Installing & Using the TCS TXM10-B Crystal Drive on your Bolex H-16 Spring-Wind Camera

1. Installation

1A. First prepare the camera for motor attachment by following these steps:

1. Turn the camera's **MOT** lever to **O**.

2. Remove the spring winding handle by folding it up as if to wind the spring, but by turning it *clockwise* instead of counter-clockwise. It has a left-hand thread.

3. Set the speed dial to **64** or higher, fully clockwise.

4. Lock the release slide in the **M** (lock-run) position.

5. On H-16 Rex models with a variable shutter, remove the Rexofader if present, and lock the variable shutter in the **top** (fully open) position.

Warning: *Failure to follow these steps can result in motor or camera damage, or inferior film.*

1B. Attach the motor to the camera by following these steps:

1. Lay the camera down on a cushion or other soft surface, with the lid side down.

2. If the camera bottom has a 3/8" to 1/4" thread adapter, add-on flat base adapter, or quick-release tripod adapter, this must be removed with a screwdriver.

3. Line up the motor drive shaft with the camera's 8-frame shaft. If the camera has two shafts, it is the one above and to the rear of the other. Place the spring-loaded motor drive shaft on the camera's shaft.

4. Attach the one or two 3/8" x 3/4" screws through the motor bottom plate up into the camera's one or two tripod threads. (Newer cameras will have two 3/8" tripod threads. Older cameras will have just one rear thread.) Tighten gently with a screwdriver or coin.

5. If you notice a gap between the motor standoff and the winding shaft, first place a #10 x .047" thick plastic washer on the screw threads to prevent pulling the motor out of alignment when it is tightened. Some older cameras have a winding shaft that does not protrude as much as on newer cameras. Gently tighten the winding shaft screw by turning it *counter-clockwise* as it is a left-hand thread.

6. Turn the inching knob on the bottom of the motor slowly until the spring-loaded shaft coupling pops into place on the camera shaft drive pin. After this, turning the knob counter-clockwise will advance the camera

mechanism and the film.

2. Operation

Power is supplied to the camera and crystal drive by the 4-pin XLR connector on the base. 12 volts DC is required. Pin 1 is negative (—) and pin 4 is positive (+). Do not apply reversed DC polarity as this will blow the fuse and could damage the motor. If you are not sure your battery and all cables are correctly wired, do not use them until proper polarity is verified with a voltmeter. Do not apply more than 18 V.

Running speed is selected by the rotary 16-position switch on the rear. The speeds are organized according to the AC power line (mains) frequency powering HMI or fluorescent lights used for filming the scene. The eight speeds on the top are for 60 Hz HMI's and include 6, 12, 15, 20, 24, 30, 40 and 60 FPS (frames per second.) The eight speeds on the bottom are for 50 Hz HMI's and include 5, 10, 12-1/2, 16-2/3, 20, 25, 33-1/3 and 50 FPS. The two lowest 50 Hz speeds (5 and 10) can also be used for filming under 60 Hz HMI's. These two speeds, plus 20 FPS, can be used if you have mixed 50 Hz and 60 Hz power as could conceivably occur in foreign location filming. If you are filming under daylight or high-amperage incandescent light any of the speeds can be used at will. No harm should be done by changing speeds while running; the new speed should lock in almost instantly except between 50, 6 and 12; or 60, 5 and 10 FPS. Remember that a speed change calls for a corresponding lens aperture change.

Running is controlled with the front rocker switch. In case the camera has a film jam, be ready to stop the camera immediately to prevent blowing the fuse or causing camera or motor damage.

A sync alarm light is provided. It will light up whenever the chosen speed (internal or external) is not being maintained. The fuse, a 3 ampere GMA (5 x 20mm) 32 volt type, should never blow in normal operation. It protects all circuits from gross faults that could melt or burn the wiring.

Three threaded holes are provided for mounting on a tripod; two have the heavy camera/ European 3/8"-16 thread and one has the 1/4"-20 U.S./small-camera thread. A 3mm slot is present for anti-turn provision for certain tripod accessories. The three holes are the same distance from the front of the camera as the original three holes in the Bolex flat base.

If you are using a Rex-5, M-5, or SBM with a 400' film magazine, connect the magazine takeup motor to the socket on top of the TXM10-B motor. Note that if using the MM takeup motor, either (a) use a 3" diameter core for takeup (available from film laboratories); or else (b) do not film at 50 FPS until you have already exposed 30 feet, or at 60 FPS until you have already exposed 75 feet, at lower speed. For the MM motor, TCS makes an accessory cable to connect the magazine to the motor. For the WM motor, the motor must be shipped to TCS for attaching the proper plug, or your qualified local technician could do the conversion. (The 7-pin male Tuchel plug is wired so that pin 1 is +12 volts, pin 2 for the MM motor is 18Ω to ground at 24 FPS or less and grounded directly at higher speeds, and pin 7 for the WM motor is always ground.)

Your Bolex is not a self-blimped (quiet) studio camera. For sound filming, you must either use a blimp or barney indoors, or else film outdoors at a distance, or through a closed window.

For double-system sound, you should use a film sound recorder such as a Nagra, or else a stereo cassette recorder that has been modified to record a crystal pilot signal on one track, such as from a TCS model TX-10 or TX-9. (The normal speed in North America is 24 FPS with a 60 Hz pilot; in Europe the standard is 25 FPS with a 50 Hz pilot.) At the beginning of each sound take, you need to use a clapstick that can be seen by the running camera and heard by the running recorder's microphone, as a start mark. The crystal pilot is then used for resolving (transferring in sync) to 16mm perforated magnetic film that has the same number of holes per second as does the picture film. Subsequent editing and mixing steps are beyond the scope of these instructions and we refer you to the books and courses on the subject.

3. Using External Speed Control

The TXM10-B has a 9-pin WPI (formerly Amphenol) "Tiny Tim" connector for external speed control, as used with the Aaton cameras. This permits running at some 55,000 speeds between about 5

and 60 FPS. This will fit the TCS TMC-55Aa Milliframe Controller and most other brands of precision speed controller. The socket provides 12 V as long as the battery cable is connected, giving the required standby power to the controller. The TMC-55Aa draws very little current, and would take a week, 24 hours a day, to discharge the average battery, so to simplify operation no separate standby switch is provided. The socket accepts 100 pulses per frame from the controller, changing over automatically when the signal is received, and outputs 1 pulse per frame (5 V CMOS logic) as required for a redundant footage counter, or for proper operation of some brands of external controller. Note that the 1 pulse per frame signal is electronically generated and does not correspond to any particular shutter position, and so it cannot be used for automatic shutter re-phasing, and strobe sync may not be completely reliable.

External control permits "odd" speeds to be used, such as for filming when a video or computer monitor is in the scene, reducing shutter bar. It also permits the use of unusual HMI speeds, or traditional speeds, that are not provided on the camera's speed dial. In addition, it permits keeping much closer sync when filming, say, a music video with DAT (digital audio tape) or CD playback. This is because the filming rate can be set to equal the Rank or Bosch NTSC video transfer rate of 23.976 or 29.970 FPS and eliminate sync drift on long takes of 20 or more seconds.

NOTE: The TXM10-B's speed switch is still partially active when using external speed control, to enable reaching the externally chosen speed more rapidly. To take advantage of this feature, set the TXM10-B speed switch to approximately the external speed.

The male Tiny Tim connector is susceptible to dirt, bent pins, and short circuits so the furnished dummy plug should be left installed when not using external control.

3A. Special considerations for filming from video or computers

Your eye is not fast enough to see it, but the image on a video monitor or TV is actually composed of a spot of light that scans across the face of the picture tube from left to right, and from top to bottom, to paint the rectangular "raster" area that your eye sees as a picture.

To conserve video bandwidth and increase the number of available TV channels, video employs "interlaced scan" which means that it writes the odd-numbered lines and then goes back and fills in the spaces with all the even-numbered lines. Each set of odd or even lines is known as a "field" of which there are 59.94 per second; a full set of lines is a "frame" and there are half as many, namely 29.97 per second. This works well when viewing the TV at a distance, but close-up your eye can see that the illuminated lines are alternating back and forth and this appears as "line crawl" so it looks like the lines are moving up or down. There are incidentally 525 nominal lines per frame, or 262½ lines per field, 15,734¼ lines per second. (European video in PAL or SECAM has 50 fields, 25 frames, 625 lines per frame.) A regular cine camera has a shutter that is open half of the time or less, 24 times per second, and only part of each video frame is illuminated during that time. So, just pointing an ordinary camera at a TV set will yield alternating light and dark bands in a different place in each film frame, an irritating effect known as "shutter bar."

How Other Cameras Do It

High-end professional cameras are able to include a regular video monitor in the shot by virtue of filming at 29.970 or 14.985 FPS (frames per second) with a 180° shutter opening, giving an exposure time equal to one field or one video frame respectively. The slight remaining shutter bar can be seen in the mirror reflex finder and moved, with the speed controller's "phase" button, to the bottom of the monitor's picture, where it will remain for the duration of the shot. People with unlimited budgets use instead special rented 24 FPS video equipment so they can film from it at 24 FPS.

Kinescope cameras used for video-to-film transfers solve this problem by instead employing a special fast-pulldown movement and about a 288.289° shutter opening, which is also in front of the lens so it is out of focus and is also very smoothly driven, to record 2 fields out of every 2½ without shutter bar, converting 29.97 FPS video to 24 FPS film.

How Your Bolex Can Do It

Your Bolex does not have a 180° shutter opening, so you can not film at 29.970 or 14.985 FPS because the resulting shutter bar will be very wide, though stationary, and you will not be able to see where it is through the viewfinder because the camera does not have a mirror shutter. Also, the Bolex shutter is very close to the film plane which will give greater difficulty with shutter bar owing to the small penumbra of the shutter edge. The shutter is also driven through multiple gear meshes so there may be increased random variation in shutter timing from one frame to the next.

The best you can do is film at an FPS rate, suited to your shutter opening, so that your exposure time is exactly 1/29.97 or 1/59.94 of a second per frame. This will give an optical splice that is in a different place in each frame, but it may not be too visible if conditions are right. You will be using "odd" filming rates so double-system sound filming is probably not feasible.

In the following formula, you can calculate the FPS rate if you know your camera's exact shutter opening, and the video frame rate which is 29.970 in the U.S., 25 in Europe.

$$\text{Filming Rate (FPS)} = \frac{\text{Video Frame Rate} \times \text{Shutter Opening}}{360}$$

Thus, in the U.S., if your shutter is 131° you would film at 10.906 or 21.812 FPS. If your shutter is 143° you would film at 11.905 or 23.810 FPS. If your shutter is 170° you would film at 14.153 or 28.305 FPS. Use the lower speed if the monitor is large in the film frame; you could get away with using the higher speed if the monitor is small in the film frame.

For filming from a computer monitor you would need to find out the frame rate, generally 60 to 75 on non-interlaced monitors and 30 to 37.5 on interlaced ones, to enter into the above formula. You may be able to establish a frame rate by removing the lens and pressure plate, and running the camera without film while looking through the running shutter. Vary the speed to get a stationary shutter bar. This computer frame rate is then entered into the above formula to calculate the filming rate.