ADJUSTING ELEVATOR GENERATOR COMPOUNDING

I. GENERAL

Prior to making final generator compounding adjustments it is essential that the equipment be free of construction dust and dirt, the commutators should be well filmed, the brushes should be fully seated and free moving in their holders, and all electrical connections in the loop circuit should have good contact and be securely tight.

The purpose of generator compounding is to compensate for the effects of car loading upon elevator speed. Because of saturation in the generator magnetic iron it is necessary, or desirable, to have two values of compounding:

(1) a comparatively high value of compounding (series winding ampere turns) is required for high speed operation.

(2) a comparatively low value of compounding is required in order to give fairly uniform leveling speeds for a wide range of loads.

II. HIGH SPEED COMPOUNDING

Of the two compounding values the leveling compounding is much more critical and essential for good elevator performance. As far as high speed compounding is concerned the adjustment is not too critical and it is usually satisfactory to proceed as follows:

(1) Adjust hoist motor shunt field current to the running value indicated by manufacturer. Before running the elevator adjust generator shunt field control to give the field current recommended by the manufacturer for rated voltage output. Place balanced load in the car and operate the car in both directions of travel at full speed. Record loop volts measured at motor brush studs, car speed or motor speed and, if possible, loop amps for both directions. With true balanced load and with motor brushes in electrical neutral the loop volts and amps and car speed will have equal values in both directions. (If these values are not essentially the same the car load and counter weight do not balance.)

Assuming balanced load values are obtained, adjust generator shunt field control to give rated generator voltage as measured at the motor brush studs. With rated voltage at the motor terminals the car speed should be at rated value or slightly higher. A slight adjustment of motor shunt field current may be necessary if car speed is not then reasonably close to rated value with rated loop voltage.

(2) After completing balanced load adjustments operate the car empty in both directions at full speed. Record loop volts and car speed for both directions. If DOWN speed is higher than UP speed, the compounding is too strong. Add shunts or change series tap to reduce generator series turns. Repeat the readings and the compounding adjustments until the speeds are approximately equal for both directions.

(3) High speed compounding adjustment with empty car will usually give satisfactory results for all loads but occasionally on a critical installation (especially the higher speed ratings) it may be desirable to also check and adjust compounding with full load in the car. If UP speed is higher than DOWN speed, the compounding is too strong.

III. LEVELING SPEED COMPOUNDING METHODS

There are two methods for adjusting generator compounding for leveling speed operation. The first of these methods which is almost a universal method will be called the basic method. In this method the compounding is so adjusted that the same leveling speed is obtained with a full load on the elevator in both directions of travel. The compounding is adjusted by means of resistance material shunting the series winding of the generator or by changing the turns tap connection to the series winding.

The second method, which will be called the "simplified" or "stationary motor" method for this discussion, involves a test where

(1) the hoist motor armature and elevator car are held stationary by the brake

(2) The hoist motor shunt field is disconnected from the power source, and

(3) the generator shunt field is arranged so that it can be connected to a 6 volt battery or rectifier source by means of a double pole-double throw switch. In this method the compounding is adjusted so that the loop current remains steady at about rated value with the motor-generator set running and the field switch open. Correct compounding is indicated when the loop current remains steady with the switch open and where this current can be increased, decreased, or reversed by momentarily closing the field switch.

The basic method probably is somewhat more expensive and tedious to use than the simplified method; however, when the ultimate in compounding adjustment and leveling performance is desired it is the preferred method.

It is believed that the basic method gives the more nearly correct compounding adjustment because it more properly accounts for the factors which cause leveling speed to change with load; namely,

(1) loop circuit IR drop

(2) hoist motor armature reaction and interpole effects

(3) generator magnetic iron hysterisis effects, and

(4) motor brush contact drop under actual running conditions.

The simplified method primarily allows correction for loop IR drop and thus results in compounding adjustments which may only be approximately correct as far as best leveling speed performance is concerned.

IV. PROCEDURE FOR BASIC METHOD

A suggested procedure for compounding adjustment by the basic method is as follows:

(1) In this method the elevator is always brought up to rated speed and then slowed down to leveling speed in the normal sequence of control operation. When leveling speed is reached the control relay is held in manually long enough to measure the steady value of leveling speed. Do not take any readings by bringing the elevator from rest directly to leveling speed.

(2) Place balanced load in the car. Run the elevator at full speed, then measure and record leveling speed at the middle floor for both directions of travel. The leveling speed will be about the same value for both directions and this value should be about 20% less than the desired leveling speed with full load. In other words, if the nominal leveling speed is to be say 20 FPM, the balanced load speed should be about 15 or 16 FPM. The balanced load leveling speed can be adjusted for the required value by adjusting generator shunt field current accordingly.

(3) Next, place full load in the car. Run the elevator at full speed, then measure and record leveling speed at the middle floor for both directions of travel. Correct compounding adjustment has been obtained if the UP and DOWN speeds are equal or within 1 FPM of each other. If the UP (hoisting load) direction speed is higher the compounding is too great, and if the UP speed is lower

the compounding is too low. Adjust the series winding to correct the speed accordingly and keep adjusting and measuring until the correct compounding value is obtained.

NOTE: Sometimes the standard elements of resistance material used for shunting the series winding will not produce the correct compounding. In such cases it is necessary to make or tailor special resistance elements which will produce the correct compounding.

(4) It should not be necessary to change the compounding once it has been correctly adjusted as outlined above. Any "spotting" or "releveling" of the car which may occur with correct compounding should be taken care of by proper adjustment of the appropriate control elements; for example, proper adjustment of floor slowdown and stopping switches, proper adjustment of generator shunt field deceleration control, etc.

V. PROCEDURE FOR SIMPLIFIED METHOD

The loop circuit arrangement and the equipment needed to adjust compounding by the simplified method is shown schematically in Figure 1. Preparations for this test must include provisions for the following:

(1) The test is made with the M-G set running but with the elevator and hoist motor held stationary by the brake at all times. Arrange the elevator control circuits so that the M-G set can be started and stopped but so that the elevator will not run. The loop circuit remains closed.

(2) Disconnect the hoist motor shunt field from its power source so that current in the loop circuit will not cause the motor to rotate and pull through the brake. As an added precaution, the brake coil should also be disconnected from the control so that the brake cannot release for any reason.

(3) Disconnect the generator shunt field terminals from the control panel so that low voltage can be applied to the field as shown in Figure 1.

(4) The 6 volt dc power can be obtained from a storage battery, dry cell battery, or from a rectifier.

(5) Use a zero center meter with a 100 or 200 amp ammeter shunt to measure the current in the loop circuit. A d. c. tong type meter may be used in place of ammeter and shunt.

The simplified method test and adjustment are conducted as follows:

(1) Make sure generator field switch is open.

(2) Start the M-G set but stand by disconnect switch and be prepared to shut down if the loop current builds up to an excessive value (200% of rated current or more). Excessive series winding will cause the current to build up rapidly to an excessive value.

(3) If excessive series winding was indicated, add shunts or change series field taps to reduce series turns and repeat step (2).

(4) When the series field has been reduced sufficiently to prevent excessive current buildup, the current will remain at a low value and the generator may be allowed to run. However, the M-G set shutdown switch should be within easy reach at all times.

(5) Close the field switch to apply battery voltage in either polarity. The loop current will build up in one direction and when the polarity of the applied voltage from the battery is reversed it will return to zero and build up in the opposite direction.

(6) Open the field switch and hold it open. If the current returns to zero from either direction there is not enough series winding. If the current continues to increase steadily after the switch is open there is too much series.

(7) The series winding has been properly adjusted when the loop current has a steady continuous value which can be increased, decreased, or reversed by momentarily closing the field switch in either polarity.

(8) In order to be conclusive the steady current observed in step (7) should be at or near rated value. Opening the switch may cause this current to go up or down slightly but it should become steady with the switch open at a value near rated value.

If upon opening the switch, the current rises from near rated value to about 1-1/2 or 2 times rated value, there is still too much series. Adjust shunts so that the current will become steady at any value below 1-1/2 times rated current but not below 75% of rated value.

(9) The compounding has been properly adjusted for leveling speed when the condition described in step (7) has been satisfied. The special test equipment and connections can now be removed and the original connections restored for normal elevator operation.

(10) Proceed with the control adjustments which are usually followed when proper compounding has been established.

VI. ELEVATOR SPEED-LOAD CHARACTERISTICS

Figure 2 graphically depicts the general type of "leveling speed versus load" characteristic which can be expected for the usual geared elevator installation. Such graphs or curves are obtained by measuring leveling speed for various values of load in both directions of travel.

It will be noticed from Figure 2 that with correct compounding adjustment the lowest leveling speed occurs at balanced load and the highest at full load. These relations come about from the inherent electrical nature of the hoist motor and generator.

From the curve for correct compounding it is concluded that the adjustment of compounding could be made with an empty car as well as with full load in the car.

Once the compounding has been correctly adjusted for normal running load conditions, it should not be changed for such reasons as to get faster releveling. With correct compounding adjustment the desired releveling operation should be obtained by proper adjustment of releveling control in generator shunt field circuit.

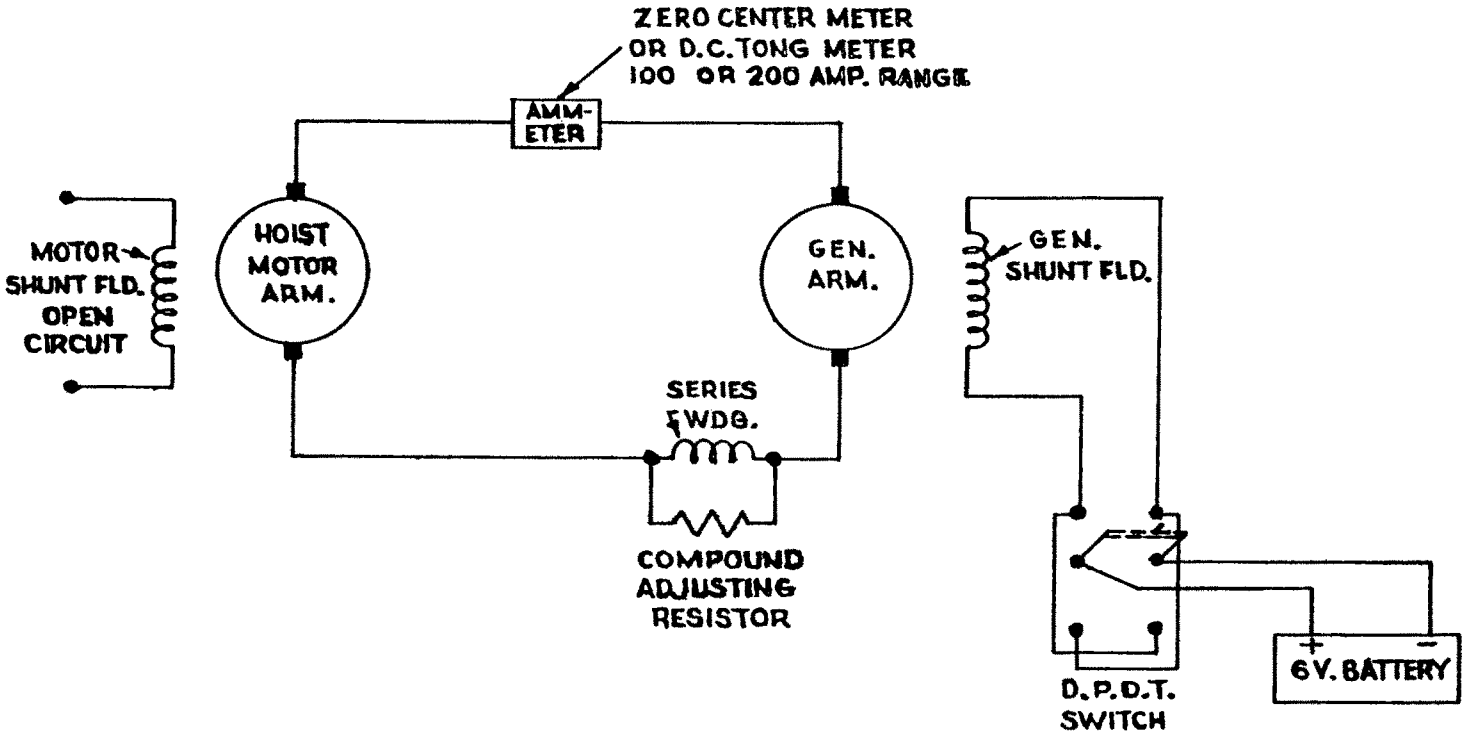

FIGURE 1

CIRCUIT ARRANGEMENT FOR ADJUSTING COMPOUNDING BY THE "SIMPLIFIED" METHOD

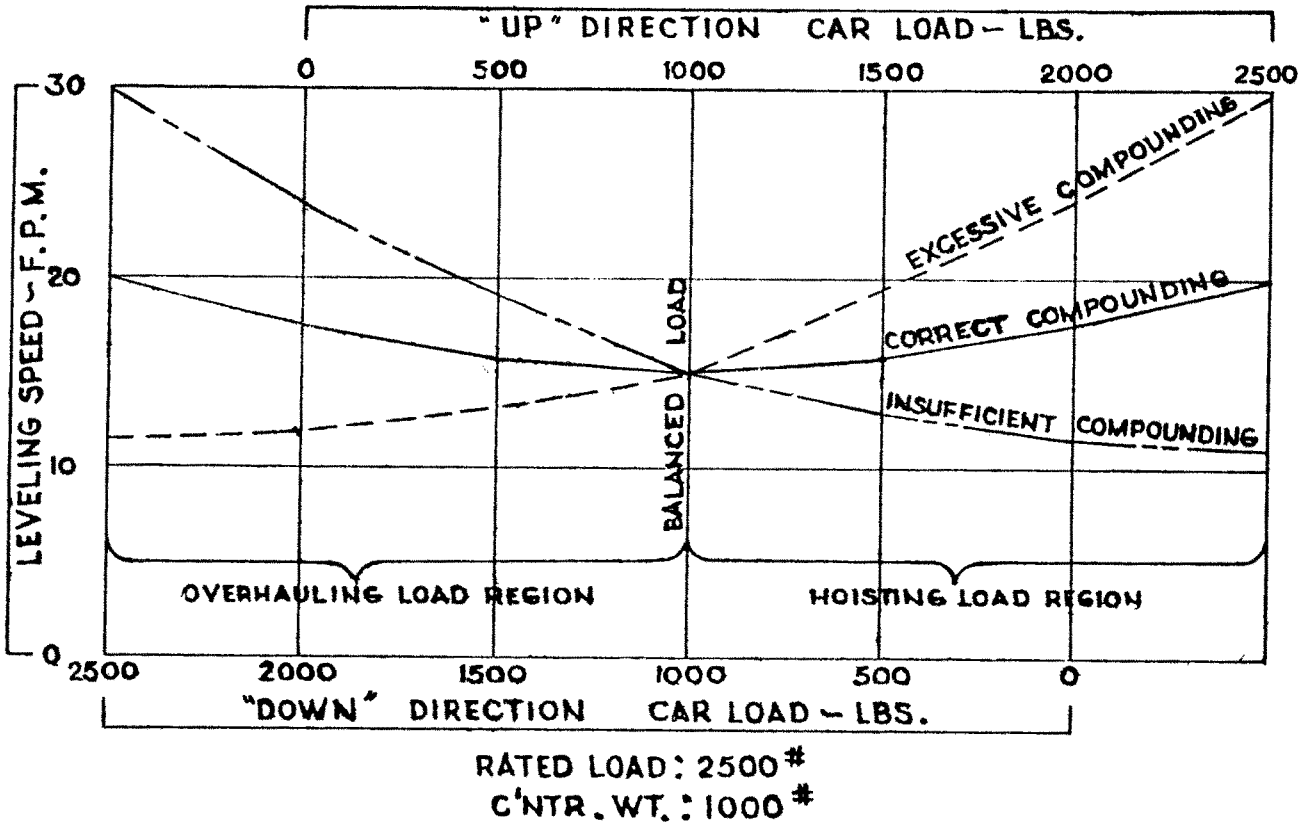

FIGURE 2

SPEED-LOAD CHARACTERISTIC