will have to be used as previously described. A multiplying, or in other words a doubling error, can be corrected by pendulum adjustments. Any error that does not multiply requires both cam and pendulum adjustments.

In the field when the scale is tested as a complete unit, the adjustments are the same, except that in this case 20, 000 lbs. of actual accurate load will have to be placed on the platform to test the 20, 000 lb. graduation. The simplest way to adjust a Weightograph in the field is to test the scale first with the poises, using the zero position as an indicator.

Let's assume that the sections of a motor truck scale have been already adjusted and when a 20, 000 lb. load is placed on the platform, with the poise in the 20, 000 lb. notch, the Weightograph indicates 40 lbs. instead of zero. To correct this error, the nose iron of the transverse lever will have to be moved away from the fulcrum pivot; or in other words, the power arm will have to be lengthened.

Remove load and zero Weightograph with poise in the zero notch. Reload and check again. Repeat adjustments until correct. A short cut is to zero the Weightograph immediately after the nose iron adjustment, before the load is removed. If the Weightograph indicates zero when the load is removed and the poise pushed back to the zero notch, the scale can be considered correct.

The next step is to adjust the Weightograph. With 20, 000 lbs. on the platform, and the poise in the 20, 000 lb. notch, Weightograph will indicate zero. Move the poise to the 10, 000 lb. notch. The Weightograph should read 20, 000. In the zero notch, it should read 20, 000. Any possible errors should be corrected as already described.

On occasions when no accurate load is available, but it is reasonably certain that the scale itself is accurate, a Weightograph that does not correspond with the beam can be adjusted by placing the unknown load on the scale. The load should be equal to the chart capacity or greater. Move the capacity poise to the 20, 000 lb. notch. If the load is greater than 20, 000, the Weightograph may be zeroed by using the tare poises. Check and adjust as previously described. In this case, again, the Weightograph is being adjusted to a presumably correct beam. If the scale and the beam is not correct, the Weightograph will be also incorrect.

In a pinch, when it is impossible to obtain even an unknown load and the Weightograph has to be adjusted to the beam, it may be done by clamping two angle irons to the steelyard rod and by loading these angle irons until the Weightograph indicates zero while the poise is in the notch that equals the chart capacity. Check and adjust as previously described.

It is not advisable to load the back balance pivot for adjusting purposes, because if the back balance pivot happens to be slightly below the pivot line, the extra load on the pivot will decrease the sensitivity of the beam, thus creating a minus error on the Weightograph. The next logical step would be to raise the pendulum to correct this minus error. This is wrong. It is wrong because when the back balance load is removed in order to return to normal operation, the stabilizing factor of this temporary load will also be removed with a resulting plus error in the Weightograph.

An opposite effect will be created if the back balance pivot is higher than the pivot line of the load, fulcrum, and power pivots. The error will be plus.

1. 2. 24 SELF-CONTAINED WEIGHTOGRAPHS

Low capacity Weightographs are made with low multiple understructures. The low multiple is necessary in order to make it possible to use a heavy pendulum. A light pendulum will not keep the steel tape taut and as a result may cause inconsistency.

A typical low multiple understructure is illustrated by Figure 1. 2. 38. It is a schematic side view of the lever system. The 1 levers are actually triangular. The illustration merely shows the hook up of the levers.

The lever "A" of Figure 1.2.38 is a second class lever with two load pivots on each side of the triangle. The sketch shows only one on each lever. Pivots a, b, c, d, and e are all double. Pivot "f" is single. The pivots "a" receive the platform, and the lever at this point has a ratio of 2:1. A 50 lb. load placed over these pivots will produce a 25 lb. power pull at the nose iron of lever "A".

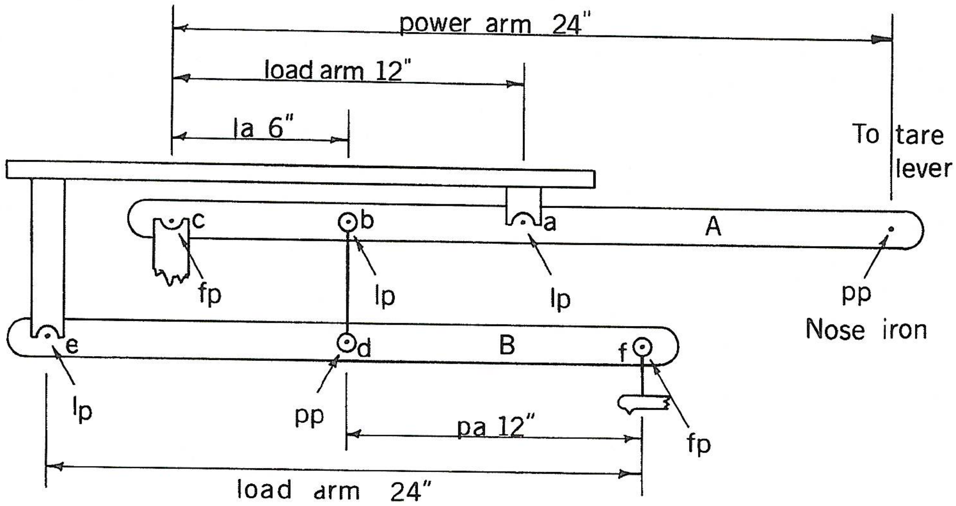

Figure 1.2.38. Low Capacity Weightograph

Pivots "b" are the second sets of load pivots of the same lever. Lever "B" is suspended on these pivots by the two power pivots marked "d". The ratio of the lever at this point is 4:1.

Lever "B" is a floating third class lever and its ratio is pa divided by load arm = 12 + 24 = 0.5. In other words, the ratio is 1/2:1. The load pivots of this lever are marked with "e" and they receive the rear end of the platform. A 50 lb. load placed over pivots "e" will exert a 100 lb. power at pivots "d", because 50 divided by five tenths will equal 100. The action of this lever is clearly explained in the section dealing with multiples. (See third class lever.)

This 100 lb. power is the result of the 50 lb. load on the platform and is transmitted with the aid of two shackles to the load pivots "b" of Lever "A". This 100 lb. power is now the load on pivots "b".

The ratio of lever "A" at this point, as we have already established, is 4:1. A 100 lb. load divided by 4 equals 25 lbs., which will be the power exerted by the 50 lb. load on the platform at the power pivot (nose iron) of Lever "A".

In conclusion, a certain load placed on any side or portion of the platform will always produce the same power at the power pivot of lever "A". The final result is an understructure with a multiple of two.

Repair Weightograph mechanism in the same manner as described previously. Make sure that the image is properly focused and the chart aligned before attempting to adjust the scale.

The corners should be adjusted in the same manner as any other ordinary platform scale. The pivots are round shanked and can be turned with the aid of two set screws. Release one and tighten the other. If the scale is made without set screws, the pivots will have to be turned with a special wrench that fits over the pivots, but will not damage the edge when pressure is applied. A wrench of this type can easily be made. It is not advisable to hone the pivots, because of the "V" bearings. Make adjustments on the "a" and "b" pivots.

After the corners have been equalized, the parallel condition of the tare bar should be checked and adjusted. For example, let us assume that the chart capacity is 100 and the tare bar capacity 30 lbs. Place 30 lbs. on the platform. Note reading. Let us say that the reading is 29 lbs. Do not attempt to adjust this error. Move poise to the 30 lb. graduation. If the indication is not zero, adjust the balance ball. Now place 30 lbs. more on the platform. The reading on the Weightograph should be 29 lbs. again. Should it happen that the reading is 30 lbs., the capacity end of the tare bar will have to be lowered, because the tare bar has an upgrade in its relationship to the tare lever pivot line. By moving the poise uphill, the weight distribution of the lever body has been altered. There is more mass above the pivot line. This increases sensitivity. Increased sensitivity will increase structural travel, which in turn means a plus error. By lowering the capacity end of the bar we eliminate this varying sensitivity factor. Raise the bar if the reading is 28 lbs. Repeat adjustments until both readings are the same. We are now ready to check and adjust the chart readings.

Zero scale. Place 50 lbs. on the platform. Correct a plus error by lowering the pendulum. Raise pendulum for minus error. Remove weights and zero scale. Test again. Repeat adjustments until correct.

Place 100 lbs. on the platform. Correct any possible errors with the cam. For a plus error loosen top cam set screw and tighten the bottom one. Do the opposite for a minus error. The error should decrease with this adjustment. For a one graduation plus error the cam should be adjusted until the reading is about six graduations minus.

Remove the weights from platform and zero scale. The cam adjustment has spoiled our half capacity adjustment and for this reason it will have to be readjusted as previously explained. When half capacity is correct, check full capacity. The full capacity may still not be correct. If it is not, the above procedure will have to be repeated. Make sure to zero scale after each adjustment.

In this case also, short cuts may be made by making the cam and pendulum adjustments simultaneously, but it requires a great deal of skill and experience.

Now that the chart readings are correct at half and full capacities, the readings should be checked in between. There are no 1/4 and 3/4 adjustments on a Weightograph. If there are any errors between the previous adjustments it may be due to dirt between cam and tape, or the tape or cam may be damaged.

The final step is to check and adjust the poise. Place 30 lbs on platform and move poise to the 30 lb. graduation. If the indicator points to the first or second graduation, it is a plus error. Lead should be added to the poise. If the reading is zero, the poise is correct. Adjust poise in the same manner as a portable scale. Remove lead for minus error.

Now just a word of warning regarding all types of Weightographs. Do not adjust scale until the image is properly aligned. Some mechanics and scale users are under the false impression that the zeroing of the scale may also be accomplished by adjusting the mirror. This is absolutely wrong. After the scale has been adjusted, the mirror should not be touched. The cam has a varying multiplying factor. It will give the correct amount of variation only if the starting point is always the same. When the scale is off zero, it means that the whole lever system, together with the cam, pendulum, and chart is off the normal starting position and should be brought back to the correct position by the proper balancing procedure. By adjusting the mirror, we are simply moving the image on the screen and aligning it to the false start. By doing this we are creating a cam error.

1.2.25 CABINET WEIGHTOGRAPH

The cabinet Weightograph is used for high capacity scales. They are used on "Dormant", "Industrial" and also "Motor Truck Scales".

For an example let us take a Motor Truck Scale with a 100,000 lb. total capacity. With a chart capacity of 20,000 lbs. and a tare bar capacity of another 20,000 lbs. we have a weighing range of 40,000 lbs. To enable us to weigh 100,000 lbs., drop weights will have to be used.

The drop weights are dropped on a weight bucket which hangs on special pivots on the end of the tare lever, either manually or electrically, with the aid of a combination gear and chain assembly.

Each drop (unit) weight should be heavy enough to counter balance the load on the platform. In other words, it should be heavy enough to return the indicator to zero, when it is dropped on the weight receiving element.

The tare lever is a combination first and second class lever and is illustrated by Figure 1.2.39.

1.2.26 ADJUST/CABINET WEIGHTOGRAPH

When a cabinet Weightograph is adjusted in the shop as a separate unit, it is best to use the following procedure. Level the cabinet. Adjust the optics as already described. Hang a weight pan on the load loop of the tare lever. Zero the scale with the poises at zero position, and the unit weights lifted clear of the weight receiving element (balance cup). The next step is to divide the chart capacity with the multiple of the understructure, in order to establish the pull (pounds per movement from zero to capacity).

Example: Understructure multiple is 300. The chart capacity is 20,000 lbs. 20,000 ÷ 300 = 66.666. This means that the 20,000 lbs. on the platform, the pound per movement from zero to capacity will be 66.666 lbs. This is called the "pull" and should be applied to the weight pan. Place 66.666 lbs. on the weight pan. Drop one unit weight. The Weightograph should now read 20,000 lbs. at the zero position of the chart, because a shutter arrangement that is activated by the unit weight mechanism automatically changes the image to read 20,000 instead of zero. If the reading happens to be 20,020, the load pivot of the tare lever should be honed or ground toward the fulcrum pivot. If the error is minus, the load pivot should be honed away from the fulcrum pivot. Zero the scale and check again. Repeat honing until correct.

Next, lift the unit weight. The chart should again read 20,000 lbs. at the capacity end. Should it happen to read 29,960 for instance, make note of it; but do not adjust. Now double the load by placing 133,333 lbs. on the pan and drop a second unit weight. The chart should now read 40,000 lbs. at the zero end, providing that the load pivot has been properly adjusted with the first unit weight.

Lift the second unit weight, but leave the first one on. The reading should be 39,960. If the reading is 39,940 for instance, the unit weight (pp) pivot should be raised slightly. If the error is plus, it should be lowered.

Some makes of scales do not have vertically adjustable unit weight pivots. This is alright if the pivot lines of the tare lever is perfectly neutral, including the unit weight pivot. In this case, any errors in the second travel are caused by a non-vertical steelyard rod. If such is the case, any plus or minus error in the second travel may be corrected by shifting the cabinet to correct a probably unnoticed out of plumb condition of the steelyard rod.

The height adjustments made on the unit weight pivots eliminated the varying sensitivity

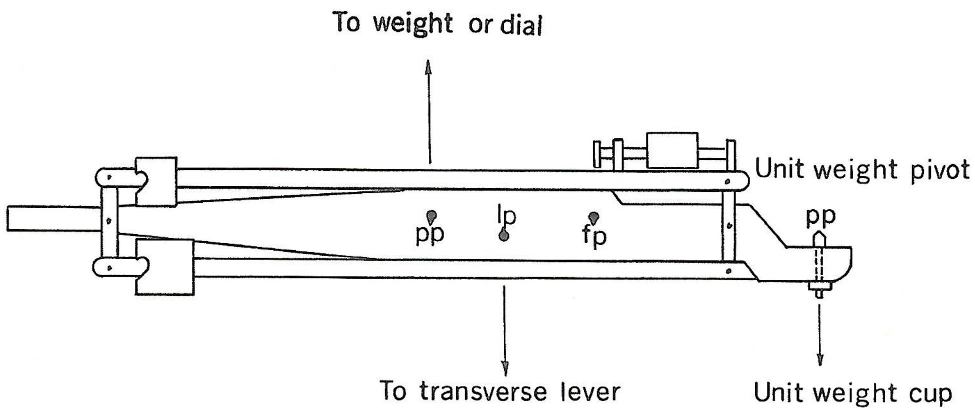

Figure 1.2.39. Cabinet Weightograph

factors. When the second chart travel indicates more than the first, it also indicates that the edge of the unit weight pivot is above the pivot line. The lever has a closed range. As has already been explained in the section dealing with sensitivity, any additional weight added to the pivot edge that is above the fulcrum pivot line will increase the weight mass above the fulcrum. This increase in the mass above will decrease the stability of the scale, or in other words, it will increase its sensitivity. The increase in sensitivity will increase the structural movement per pound. To put it in other words, the chart and pendulum assembly will move farther per pound. A longer movement means a plus error. A low unit weight pivot, that is to say an open range, will create a minus error.

A similar effect may be created by tare and capacity bars that do not run parallel with the pivot line. To adjust the parallel condition of the tare and capacity bars to the pivot line, zero scale and place 66.666 lbs. on the weight pan. Note the reading, but do not adjust. Next, move the capacity poise to the 20,000 lb. graduation and zero the scale again. Place 133,333 lbs. on the weight pan. The reading should be the same as it was with 66.666 lbs. If the scale indicates more, lower the bar bracket at the capacity end. For minus error, raise the same end. The correction to the capacity bar also corrected the tare bar because it is usually mounted on the same bracket and runs parallel with it.

The next step is to adjust the poises. Zero the scale. Place 66.666 lbs. on the weight pan. Move the poise to 20,000. The reading should be zero. If there is a plus error, add lead to the poise. Zero the scale and check again. Repeat until correct. Remove lead from a minus error. Adjust the tare poise in the same manner. The scale is now ready for chart reading adjustments. The following adjustments will not affect the previous ones.

If the chart travel had been adjusted first, the adjustments made to the unit weight pivot and the tare bar brackets would spoil the previous chart adjustments. Corrections to the chart travel should be conducted in the same manner as described for the self-contained Weightographs.

Dormant scales can be adjusted in the shop as complete units, coupled to the understructure. In this case the zero position of the unit weights can be adjusted with the nose iron of the transverse lever. In this case the multiple of the understructure will be altered to make up for a discrepancy in the tare lever multiple. To achieve the same purpose, the weight of the unit weights could be altered too, but all unit weights would have to be changed the same amount and this would be rather difficult to do without disassembling. It is best to leave them alone.

In the field or the job site, the unit weight adjustments should always be made on the nose iron of the understructure.

1.2.27 ROUND FACED DIAL SCALES

A great variety of methods are used in the construction of round faced dial scales. Each and every type has its advantages and disadvantages in various degrees. The scales dependability and accuracy depends on the quality workmanship, various mechanical factors accompanied by the inevitable wear and unavoidable friction.

The principles of construction are basically the same. There is the floating pendulum type used by the Triner; Toledo; Lindel; and Stathmos scale companies. The inverted floating pendulum system of the Fairbanks-Morse Company. The old pivot fulcrum system of Fairbanks-Morse. The Howe-Richardson tape drive dial. The camless Detecto, and the Berkel systems to name a few.

Low capacity dial scales require low multiple understructures. This is necessary in order to make it possible to use relatively heavy pendulums. Light pendulums would not keep the steel tapes sufficiently taut.

Figure 1.2.40 illustrates a widely used type of low multiple understructure. It has a total multiple of 2. The multiple may vary. The multiple of the structure can be increased by increasing the multiple of the transverse lever "c". Another advantage of this system is that it can be equipped with a platform that has practically no overhang.

Levers "A" and "B" are first class even arm levers. Lever "C" is a first class 2:1 multiplying lever. Basically a dial scale is an ordinary beam scale with an automatically varying multiple in the last stage of its lever system. This varying multiple is accomplished by the combined and coordinated action of the cam and pendulum assemblies.

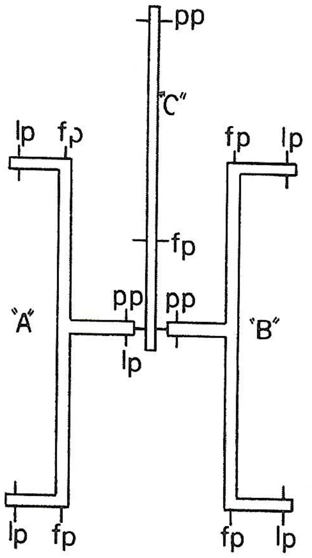

Figure 1.2.40. Dial Scale

The dial is the picture of the indicator travel and predetermines the scale's sensitivity. This in turn regulates the amount of required structural movement when a certain load is placed on the platform. The indicator proper is a mechanically amplified extension of the pendulum travel.

There are several methods used in travel amplification. Each system has its advantages and disadvantages and also each system has the common enemy, namely, the unavoidable friction.

Cam and pendulum assemblies are made in many different ways, but their purpose is always the same.

The repair and adjustment procedure for the understructure is the same as that of a beam scale. The tare lever can be classified as the beam of a beam scale. However, special care should be taken to align the pivots and bearings. Generally speaking a much higher quality workmanship is required in order to maintain a linear travel by eliminating any and all variables and all avoidable friction.

The parts of the dial head mechanism should be carefully cleaned and checked. Cut "V" bearings should be either replaced or lapped. Pivots must be honed to a fine straight edge. Ball bearings should be washed, checked, and replaced if necessary. Steel tapes should also be washed and examined for possible kinks and deformations. Rusty and deformed tapes should be replaced. It is useless to attempt to straighten a steel tape. Shafts should be checked to see that they run true. Worn racks and pinions should be replaced. Cam surfaces should be cleaned with a solvent, preferably benzine. Never buff a cam. Pitted, scratched cams must be replaced.

The dial must be properly centered. This can be easily done with the indicator, by marking the exact length of the radius on its tip, and checking at least four positions on the dial. Another way is to make a gauge out of a piece of metal rod or a compass.

The indicator should be balanced. Use indicator tail and balance weights to do this. During the process of adjusting the 1/4 and 3/4 capacities, this balance may have to be disturbed to correct errors at these points. The excessive use of these balance weights is not advisable, because a badly unbalanced indicator will have a tendency to force the rack against the rack guide. This will create inaccuracies, because the teeth will not mesh properly, and because the pressure against the rack guide will produce considerable friction. It will also cause an uneven wear on the teeth of the rack and pinion.

The rack suspending pin is placed off center in order to provide a gravitational thrust against the pinion. This is necessary to mesh the teeth snugly. Too much thrust will create excessive friction and wear. The rack suspending pin should be polished smooth to insure free movement. The multiplying wheel of the tape drive dials should be balanced also.

Dashpot plungers that are connected to a lever should be centered in the pot at 1/4 and 3/4 capacities, because it is at these two points that the suspending pin is in the center of the two extreme positions of the arc described by the lever. In some cases the rack assembly has the plunger connected to it. Under such conditions the movement is straight up and down, and as a result the plunger can be centered in any position.

1.2.28 TRINER, LINDEL, STATHMOS, OLD STYLE TOLEDO DIALS

These scales are similar in structure and use the floating pendulum system. There are four fulcrum sectors suspended on a frame by four steel tapes. These are sections of concentric circles. Mounted between two of these sectors on a common shaft is the load sector. The load sector is the cam, and it is a section of a sine hyperbolic spiral.

The use of a sine hyperbolic spiral for a cam makes it possible to use a pendulum travel greater than 45 degrees. As a result, there is more movement per graduation and a smaller indicator travel amplification.

1.2.29 ADJUSTMENTS

Compensating bar pin screws should have .002 to .003 inch end play. Balance indicator. Lock scale. Adjust connecting rod until pendulums hit bumpers. Adjust the indicator with the rack adjusting screw until the indicator points to the center of the open space between zero and capacity. Center balance ball. Add or remove lead to or from back balance weight until indicator points to zero. Equalize the four corners of the understructure, disregarding actual accuracy. Example: Dial capacity is 500 lbs. Capacity bar 200 lbs. Tare bar 100 lbs.

First step is to test and adjust the parallel condition of the tare and capacity bars with the pivot line. Place 300 lbs. on the platform. Read indication exactly, but make no corrections. Move both poises to their capacity graduations. Zero indicator again. Add three hundred pounds 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 poises for accuracy.

Zero scale. Place 200 lbs. on the platform and move capacity poise to the 200 lb. notch. The reading should be zero. If the reading is plus, lead should be added to the poise. Remove weights and zero scale. Reload scale and move poise again to 200 lbs. If the reading is minus, cut a piece off the lead. Repeat previous procedure until reading is correct.

Remove the poise from the bar. Open it and punch a hole in the existing lead, and insert the lead. Swage lead over. Make sure that all lead is tight in the poise. Shifting lead will cause inconsistency. If the reading were minus in the first place, lead should be removed using the above procedure. Check and adjust the tare poise in the same manner. Adjust scale for out of level condition.

A dial scale should weigh correctly even in an out of level position. Place a half inch board under the right hand side wheels while facing the dial head from the back. If there is a plus error, the right hand pendulum should be lowered and the left side pendulum raised an equal amount. Remove board and zero scale. Repeat procedure until indicator remains at zero both at level and out of level positions.

This is a good feature in double pendulum dial scales, 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 probably 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.

1.2.30 SWIVEL ADJUSTMENTS

If the head of the dial swivels, turn the head half way around and check 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 and check again. Check the 90 and the 270 degree angle positions. To correct any errors, shift the tare lever fulcrum stand at right angle to the poise run.

Adjust dial mechanism. Zero the scale. Place 500 lbs. on the platform. If there is a plus error, lower both pendulums an equal amount. Raise the pendulums for a minus error. Remove the load and zero the scale. Repeat testing and adjusting until half capacity is correct.

Place 500 lbs. on the platform. If there is a plus one lb. error, remove the load from the platform. Loosen cam sector locking screws on both sectors. Loosen bottom cam adjusting screw on one sector and tighten top screw until the indicator points to 4 lbs. Tighten the cam lock screw on this sector. Next, loosen the bottom cam adjusting screw on the other sector and tighten the top one until the indicator points to 8 lbs. Tighten the cam lock screw. Zero the scale with the rack adjusting screw. Readjust half capacity with pendulums as previously described. Repeat the procedure until the scale is correct. If the error at capacity is 1 lb. minus, the cam adjustment should be made at capacity, using the same methods. One cam should be adjusted until the reading is 4 minus, and the second cam is to be adjusted until the reading is 8 minus. Readjust half capacity. Repeat until both positions are correct.

Adjust quarters. Place 125 lbs. on the platform. Correct any errors with the indicator tail weight. Next place 250 lbs. more on the platform. The reading should be 375 pounds. If there is a 1 lb. minus error, remove 125 lbs. and create a similar error at half capacity by moving the indicator balance weights. As a result of these adjustments, the half and full capacities will have to be readjusted as previously described, with the aid of the cams and the pendulums. Test and repeat procedure until scale is correct. Any errors between the quarters may be due to faulty steel tapes, cams, ball bearings, pivots and bearings, dirt, and incorrect angle of the connecting rods.

1.2.31 CABINET DIALS

The adjusting procedure of cabinet dials is exactly the same as that of ordinary low capacity dials, with one exception. If the cabinet dial uses unit weights to increase the total capacity of the scale, the unit weights and the range of the unit weight pivot has to be tested and adjusted first. A unit weight cabinet dial is basically a beam scale with a dial scale attachment. The tare and capacity bars act as the beams of the scale, and the unit weights are the counterpoise weights. For the purpose of the following tests and adjustments, the dial indicator should be used as a zero (balance) indicator.

Zero the scale. If the scale has a chart capacity of 1000 lbs., place 1000 lbs. on the platform. Drop one unit weight. The indicator should point to zero. If the indicator points to plus 1 lb., or any other graduation, then the nose iron of the transverse lever will have to be moved away from the fulcrum. Zero the scale after each adjustment and test again. Repeat if necessary. If the error is minus, shorten transverse lever by moving the nose iron toward the fulcrum pivot. If the cabinet dial is pan tested, then the corrections will have to be made by honing the load or fulcrum pivots, or moving them if they are movable.

Continue this procedure for at least three unit weights, or more if possible. From the notations a pattern should have developed indicating the adjustment or adjustments required to correct.

If the pattern shows the errors equal and in opposite directions, and increasing proportionately, a cabinet shift is indicated. This is the result of an incorrect alignment of the connecting rod between the cabinet and main levers.

RULE

Shift the cabinet in the direction the indicator should move at full.

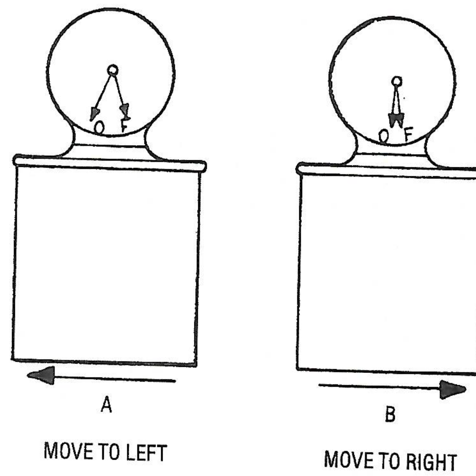

Figure 1.2.41. Cabinet Dial Adjustment

Should the pattern show errors equal and in the same direction, and increasing proportionately, a nose iron adjustment is indicated. This is the result of an incorrect lever ratio to the tare beam lever.

Should the pattern show errors unequal and increasing proportionately, both a cabinet shift and nose iron adjustment are indicated. The cabinet should be shifted to make the errors equal and in the same direction.