1. GENERAL

1.1 This information is intended for use when overhauling or re-adjusting S.P.B. Impulse Transmitters.

1.2 The adjustments are given in the order in which they should be carried out when the transmitter is being completely overhauled. It is emphasised that when individual adjustments are being made, it may be necessary to check other details since many of the adjustments are inter-related.

2. SUSPENSION SPRING, PENDULUM AND CRUTCH (Drawings A.1402 and A.1403)

2.1 Suspension Spring

The suspension spring must be straight and free from kinks, cracks or rust. Its surface must be lightly oiled to prevent rusting. The locating pin in the bottom end of the spring should be true and square with the spring itself. (See figure 2.)

2.2 Pendulum

The pendulum must be examined to ensure that the suspension slot is free from burrs and that the rod does not rock in the bob. The lower face of the bob must be examined to ensure that it is clean and smooth under the lock nut. Should play exist between the rod and bob the rod must be removed and the hole in the top of the bob closed by tapping it with the ball end of a ball pein hammer. When reassembling the pendulum the initial setting should be about right when 4 to 6 threads protrude below the lock nut on the rod.

2.3 Hang the pendulum, with the slot facing the front, onto the suspension spring. Loosen the suspension spring clamp screw and, ensuring that the spring is seated correctly in the "V" block, pull vertically downwards on the bob with the left hand and, whilst retaining this pressure, re-tighten the clamp screw. (See figure 3.) Failure to do this may result in pendulum roll or 'figure of eight' oscillation. It must be emphasised that this adjustment is critical and if pendulum roll is evident the clamp screw should be slackened and the spring reseated.

NOTE:

On some early transmitters the suspension spring fixing is by means of two screws (see figure 3A). The spring in this case should be placed in position so that the round chops rest firmly on the top edges of the bracket and the clamping plate. It should hang immediately in the centre between the two screws which should be turned home so that the plate clamps the spring firmly and evenly over the whole of its width. Final tightening up must be done by turning both screws equally.

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2.4 Engage the pendulum into the crutch fork which is fitted at the bottom of the crutch rod. Apply a spot of clock oil to the inside face of each arm of the crutch fork. Check that minimum clearance exists between the crutch fork and the pendulum rod. This is adjusted by a small screw (see figure 3) and the adjustment should be made so that when the pendulum rod is gently pushed towards the back plate the crutch does not follow it but allows the rod to just slide between its arms.

2.5 Plumb the S.P.B. so that the centre line on the crutch coincides with the centre line on the crutch guard, and check that the S.P.B. is vertical when viewed from the side. A plumb line should be used for this. (See figures 3 and 4.)

3. THE TRIGGER WIRE

3.1 The trigger wire is illustrated in figures 5 and 6. On earlier types, the trigger wire must be set in a slight bow where it passes through its bearing to prevent the wire binding on the top plate. On later types, in which the top bearing plate is slotted, bowing is unnecessary. The wire must be perfectly free in its bearings.

3.2 The trigger wire guard must be set in a vertical plane so as not to restrict the up and down movement of the trigger wire. That portion of the trigger wire operated by the detent toggle lever flag should be raised so that the detent toggle lever does not butt the axial length of the wire. (See figure 7.)

3.3 When the pendulum is at rest, the trigger wire must rest against the underside of the bracket carrying the recording roller. (See figure 8.)

3.4 The bracket on which the trigger wire is depressed by the flag, should have its top surface parallel with the impulse bracket. (See figure 9.)

3.5 The end of the trigger wire must be set so that the toggle lever flag operates it cleanly without butting the end. (See figure 10.)

3.6 Crutch Rod

The crutch should be free in its bearings with slight endshake and the crutch should swing centrally between the bracket and the crutch guard which is situated at approximately the centre of its length.

3.7 Recording Roller

The recording roller and its pin should revolve freely in the bearings in which it is retained by a collet, with minimum endshake.

4. SUSTAINING SPRINGSET AND COIL ASSEMBLY
(Drawings A1404 and A1405)

4.1 The adjustments relating to the contacts and the angle of the latch should be carried out with the sustaining unit detached from the transmitter. The latch must be checked for freedom at all points.

4.2 Before fitting a sustaining springset to the unit the following points must be checked. (See figure 11.)

(a) That a gap of approximately 40 mils. exists between the contacts. Adjust by stroking roller spring with duck-bill pliers. This assists the setting of the tension of the roller spring, this tension being checked later.

(b) That the contacts are securely rivetted in the springs.

(c) That the buffer spring is parallel to the buffer and has a pressure of 3-5 grms. against the buffer.

(d) That the contacts are accurately twinned.

(e) That the roller rotates freely on its axis.

4.3 Place the springset in position on the unit plate with the roller engaging the heart-shaped cam affixed to the latch spindle. Tighten the two fixing screws and check the position the cam takes up on the roller, which should be approximately in the centre of the roller. Adjust if necessary, by slackening springset assembly screws and moving springs and buffer together. On obtaining the foregoing position check that the contacts are in alignment and that the spring rests in tl centre of the buffer bar. Also check that the protruding end of the roller spindle does not foul the small pin attached to the latch spindl when the spindle is rotated.

4.4 Slacken fixing screws and adjust springset position by placing trigger angle gauge K8922 along base of sustaining unit (see figure 12) and move the springset within the tolerance of its fixing screw holes until the whole under surface of the latch aligns itself to the 20^{0} angle of the gauge. Hold springset steady and re-tighten the top one of the two fixing screws only.

4.5 On obtaining the above adjustment, pivot the springset on its top fixing screw until a gap of 6 mils. is obtained between the contacts. Re-tighten the lower fixing screw. Pivotting the springset about its top screw should have no affect on the latch alignment. Re-check the contacts for twinning.

4.6 Check the tension of the roller spring. The roller should have a pressure of 6-8 grms. against the heart-shaped cam. Apply finger of tension gauge against bracket carrying roller and adjust if necessary by stroking spring with duck-bill pliers. Re-check contact gap.

4.7 Coil Unit

Replace coil unit and armature. Check armature residual 2-4 mils. if armature is fitted with residual stud. On later type transmitters the coils are fitted with a residual spring and when the armature is fully operated no residual gap exists. This spring is clamped between the yoke of the coil and the mounting bracket. If this spring is fitted it must be located correctly on the yoke and position itself without tension against the pole-face of the coil.

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7. DRIVING UNIT - ADJUSTMENT AND SETTING IN BEAT
(See Drawing A1446)

Before the driving unit is fitted to the transmitter the following checks should be made:-

7.1 Driving Wheels (See Figure 16)

The driving wheels should have end shake and minimum back lash between the driving teeth consistent with free spinning of the wheels If back lash between the teeth is excessive the top plate should be removed and the bearing arm bent inwards with combination pliers.

7.2 Driving Pallet (See Figure 17)

The driving pallet should be securely shellacked in its clip and be perfectly upright when viewed from both angles.

7.3 Pallet Engagement (See Figure 18)

The pallet engagement with the two driving wheels should be as deep as possible, and the corners of the pallet should clear the tip of the teeth from which it is retreating. This adjustment is made by bending the bearing arms in which the pallet lever is pivoted. Care should be taken to ensure that both bearing arms are bent by an equal amount. In addition, the wheels should be free to trip past the pallet corners without 'butting' when drive is applied to the wheels in the reversed direction.

7.4 Beat (Drawing A1410, Figures 27 and 28)

Open the toggle lever forks using Spanners K8809 and K9049, so that no drive is applied to the pallet, slacken off the pallet tensioning spring so that the pallet is quite free, move the pendulum slowly to the right to the exact position where the toggle lever flag escapes upwards from the recording roller. At this instant the position occupied by the centre line of the crutch against the crutch guard should be noted. Repeat the test by moving the pendulum slowly to the left until the toggle lever flag just escapes downwards from the recording roller. Again note the position occupied by the crutch line against the crutch guard.

These distances left or right from the centre line of the crutch guard must be equal. If they are not, then the fixing screws of the driving unit must be loosened and the movement moved left or right until true beat is obtained. The lower screw gives coarse adjustment and the upper screw gives fine adjustment (see figures 27 and 28).
If difficulty is experienced in reading accurately the crutch position left or right of centre, then proceed as overleaf.

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7.5 At the instant the flag escapes upwards or downwards from the roller (pendulum moved either left or right) the pendulum should be released and in its swing in the opposite direction the flag should not disengage itself from the recording roller. If accurately adjusted it will be found that the point of the flag will move to a "2 o'clock" position on the roller when escaping upwards, and to an "8 o'clock" position when escaping downwards. Should the flag move right round the roller in either direction then the position of the driving unit must be adjusted.

8. SPRING, TENSIONING FOR TOGGLE LEVER (CENTRE LINE SPRING)

8.1 Measurement of the centre line spring pressure can be made by releasing the spring from its lower anchorage and observing that under a pressure of 18.29 gms. the loop is extended to the anchor point, i.e., 11/16". If this measurement cannot be met then:-

(a) The Spring K4996 should be changed.

(b) The lower anchor point of the spring should be bent up or down to give a radius of 11/16".

8.2 The anchor point on which the centre line spring is fixed should be bent to left or right so that the recording roller engages centrally on the front and rear sides of the inclined face of the toggle lever flag. The forks must be opened to check or perform this adjustment. The hole in the toggle lever forks to which the centre line spring is secured should be chamfered on each side to present a smooth surface, similarly the lower anchor point should have its edge chamfered to obviate chaffing.

NOTE: If either of the above adjustments have to be made then a further check of the 'beat' adjustment (paragraph 7.4) will be necessary.

9. ADJUSTING FOR DRIVE (See Drawing A1411)

9.1 The right-hand toggle lever fork shall be so adjusted to the pallet that there is a minimum clearance between the toggle lever flag and the recording roller, consistent with free passage, at the point of maximum displacement of the flag. Check by holding the toggle lever fork firmly against the pallet with a length of pegwood and see that the recording roller does not rotate as it passes over the toggle lever flag. (See figure 29.)

9.2 The left-hand toggle lever fork should be so adjusted to the pallet that there is a minimum clearance between the toggle lever flag and the recording roller, consistent with free passage at the point of maximum displacement of the flag. Check by holding the toggle lever fork firmly against the pallet with a length of pegwood and see that the recording roller does not rotate as it passes under the toggle lever flag. (See figure 30.)

9.3 The adjustment of the toggle lever forks should be carried out by using Spring Adjuster K9809 and Spanner K9049, as illustrated in figure 31, the fork being bent in or out as required.

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9.4 In normal use, providing the movement is in correct adjustment, the toggle lever forks should never open out. If they do, the forks themselves may be weak. In such a case the complete toggle lever flag and fork (Lever, Toggle K.4830) should be replaced and readjusted as above and in paragraph 7.4).

9.5 If the fork opens and, on examination, it is not found to be weak, then all adjustments should be very carefully checked. (See also paragraph 8.4.)

10. STOP CLICKS, MAGNETICALLY CONTROLLED
(See Drawings A.1407 and A.1408)

10.1 The stop click bearing block should be free from all roughness at the edges of the plate and block, and the clicks should have endshake in all positions. Stop click bearings must be free from oil. (See figure 19.)

10.2 When viewed end on the pivoting and locking portions of the clicks should be in the same plane. (See figure 20.)

10.3 The stop click bearing block should be rotated on its centre fixing so that the centres of each stop click bearing are equidistant from the left-hand drive wheel pivot. This is checked by the use of the Trigger Angle Gauge K.8922 as shown in Figures 21 and 22 showing incorrect and correct adjustment respectively. On later versions it is not possible to use the gauge and compasses or dividers, should be used.

10.4 After correct alignment has been determined, the fixing bolt should be firmly secured and the lock nut tightened, after which the bearing block must NOT be disturbed. Further adjustments to the stop clicks are made by bending them. To tighten the lock nut the entire stop click bearing bracket should be removed from the driving unit. Replacement of the bracket will not alter the setting of the bearing block.

10.5 With the driving pallet in the left-hand wheel, the left-hand stop click should rest squarely between teeth 11 and 12, whilst the right-hand click should rest on the crest of tooth 9. (See figure 23.)

10.6 With the driving pallet in the right-hand wheel, the left-hand stop click should rest on the crest of tooth 12, whilst the right-hand stop click should rest squarely in the valley between teeth 9 and 10. (See figure 24.)

10.7 Should the left-hand stop click impede the passage of the drive wheel, it should be offset with a pair of pliers, as illustrated in figure 25 drawing A.1409. The stop click assembly should be removed from the drive unit for this adjustment.

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11. THE EFFECTIVE LENGTH OF THE STOP CLICKS

11.1 To adjust effective length of stop clicks, remove stop click assembly from drive unit and hold the clicks in approximately the same position they would take up on the wheel and bend the locking portion (figure 26) as follows:-

(a) To shorten the click, bend directly to the left. This will increase backlash which will overcome skidding.

(b) To lengthen the click, bend directly to the right. This will decrease backlash which will increase the risk of skidding.

11.2 The stop clicks should be adjusted so that there is perceptible backlash of the driving wheels in every position. Backlash is essential to prevent "skidding". It should, however, be kept to a safe minimum.

11.3 Skidding need not be due to incorrect click lengths. If the toggle-lever forks open outwards, giving play between flag and roller, then this condition can also cause skidding. Therefore, check forks first when skidding occurs.

11.4 Permanent Magnet

The stop clicks are maintained in firm contact with the teeth of the left-hand wheel by a permanent magnet situated at the rear of the driving unit. The magnet may be considered satisfactory if, when the driving unit is held upside down, the stop clicks do not leave the wheel.

11.5 Pallet Spring and Tensioning Screw

The pallet spring should be positioned so that the tail of the driving pallet bears evenly on both sides of the tensioning stud. Adjust if necessary by loosening the fixing screw and moving the spring within the limits of its fixing hole. The tensioning screw should be friction tight and should be advanced only sufficiently to ensure that the pallet spring holds the pallet in engagement with the driving wheels on the return of the toggle-lever fork.

12. CHECK FOR SATISFACTORY DRIVING AND FREEDOM FROM SKIDDING

12.1 The pendulum should now be allowed to swing normally when, upon pressing the right-hand driving wheel in an anti-clockwise direction, the pallet should securely lock the wheels between every swing of the pendulum.

12.2 In the same way, the stop clicks should also prevent movement of the wheels in a backwards direction when pressure is applied in a clockwise direction to the right-hand wheel. This pressure should be sufficient to call for a sustaining pulse every time the pendulum swings to the left. Every tooth of the wheels should be checked. If the drive fails on one or more teeth then "skidding" is taking place and further checks and/or adjustments to the toggle-lever forks, or that stop-click trying to enter the "valley" between the teeth will be necessary. The above refers to a partially dismantled transmitter, for transmitter with minute wheel fitted see paragraph 17.4.

13. MINUTE WHEEL

13.1 The minute wheel should be fitted with some endshake and a minimum of play between teeth. Adjust via front bearing cock fixing hole tolerance, keeping bearings in alignment.

14. IMPULSE SPRINGSETS (See Drawing A 1412)

14.1 The adjustments of the half-minute and minute springsets are as shown in figures 32, 33 and 34. If the adjustments shown in figure 32 are carried out on the bench the final adjustments where the springbanks are fitted to the transmitter will be simplified.

15. CAM SETTINGS (See Drawing A.1412)

15.1 ½ minute cams (figure 33)

(a) With pendulum to right, cam engages tip of buffer spring at 29th or 59th second.

(b) With pendulum to left, cam engages on make face of lever spring, contacts made at 29½ and 59½ seconds. Adjust rear screw for 5-8 mils lift between buffer and buffer spring.

(c) With pendulum to right, cam clear of lever spring, contacts broken at 30th and 60th second. To ensure that the other ½ minute cam operates after 30 seconds, let the pendulum swing and count the number of swings to the right. If the count is not 30 the cam which was not originally adjusted must be carefully bent up or down. See paragraph 15.3

15.2 1 minute cam (figure 34)

(a) Pendulum to the left, cam engages tip of buffer spring at 58½ seconds.

(b) Pendulum to the right, cam engages make face of lever springs, contacts made at 59th second. Adjust rear tension screw for 5-8 mils lift betwee buffer and buffer spring.

(c) Pendulum over to the left, cam still on make face of lever spring, contacts still made at 59½ seconds

(d) Pendulum to right, cam clear of lever spring, contacts broken at 60th second.

15.3 The adjustments above must be made with full regard to the backlash via the minute wheel, and this backlash must be taken to its extremities in both directions to ensure that each cam does not "hang on" or "operate early" due to the backlash.

15.4 Seconds Hand

The seconds hand should be set so that it registers the 60th second at the instant the minute and half-minute contacts break. If the second hand is engaged too far on the pivot the endshake of the minute wheel will be eliminated.

16. LUBRICATION

16.1 Oiling of units should preferably be carried out with the units removed from the chassis.

16.2 Oil sinks must not be overfilled. Oil should be applied with the flattened end of a piece of 20 gauge iron or steel wire which, after flattening, has been shaped to an arrow head. A paper clip is very suitable for this work.

16.3 Apply clock oil to:-

(a) All pivots (half filling oil sinks).

(b) Minute wheel bearings.

(c) 1 drop on the operate face of the latch.

(d) 1 drop on top of the recording roller.

(e) Lightly oil the trigger wire bearing.

(f) Lightly oil the crutch fork.

(g) Lightly oil the pallet spring stud.

(h) Lightly oil the top anchorage of the centre line spring.

Smear the minute and half minute cams with oil which should then be wiped off.

N.B. Do not oil: The stop click bearings.
The sustaining springset roller.

16.4 The rear crutch pivot should be lubricated with 1 drop of oil on each E.V. On earlier S.P.Bs. the oil sink is not readily accessible without dismantling the crutch assembly, but the pivot can be reached if the top of the crutch is eased forward and a wire shaped as suggested above is used to apply the oil. On later issues the oil reservoir is in the top edge of the rear bridge piece and it is unnecessary to move the crutch.

17. MAINTENANCE NOTES

17.1 Pendulum Roll or 'Figure of 8' Oscillation

The fault may be due to the spring being incorrectly seated in the 'V' block, or even to a kink or fracture in the spring itself. Slacken the clamp screw and remove the spring for examination; make sure there is no dust or grit on the 'V' block or sides of the clamp plate. If the spring is undamaged, re-fit and re-hang pendulum which should be pulled downwards to seat spring into 'V' block. While maintaining downward pressure, tighten the clamp fixing screw.

It must be emphasised that this adjustment is critical and, if pendulum roll is still evident, the clamp screw should be slackened and the spring reseated as detailed.

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17.2 Trigger Wire Occasionally Fouls Latch Edge

This can sometimes occur, though infrequently with an S.P.B. which is in correct adjustment. It has no known detrimental effect on the timekeeping and can be ignored.

17.3 If the trigger wire is fouling the trigger edge frequently it may be due to the setting of the trigger wire. This must be carefully checked and, in particular, that portion of the trigger wire which operates the latch must be set parallel with the face of the latch.

17.4 Skidding: Test on the Complete Impulse Transmitter

The previous description of a skidding test covered a partially dismantled movement. The following deals with this test as it should be applied to the complete impulse transmitter.

If skidding takes place it usually occurs when either the ½ minute or 1 minute contacts are being operated, i.e., when the movement is called upon to do extra work

Proceed as follows:-

(i) Apply the fore-finger in a downward direction to the periphery of the 60 tooth minute wheel. Start with very gentle pressure and steadily increase this until just sufficient is applied to cause the transmitter to call for a sustaining pulse every swing of the pendulum.

(ii) When the correct pressure has been reached, observe that the pallet enters safely between the tooth of the appropriate wheel and progresses it. Pay particular attention to the ½ minute and 1 minute periods and check every tooth of the wheels. If the drive fails on one or more teeth then skidding is taking place.

17.5 Clearing the Trouble

There are two main causes for the above, namely:-

(i) Incorrect adjustment of the magnetically controlled stop clicks.

(ii) Incorrect adjustment of the toggle lever forks and flag.

17.6 Sustaining Contacts

Occasional trouble has been experienced with the sustaining contacts. It has been found that a continuous arc is maintained between them, thus holding up the sustaining armature, and the consequent stoppage of the S.I.B. The arcing may be caused by a fine particle of metal which has become detached from one of the sustaining springs, possibly from the punch hole immediately above the contacts.

Thorough cleaning of the contact spring and the contacts

18. CHECKING PERIOD OF SUSTAINING IMPULSES

18.1 Since the pendulum is sustained on demand, the period of time elapsing between sustaining impulses will provide a satisfactory means of determining variations in friction existing in the whole movement. Indications of increasing friction demand attention, whereas decreasing friction usually denotes a satisfactory settling down of the movement.

18.2 Sustaining should be checked as detailed below, both at the commencement and on completion of a fault or visit:-

(a) From any sustaining impulse, count the number of seconds before the next sustaining impulse occurs and enter this figure onto a piece of paper (count seconds by observing the swing of the pendulum).

(b) Repeat this operation for twelve successive impulses.

(c) Add together the twelve recorded figures.

(d) Enter the total figure and the highest individual recorded figure on the Fault/Visit card and in the Log Book.

Example: From a typical S.P.B. the following figures were obtained, 18, 13, 19, 15, 16, 14, 17, 17, 14, 16, 15, 18. These added together equal 192 and the highest figure recorded is 19.

A convenient method of entering these figures on the Fault/Visit card, or in the Log Book, is to draw a line diagonally across the amplitude or pulses space and enter the total figure in one half and the highest figure in the other half.

18.3 When faced with increasing friction it is necessary to exercise your own judgement in determing whether or not a complete overhaul is necessary, or whether oiling will suffice.

18.4 Resetting the Impulse Transmitter

To advance the movement the top of the pallet lever should be rocked gently from side to side whilst holding the pendulum to the left.

The flag should never be used to impulse the movement manually, due to the danger of spreading the toggle-lever forks.