COMPUTER CONTROLLED CATV SYSTEM

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INTRODUCTION

The most crucial parameter of any CATV system is the complete system alignment. Presently each amplifier is aligned by hand using a Field Strength meter or a simultaneous sweep system and, consequently, takes a number of days to complete the entire system alignment. The only problem is that the system alignment does not remain stable over periods of time due to temperature changes, voltage variations, and component degradation.

There are several ways to detect the condition of system alignment, but all require going through the system by hand with a Field Strength meter to make corrections. Usually an alignment problem shows up as a poor picture on a customer's TV set. After a few complaints are made, the system operator determines that it is time to realign the amplifiers. There have been several attempts to curb the variations in system alignment, but none have proven good enough to eliminate periodic system alignments.

One attempt is to place AGC amplifiers every second or third amplifier in the system. The AGC amplifier corrects the gain of the amplifier by sensing the level of a pilot carrier at the output of the amplifier. Theoretically, the AGC function is to change the gain of the amplifier equally at every frequency. However, in practice, there is always some tilt introduced in the AGC circuit. This tilt may or may not be needed to correctly compensate for the given gain change. Another problem of AGC amplifiers is that each amplifier corrects its own gain; and, therefore, works independently of other following amplifiers. Thus, the AGC amplifiers cannot detect overload conditions that occur on down the line. An AGC amplifier might correct its own operating levels but may shift the operating level of following amplifiers out of range of the AGC compensation; or excessive tilt can build up after several AGC amplifiers so that only part of the frequency range is properly adjusted.

Another way to help curb system alignment variation is to use Thermal equalizers. Thermal equalizers compensate for attenuation variations that are introduced in the system by the cable changing temperatures. Thermal equalizers equalize several thousand feet of cable and are usually placed every fourth amplifier. The problem is that the thermal equalizer may be in the sun or the shade, while part of the cable is in the shade and part is in the sun. Therefore, the thermal equalizer cannot properly equalize a length of cable.

Some of the new amplifiers use both automatic gain and automatic tilt circuits. Here the idea is to change both gain and tilt to offset the attenuation variations of the cable. This type of amplifier works best, but even these amplifiers need periodic alignment to keep the system levels optimized.

A system that would automatically align each amplifier in the entire cable system from a central point would eliminate all of the above mentioned problems. Such a system could automatically align a complete cable system in a few hours. The features of such a system will be discussed under the following two topics:

A. Auto alignment.

B. Maintenance and records.

AUTO ALIGNMENT

A proposed method of controlling system alignment is to use a computer at the head end that is capable of determining system levels and can make corrections where necessary. The auto-alignment system requires that the trunk line be a two-way system of some sort. The system must have the capability of sending and receiving information from the amplifiers. A pilot carrier with pulse code modulation can be used to interrogate the amplifiers and change levels. A likewise carrier in the reverse direction would be used to send level information back to the computer. The computer can communicate with each amplifier on an individual basis and align the entire cable system from the first trunk amplifier to the last distribution amplifier. A pulse code modulation system using twelve serial bits is needed to provide 4096 different codes to service up to 1016 amplifiers. Binary codes 0 through 31 are reserved for adjusting gain and tilt of amplifiers. Code 0 represents minimum gain or minimum tilt, while code 31 represents full gain or full tilt. The rest of the 4064 codes are divided between 1016 amplifiers (4 codes per amplifier). Each amplifier has a separate code for each of the following functions:

Code #1 Request output level of high channel.

Code #2 Request output level of low channel.

Code #3 Open memory unit for new gain data.

Code #4 Open memory unit for new tilt data.

The computer will send the first code to the first amplifier via the forward pilot carrier. The first amplifier receives this code and immediately sends a code (0 to 31) back to the computer via the reverse pilot carrier, indicating the output level of the high channel. After receiving and storing this information, the computer sends out the second code to the first amplifier. Again the first amplifier receives the code and sends a code back indicating the output level of the low channel. After receiving the output levels of both the high channel and low channel, the computer calculates corrected gain and tilt values for the first amplifier. Next, the computer adjusts the gain and tilt of the first amplifier by sending out code 3 followed by a correction code. The tilt is adjusted in the same manner except that code 4 is sent followed by a correction code. The codes that are sent between the computer and amplifier that is being adjusted do not affect the gain or tilt of any of the other amplifiers in the system. This is true because of two conditions:

1. Correction codes (0 to 31) are not used for any of the four control codes.
2. The correction codes that are sent to the amplifiers are preceded by a code that opens the memory unit for only one particular amplifier. Thus, the correction code is ignored by all other amplifiers.

The system alignment is adjusted by starting at the front of the cable system and working down each trunk until every amplifier has been adjusted.

MAINTENANCE AND RECORDS

Each time an amplifier requires a correction in gain or tilt, the computer will print the output levels before the correction and after the correction has been applied. This gives the system engineer a complete record of valuable data that will let him analyze each amplifier's performance. Another feature lets the system engineer interrupt the auto-alignment system and request or change output levels at any point in the cable system. If an amplifier requires too many corrections, the system engineer could replace the amplifier before a system fault occurs. If a system fault does occur, the computer will sound a general alarm and print out the improper levels at the point of the fault along with the location or identification of the faulty amplifier. It is even possible to add additional codes so that the computer can switch in a good trunk amplifier where one has failed. This would give the system minimum down time with a high reliability. Reliability of system performance cannot be over emphasized especially when the system is used for commercial purposes.

The system described is not available from any manufacturer, but may be in the near future, especially since other proposed functions of the CATV system will require computers. The system is simple in technology and could be developed to work with any amplifier that can accept auto-gain and auto-tilt modules. The auto-gain and auto-tilt modules would be replaced with other modules containing logic circuits that allow the computer to communicate with the amplifier. The two-way requirement of the system can be either a two-way trunk line or a separate reverse cable going back to the head end. It is estimated that the system would add 50% to the equipment cost. This would be easily offset by a large reduction in maintenance costs.