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PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

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hereby apply for the grant of a standard patent for an invention entitled:

ARRANGEMENT FOR THE VISUALISATION OF THE MOVEMENTS OF MARINE VESSELS BY TELEVISION DISPLAY

which is described in the accompanying complete specification.

Details of basic application(s):

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My/our address for service is care of CLEMENT HACK & CO., Patent Attorneys, 601 St. Kilda Road, Melbourne 3004, Victoria, Australia.

DATED this 06th day of January 1987

SAILVISION AB

CLEMENT HACK & CO.

TO: The Commissioner of Patents.
1. Arrangement for visualisation of the positions and movements of floating units, preferably marine vessels by television display CHARACTERIZED BY the combination of a position determination unit which is arranged to continuously provide position determinations for the floating units, among which the vessels are present, in the form of coordinate values in a certain system of coordinates comprising land-based units, a master transmitter/receiver unit and a slave transmitter/receiver unit between which the distance is known, also on the floating units each having at least one reply transmitter/receiver unit, whereby the transmitter of the master transmitter/receiver unit is arranged to emit a signal of a special character which can be interpreted by the reply transmitter/receiver unit, which are arranged to receive this signal and after a short accurately defined interval of time to emit a coded signal, which differs for the different reply transmitter/receiver unit, the receiver unit of the master transmitter/receiver unit being arranged to receive the said coded signal and to identify the interval of time which has elapsed since the corresponding transmitter signal was transmitted by the master transmitter/receiver unit and up to the receipt of its respective coded reply signals; the slave transmitter/receiver unit is likewise arranged to receive the coded reply signals and, after an accurately defined short time interval, to transmit them further to the master transmitter/receiver unit in such
a way that the time value between the transmission of the corresponding transmitter signal from the master transmitter/receiver unit until the corresponding reply signal arrives at the receiver unit of the master transmitter/receiver unit can be identified as a particular value for each reply transmitter/receiver unit in accordance with their specific code and as a value which is obtained via the slave transmitter/receiver unit, so that for each signal transmitted from the master transmitter/receiver unit its receivers thus receive back two signals for each slave transmitter/receiver unit, i.e. for each floating unit, also a direct coded reply signal and an indirect coded reply signal which are relayed by the slave transmitter/receiver unit, whereby the interval of time between the transmitter signal and the direct reply signal corresponds to the time required by the radio waves to cover the distance from the master transmitter/receiver unit to the slave transmitter/receiver unit and back with a supplement for the time interval which can be required for the slave transmitter/receiver unit to re-transmit the signal after it has received it, whilst the time interval for the reply signals which pass via the slave transmitter/receiver unit corresponds to the time interval required by the transmitter signal to cover the distance to the reply transmitter/receiver unit, from this to the slave transmitter/receiver unit and from the latter and back to the master transmitter/receiver unit, with a supplement for the time interval which can have been required by the reply transmitter/receiver unit and the slave transmitter/receiver unit to transmit the reply signal after the incoming signal has been received; since the distance between the master transmitter/receiver unit and the slave transmitter/receiver unit is known, and hence also the time interval required for the slave transmitter/receiver signal to reach the master transmitter/receiver unit, it is possible by subtraction to also obtain the time interval for the reply transmitter/receiver signal to reach the slave transmitter/receiver unit and from these times, by knowing the speed of propagation of the radio waves, to thus establish the distance between the respective reply transmitter/receiver unit and the master transmitter/receiver unit together with the slave transmitter/receiver unit, a data processing equip-
ment which is arranged to supply the coordinate values with predetermined control signals each in the form of a television control signal arranged to bring about a stylised image on the television screen of the respective floating unit and connected together in such a way with the respective coordinate values that the control signals are arranged to bring about a number of images on a television screen of the floating units in locations which correspond to the mutual location between the floating units in the said coordinate system and in such a manner that these images are moved on the television screen in accordance with the change in the coordinate values which are being continuously output, whereby the data processing equipment is designed to control the direction of rotation of the images in accordance with the direction of movement for the respective coordinate signals which are continuously coming in, so that a bow marked on the image is orientated mainly in the direction of movement of the respective position coordinates and is connected to a number of television cameras, the data processing equipment being arranged to integrate any or more of the incoming camera signals with the said signals arranged to bring about a presentation of the positions of the floating units in the coordinate system, so that superimpositioning of the resultant images is obtained.
The following statement is a full description of this invention including the best method of performing it known to me:
Arrangement for the visualisation of the movements of marine vessels by television display

The present invention relates to an arrangement for visualising the movements of marine vessels by means of television display.

Using normal means it is extremely difficult to get an idea of the movements of marine vessels and their mutual positions. This is because generally it is only possible to observe the vessels from an extremely shallow angle, this applying particularly if they are far from land or if one is located in a boat. Furthermore there are no clear reference points in open waters. A survey from an aircraft can give clear results if the area is not too large, but for cost reasons this is feasible only for a few cases. For this reason competitions between sailing boats or other vessels are not very spectacular. Furthermore during sailing the lead position is certainly not the best because subsequently wind and current conditions can favour the one which in a certain location is apparently in an unfavourable position; this makes it even more difficult to obtain a clear picture.

By means of the present invention means have been provided for visualising the mutual positions and movements of marine vessels in an extremely clear and instructive manner. The aim is to employ the invention for visualisation by means of television display for teaching purposes, for control purposes, e.g. during competitions or to meet the needs of those who are interested in sailing sports.

The appended drawings show an embodiment of the invention. Fig. 1 illustrates a schematic diagram of the arrangement; Fig. 2 shows the block structure of a master unit of the arrangement; Fig. 3 shows a coordinate diagram of a position, calculation; Fig. 4 shows the block structure of a television presentation unit; Fig. 5 shows the block structure of a broadcasting unit and Figs. 6, 7 show the configuration of a television picture in two different forms.
The arrangement in accordance with the invention is illustrated in Fig. 1. It consists of the following main components; a position determination unit 1, equipment for the graphical or electronic presentation of measured positions in the following designated the presentation unit 2, equipment for taking one or more camera pictures, in the following designated the camera unit 3, equipment for making up and transmitting a television signal in the following designated the transmission unit 5, and a number of receiver units 5 for receiving the television signals transmitted from the transmitter equipment.

The position determination unit in the following designated as the positioning system 1 consists of a number of radio transmitters and receivers. This system is according to a preferred embodiment a X-band secondary radarsystem and consists of a master unit, a slave unit and reply units. Some of these are located on a shore area 6 and some on a number of units floating on a water surface 7. A shore line between the water surface and the shore area is denoted by 8. The land-based units includes a master transmitter/receiver unit 9 and a slave transmitter/receiver unit 10. The floating units, which are shown, are two vessels 11 and 12 together with a buoy 13. In the following the vessels are designated as the boats. The slave unit is a unit that just repeat each answer it receives from a reply unit. I.e. it will transmit an answer each time it receives an answer from a reply station.

The master unit 9 consists of the logic blocks indicated in figure 2. It comprises a microcomputer 50, a general type microcomputer for example a Motorola 68008. A serial I/O logic 51 constitutes standard serial I/O links Motorola RS 232 and RS 422. A real-time clock 52 is used to provide the sample time interval, which is 1 second. A console terminal 53 consists of a small dedicated key board 54 and a 40 character 8 lines LCD display 55 with graphic facilities. There are also included a unit 54 provided to work with an interrogation code and a range logic and also a radar transmitter/ receiver unit 55 and a connection line 56 to the presentation unit 2.

On all the floating units 11, 12, 13 there is a reply transmitter/ receiver unit 14, 15 and 16 respectively. The reply unit is a selectable transponder that constitutes the secondary station in the radar system. Each of these units has a unique interrogation code and will only transmit an answer if it receives its interrogation code. The interrogation
code and the answer will be described in the section that describes the master unit.

The distance designated as A between the master transmitter/receiver unit 9 and the slave transmitter/receiver unit 10 is accurately defined, this being achieved appropriately by means of an initial transmitter/receiver value of the same type as is employed for determination of distances, otherwise in accordance with what will be stated in the following. By this means mobile units can be set up without any special measurements, merely by sending/receiving a control value after installation.

The master transmitter/receiver unit 9 is arranged to transmit a signal of a special character which can be comprehended by the reply transmitter/receiver units. The reply transmitter/receiver units 14-16 are arranged to receive this signal and after a short accurately fixed length of time to transmit a code signal which differs for the various reply transmitter/receiver units 14, 15, 16. The receiver unit of the master transmitter/receiver unit 9 is arranged to receive this reply signal and to identify the length of time which has elapsed since the corresponding transmitter signal was emitted by the master transmitter/receiver unit until its respective coded reply signals arrive. The slave transmitter/receiver unit 10 is similarly arranged to receive the coded reply signals and after an accurately defined short space of time to transmit these further to the master transmitter/receiver unit in such a way that the time value from transmission of the corresponding transmitter signal from the master transmitter/receiver unit until the corresponding reply signals arrive at the receiver unit of the master transmitter/receiver unit can be identified as a particular value for each reply transmitter/receiver unit in accordance with its specific code and as a value which is obtained via the slave transmitter/receiver unit.

For each transmitted signal from the master transmitter/receiver unit 10 its receiver thus again receives two signals for each slave transmitter/receiver unit, i.e. for each floating unit, on the one hand a direct coded reply signal and secondly an indirect coded reply signal which is relayed by the slave transmitter/receiver unit. The length of time between the transmitter signal and the direct reply signal corresponds to the time required by the radio waves to cover the distance from the master transmitter/receiver unit to the slave transmitter/receiver unit.
and back plus the period of time which can be required for the slave transmitter/receiver unit after it has received the signal to re-transmit it. The time interval for the reply signal which passes via the slave transmitter/receiver unit corresponds to the time interval required by the transmitter signal to cover the distance to the reply transmitter/receiver unit, from this to the slave transmitter/receiver unit and from the latter and back again to the master transmitter/receiver unit plus the period of time which could have been required on the part of the reply transmitter/receiver unit and the slave transmitter/receiver unit to transmit the reply signal after the incoming signal has been received. Since the distance between the master transmitter/receiver unit and the slave transmitter/receiver unit is known and hence also the period of time required for the slave transmitter/receiver signal to reach the master transmitter/receiver unit, it is possible by subtracting also to get the period of time for the reply transmitter/receiver signal to reach the slave transmitter/receiver unit. From these time values it is possible, knowing the speed of propagation of the radio waves, to this establish the distance between the respective reply transmitter/receiver unit and secondly the master transmitter/receiver unit, also the slave transmitter/receiver unit. Furthermore, as mentioned, the distance between the master transmitter/receiver unit and the slave transmitter/receiver unit is known (as mentioned above this is best determined at the outset using methods similar to those employed for determination of the previously mentioned distance). By this means all three sides of the triangle formed between each reply transmitter/receiver unit and the land-based transmitter/receiver units (see Fig. 1) are known. The various triangles formed are identified, as will be understood, by the said coded signals.

Thus the master transmitter/receiver unit can emit an output signal which indicates the length of the said triangle sides and from these values it is possible to provide the microcomputer 50 to calculate the positions in a system of coordinates of the floating units 11, 12, 13. As the master transmitter/receiver unit is designed to operate continuously, thus a flow of coordinate values is issued which successively indicates the instantaneous locations in the coordinate system of the various floating units. It should be understood here that the boats 11 and 12 move throughout the entire period whilst the buoy 13 remains
anchored. The positions of the master unit 9 \((x_M, y_M)\) and the slave unit 10 \((x_S, y_S)\) and the interrogation code of the reply unit are to be entered to the microcomputer 50 via the built in console terminal 53. In a measurement the master unit transmits the interrogation code of the intended reply unit 14. This code consists of two short (approx. 300 ns) X-band RF pulses with the identification of the reply unit in the distance between the two pulses. Fortyeight different codes are used in practise and the distance varies from 54 microseconds to 219 microseconds. The frequency of the carrier in the pulse is denoted \(f_1\). When the second pulse is transmitted, the master unit starts to record in to a RAM memory the existence of X-band RF-energy at the frequency \(f_2\) in the ether. The frequency \(f_2\) is the answer's frequency. This recording will continue for close to 1 millisecond, which corresponds to a distance greater than 100 km.

The reply unit 14 receives on frequency \(f_1\) and when it recognizes its interrogation code's second pulse it transmits an answer. This answer is an X-band RF pulse approximately 300 ns long with a frequency \(f_2\).

The slave unit 10 receives on the frequency \(f_2\) and when it detects an answer identical with the answer described above.

When 1 millisecond has passed, the recording of the answers has stopped. The microcomputer examines the content of the RAM in the range logic and finds the two answers in the RAM. One answer from the reply unit 14 and one answer from the slave unit 10. The microcomputer calculates the time that has elapsed between the second pulse in the interrogation code and the corresponding answers. In the RAM the corresponding time is calculated as elapsed time = \([(\text{RAM addr. } -1) \times 8 + 7 \text{- bitno}] / f_X\) where \(f_X\) denotes the clock frequency (74,9237 MHz). Denote the time for reply unit \(T_R\) and the time for the slave unit \(T_S\).

In the conversion of the two times to distances assume the following

\[ T_{TM} \quad \text{Master units time between logic transmit and RF energy in the ether at the master unit's antenna.} \]
\[ T_{RM} \] Time between RF energy and the antenna and logic receive.

\[ T_{TS} \] The slave units \( T_{TM} \)

\[ T_{RS} \] The slave units \( T_{RM} \)

\[ T_{TR} \] The reply units \( T_{TM} \)

\[ T_{RR} \] The reply units \( T_{RM} \)

\[ T_{CS} \] The time it takes for the slave unit between logic receive and logic transmit

\[ T_{CR} \] The reply units \( T_{CS} \)

\[ T_{ER} \] The effective part of the time \( T_R \) the RF pulses propagates in the ether

\[ T_{ES} \] The corresponding for \( T_S \)

The \( T_{ER} \) and \( T_{ES} \) will be as follows:

\[ T_{ER} = T_R - T_{TM} - T_{RR} - T_{CR} - T_{TR} - T_{RM} \] ...........................(1)

\[ T_{ES} = T_S - T_{TM} - T_{RR} - T_{CR} - T_{TR} - T_{RS} - T_{CS} - T_{TS} - T_{RM} \] ...........................(2)

If these times are multiplied by the propagation velocity of light in the ether the corresponding total distances the RF pulses have propagated are obtained.

In order to explain how the position is obtained look at figure 2. The distance corresponding to \( T_{ER} \) is \( 2r \) and the distance corresponding to \( T_{ES} \) is \( r + s + a \).
Hence

\[ r = c \cdot \frac{T_{ER}}{2} \]  \hspace{1cm} (3)

\[ s = c \cdot T_{ES} - a - r \]  \hspace{1cm} (4)

where \( c \) is the propagation velocity of the RF pulses in the eter.

The distance \( a \) is obtained as

\[ a = \left[ \left( x_S - x_M \right)^2 + \left( y_S - y_M \right)^2 \right]^{0.5} \]  \hspace{1cm} (5)

With vector notation the position can be calculated by the following formula

\[ \overrightarrow{OR} = \overrightarrow{OM} + \overrightarrow{MP} + \overrightarrow{PR} \]  \hspace{1cm} (6)

The vector \( \overrightarrow{OM} \) is known and are\( \overrightarrow{OM} = (x_M, y_M) \) \hspace{1cm} (7)

The vector \( \overrightarrow{MP} \) is

\[ \overrightarrow{MP} = (x_S - x_M, y_S - y_M) \cdot r \cos \alpha \]  \hspace{1cm} (8)

where

\[ \cos \alpha = \left( a^2 + r^2 - s^2 \right) / (2ar) \]  \hspace{1cm} (9)

The vector \( \overrightarrow{PR} \) is

\[ \overrightarrow{PR} = (y_M - y_S, x_S - x_M) \cdot r \sin \alpha \]  \hspace{1cm} (10)
The direction of the vessel 11 is determined by calculation of the different vector of two consecutive sampled positions. In order to avoid waves and other disturbances to give a wrong direction, the direction is filtered in an averaging filter. Denote the direction vector \( \vec{D} \) and let indicate the sample time the following will define the direction.

Now it will be described how the presentation unit 2 is working. The coordinate values are produced gradually and fed into a computer 17 in the presentation unit 2. The computer 17 is arranged to receive the said coordinate-determining values and to impart to them such a shape that they can be presented as a visual signal on an image screen. This presentation must take place together with further signals for visual presentation of the actual system of coordinates and certain supplementary values, such as units for wind direction, wind strength, time factors and possible other values. Furthermore the computer is designed to give the coordinate values a directional indication for their forward movement in the system of coordinates. As shown in Figs. 6 and 7 the various coordinate values are presented on the TV screen in the form of boat contours in the case where they relate to units capable of movement such as the boats 11 and 12. These boat contours illustrate a bow and a stern and it is obviously essential that the bow be pointed in the direction of the movement. In the case of larger boats this can be achieved by means of two reply units so that the boat contour is made to follow the mutual location of these two units. In general however it is likely to be most practical to give the contour a location which is governed by the direction of movement of the coordinates. Hence the computer is provided by means of a suitable programming to calculate this direction of movement and to provide control values for the alignment of the boat contour. In Fig. 6 a net of each other crossing lines are shown utilizing the determination of the relative position of the vessels and the goal. In Fig. 7 are shown corresponding lines but in the form of circles around the goal.

Further functions can also be appropriately incorporated into the computer by programming the same. Thus it may be desirable to obtain a line which shows the movement path of the individual units during a period of time backwards, also a line astern from the respective boat contours. Furthermore it may be required to manually adjust the scale on the coordinate network and different types of centering.
may also be required, e.g. centering to one of the sailing boats. Units for these functions have been shown by way of example in fig. 1. Thus 18 denotes a unit for feeding in weather data such as wind direction and wind strength. Furthermore the computer must be provided with a time measuring unit and for this purpose an output signal can be present in the form of a time indication or several time indications of different types, e.g. the time which has been taken for different boats. 19 gives an example of a keyboard for feeding in the certain data such as the designations of the individual boats, e.g. a numerical code, which in each case is provided at intervals in clear text in the TV image. 20 indicates a manual control unit where, e.g. by means of a joystick it is possible to center the image and to change the scale as required. 21 indicates that the computer is provided with a memory unit such as a disc memory for basic data fed in e.g. from the keyboard. Naturally there is also a working memory for the working program.

23 gives an example of a further ancillary unit, a recorder by means of which incoming data can be written in. For example a list of the positions may be required for each boat at uniform intervals of time.

Data output from the computer is transmitted to an image memory 22 which ultimately converts the computer output signals to a control signal for production of a television image. This signal is transmitted on the one hand to a TV tape recorder 25 which stores the image signals produced for replay when required, possibly at a different speed.

The television signal is also transmitted to an image screen 26 where the signals which have been processed and then supplemented by the computer are given a visual shape. Thus on the image screen, on the desired scale and with the centering required, it is possible to directly observe the positions of the floating units 11, 12, 13 together with other ancillary data fed in. This picture can be controlled from the keyboard 19 and the control unit 20 as regards presentation of the position and ancillary data.

The camera unit 3 consists of a number of television cameras 27 and 28 which by way of example are shown placed some on one of the floating units, the boat 12, and some on a special camera vessel 29. Via TV links the camera signals are transmitted to a receiver station 30 for re-transmission via a link system or cable to a television station.
31. The camera images from cameras 27 and 28 are fed together with an image corresponding to the image on the image screen 26 as position presentation to a mixer unit 32. In this the various images are mixed so that a camera image can be at the rear of the position presentation. The camera images can be changed and in certain cases the position presentation can also stand on its own against a neutral background, whilst similarly some of the camera images can stand on their own. The image material selected is finally transmitted to a TV network, exemplified by a transmitter 33 for transmission to the receiver units 5. The receiver units can naturally be ordinary receiver, coded receivers for coin in the slot TV, cable receivers or some other conventional type.

Supplementing the image it is also appropriate to transmit a voice commentary. In support of this the transmitted images employed and the commentator should also have access to the unmixed position presentation on the image screen 26. The commentator or an operator in a separate department can then control the position representation with reference to the main presentation and the presentation of ancillary data.

The presentation unit will now be closer described below. The unit comprises a standard video tape recorder 64 for recording of the picture of a display in a TV-monitor 65. It has also a terminal for connection to a videomixer.

Figure 4 is a logic block description of the presentation unit. It consists of two microcomputer parts which are described separately.

The communication computer 17 is based on the processor 68038. It has also a floppy disc interface 68 and serial I/O-logic. The floppy disc drive 67 is a standard 3" disc drive. The serial I/O logic included constitutes a standard serial communication such as RS 422, RS 232 and 20 mA current loop with a keyboard 61, joystick 62, wind data unit 63 and the positioning system 1 described.

A keyboard 61 is used for entering commands to the computer. These commands can also be directed to the graphics computer. Commands to the communication computer are start of the recording of position data, end of recording, start of replay, stop of replay, replay speed, still picture, manual wind data and the real time clock set. There are also commands to handle the floppy disc formatting.
The joystick 62 is only used for commands to the graphics computer and its function will be described there.

The wind data unit 63 is a commercial wind data measurement unit that measures wind force and wind direction and transmits it via a serial link to the computer.

The positioning system supplies the computer with data of the vessels' position and direction. It also supplies the computer with positions of the buoys if they are equipped with a reply a unit of the positioning system. Those data are sent to the graphic computer or eventually recorded on the floppy.

The floppy disc is used as a storage for the race. All positions and wind data during the race can be saved on this media. The race can by entering commands from the keyboard be replayed with an accelerated rate from any point of time during the race. There exists a facility to show a still picture of a situation at a specific time.

The graphic computer receives data and commands from the computer. The data are vessel positions and direction, buoy positions (if a reply unit is present) and wind data. It receives even specific information that is to be displayed. Such information can be of any type in clear text. All these data are used for making an artificial display picture as indicated in figure B2. The graphic computer has internally a model of the race track, that is a coordinate system that covers an area of 65 km x 65 km.

In this coordinate system all objects of interest (vessels, buoys and start/finish lines) are assigned to their positions on the track. The joystick is used to selecting the part of the track to be displayed. The enlargement of a part is entered as a command from the keyboard. In the display are distance circles marked in order to give an idea about the distance between the boats and buoys. Those circles are centered around a boat or a buoy. The center object is selected via the joystick and keyboard. In the bottom of the picture is space for text information entered from the keyboard. At the top of the picture is space for a sponsor's name and time.

The display picture is performed with a graphic video generator. This video generator is based on the circuit NEC 7220. The output from this generator is a standard RGB video signal.
The TV monitor and the video tape recorder can be of standard commercial types.

The broadcasting unit will now be described more in detail with reference made to fig. 5 in which new reference numerals are used. The broadcasting unit consists of standard equipment used for broadcasting. Figure 5 illustrates schematically the equipment in the broadcasting unit. This unit constitutes the mixing of pictures of the natural pictures with boats and the sea with the camera picture of the race that is supplied by the presentation unit.

The camera units 70 are standard TV cameras eventually equipped with equipment for sound recording. These cameras are used for recording of the natural picture and sound. They could be positioned at different places on a boat, on the shore, in a helicopter or in a studio for example. Several camera units can be connected to a camera multiplexor eventually via a TV link equipment.

The camera multiplexor unit 71 is used for selecting which camera picture and which sound are going to be transferred to the video mixer unit.

In the video mixer unit 72 it exists a facility to mix natural pictures and sound with the artificial picture that is a model of the real race with the boats and buoys indicated with correct scale factors. This unit constitutes the possibility to get a good overview of the race via the artificial picture. This overview is very hard to achieve with only natural camera pictures due to the geometrical problem to always have the camera in a good position. This mixed TV picture is then transferred to the broadcasting antenna and received in standard TV-sets all over the world.

The final result is extremely clear as regards to the movement and various positions of the boats at different moments. At the same time, thanks to the camera image, a living picture can be given of conditions at sea. A camera picture on its own gives an extremely poor overview as regards to the actual movements and positions of the boats, whilst position presentation of the type described here gives a very clear picture. First of all the double presentation of positions and of a direct camera image is valuable during competitions, being shown not only with a pure aim of imparting information but also with the aim of entertainment. However, the result achieved by means of the arrange-
ment can be used also under other circumstances, e.g. in conjunction with complicated work at sea or marine operations.

Hence the arrangement is characterised by the fact that it utilizes an arrangement by means of which two fixed stations can record the position of a plurality of moveable units, a computer being provided to give a signal, which can be shown as a television picture, of their positions and simultaneously to add directional information for movement and certain ancillary data. Furthermore the image signals concerning the position presentation are supplemented by a direct camera signal to create the complete television picture. A special type of equipment has been proposed in order to obtain position information. It should be added that the presentation can be made in color, e.g. different colors for the different floating units.
CLAIMS
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Arrangement for visualisation of the positions and movements of floating units, preferably marine vessels by television display CHARACTERIZED BY the combination of a position determination unit which is arranged to continuously provide position determinations for the floating units, among which the vessels are present, in the form of coordinate values in a certain system of coordinates comprising land-based units, a master transmitter/receiver unit and a slave transmitter/receiver unit between which the distance is known, also on the floating units each having at least one reply transmitter/receiver unit, whereby the transmitter of the master transmitter/receiver unit is arranged to emit a signal of a special character which can be interpreted by the reply transmitter/receiver unit, which are arranged to receive this signal and after a short accurately defined interval of time to emit a coded signal, which differs for the different reply transmitter/receiver unit, the receiver unit of the master transmitter/receiver unit being arranged to receive the said coded signal and to identify the interval of time which has elapsed since the corresponding transmitter signal was transmitted by the master transmitter/receiver unit and up to the receipt of its respective coded reply signals; the slave transmitter/receiver unit is likewise arranged to receive the coded reply signals and, after an accurately defined short time interval, to transmit them further to the master transmitter/receiver unit in such a way that the time value between the transmission of the corresponding transmitter signal from the master transmitter/receiver unit until the corresponding reply signal arrives at the receiver unit of the master transmitter/receiver unit can be identified as a particular value for each reply transmitter/receiver unit in accordance with their specific code and as a value which is obtained via the slave transmitter/receiver unit, so that for each signal transmitted from the master transmitter/receiver unit its receivers thus receive back two signals for each slave transmitter/receiver unit, i.e. for each floating unit, also a direct coded reply signal and an indirect coded reply signal which are relayed by the slave transmitter/receiver unit, whereby the interval of time between the transmitter signal and the direct reply signal corresponds to
the time required by the radio waves to cover the distance from the master transmitter/receiver unit to the slave transmitter/receiver unit and back with a supplement for the time interval which can be required for the slave transmitter/receiver unit to re-transmit the signal after it has received it, whilst the time interval for the reply signals which pass via the slave transmitter/receiver unit corresponds to the time interval required by the transmitter signal to cover the distance to the reply transmitter/receiver unit, from this to the slave transmitter/receiver unit and from the latter and back to the master transmitter/receiver unit, with a supplement for the time interval which can have been required by the reply transmitter/receiver unit and the slave transmitter/receiver unit to transmit the reply signal after the incoming signal has been received; since the distance between the master transmitter/receiver unit and the slave transmitter/receiver unit is known, and hence also the time interval required for the slave transmitter/receiver signal to reach the master transmitter/receiver unit, it is possible by subtraction to also obtain the time interval for the reply transmitter/receiver signal to reach the slave transmitter/receiver unit and from these times, by knowing the speed of propagation of the radio waves, to thus establish the distance between the respective reply transmitter/receiver unit and the master transmitter/receiver unit together with the slave transmitter/receiver unit, a data processing equipment which is arranged to supply the coordinate values with predetermined control signals each in the form of a television control signal arranged to bring about a stylised image on the television screen of the respective floating unit and connected together in such a way with the respective coordinate values that the control signals are arranged to bring about a number of images on a television screen of the floating units in locations which correspond to the mutual location between the floating units in the said coordinate system and in such a manner that these images are moved on the television screen in accordance with the change in the coordinate values which are being continuously output, whereby the data processing equipment is designed to control the direction of rotation of the images in accordance with the direction of movement for the respective coordinate signals which are continuously coming in, som that a bow marked on the image is orientated mainly in the direction of movement of the respective position coordinates and is
connected to a number of television cameras, the data processing equipment being arranged to integrate any or more of the incoming camera signals with the said signals arranged to bring about a presentation of the positions of the floating units in the coordinate system, so that superimpositioning of the resultant images is obtained.

2. Arrangement in accordance with patent claim 1, CHARACTERIZED IN that the data processing equipment is arranged to store the coordinate values applicable to the respective floating units and to provide a television control signal which is arranged to provide a line on the television screen extending from the instantaneous image of the respective floating unit and comprising a presentation of a number of previous coordinate values for the respective floating unit.

3. Arrangement as in patent claim 1 or 2, CHARACTERIZED IN that an actuating device which permits manual centering of a certain section of the coordinate system on the television screen and modifications to the scale in the coordinate system presentation on the television screen is connected with the data processing equipment.

4. Arrangement as in patent claim 3, CHARACTERIZED IN that arrangements are connected to the data processing equipment for feeding in data such as wind strength and wind direction, the data processing equipment being arranged to convert these data to an adequate television signal.

DATED THIS 6TH DAY OF JANUARY 1987

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FIG. 1
FIG. 2

Radar transmitter/receiver

Interrogation code and range logic

Microcomputer with ROM and RAM

Serial I/O logic

Realtime clock

Built in console terminal

Presentation unit
FIG. 4

Diagram showing the flow of data and connections between various components:

1. Graphics processor with display memory
2. Microcomputer with ROM and RAM to handle the graphic facilities
3. Microprocessor with ROM and RAM to handle the communication
4. Serial I/O logic
5. Keyboard
6. Joystick
7. Wind data unit
8. The positioning system
9. Videotape recorder
10. TV monitor
11. The mixer
12. Realtime clock
13. Floppy disc interface
14. Floppy disc
Camera unit 1

Eventual TV-link equipment

Camera unit 2

Eventual TV-link equipment

Camera unit 3

Eventual TV-link equipment

Camera multiplexer unit

Presentation unit

Video mixer unit

TV-broadcasting antenna

Standard TV-set

FIG. 5
direct camera image is valuable during competitions, being shown not only with a pure aim of imparting information but also with the aim of entertainment. However, the result achieved by means of the arrange-