

AUSTRALIA
PATENTS ACT 1990

PATENT REQUEST: STANDARD PATENT

I/WE, being the person(s) identified below as the Applicant, request the grant of a patent to the person identified below as the Nominated Person, for an invention described in the accompanying standard complete specification.

Full application details follow:

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[54] Invention Title: "TRANSMISSION SYSTEM COMPRISING A
PLURALITY OF SUBSCRIBER ARRANGEMENTS"

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8024838 08/10/91

Attorney Code PH

BASIC CONVENTION APPLICATION(S) DETAILS

[31] Application No.	[33] Country	Country Code	[32] Date of Applc.
9012416	France	FR	09.10.90

Drawing Number recommended to accompany the Abstract: FIG 1

For and on behalf of
N. V. PHILIPS' GLOEILAMPENFABRIEKEN

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1/10/91
.....
(Date)

AUSTRALIA

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NOTICE OF ENTITLEMENT

(TO BE FILED BEFORE ACCEPTANCE)

WE N. V. PHILIPS' GLOEILAMPENFABRIEKEN

of Groenewoudseweg 1, 5621 BA Eindhoven, The Netherlands

being the applicant in respect of Application No. state

the following:-

1. The person nominated for the grant of the patent has entitlement from the actual inventor by:

virtue of an assignment from T.R.T. Telecommunications Radioelectriques et Telephoniques of 88 rue Brillat Savarin 75640 Paris who in turn are the assignees from the actual inventors.

2. The person nominated for the grant of the patent: has entitlement from the applicant of the basic application listed on the patent request form by: virtue of an assignment.

3. The basic application listed on the request form is the first application made in a Convention country in respect of the invention.

For and on behalf of
N. V. PHILIPS' GLOEILAMPENFABRIEKEN

P. Mackenzie
.....
P.W. Mackenzie (Attorney)

8-10-91
.....
Date



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(19) AUSTRALIAN PATENT OFFICE **(10) Acceptance No. 656**

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TRANSMISSION SYSTEM COMPRISING A PLURALITY OF SUBSCRIBER ARRANGEMENTS
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- (43) Publication Date : **16.04.92**
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- (56) Prior Art Documents
US 5054042
US 5025442
US 4783780
- (57) Claim

1. Transmission system comprising a first transceiver station termed base station and at least two transceiver stations termed mobile stations the transceiver stations exchanging information in a time-division multiplex mode transmitted over a time-division multiplex radio channel in which series of T traffic time intervals occur which are to be allocated to a variable number of C of channels depending on the number and type of subscriber arrangements to be connected, wherein a control time interval (XCCH) is provided situated between these series of time intervals, characterized in that the time interval (XCCH) can be used for communications in the half duplex mode for transmitting information signals from mobile station to mobile station without the intervention of the base station, these communications being synchronised with and under control of the base station in a same time interval (XCCH), the base station in this case managing establishing or terminating the communication and the distribution of the frequencies and time intervals.

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COMPLETE SPECIFICATION
FOR A STANDARD PATENT
ORIGINAL

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Invention Title: "TRANSMISSION SYSTEM COMPRISING A
PLURALITY OF SUBSCRIBER ARRANGEMENTS"

The following statement is a full description of this invention
including the best method of performing it known to us.

FIELD OF THE INVENTION.

The present invention relates to a transmission system comprising a plurality of subscriber arrangements connected to at least two transceiver stations exchanging information in a time-division multiplex mode transmitted over a time-division multiplex radio channel in which series of T traffic time intervals occur which are to be allocated to a variable number C of channels depending on the number and type of subscriber arrangements to be connected.

Such a system finds important applications, more specifically, in the transmission system utilizing radio links.

BACKGROUND OF THE INVENTION.

A prior-art system is described in European Patent Application 0 261 127. Although this system provides advantages with respect to its possibilities to adapt to different speech coders/decoders available on the market by allocating a convenient number of time intervals to each channel, it is estimated, however, that this prior-art system does not properly manage the use of these channels.

Thus, because this system has the structure in which one transceiver station is considered the base station and the other transceiver stations the auxiliary stations usually portable or radio stations on board mobile vehicles, it requires the intervention of the base station for the exchange of traffic information between two of the auxiliary stations. This is considered a disadvantage because the traffic is increased by the information exchanges between auxiliary station/base station and base station/auxiliary station.

This is all the more disadvantageous because these systems are private radio transmission systems (as opposed to public systems) where the radio

resources (reduced bandwidth frequency channels) are sparsely distributed.

SUMMARY OF THE INVENTION.

5 In order to provide a proper management of radio means, the transmission system in accordance with the invention comprises a first transceiver station termed base station and at least two transceiver stations termed mobile stations the transceiver stations exchanging information in a time-division multiplex mode transmitted over a time-division multiplex radio channel in which series of T traffic
10 time intervals occur which are to be allocated to a variable number of C of channels depending on the number and type of subscriber arrangements to be connected, wherein a control time interval (XCCH) is provided situated between these series of time intervals, characterized in that the time interval (XCCH) can be used for communications in the half duplex mode for transmitting information signals from mobile station to mobile station without the intervention of the base station, these communications being synchronised with and under control of the base station in a same time interval (XCCH), the base station in this case managing establishing or terminating the communication and the distribution of the frequencies and time intervals. The invention has the advantage that the time interval XCCH makes
20 communication in the half duplex mode possible without intervention of the base station.

BRIEF DESCRIPTION OF THE DRAWINGS

25 The following description with respect to the annexed drawings all given by way of a non-limiting example, will make it better understood how the invention can be realised, in which:

Fig. 1 shows a transmission system in accordance with the invention;

Fig. 2 shows the diagram of what is commonly referred to as a base
30 station;

Fig. 3 shows the diagram of an auxiliary station;

Fig. 4 shows the spectral position of the frequency channels used by the



system;

Fig. 5 shows the organisation of the multiplex mode;

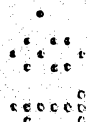
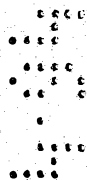
Fig. 6 shows how the control time interval according to the invention is inserted;

5 Fig. 7 shows another way of how the control time interval is inserted according to the invention; and

Fig. 8 shows how a full-duplex or half-duplex link is set up.

10 DESCRIPTION OF (PREFERRED) EMBODIMENTS.

Fig. 1 shows a system according to the invention. This system is formed by a set of transceiver stations STB, STM1 and STM2. Needless to observe that the number of stations may be any number. STB is a base



transceiver station, STM1 and STM2 are auxiliary stations, that is to say, managed by the base station. In practice, the base station is a fixed station, whereas the stations STM1 and STM2 are portable stations or stations on board mobile vehicles. To the mobile station STM1 are connected a plurality of
5 subscriber sets A1, A2, ..., Am and to the mobile station STM2 a plurality of subscriber sets B1, B2, ..., Bn. The stations communicate among each other over radio links which use two frequency channels F_{BM} and F_{MB} .

Generally, the channel F_{BM} is used by communications in the direction from the base station STB to the mobile stations STM1 and STM2 and
10 the channel F_{MB} by the communications from the mobile stations to the base station. The communications established over these frequency channels are organised in a time-division multiplex mode of the TDMA type which provides communication channels further termed time-division channels.

For a proper understanding of the interest of the invention it is
15 useful to explain several notions.

In effect, a distinction is to be made between the mode of communication and type of communication.

The mode of communication is termed duplex when the communication between two subscribers of the stations STM1 and STM2
20 respectively, passes through the base station STB. In that case the two frequency channels are used, the channel F_{MB} also termed upstream channel and the channel F_{BM} also termed downstream channel.

The mode of communication is termed half-duplex when the communication takes place directly between the two mobile stations.

The type of communication is called duplex (or full-duplex) if the
25 subscribers of the mobile stations can transmit or receive (talk or listen) simultaneously, which is realised, for example, within the concept of this invention, by dividing the channel in time (that is to say, one time interval for speaking and another time interval for listening).

The type of communication is called half-duplex if the
30 subscribers of the stations can only transmit or receive in the same time interval.

Because the subscriber sets may have different formats of data to

be received or transmitted, the TDMA frames may allocate time-division channels to more or fewer time intervals in a manner which will be explained hereinafter.

Fig. 2 shows a block diagram of the base station STB.

5 It is formed by a transceiver set 10 controlled by two reference oscillators 13 and 15 oscillating with the frequencies F_{MB} and F_{BM} . This set creates a TDMA frame by means of a frame generator 17. Subscriber sets or other links may be connected to input ports, $I_1, I_2, \dots, I_m$ and output ports $O_1, O_2, \dots, O_n$. A connecting element 20 connecting the outputs O_i to the inputs I_j makes it possible to establish communications between mobile stations which
10 communications pass through the base station (duplex mode). A duplex filter 22 makes it possible to transmit with a frequency F_{MB} and receive with the frequency F_{BM} different from F_{MB} over the same aerial 24. A transmitter amplifier 25 and a receiver amplifier 26 are connected to this coupler 22.

15 The set 10 is formed by a transmitter section 40 cooperating with a filter 41, centred at an intermediate frequency F_I , and a modulator 42. The modulator centres the information signals produced by the section 40 at the carrier frequency fixed by the oscillator 13. The section 40 arranges the information signals to be transmitted in accordance with the commands given by the TDMA frame generator 17, and phase, frequency or amplitude modulates the
20 information signals on an intermediate frequency F_I . This frame generator 17 makes it also possible to recover the different information signals contained in the TDMA frame received by a receiver ensemble 44. The input of this ensemble is connected to the output of a filter, centred at the frequency F_I , connected to the output of a demodulator 48. This demodulator 48 receives the signals from the amplifier 26 and the oscillator 15. The outputs $O_1, \dots, O_n$ are constituted by the outputs of the ensemble 44.
25

The block diagram of one of said mobile stations STM_i is shown in Fig. 3. This station is formed in a similar manner to that of the base station
30 with respect to the elements 74, 75, 76, 50, 80, 81, 82, 84, 86, 88 which are to be compared to the elements 24, 25, 26, 10, 40, 41, 42, 44, 46, 48 of Fig. 2. The differences relate to the aerial coupling, the reference oscillator and the

frame generator:

- The connection to the aerial is realised by means of a switch (diode switch) 92 controlled by the frame generator 95 depending on whether transmission or reception takes place. A switch is used *in lieu* of a duplex filter for reasons of costs of the mobile stations; the duplex communications are realised by means of time-division (a time interval for transmission with F_{MB} and another time interval for reception with F_{BM}). This will be explained in more detail hereinafter with the description of Fig. 8.
- The reference oscillator 97 may generate frequencies equal to F_{MB} for transmission (F_{BM} for reception) in the duplex communication mode and F_{MB} or F_{BM} for transmission (F_{BM} or F_{MB} for reception) in the half-duplex communication mode. The frequency change is made possible by a frequency synthesizer capable of generating frequencies equal to F_{BM} or F_{MB} and constituting the generator 97.
- The TDMA frame generator 95 controls the sections 80 and 84 but also the choice between the frequencies F_{BM} and F_{MB} and the aerial switch 92.

The input ports for the subscriber sets are referenced IM1, IM2, ..., IMp and the output ports OM1, OM2, ..., OMq.

Fig. 4 shows the frequency channels centred around the carrier frequencies F_{MB} and F_{BM} , used to accommodate TDMA frames.

The passband BP around these carrier frequencies is 25 kHz. The carrier frequencies are included in the band ranging from about 400 MHz to 900 MHz.

Fig. 5 shows the organisation of this TDMA multiplex. It is constituted by a multi-frame MTR formed by M frames TR in turn consisting of T time intervals TCH_i ($i = 1, \dots, T$) and also a time interval XCCH. The time interval XCCH is used for organising the multiplex, whereas the time intervals TCH_i are there for transmitting the useful traffic. Each of these time intervals TCH_1 to TCH_T comprises neb bits.

Within the scope of the described example the multiplex is to be

adapted to different speech coders and decoders connected to the subscribers and to different data transmission sets transmitting at different rates. These coders/decoders operate with rates of 2.4 kbit/s, ..., 13 kbit/s. The multiplex is thus to be capable of presenting C time-division channels $C = 1, \dots, C_{MAX}$, $C_{MAX} =$

5 6, where:

M = 60 frames per multi-frame,
T = 19 time intervals TCH per frame, that is to say, a total
of 20 intervals including the time interval XCCH,

10 neb = 190 bits, 46 of which are used for recovering 144 traffic bits
and for communication management
(synchronization, state of the subscriber, off-hook or
on-hook..).

15 Within the framework of the described example, with 200 useful
traffic time intervals transmitted in one second, the array of traffic channels has a
rate of 28.8 kbit/s.

M is chosen in such a way that it is the lowest common multiple of
the numbers 1 to C_{MAX} .

20 According to the invention, the value T is a prime number for all
the numbers ranging between 1 and C_{MAX} .

Thus, a variation or a channel rotation is obtained around the time
interval XCCH; that is to say, that all the channels are directly to precede (or
directly succeed) the channel XCCH once every C times. This is represented in
Fig. 6 for $C = 2, \dots, 6$.

25 Although in this example the value T is equal to 19, other values
may also be suitable, for example, $T = 7, 11, \dots, 23, \dots$. The value T is finally fixed
by the rate one wishes to give to the control channel XCCH and to the efficiency
of the rate of channel XCCH relative to the overall rate. Preferably, the time
interval XCCH has a number of bits also equal to neb which facilitates the
30 synchronization operations.



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In this Figure the different time intervals IT are denoted by means of
a continuous numeration which disregards the frames. The time



intervals XCCH are represented by a double line.

Fig. 7 shows this variation in a different manner.

Due to this variation each channel is sure to obtain the information signals transmitted by the base station in XCCH (F_{BM}), in this case once every C, and to transmit in the direction of the base station in XCCH (F_{MB}) once every C (Fig. 8).

In effect, the time intervals XCCH being shifted, the mobile station which transmits to the base station in the time interval TCH (F_{MB}), simultaneously with a time interval XCCH (F_{BM}), is unable to receive the information signals coming from this time interval XCCH (F_{BM}). The mobile station, however, may transmit in the next time interval, that is to say, XCCH (F_{MB}).

In the same fashion any mobile station which is to receive in the time interval TCH (F_{BM}), following the time interval XCCH (F_{BM}) of the base station, is unable to transmit over the channel XCCH (F_{MB}). However, it has been able to receive the information signals transmitted by the base station in the time interval XCCH (F_{BM}).

Thus, the variation of the channels relative to the time interval XCCH makes it possible at one instant to receive the information signals transmitted by the base station (XCCH with F_{BM}) and at another instant to transmit the information signals in the direction of the base station (XCCH with F_{MB}).

The time interval XCCH may find important applications.

It makes a communication in the half-duplex mode possible without intervention of the base station. This is made possible if the base station with the downstream frequency F_{BM} leaves 1 or 2 time intervals free, that is to say, that it does not transmit during this time interval and that it reserves one or two time intervals with the upstream frequency F_{MB} . This being observed, the mobile stations are to remain synchronized with the base station in order not to overlap in the adjacent time intervals. This is rendered possible if the base station is sure to transmit in several time intervals, which are the time intervals XCCH (F_{BM}) used both as a resynchronization time interval and a control time interval.

These control time intervals are also used for synchronizing half-duplex communications.

This case is shown in a diagram in Fig. 8 in which the time interval XCCH is represented. In this time interval the station STB may transmit to the mobile stations in the TDMA multiplex mode transmitted with the frequency F_{BM} and it may receive information signals coming from the TDMA frame transmitted in the multiplex mode with the frequency F_{MB} .

The time intervals TCHi allocated to the mobile stations communicating in half-duplex, make it possible more or less to communicate as a function of their type:

- for the full-duplex mode (Fig. 8a) in a time interval TCHi, the mobile station STM1 transmits with F_{BM} , arrow F1, whereas the mobile station STM2, arrow F2, listens with the same frequency and, reciprocally, in another time interval the mobile station STM2 transmits with F_{MB} , arrow F3, whereas STM1 listens with the same frequency, arrow F4.
- for the half-duplex mode (Fig. 8b) in a time interval TCHi, the mobile station STM1 transmits with F_{BM} , arrow F10, in the direction of STM2, arrow F11, and in another time interval the mobile station STM3 transmits with F_{MB} , arrow F12, in the direction of STM4, arrow F13. In this manner the capacity of the RF channel has been augmented by a factor of 2 on the basis of the same TDMA frame.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Transmission system comprising a first transceiver station termed
5 base station and at least two transceiver stations termed mobile stations the
transceiver stations exchanging information in a time-division multiplex mode
transmitted over a time-division multiplex radio channel in which series of T traffic
time intervals occur which are to be allocated to a variable number of C of channels
depending on the number and type of subscriber arrangements to be connected,
10 wherein a control time interval (XCCH) is provided situated between these series of
time intervals, characterized in that the time interval (XCCH) can be used for
communications in the half duplex mode for transmitting information signals from
mobile station to mobile station without the intervention of the base station, these
communications being synchronised with and under control of the base station in a
15 same time interval (XCCH), the base station in this case managing establishing or
terminating the communication and the distribution of the frequencies and time
intervals.

2. Transmission system as claimed in claim 1, comprising a
number of channels smaller than or equal to C_{MAX} , characterized in that T is a prime
20 number for all the numbers $C = 1, \dots, C_{MAX}$.

3. Transmission system as claimed in Claim 1 or 2, characterized
in that the multiplex comprises M traffic time intervals, M being the lowest common
multiple of $1, \dots, C_{MAX}$.

4. Transmission system as claimed in any one of the Claims 1 to 3,
25 characterized in that the information signals are transmitted directly by the mobile
stations in traffic time intervals, whereas the control information signals for setting up
and terminating the communication are transmitted to and from the base station in
control time intervals.



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5. Transmission system substantially as described herein with reference to the accompanying drawings.

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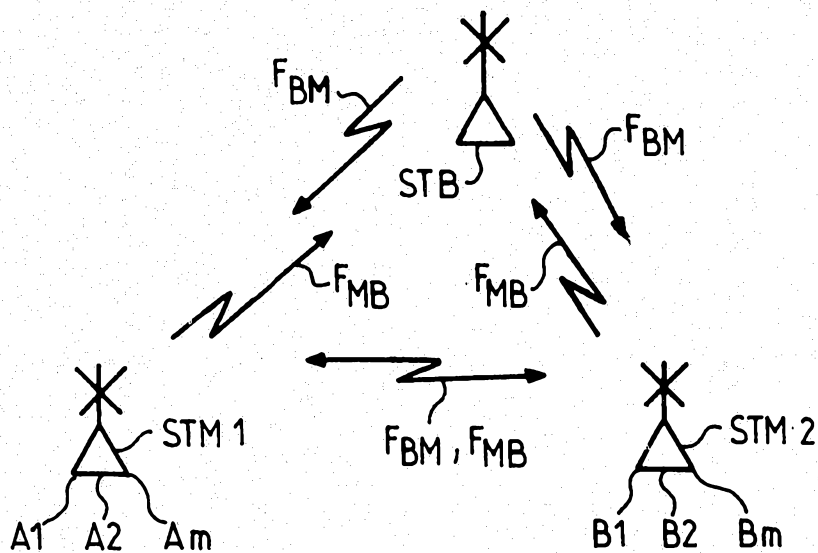


FIG. 1

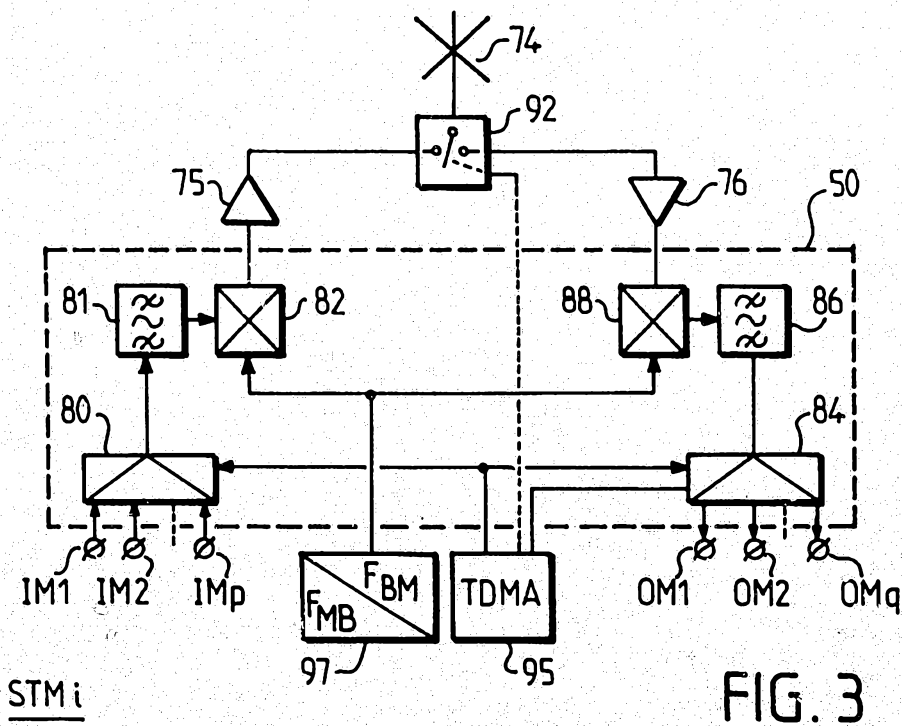
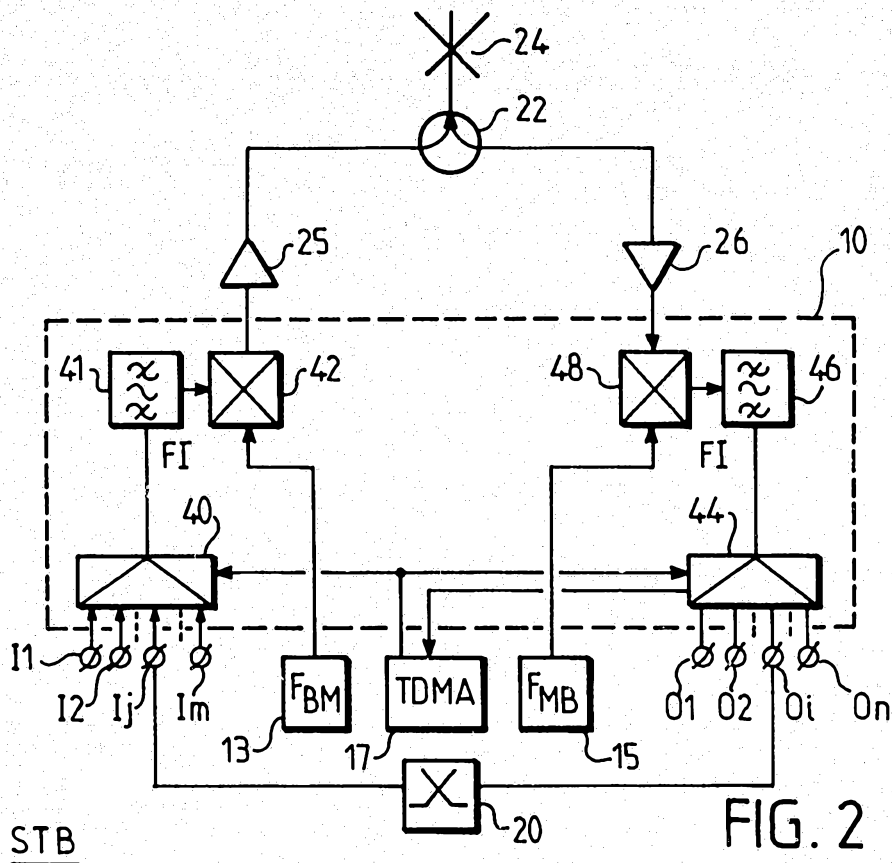


FIG. 3

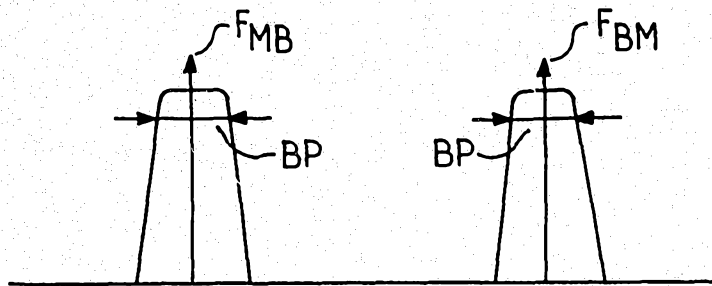


FIG. 4

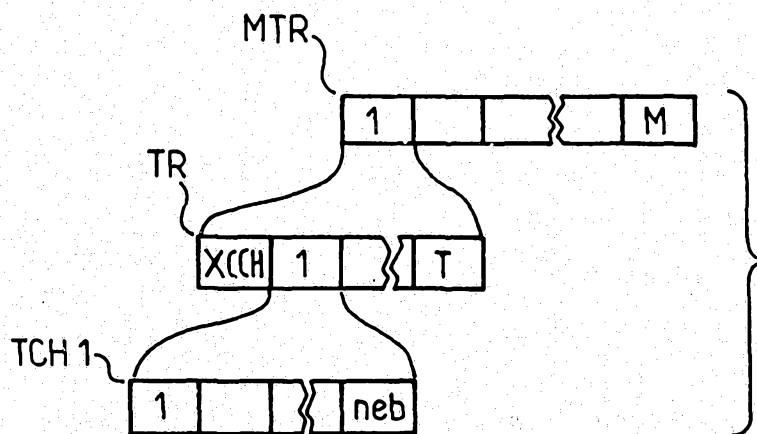


FIG. 5

0001 0000

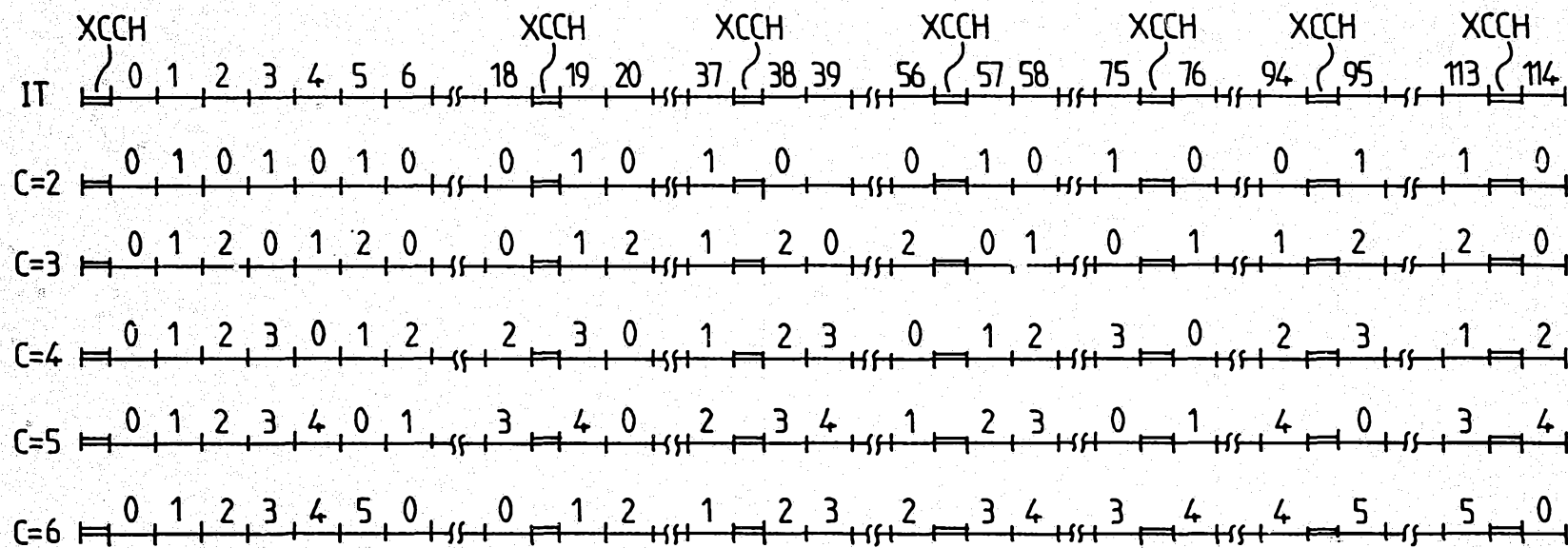


FIG. 6

C=1

XCCH	0	0	0	0													0
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C=2

XCCH	0	1	0	1													0
XCCH	1	0	1														1

C=3

XCCH	0	1	2	0	1	2											0
XCCH	1	2	0	1	2												1
XCCH	2	0	1	2													2

C=4

XCCH	0	1	2														2
XCCH	3	0	1	2													1
XCCH	2	3	0	1	2												0
XCCH	1	2	3	0	1	2											3

C=5

XCCH	0	1															3
XCCH	4	0	1														2
XCCH	3	4	0	1													1
XCCH	2	3	4	0	1												0
XCCH	1	2	3	4	0	1											4

C=6

XCCH	0	1	2	3	4	5											0
XCCH	1	2	3	4	5												1
XCCH	2	3	4	5													2
XCCH	3	4	5														3
XCCH	4	5															4
XCCH	5																5

FIG. 7

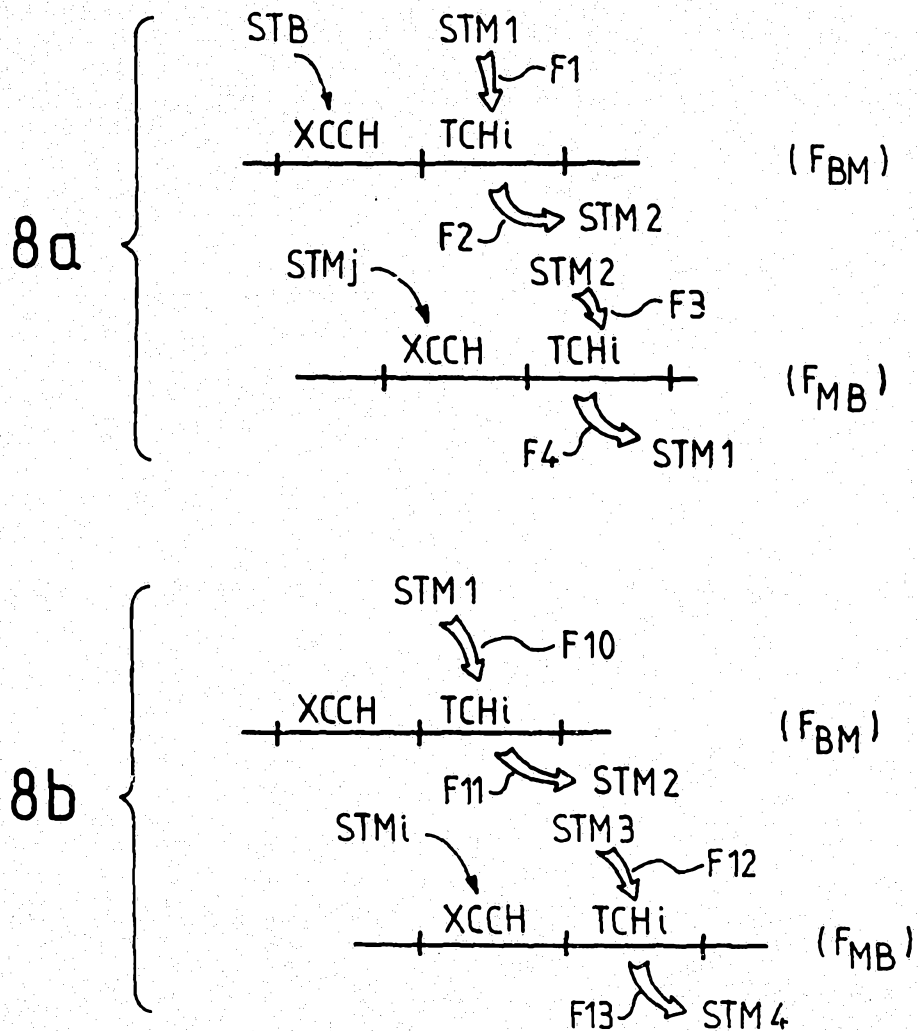


FIG. 8