

ation when tape is exhausted from the reel, or if the tape breaks.

### Operational Requirements

We must provide adequate torque for the fast forward and rewind modes, with the actual torque requirements varying with the tape width. But we must bear in mind that excessive torque might result in our exceeding the elastic limits of the magnetic tape, and result in breaking or deforming the tape.

The tape must be stopped without damage. The elastic limit of the tape again determines our maximum braking force. Since a minimum brake differential must be maintained, this factor also determines our lower braking limit.

We must also have reasonable start and stop times.

Therefore, we must provide optimum torque and braking force, adequate for fast winding and acceptable start and stop times, but which will not exceed the elastic strength of our medium. Typical values for a 1/2-inch tape equipment would be 35-40 ounce-inches of torque, with a maximum braking force of approximately 30 ounces, measured on a 2 1/4-inch radius (N.A.B. reel hub).

**TAPE THREADING** — From the human engineering standpoint, tape threading paths using the wrap-around principle are superior to those utilizing a "drop-through-the-slot" type. The utmost efficiency in threading tape would be provided by a transport that had a simple wrap-around path from supply reel to takeup reel, with no necessity for threading behind idlers, guides, etc. Unfortunately this perfection is impossible of achievement — although it can be approached — because of the necessity for threading the tape between the capstan and the capstan idler. Of course, a transport employing a system of self-

threading, with reels compatible with those now existing, offers a definite improvement. The threading path can then be engineered for optimum performance of the equipment, disregarding the human equation.

**TAPE WRAP** — The amount of wrap-around the heads should be held to a minimum, because the build-up of tape tension will increase with the degree of head wrap. Depending on the flexibility of the tape and the geometry of the head, it is possible that a large tape wrap will result in the tape bowing out at the apex of the head and losing contact at the gap. A wrap of 4 to 6 degrees on each side of the head gap has proved quite satisfactory.

Large tape wraps (in degrees) around small diameters should be avoided. This is not only a case of holding tension build-up to a minimum. While there are no qualitative data available *it has been proved that sharp bends around small diameters result in measurable losses of recorded high frequencies during the first three or four playbacks.*

Tape wrap around the reel idler must be sufficient to ensure a good, solid coupling between the tape and the idler. On AMPEX machines operating at 60 and 120 ips, it has been necessary to groove the tape contacting area of the idler pulley so that the air film is dispelled and good coupling is ensured. The effect of insufficient coupling can be seen in the fast forward or rewind modes of a standard recorder; the air film picked up by the fast moving tape acts as a cushion and the idler barely turns. The air film can be advantageous if we wish to operate in a fast winding mode without mechanically lifting the tape from the heads, but it proves quite troublesome at times (especially when we are trying to get a good pack during a fast winding mode using 1-inch tape).

**DRIVE LAYOUT** — The heads, capstan and capstan idler should be arranged so that the tape from the heads first contacts the capstan not the idler. In those layouts where the tape from the playback head contacts the idler before reaching the capstan, there will be flutter — caused by idler run-out, by variations in the hardness of the rubber around the periphery, and by bumps or voids in the tire.

**NUMBER OF COMPONENTS** — The number of tape contacting components should be held to a minimum, because every additional part means more build-up in tape tension. This build-up is a function of the number of tape contacting components, the degree of tape wrap around each, and their surface roughness. The geometry of the layout must eliminate unnecessary guide posts, idlers, etc. Tension build-up can also be reduced by mounting the necessary components on ball bearings, or on other types of low torque bearings.

### Electronic Circuits

There are three main electronic circuits which usually are provided — a record amplifier, a bias and erase oscillator, and a reproduce preamplifier. These will normally be quite conventional audio



*Magnetic equipment in the recording industry. Ampex Model 300-3 installed at United Recording Studios, Hollywood.*