

High-Speed Inspection of Magnetic-Striped Release Prints

By BEN KLEINERMAN

A low-frequency (30-cycle) sine wave is recorded along with the audio when making the release print. This signal may then be picked up during high-speed (400 ft/min) examination of other physical defects. Thyatron-actuated relays stop the machine in the event of a dropout, splice or reduction in signal output level indicating an alteration in the soundtrack. The operator may then start up again at 24 frame/sec and listen for any objectionable erasure or re-recording.

WITH THE advent of nontheatrical magnetic-striped release prints, a new inspection problem confronts us. In addition to examination for visible physical defects, we must now also contend with possible damage to the magnetic soundtrack. In optical tracks such defects would be visible; in magnetic recording, however, the faults can be recognized only by ear. Furthermore, the listening speed cannot exceed much over 24 frames/sec. At installations such as film libraries this results in a costly, time consuming operation. A 2000-

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ft reel of 8mm, normally requiring only 5 min (400 ft/min) for physical examination, would take about 2 hr at 18 ft/min for audio examination.

The sound defect may have been created accidentally or maliciously, since most magnetic sound projectors are equipped for erasure and recording. In any case we can well imagine the hazards of distributing a film whose sound may have been altered.

An Approach

In our study of the problem it soon became apparent that the solution would be in the laboratory recording of the release print. A control signal could be laid down along with the program material during release recording. A low frequency was suggested, and Robert B. Johnson of Kodak's Apparatus and

Optical Div. has since made recordings using 30 cps as the control signal.

At 400 ft/min this signal would be reproduced as approximately 660 cps and all other intelligence would be correspondingly increased to over 1800 cps. A sharp-cutting low-pass filter would provide the required attenuation of all but the control signal. Automatic monitoring of the control signal would give the operator an immediate indication of any change in the programmed material since any change which could affect it would also have affected the control track.

The Equipment

Figure 1 is an overall view of the front panel of the inspection machine built to provide these desired results. The film to be examined is loaded on the left spindle and threaded through the various sections in the following order:

- (1) emulsion side cleaning tape,
- (2) base side cleaning tape,
- (3) splice defect detector,
- (4) splice counter,
- (5) control signal transducer,
- (6) enlarged sprocket detector,
- (7) torn sprocket detector,

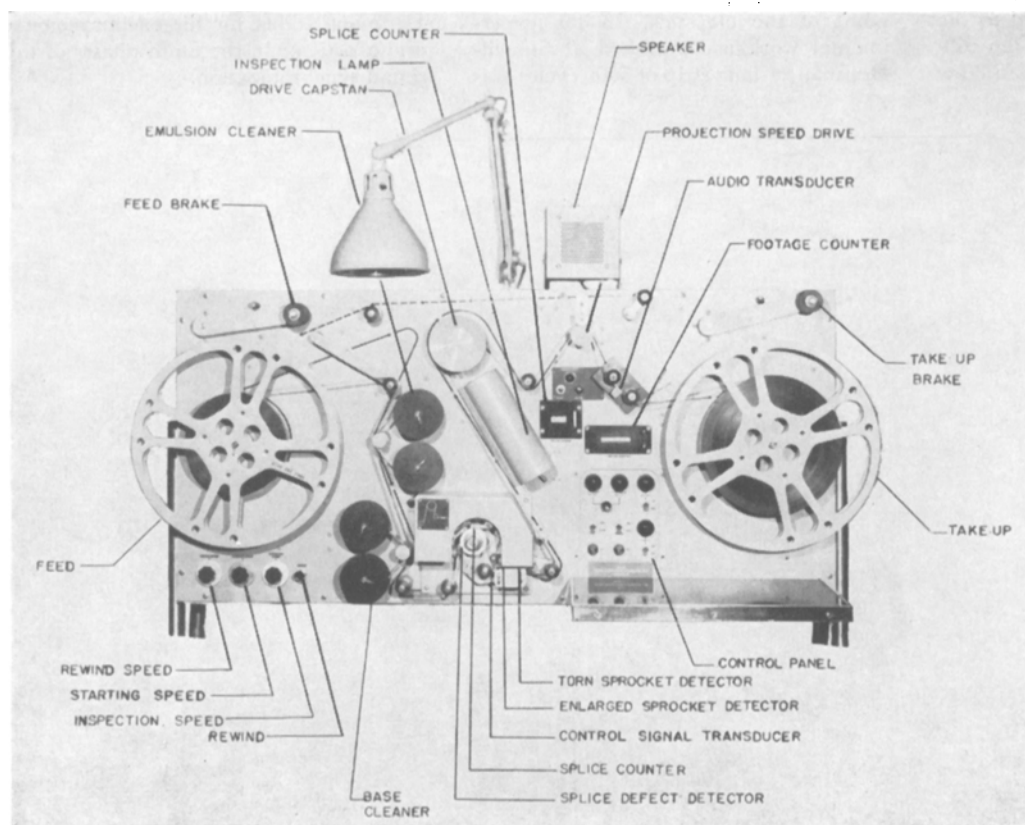


Fig. 1. Front panel of film inspection machine.

- (8) inspection lamp,
- (9) drive capstan,
- (10) footage counter,
- (11) audio transducer, and
- (12) take-up reel.

The machine is put into operation by simply turning on the power switch. This action energizes the brake solenoids for 3 sec. After a brief warm-up period, the sound defect bulb will light up. This is due to the fact that the control signal is absent and the equipment is nonoperative. The machine is started by pressing the reset button and continues to run until a defect occurs.

The footage counter and splice counter continue to operate as long as there is no defect. When a thick or poor splice reaches the thickness detector, the machine will come to a sudden halt. The drive motor and reel brakes are applied so that the defect comes to a rest directly under the inspection lamp. The operator may now examine the condition of this splice and judge whether or not a new splice must be made. In either case, the machine is started again by means of the resetting switch. In the event of a torn, or even enlarged sprocket hole, the machine will again stop; after examination and repair the resetting switch is used and inspection is continued.

Additionally, the detection of any sound defect brings the machine to a sudden stop, but the operator may restart the film travel at 24 frames/sec by pressing the projection speed button. The sprocket, which was used as a footage counter, now becomes the driving sprocket, driven by a separate motor. The defect, having been picked up by the magnetic head in the detector assembly, therefore, now appears under the inspection lamp. The magnetic head used for playback at 24 frames/sec is positioned so that 5 or 6 sec of unaltered track may be heard before the defect comes into playback position. The operator may then decide whether or not the alteration is objectionable. He may also make a record of the footage at which this defect occurred so that if the defect is not objectionable, he may bypass this point in future examinations. During projection speed examination, the other defect detectors are still operative so that if a fault occurs during the audio examination, the machine will stop and the indicators will reflect the damage.

Figure 2 is a rear view of the machine showing the component parts. The extreme left side shows the relay section chassis containing separate relays and thyratrons for each defect detector. The center portion contains the sound chassis. Above the chassis is the projection speed motor. Slightly to the right of center is the main drive motor and directly below is the audio amplifier. The lower motor is the rewind drive.

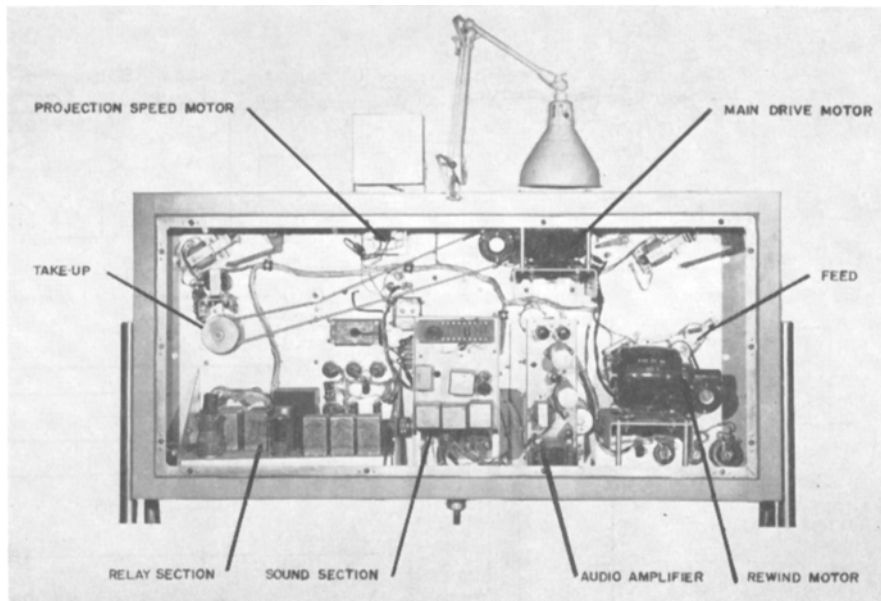


Fig. 2. Film inspection machine, rear view.

Theory and Circuitry

The physical defect detectors are straightforward, microswitch actuated, thyatron controlled relays as shown in Figure 3. The sound defect detector consists of a thyatron which is biased by a negative voltage rectified from the control signal. Figure 4 shows the pickup head which delivers the composite signal to the audio amplifier. The output of the amplifier is filtered and the low-frequency component is rectified to maintain the thyatron in an extinguished state. A reduction in negative voltage at the control grid will cause the tube to fire and energize relay K_1 . The a-c voltage to the drive motor is thereby removed and the motor and reel brakes are applied. The sound defect lamp lights up indicating a fault, and if the operator is present, he may press the projection speed button to hear the defect. Depressing this button energizes

relays K_2 , K_3 and the projection speed motor. The input to the amplifier is switched to the audio transducer; the amplifier output is switched to the speaker automatically and the machine continues to run at 24 frames/sec. At any time while listening the reset button may be pressed to continue high-speed inspection.

Conclusions

A low-frequency control signal, on the order of 30 cps, may be mixed with the regular programmed material without any audible effects when projected by standard means. This signal may be recorded at 15 db below normal recording level without creating noticeable harmonic distortion. A reduction in amplitude of as little as 2% will cause the thyatron to fire, indicating a defect. This system is by no means limited to motion-picture film but is certainly also applicable to magnetic tape.

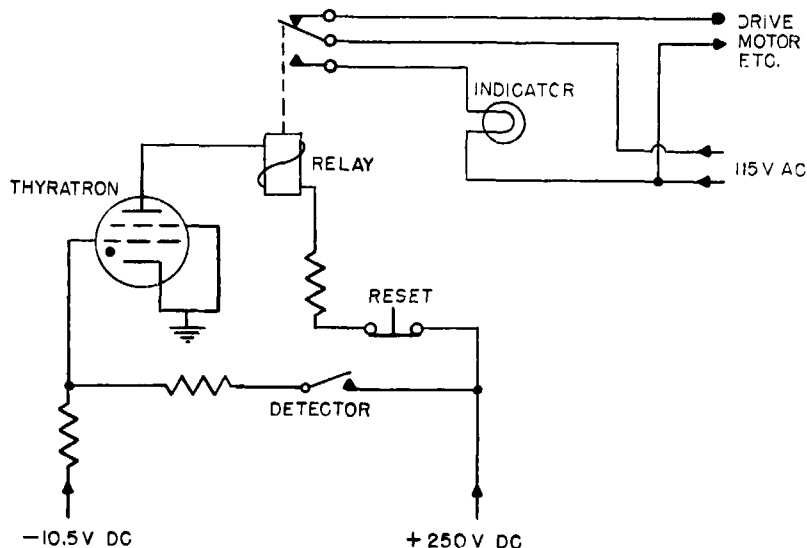


Fig. 3. Typical circuit of physical defect detector.

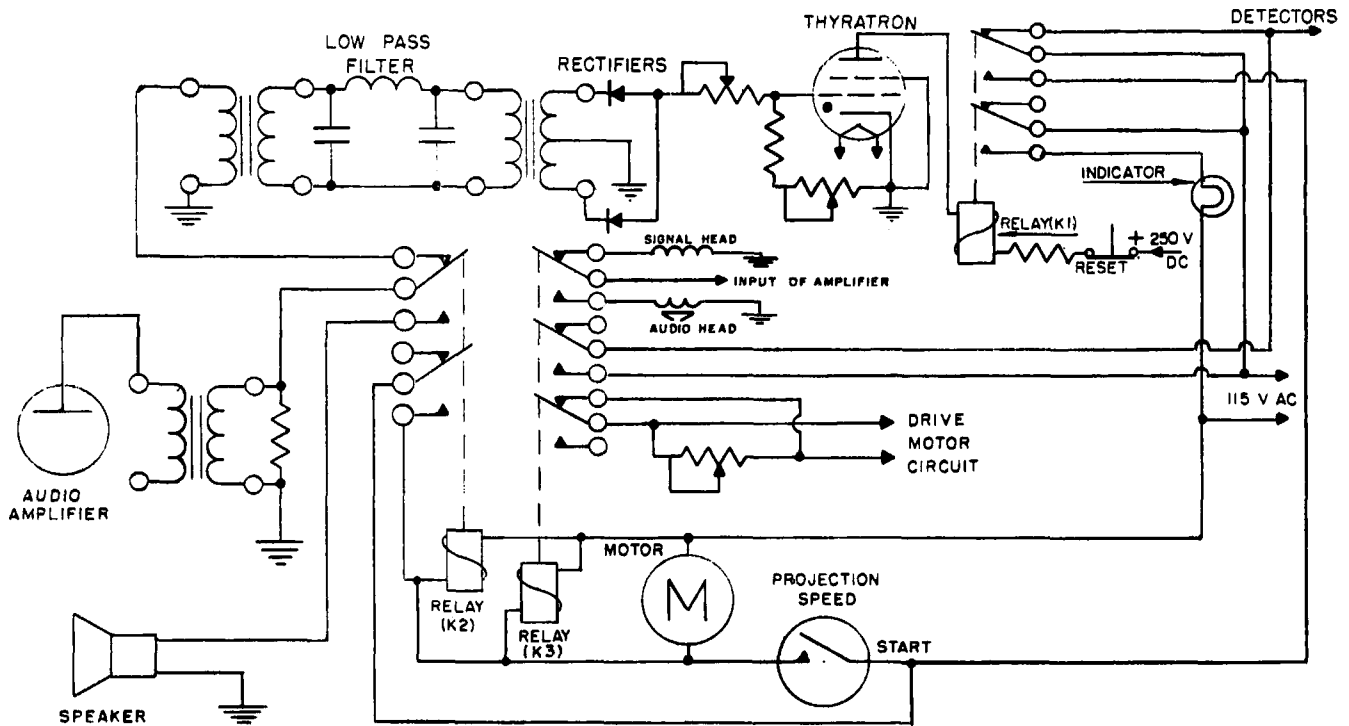


Fig. 4. Sound defect detector.

We would like to thank John Flory, Advisor on Nontheatrical Films, Eastman Kodak Co., and Robert B. Johnson for their encouragement during the preparation of this paper, and for their advice and assistance on many of the technical aspects involved.

Discussion

George Lewin (Army Pictorial Center Long Island City, N.Y.): If there is just a very momentary dropout, will it be detected?

Mr. Kleinerman: If a dropout is on the order of 2% or greater there will be a stoppage of the machine; however, as to a half-cycle, this is one of the drawbacks of the system. In the case of a splice, it is conceivable that the splice could be

made at a difference of 720 frames and would then fall exactly into the same configuration as the original recorded 30 cycles. More work would have to be done to eliminate this.

Mr. Lewin: Then I gather that even if the defect just throws the 30-cycle tone out of phase by a fraction of a cycle this will still operate the mechanism.

Mr. Kleinerman: Yes, this is a fault in this system. Now to eliminate this possibility we would require some sort of phase shift detection, as you have mentioned earlier.

Mr. Lewin: Do you expect to use this on 8mm film as well as 16?

Mr. Kleinerman: Yes, the figures we gave are for 8mm. Actually this was a 16mm machine which was in operation at the time we started on this project and we converted it to detect the magnetic sound defect, but it certainly is applicable to 8mm because the inspection speed would

still be the same. Actually it would be a difference in the 30 cycles. In multiplying it roughly by 22, you get the 660 cycles, whereas in 16mm it would turn out to be closer to 330 cycles; otherwise everything else would be the same.

Mr. Lewin: Well it seems to me, from experience I've had with dropouts on not only 16mm but even 35mm film, that the occurrence of dropouts in 8mm might be so frequent that the machine would be stopping entirely more often than it should, in other words it will keep stopping on unimportant defects or defects which can't possibly be avoided in 8mm recordings.

Mr. Kleinerman: Well this is true, and actually this paper is meant to set forth a theory, as one approach. But as you mentioned earlier today we would require something that had a time lag, which could be in the filter section as extra capacity to create a time lag; then instantaneous dropout would not stop the machine.