# TROUBLESHOOTING GUIDE FOR LK BREAKER
# TRIP-FREE AND MAG LATCH SHOCK-OUT

Trip-free is defined as the condition by wihch the breaker fails to close after an attempt is made to close it. The closing springs of the breaker discharge but the bridge blades do not latch closed. Technically, the trip latch of the breaker fails to seat against the track assembly, either intentionally or unintentionally. Here are some intentional causes of the trip-free condition:

1. When so equipped, the Kirk Key Interlock in the cradle will hold the breaker trip-free.

2. If the cradle is mechanically interlocked with another breaker, the breaker will be held trip-free if the other breaker is closed.

3. Should the breaker be equipped with an undervoltage device either instantaneous or time delay, failure to energize the undervoltage coil will hold the breaker trip-free.

4. If the breaker is equipped with a lock-out device on the auto trip indicator and that indicator is down, the breaker will be trip-free.

5. On LKD (fused) breakers, failure to reset the open-fuse trip (OFT) device will cause a trip-free.

6. If after racking the breaker, it is not in either the "Disconnected Test" or "Connected" positions and/or the racking Release Lever is not in the locked (extreme right) position, the circuit breaker cannot be charged or closed in the "OUT" position.

7. If the padlock hasp is pulled out the breaker is held trip-free.

Obviously the items listed above are not the sole causes of the trip-free condition; these items are functioning properly if they hold the breaker trip-free. One should check these items first, however, before pronouncing that the breaker is faulty.

The following are problems with the breaker which also make it trip-free. Each one is discussed at length to assist in diagnosis of a given breaker's problems:

1. Undervoltage devices, both instantaneous and time delay, can shock-out even when the coil is energized. When this happens the breaker will fail to close although the undervoltage relay will appear picked up, when one inspects it with the front cover removed. The auto-trip indicator does not drop, thus giving the indication that all is normal. To verify that the undervoltage shocked-out, use the UV defeater or hold the trip rod which extends from the undervoltage through the trip platform to the shunt trip tripper. Attempt to close the breaker. If the breaker closes, the undervoltage is probably the cause. Verify with several more trials.

Undervoltage shock-out can be corrected by changing the latch "bite" in the UV device with the adjusting screw at the top of the device (do not confuse this screw with the dashpot adjusting locknut on time delay models). A trial and error method must be used to find the adjustment which prevents shock-out. This is especially critical on time delay models to maintain timing but eliminate shock-out.

2. Escutcheon panel interference - The trip latch lever extends through the escutcheon in the "control center" of the LK breaker. If the lever drags against the front escutcheon or the escutcheon nameplate, proper seating of the trip latch against the breaker track assembly can't be assured. To see if this is a problem, lift the trip lever when the breaker is open with the springs discharged. Any interference with the escutcheon can be felt as well as seen. Replace the escutcheon if this is the case. If escutcheon replacement is not possible or timely, the escutcheon and its nameplate can be modified with a file. **DO NOT, UNDER ANY CIRCUMSTANCES, TRY TO FILE THE TRIP LATCH ITSELF.**

3. Improper contact penetration gap - When the contact gap (the distance from the bridge blade arcing contact to the forward face of the upper terminal when the breaker is closed) (see Illustration No. 1) is less than 0.100 inches, the circuit breaker toggle assembly (which is attached to the jackshaft) is positioned improperly. That, in turn prevents the track assembly from seating against the trip latch properly. This is diagnosed by lifting the trip latch with the contacts open and the springs discharged (assuming that there is no escutcheon interference). The trip latch will feel like it's contacting the track assembly and pushing it rearward as it rolls on the roller of that assembly. With the breaker closed, this problem manifests itself with exceedingly high trip latch lifting forces. The standard force for lifting the trip latch should fall between 1-1/2 and 4 pounds. Higher forces, such as 8 pounds or more are a sure sign of insufficient contact gap. Insufficient contact gap is also a leading cause of trip lever breaking in breakers since it forces the trip latch hard against the front escutcheon during a trip operation.

4. Excessive vibration - Excessive trip latch vibration will cause breaker trip-free. As the trip latch bounces up and down during breaker closing, it fails to seat properly against the track assembly. To diagnose this condition, lightly push down on the trip lever as you attempt to close the breaker. If the breaker closes satisfactorily, the breaker most likely needs the rubber bumper modification found in IB 8502. That modification requires replacement of the trip latch, and close pushbutton plunger, plus addition of a rubber bumper. (This replacement is automatically required by the update program on large frame breakers because they exhibit more vibration.)

5. Defective trip latch - Since the trip latch is the very heart of the breaker tripping system, the machining of that part is critical. One that is bent, has a poorly finished working surface, or pivot holes that are not centered can cause the trip-free condition. The above inspections assume that the trip latch is properly machined. Any trip-free investigation should begin with an inspection of the latch after the intentional causes for trip-free have been ruled out.

While performing the inspections for escutcheon interference, make sure the trip lever is perpendicular to the body of the trip latch. When verifying that the breaker has a rubber bumper (or installing the trip latch and bumper) make sure that that portion of the trip latch that rests against the bumper is painted green. If the trip latch is removed for closer inspection, check the centering of the bearings for the through pin. Inspect the latch free for obvious burrs or scarring. (Note that it is normal for the latch face to have a polished line across its face, especially if the breaker has been in service for some time. The track assembly polishes the latch face. This line should be visible but cannot be felt when one runs a fingernail across it.) Inspect the track assembly roller also for excessive wear or gouges. (Some wear of that roller is anticipated; it would not have its finely polished surface as it did when new. It should not have deep gouges, however.) Replace roller if damaged.

Replace the trip latch if it seems bent or excessively damaged.

6. Mag latch shock-out - Perhaps the most common cause of the circuit breaker trip-free is mag latch shock-out. Mag latch shock-out occurs when the recoil action of spring operation is transmitted through the mechanism and mag latch assembly to jar the armature off the permanent magnet inside the mag latch. The plunger in turn operates the trip latch via the tripper and prevents the breaker contacts from closing. This all happens in scant milliseconds. Fortunately this action leaves a telltale indicator; the auto trip indicator drops down. Other than the open fuse trip device on fused breakers, mag latch operation (either intentional or unintentional) is the only way the auto trip indicator will drop.

   Two inspections can be performed on the mag latch to be sure that it is in proper working order. The first is the 750 milliamp test described as the Magnetic Latch Trip Test in IB 6.1.1.7-2B, which is the instruction for use of the 505 test set. The other test is a check of differential force. The differential force is the force required to separate the mag latch armature from the permanent magnet. Using a spring scale with the mag latch off the breaker, push down on the mag latch trip pin with the scale. When the armature releases, the recorded force should be between 4 and 7 pounds. Differential forces below 4 pounds almost guarantee shock-out problems. Forces above 7 pounds almost guarantee failure of the 750 milliamp test.

   When the mag latch passes both these tests, the means by which the mag latch plunger is reset can be reviewed. First be sure all mounting hardware on mag latch (whether horizontal or vertical mount) is tight. Make sure, too, that the mag latch is seated firmly on trip platform on vertically mounted forms. On small frame and large frame breakers, the open/close indicator pulls up on the mag latch tripper as a direct result of toggle assembly movement during opening. On small frame breakers, this action pushes the mag latch plunger directly to reset the mag latch. On large frame breakers, tripper movement pushes up on a horizontal tripper assembly which in turn forces in the plunger of the mag latch.

After tripping breaker and with springs discharged, adjustment of the open/close indicator is accomplished first by loosening the two nuts on the shaft of the indicator. The top nut compresses a spring; the bottom will noticeably loosen the open/close "flag". Retighten the bottom nut which will pull the top of the flag firmly up against the mag latch tripper. Tighten the top screw so that it compresses the spring. Typically the top nut is adjusted properly when approximately two screw threads appear above the locking portion of this lock nut. Charge the springs and close the breaker. Trip then reclose to verify proper mag latch reset.

On large frame breakers, the above open/close indicator procedure should also be performed. The large frame breaker, however, has an additional adjustment on the horizontal mounting tripper assembly. This adjustment is discussed in detail in IB 8408. Briefly, however, the adjustment to attain mag latch reset and thus eliminate shock-out. Looking from the top of the screw, turn the adjustment screw clockwise to attain better reset, counterclockwise to retain pretravel. When the proper setting is attained Loctite no. 242 threadlocking adhesive can be used to seal the setting.

Pretravel was alluded to above. Mag latch pretravel is shown on illustration 2 attached. If there is insufficient pretravel, the mag latch will not trip the breaker. Pretravel is measured when the breaker is closed. On small frame breakers, carefully pull down the mag latch tripper and measure the gap between the tripper and the platform the mag latch sits on. It should be 0.125 +/- 0.015. On large frame breakers, this same gap will exist between the tripper and the platform, but will also be between the horizontal tripper assembly and the cross pin of the mag latch plunger, when the contacts are closed.

If the condition still exists after following this analysis, review the application to be sure there isn't a maintained trip signal applied to the breaker.

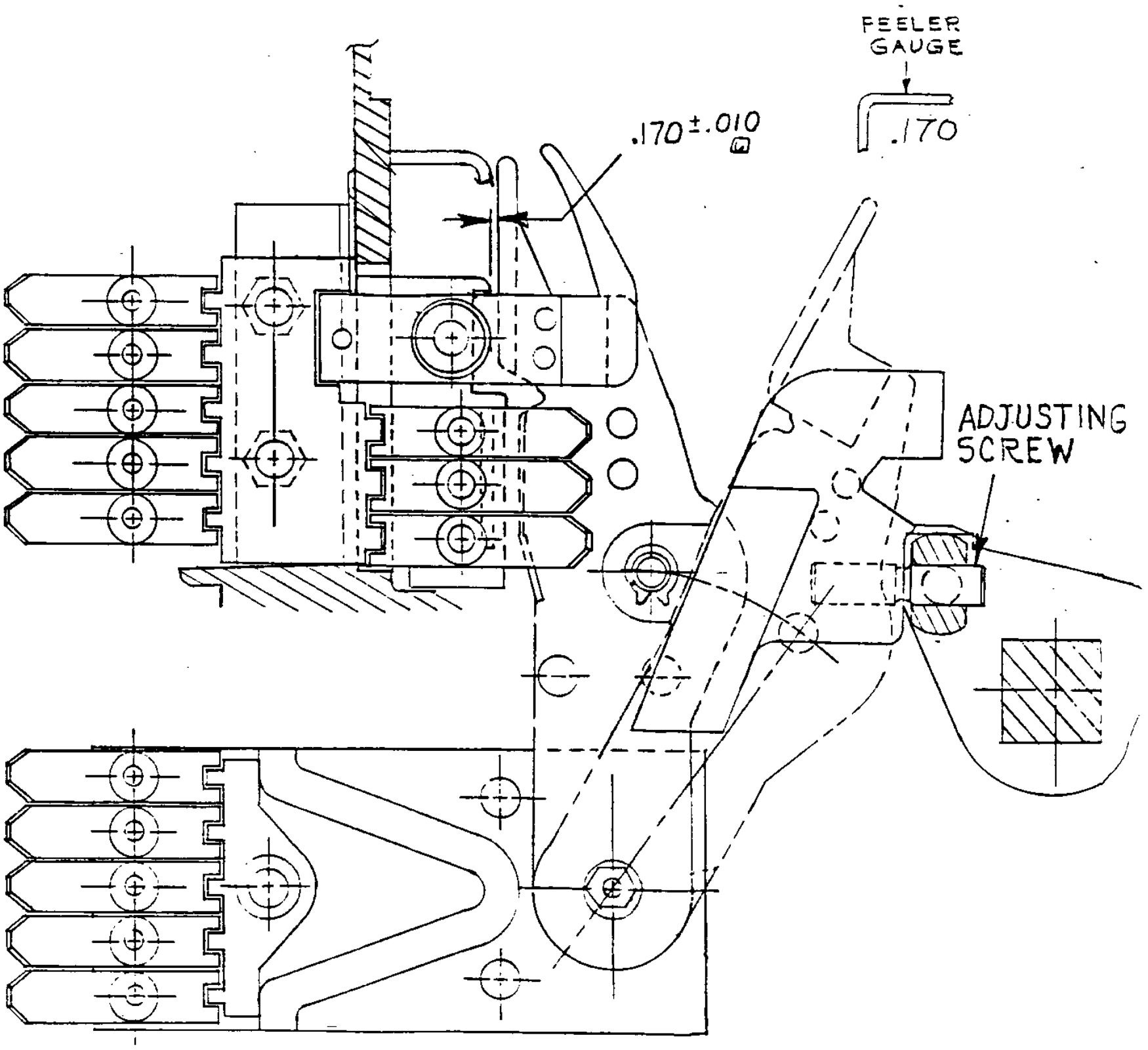


ILLUSTRATION 1

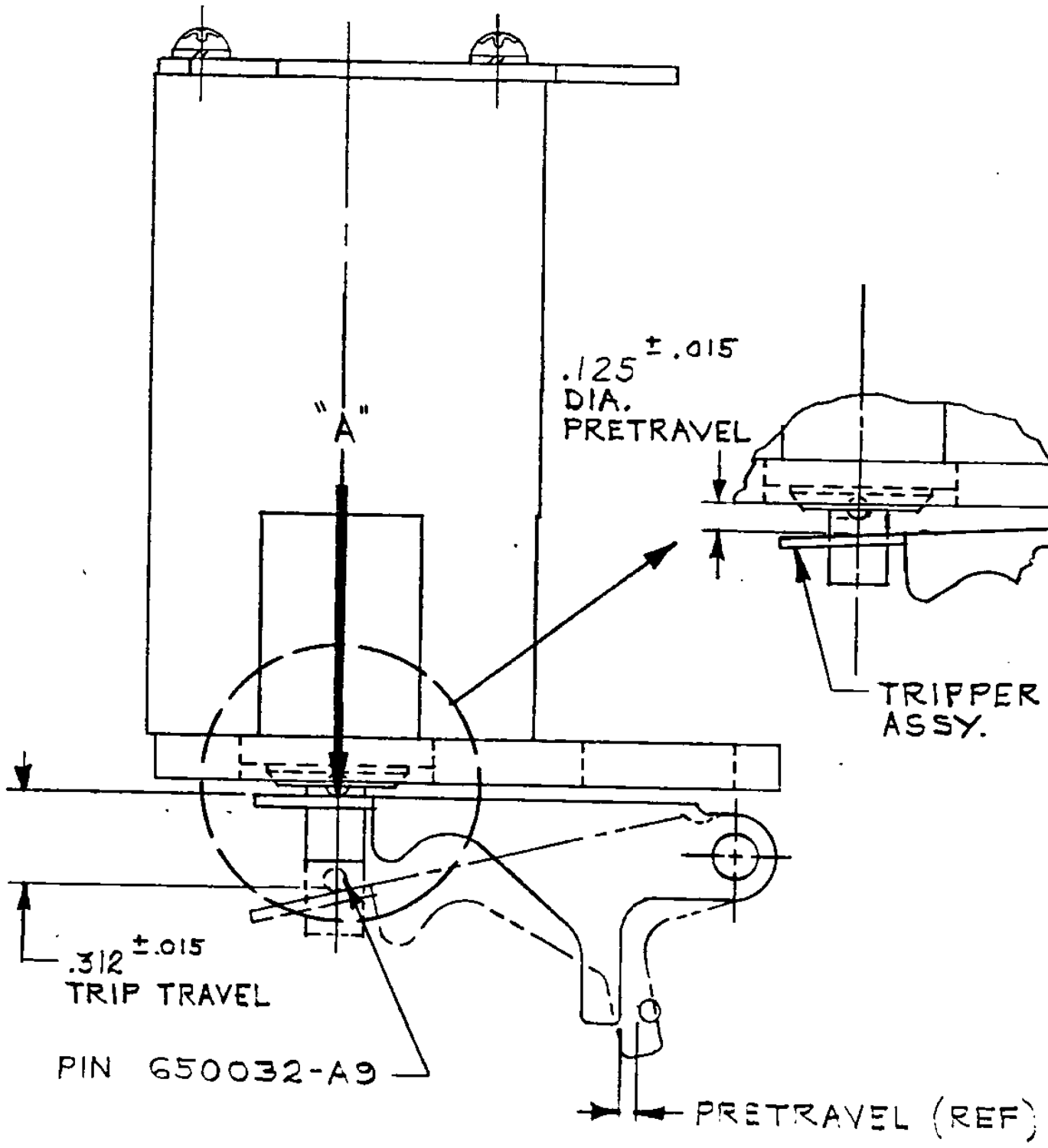


ILLUSTRATION 2