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COMMLINE

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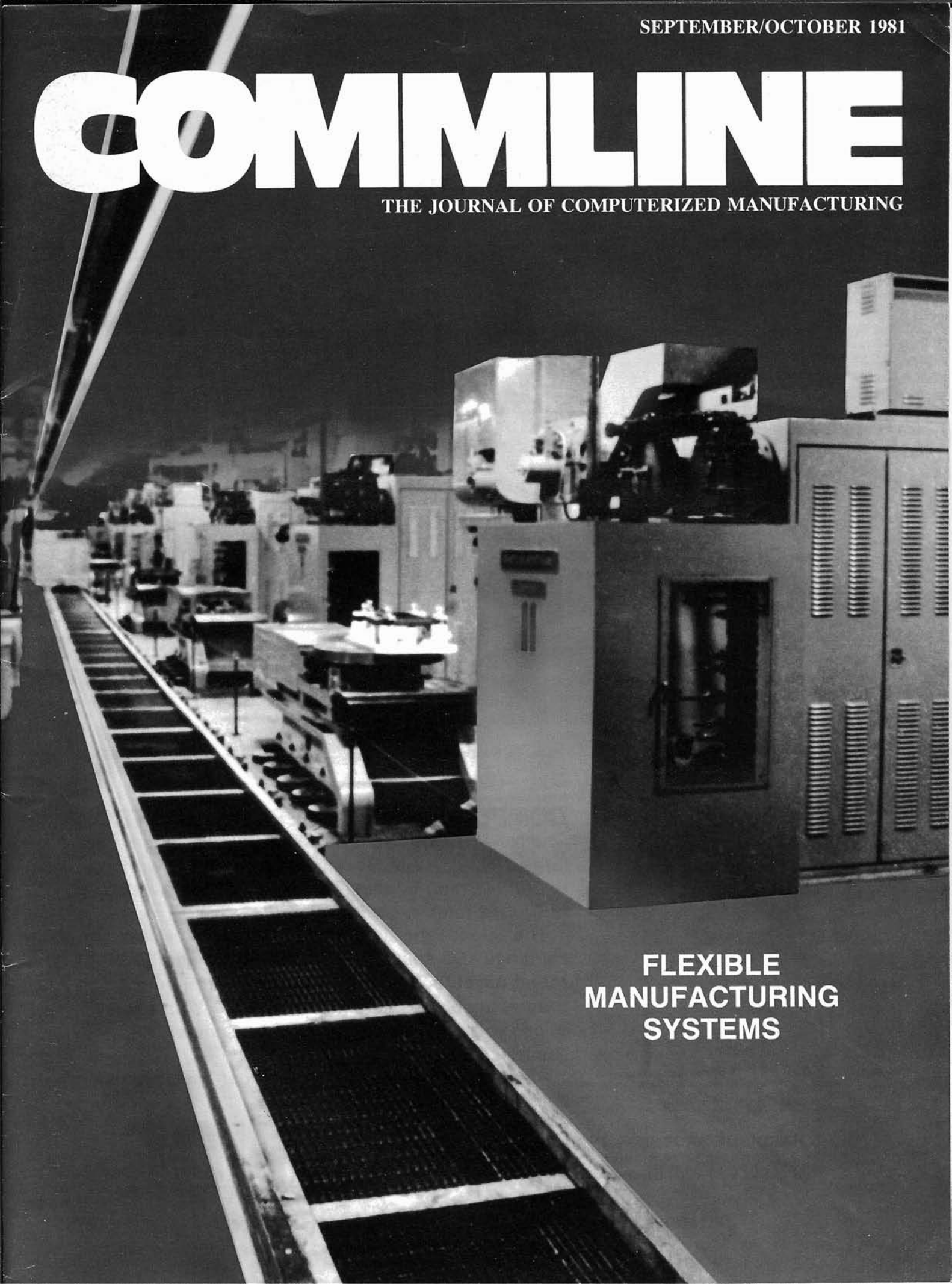

FLEXIBLE MANUFACTURING SYSTEMS

SERVICELINE

BY HOWARD COOPER

Having been an NC Maintenance Engineer for the past seven years, I have run across my share of bothersome maintenance problems which seemed to be unsolvable. I have experienced the frustration and pressure caused from being assigned to repair an NC machine that had untraceable and often intermittent revolving problems. The symptoms seemed to be untraceable and often the type of malfunction kept changing. The solution to many of these problems stems back into the days of vacuum tube technology.

The machine operator or supervisor often refers to this problem as being a "schizophrenic machine tool" or one which has frequent but varied types of memory lapse. Often it is said the machine "develops a mind of its own" because of the erratic nature of the problem.

The solution to such "schizophrenia" often lies in replacing the DC power supply electrolytic capacitors. As Figure 1 shows, when the electrolytic capacitor deteriorates due to the oil filled electrolytic drying up, the capacitor can no longer filter or smooth the bridge rectified pulsating DC. The DC wave then changes from wave form A to wave form B. If the electrolytic capacitor were completely bad or removed from the machine, wave form C would be the DC output. Therefore, as the capacitor gradually looses its electrolytic content, the pulsating ripple on the five volt line increases. These pulses get into all digital circuitry and are interpreted as intelligent pulses. Therefore, the tool unclamp solenoid may operate when not commanded by the tape. Or, any other function on the machine tool may be erroneously operated at any random point in time because of excessive ripple on the five volt DC power bus, which is interpreted as binary information in the digital control electronic circuits.

After running into this situation on numerical control machine tools, I soon realized that it was worth remembering because of the definite aging that exists in electrolytic power supply filter capacitors. These capacitors are an older technology which dates back to the era of vacuum tubes. During the late 50's and early 60's electrolytic capacitor failure caused frequent problems in radio and television repair situations. As the electrolytic would dry in the capacitor and the ripple would begin to appear on the power supply lines, as seen in Figure I, the 60 cycle ripple would impose itself upon the audio output circuits and the radio announcer's voice or singer's voice would become low, gruff, and garbled. This was a common symptom in failing vacuum tube radios. 70 to 80% of electronic failures in those days were due to the vacuum tubes failing. Another common failure was electrolytic capacitor aging failure. With the advent of solid state technology, electronic reliability has increased. Also, the reliability of electrolytic capacitors has improved somewhat, but it is still one of the most frequent failure problems in power supplies.

If the NC machine begins to "develop a mind of its own" or goes schizophrenic, the DC power supply should be checked. It should be checked for proper DC voltage and with an oscilloscope to see if rippling, as shown in Figure I, has started to develop. If rippling is seen, the electrolytic capacitor can immediately be pinpointed as the problem. The only other common cause of erratic machine jumping or malfunction is transients or spikes passing from the main AC power lines into the electronics. If this situation exists, proper suppression techniques will not only eliminate erratic machine disruptions but will increase reliability and prevent destructive effects on electronic circuitry.

In summary, the DC power supplies are often taken for granted because it is assumed that these DC voltages will never vary. However, aging of electrolytic capacitors can cause a gradual increase of AC ripple riding or be imposed upon the DC voltages. This rippling, as it increases, will finally be interpreted by digital electronic circuits as intelligent binary information and will cause random and erratic operation of various machine tool functions. DC power supplies should be checked annually with an oscilloscope for the amount of AC ripple. Usually this should be less than ½ of 1% ripple compared to the DC voltage.

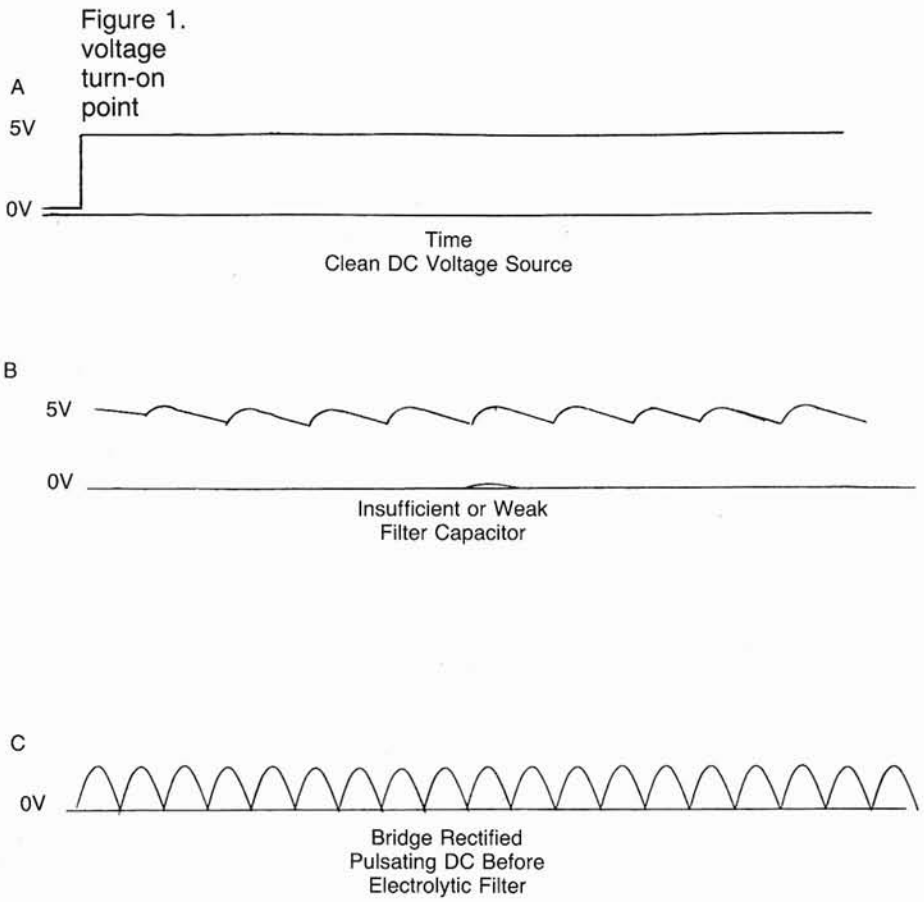

Figure 1. voltage turn-on point