FUTURE PROMOTION OF THE CABLE TV SYSTEM APPLICATIONS

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SUMMARY

The cable TV is expected to play an important role in the near future as a major medium of live data transmission in the nation-wide or a confined "information society".

In order to meet such tomorrow's demand, the cable TV total system which has four capacity and their applications as follows, was developed.

1) Multi-channel Transmission: Full channel of 4FM, 12TV and etc.
2) Various Purpose Information Service :
   Local origination, Video transmission by light emitting Device, Video Responce System, Electronic newspaper by Facsimile and etc.
3) Wide Aerial Distribution :
   Multi-cascaded trunk line amplifiers by Metropolitan Cable Television standard.
4) Bi-Directional Communication :
   ITV Telephone using lower sub-channel.

INTRODUCTION

In Japan, small community antenna TV systems have been existing from about 10 years ago. NHK started to retransmit TV signals by means of UHF band wireless TV repeating system and VHF band cable TV system for helping poor TV reception in isolated areas.

Now in large cities, they can't receive clear color pictures because of gohst phenomena due to higher buildings increasing rapidly.

At first, Tokyo Cable Vision Foundation built the technical standard of Metropolitan Cable Television (MCT) system and equipments, and then they

are beginning construction in large cities, such as Tokyo and Osaka.

In this process, near future, they are planning of an Information society by making cable TV system to be a transmission media.

This paper discribes the possibility of realizing simultaneously, the following four items with a CATV system :

1) Multi-channel transmission
2) Various purpose information services
3) Wide aerial distribution
4) Bi-directional communication

The system and its comprising equipment are based on the MCT standard and that of NCTA as well.

Various applications, such as optical transmission link using light emitting devices, electronic newspaper transmission by a high speed facsimile and bi-directional communication using ITV telephone, were tried with the system.

CONSTRUCTION OF AN EXPERIMENTAL TOTAL CABLE TV SYSTEM

Fig. 1 shows the experimental system composition where the four transmission services mentioned above are realized. This experiment was carried out at Shibaura area with high field intensity of Tokyo Metropolis. TV and FM signals received through VHF and UHF broad band log-periodic antennas are brought to the receiving terminal equipment, and then they are processed in bandwidth or converted to aother channel so that unoccupied adjacent channels can be used.

Local originating programs, facsimile, data communication, ITV telephone, pilot carrier, etc. are delivered on unoccupied channels or vacant frequency band, mixed with retransmitted TV signals, and then they are sent on to the distribution networks.

Those multiplex signals go through each ten of trunk cables and trunk amplifiers, and then they are dropped into the terminal equipment such as TV receivers, radio receivers along the distribution networks.

Bi-directional communication services take place between the head end and third trunk amplifier, and one channel of color ITV telephone and one pilot signal are transmitted toward reverse direction, using a band for reverse transmission services.

MULTI-CHANNEL TRANSMISSION

First requirement of cable TV subscribers will be "more channels". To satisfy the desire, the head end equipment are built so that each signal can be processed at a time and the total twenty signals are transmitted. The head end equipment are consisting of rack mounted type receivers and modulators, as shown in Photo. 1. The forward direction band (70 – 250 MHz) has eleven channels of color TV (seven of retransmission, one of U-V conversion and three of local origination), one of facsimile, four FM (two of retransmission and two of local origination and two of pilot carrier used for trunk amplifier's ALC and ATC.

The transmission frequency allocation and head end output spectrum are shown in Fig. 2 and Photo. 3.

The reverse direction band (20 – 60 MHz) having one channel of TV and one of phot carrier, is shown in Photo. 5. Thus, number of total transmission signals of both forward and reverse directions comes up to twenty. In order to realize this multi-channel transmission, the unique techniques of RF and IF BPF concept are applied for head end equipments, utilizing, signal processors for retransmission or channel conversion.

As the video signal is interfered with the audio carrier of adjacent down channel, the received signal is separated into video and audio in IF band (19.5 MHz), and the audio level is processed to be about 15 dB down compared with video carrier at RF output. In addition, input and output of the signal processor are connected to each helical resonated type BPF, which further improves the passband characteristics. Consequently, the total spurious level is attenuated to -70 dB or less compared with transmission signals.

In consideration of the reliability, the hybrid iC's developed by OKI are applied actively. In VHF band, MN series tantalum thin-film hybrid IC Amplifiers are used; in UHF band, microwave strip line circuits are applied for the wide band receiving mixer. Head end equipments are standardized for optimum design. An UHF band receiving unit of signal processor is shown in Photo 2.

VARIOUS PURPOSE INFORMATION SERVICES

In the second place, it must be considered about contents of multi-channel transmission. With the image of future cable television system in mind, an experimental transmission system is developed such as light telecommunication, electronic news paper, video response and ITV telephone system.

Symplified optical transmission

In the experiments, imaginating the case where the cables can't be laid between the head end and the studio separated by a river or buildings, a symbplified optical transmission system is applied as an example of wireless link system. As illustrated in Fig. 3, light emitting and photo diodes are used. The video signals are transmitted from the studio to the head end by pulse code-light modulation and lens convergent technique.

Video response and data transmission

In the future, subscriber's TV set will display many kinds of data when home terminals are linked to a computer through a cable TV system.

In this cable TV system experiments, subscriber's CRT displays the results of various questions and calculation from the key board of OKI-SCOPE, which is capable of taking memories out of OKITAC 4300 mini computer.

In addition, simultaneous directives are accomplished by using the data communication equipment.

As the results, it is confirmed that various traffic informations, shopping servies, etc. can be realized.

CATV—Facsimile transmission

Cable TV systems will also help in coping with the increasing labour cost in mail delivery system and also in satisfying the needs for quick delivery of news paper and mail. In this connection, it is considered that home facsimile systems are applied for cable TV distribution network.

In this experiments. 7th channel is used for facsimile transmission. The 7th channel is not available for normal TV transmission in Tokyo area because the 7th and 8th channel are overlapping partly in their channel allocations. Therefore the 7th channel is used for the transmission of high speed facsimile newspaper via Cable TV System. Modulate-Demodulation configuration of facsimile is illustrated in Fig. 5. Output spectrums of head end and that of 190 MHz Modulated signals are shown in Photo 6 & 7. The spectrum which is received after ten cascaded trunk amplifiers are shown in Photo. 8. Fig. 6 is a sample of a facsimile news paper received at home terminal (1/4 of actual size).

WIDE AERIAL DISTRIBUTION

From the stand point of cable TV enterprise, it is natural that they want the system to be extended and number of a subscribers to be increased. The trunk amplifiers is developed, which have functions of bi-directional and multi-channel transmission, based on MCT specifications.

In this experimental system, ten trunk amplifiers and ten drums of cable TC-10C TC-10CAF (Fujikura wire), are used. Coaxial cables are constructed by foamed polyethylen aluminum pipe. Fig. 7 shows the characteristics of distortion (2nd &3rd harmonic level of 90 MHz) after ten cascading amplifiers. Frequency allocation of Japan is different from that of U.S. In Japan the frequency range of higher TV channels twice as high the range of lower TV channels. The sum or differente beats between lower and higher TV channels generated in an amplifier fall in related TV channels. For this reason, the second harmonic distortion characteristics must be particularly improved.

Photo. 9 & 10 show the developed trunk amplifier. The latter is of underground type and techniques of undersea seismograph are applied in it, and so has complete waterproof construction. The system design chart is shown in Fig. 8. The trunk amplifiers have more than several tens of cascadability. Fig. 11 shows inter and cross modulation characteristics of trunk and bridging amplifiers.

Bi-DIRECTIONAL COMMUNICATION

In order to make the cable TV system of today applicable also for the bi-directional communication services of tomorrow, each unit of repeater equipment such as amplifier and filter units are optionized as shown in Photo 9 (b). This concept is based on the system design philosophy that the reverse direction transmission is realizable from the subscriber's terminals as illustrated in Fig. 9. Fig. 10 shows the characteristics of the dividing filter used for bi-directional truank amplifier.

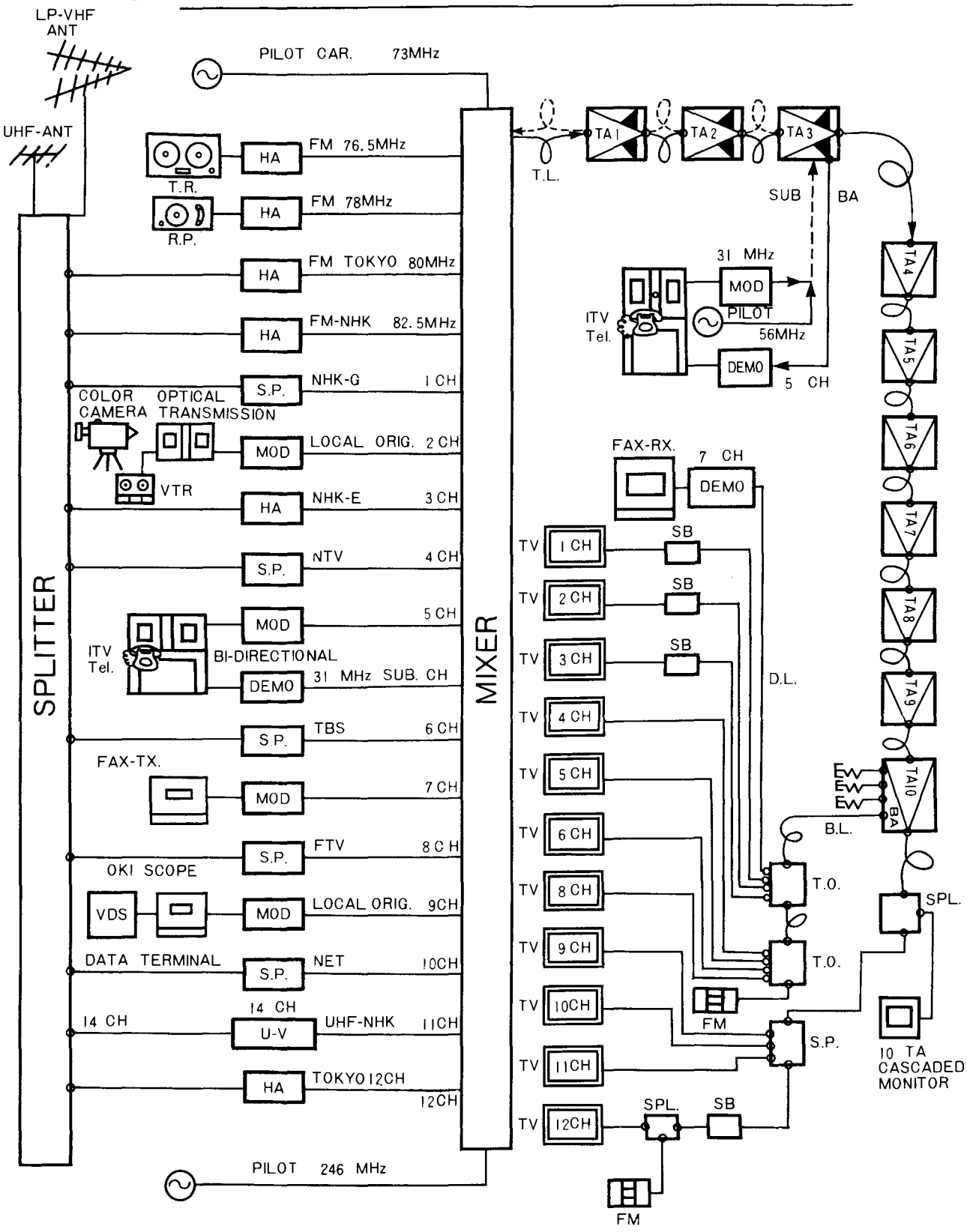
It is required that the envelope delay value be as small as possible (i.e. below 2.5 ns per channel), so that the phenomena of color shift may not occure due to multiple cascade. The echo loss occured in the loop of bi-directional amplifier is higher than 50 dB in passband, and 30 dB in the boundary area of both bands of forward and reverse direction.

In this experimental system, bi-directional services are demonstrated within three repeating section and color TV telephone shown in Photo 12 is used for end equipment. Photo 11 shows the distribution equipment such as tapoff and safety box (Border line of responsibility between CATV system and subscribers).

CONCLUSION

Now in Japan, they consider carefully and earnestly about "How the future CATV should be. They are now in the cradle including VP. Quick development and enlargement of software and video terminals for total picture communication systems are strongly required in accordance with social tends.

Fig. 1 CABLE TV SYSTEM EXPERIMENT (IN TOKYO)



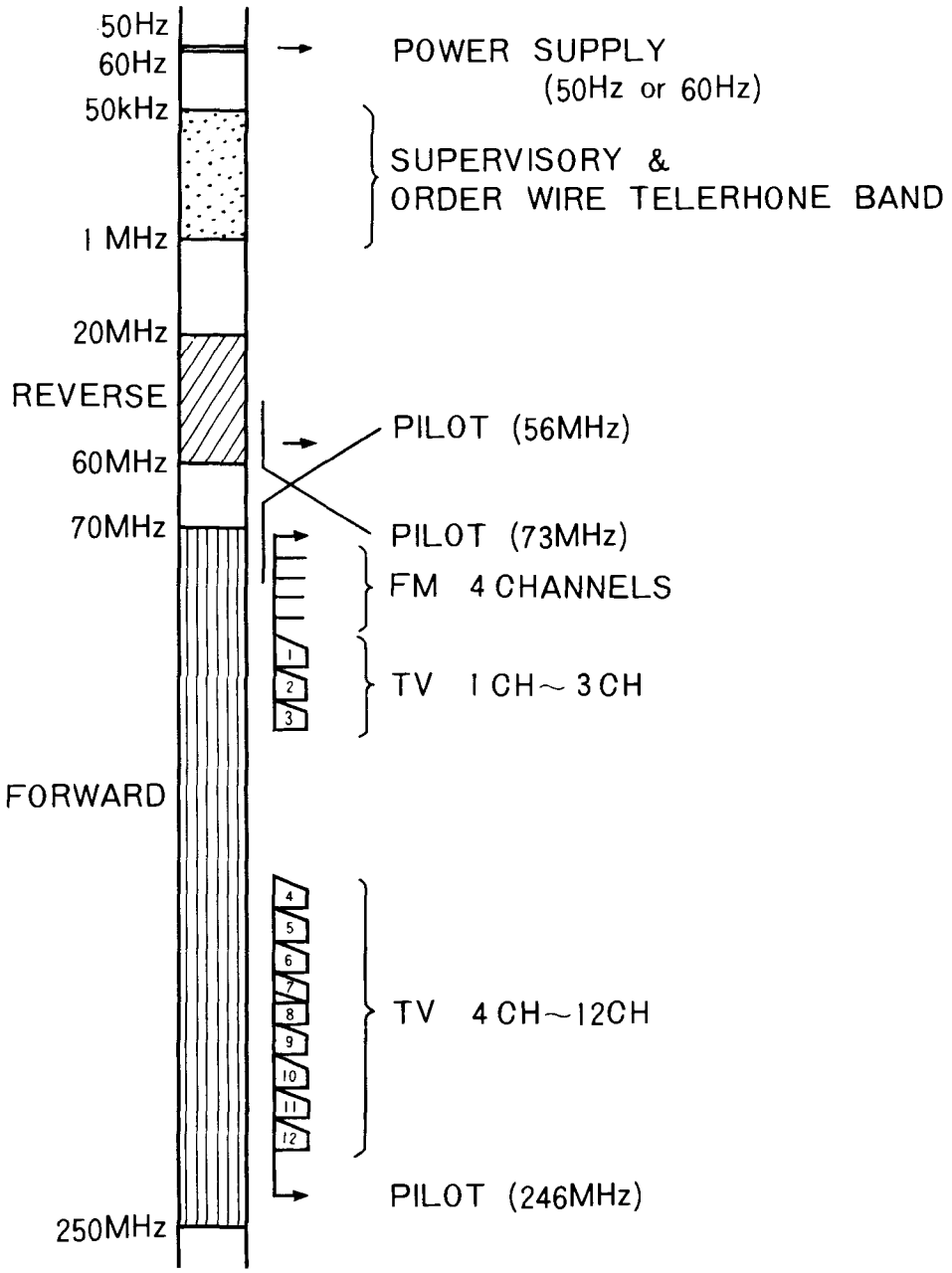


Fig. 2 FREQUENCY ALLOCATIN OF BI-DIRECTIONAL CATV SYSTEM

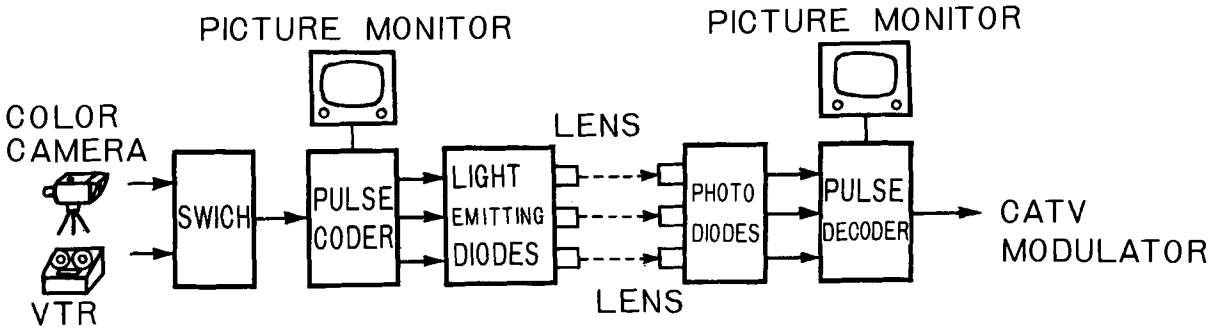


Fig. 3 OPTICAL COMMUNICATION LINK

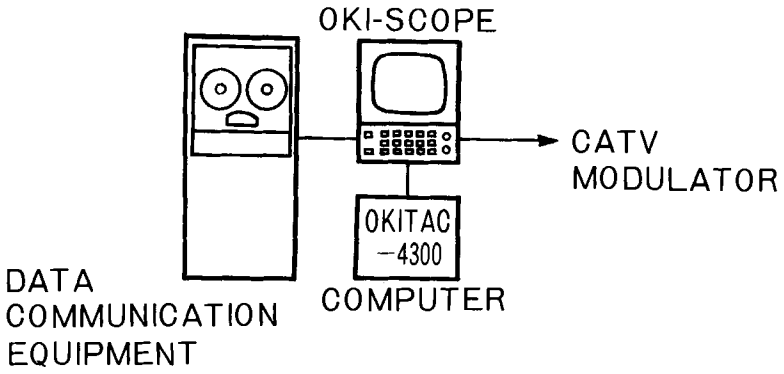


Fig. 4 VIDEO DISPLAY & DATA TERMINAL

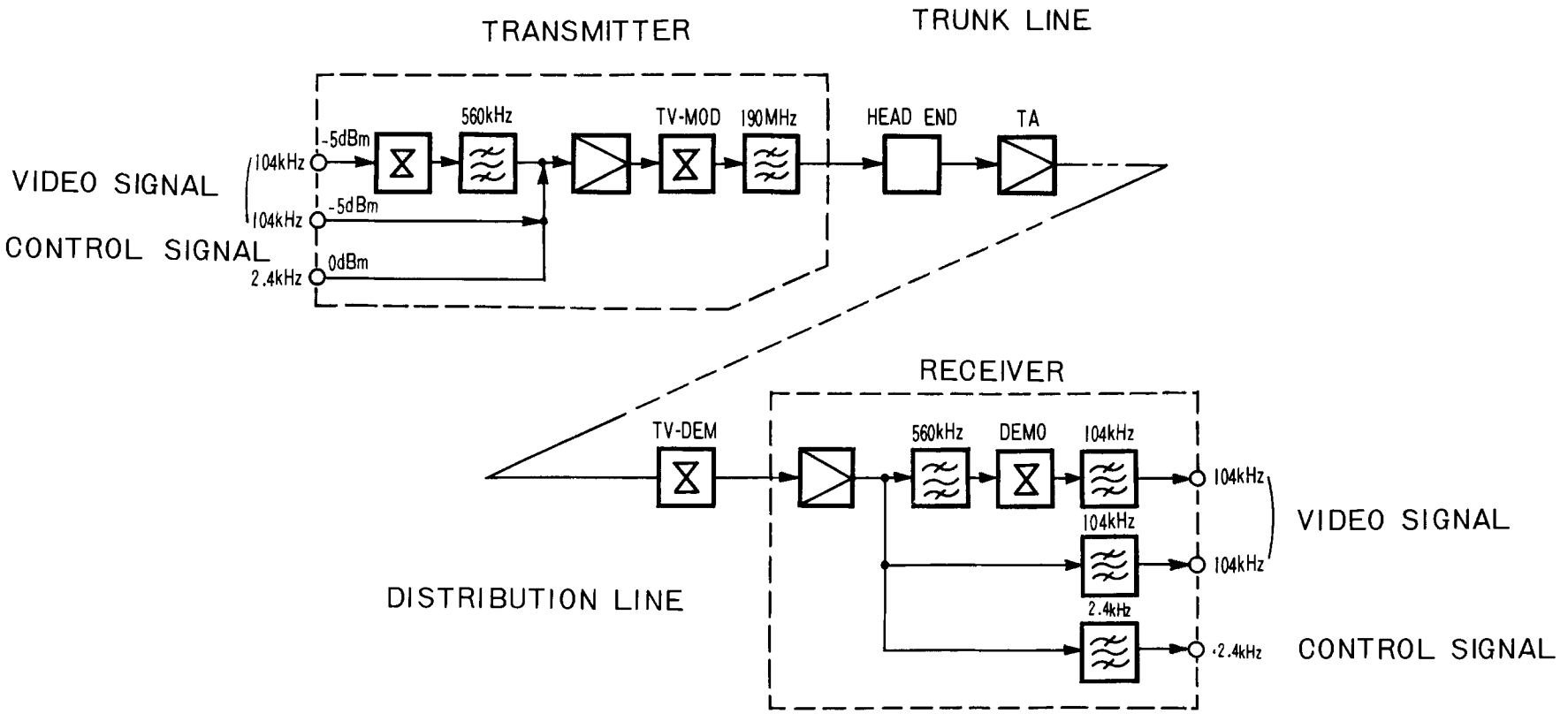


Fig. 5 CATV-FACSIMILE TRANSMISSION SYSTEM CONFIGURATION

Fig. 6 CATV-FACSIMILE RECEIVED PAPER (SIZE 1/4)

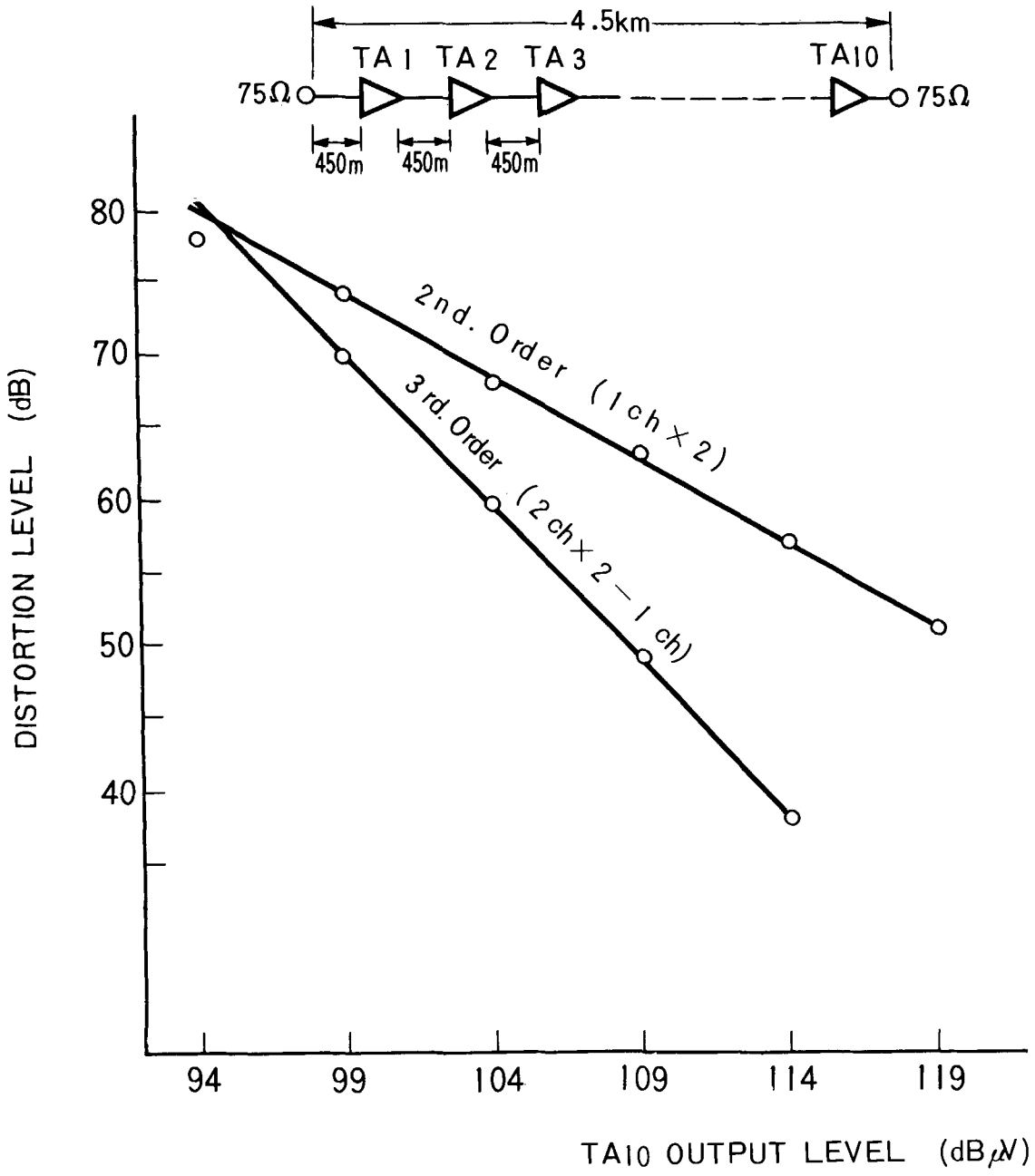


Fig. 7 MEASURED DISTORTION CHARACTERISTICS FOR 10 CASCADED TRUNK AMPLIFIERS.

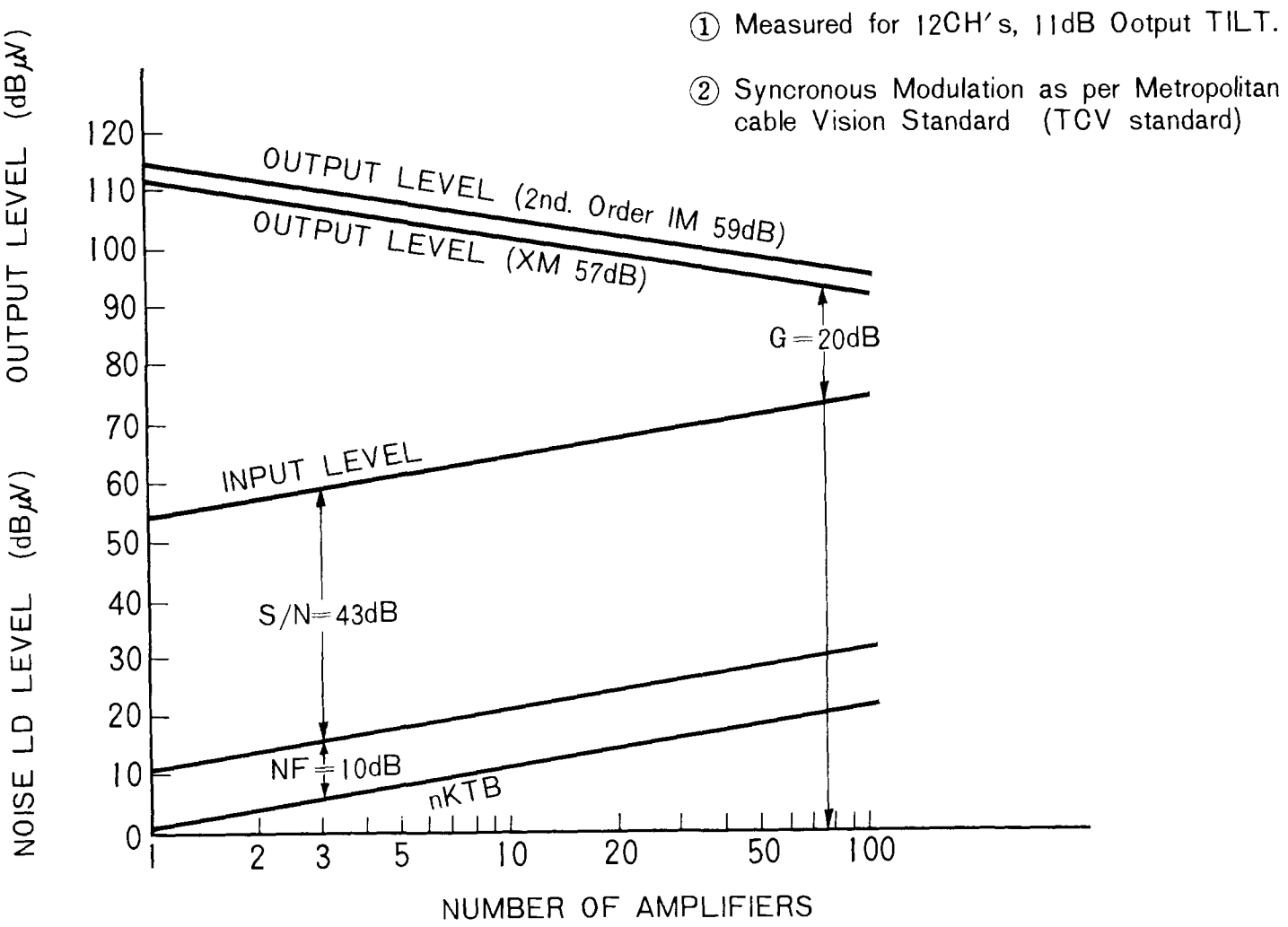


Fig. 8 CASCADABILITY CHART OF SYSTEM

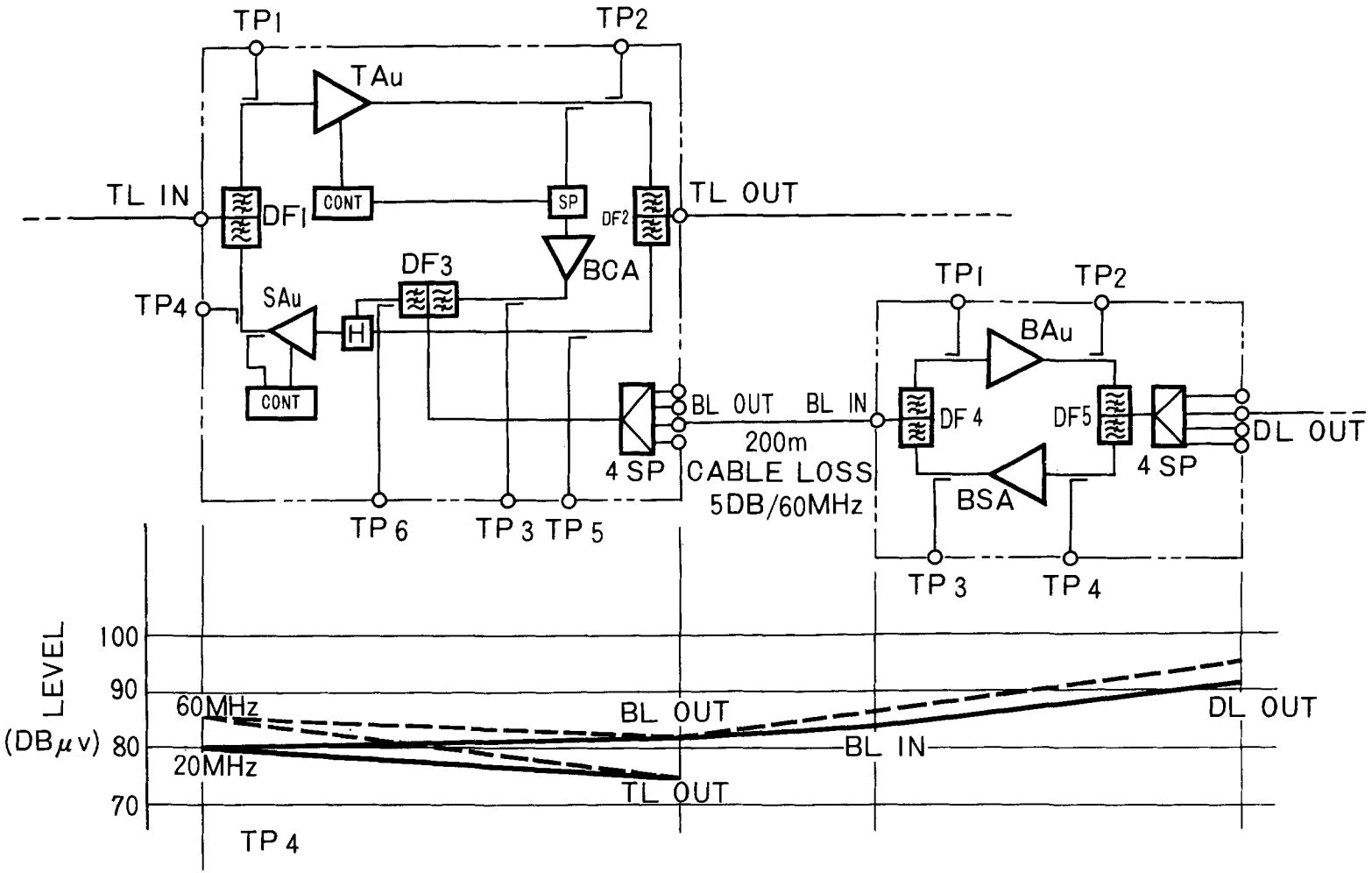
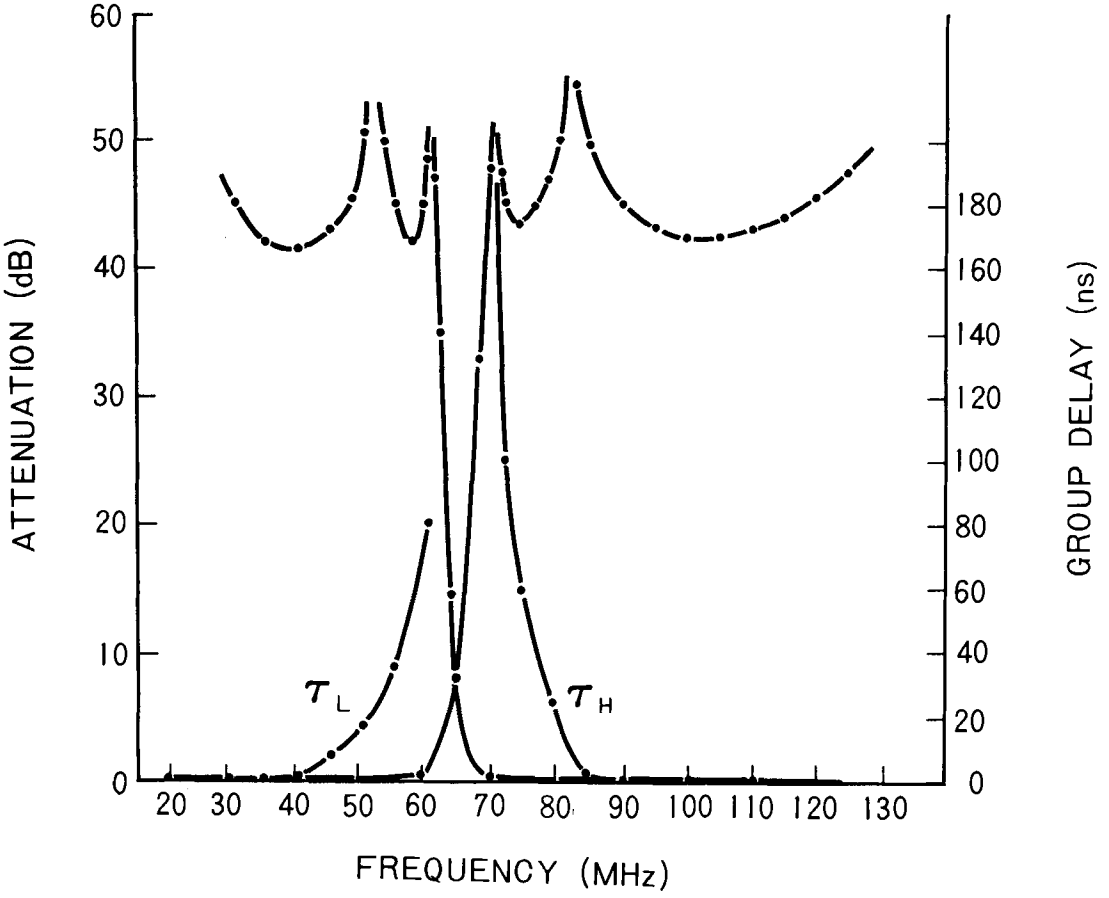


Fig- 9 BLOCK DIAGRAM & LEVEL OF BI-DIRECTIONAL TRUNK & BRIDGING AMPLIFIER

Fig.10 DIVIDING FILTER CHARACTERISTICS



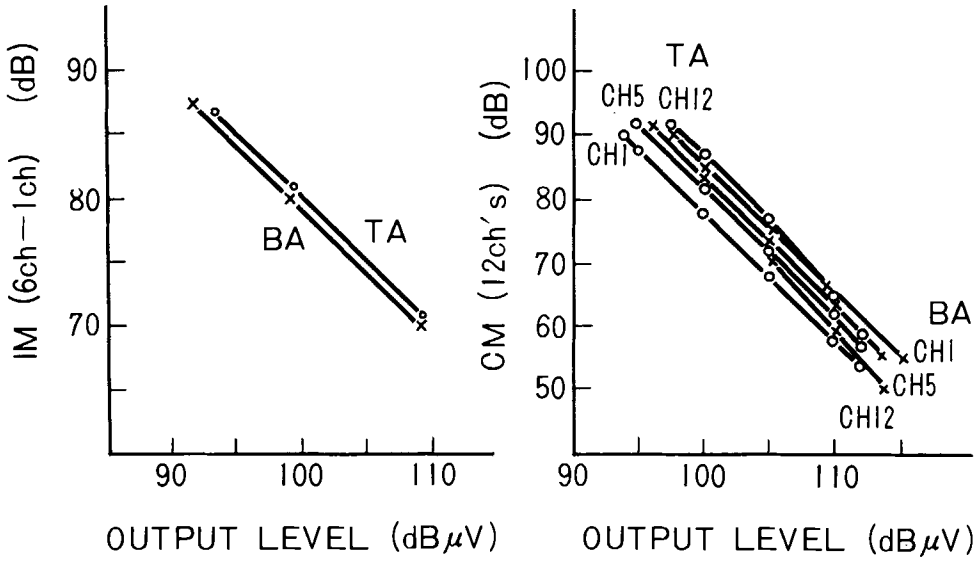


Fig.11 MEASURED INTER & CROSS MODULATION VERSUS OUTPUT LEVELS FOR TRUNK & BRIDGE AMPLIFIER.

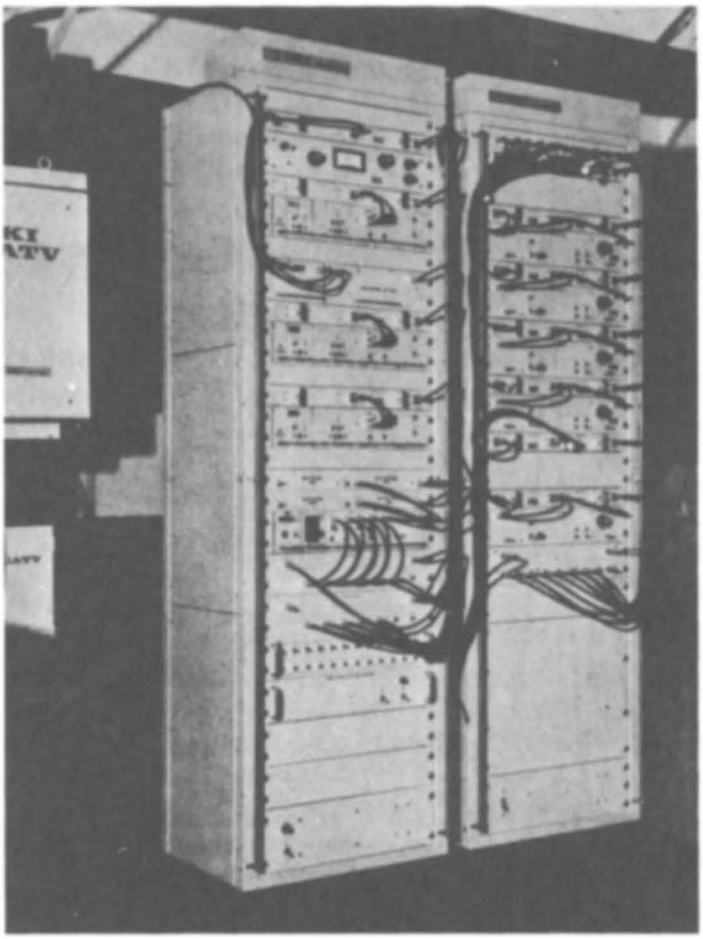


Photo 1

HEAD END EQUIP-
MENTS WITH FULL
CHANNELS

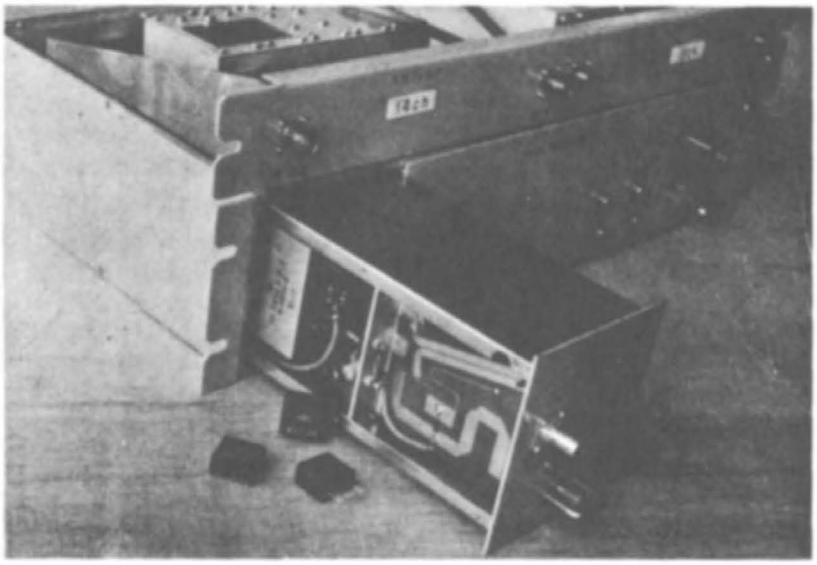


Photo 2 UHF RECEIVING UNIT OF IC DESIGN SIGNAL PROCESSOR,
UHF MIXER USING MICROWAVE-IC & VHF AMPLIFIER
USING TANTALUM THIN-FILM HYBRID- IC

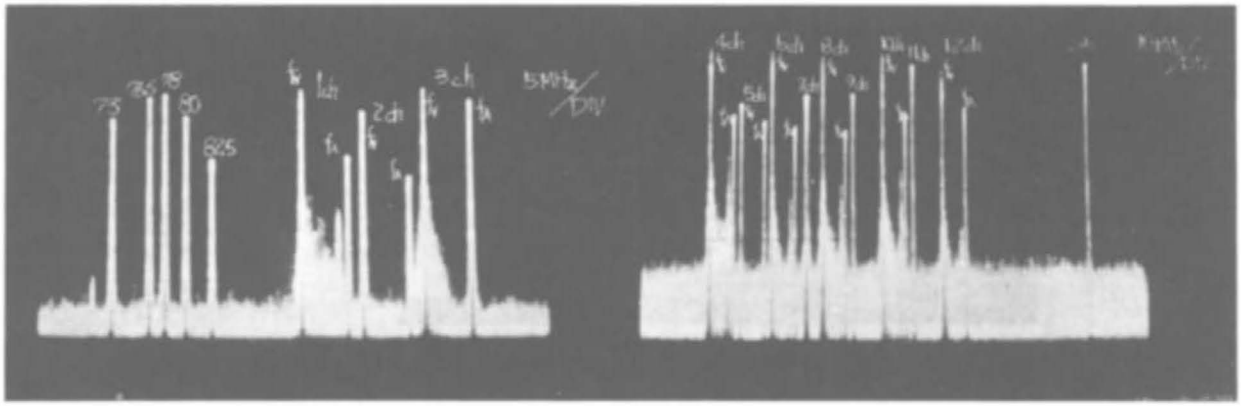


Photo 3 FREQUENCY SPECTRUM OF MULTI-CHANNEL TRANSMISSION AT HEAD END OUTPUT

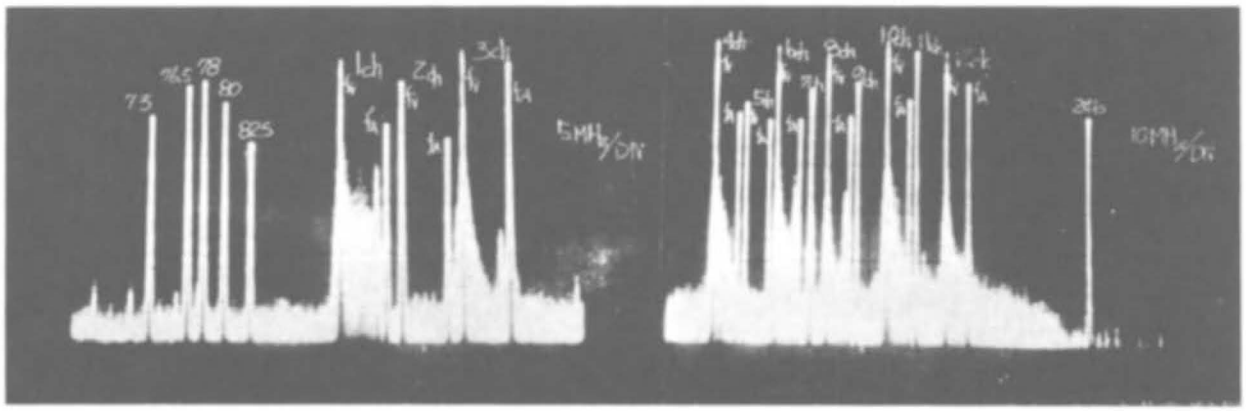


Photo 4 TRANSMISSION FREQUENCY SPECTRUM AT DROP TERMINAL (AFTER 10 CASCADED TRUNK AMPLIFIERS)

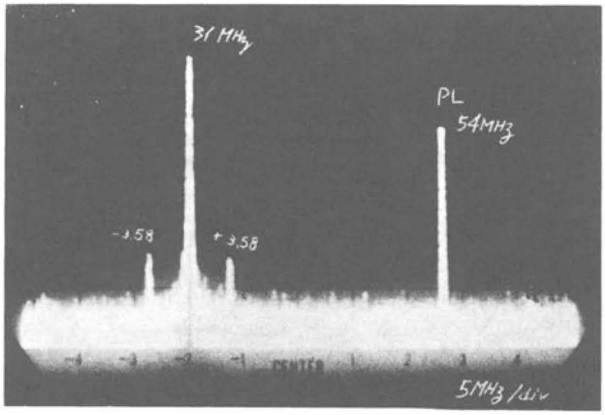
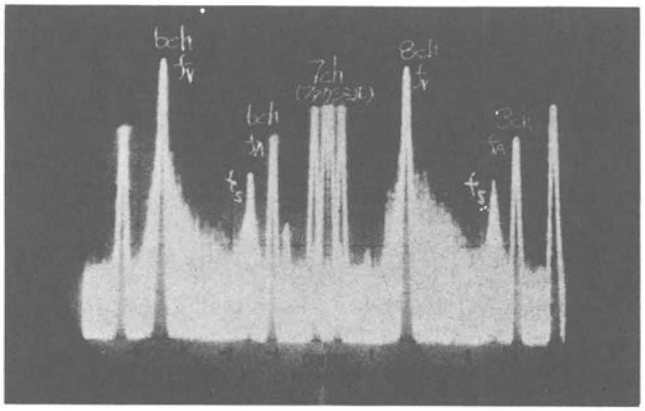


Photo 5 REVERSE BAND FREQUENCY SPECTRUM (31 MHz: Video carrier of color ITV)



V: 10 dB/div.
H: 2 MHz/div.

Photo 6 FREQUENCY SPECTRUM OF HEAD END OUTPUT. Facsimile signal is inserted in empty narrow CH.7 between CH6 and CH8.

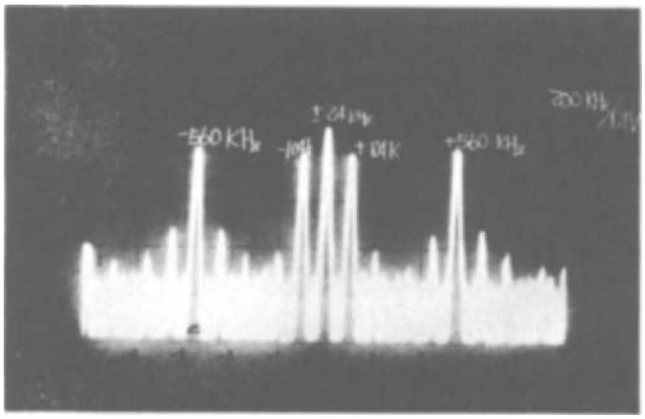


Photo 7 MODULATED FACSIMILE SIGNAL SPECTRUM AT HEAD END OUTPUT

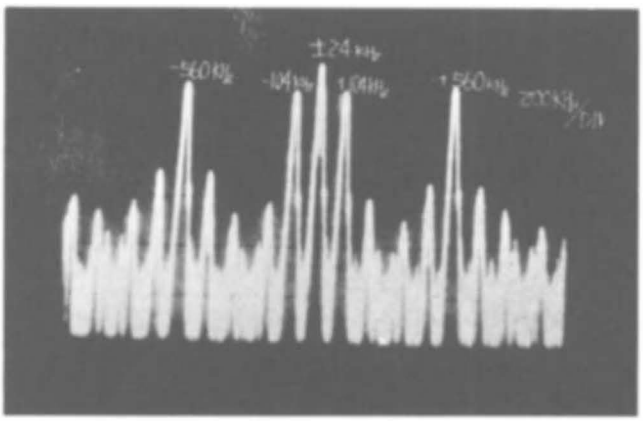
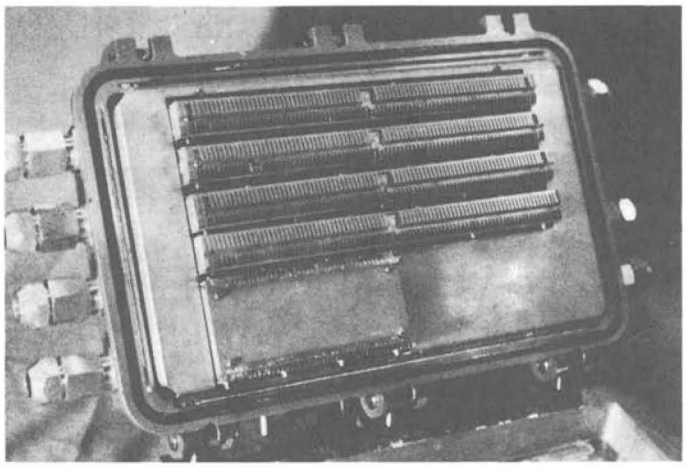


Photo 8 TRANSMISSION SPECTRUM AFTER 10 CASCADED TRUNK AMPLIFIERS

(a)



(b)

Photo 9
FEATURE OF BI-DIRECTIONAL TRUNK BRIDGE AMPLIFIER.

Plug-in unit is a signal processing equipment, such as TAU, ALC/ATC, BAU, SAU, & PSU

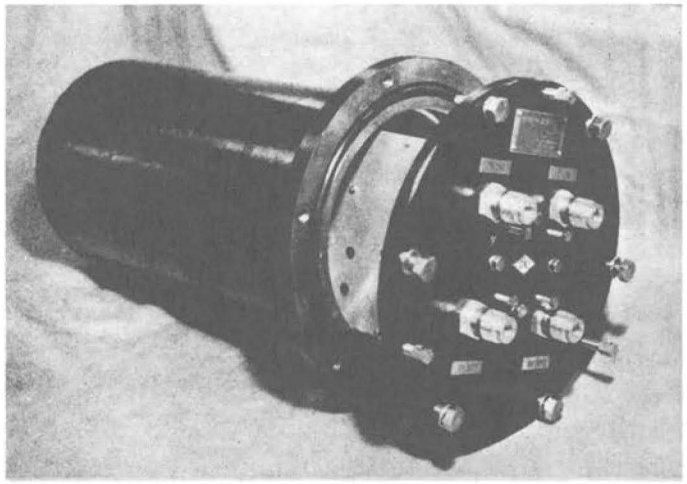


Photo. 10
UNDERGROUNDED TYPE TRUNK BRIDGE AMPLIFIER

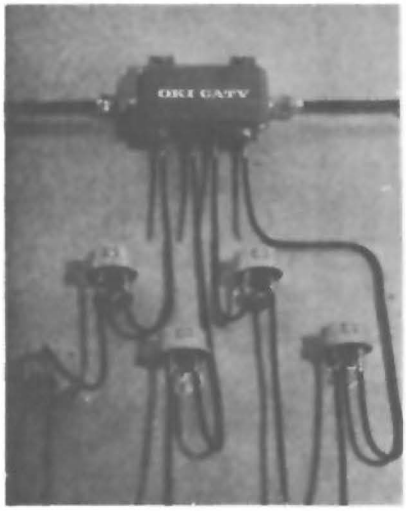


Photo 11

CONFIGURATION OF DISTRIBUTION SYSTEM—TAP OFF & SAFETY BOX

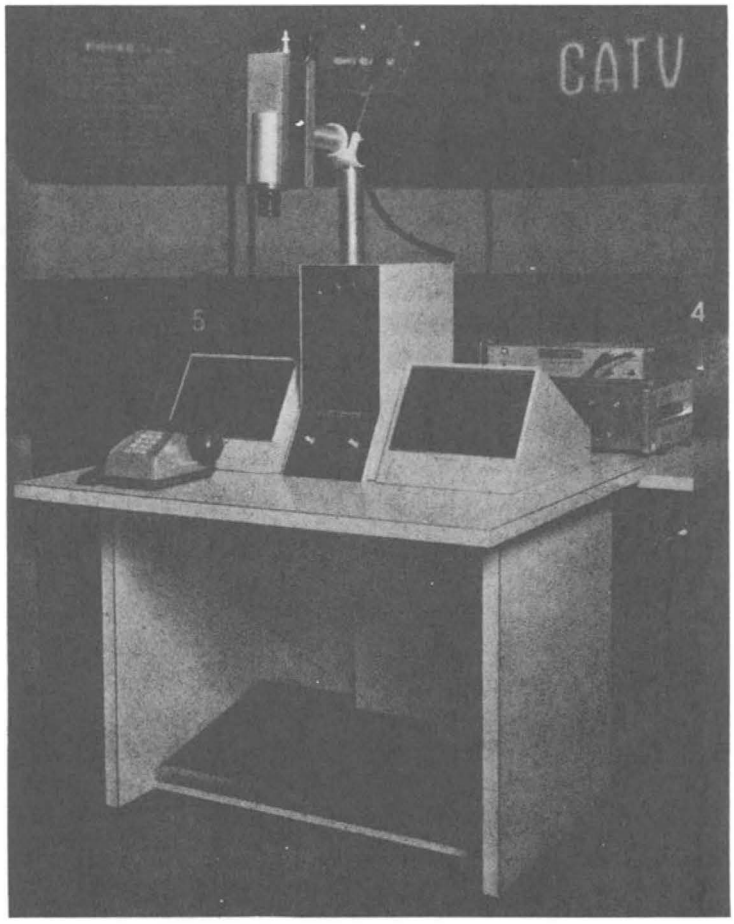


Photo 12

BI- DIRECTIONAL TERMINAL—ITV TELEPHONE EQUIPMENT