

GEORGE VI



BY THE GRACE OF GOD

Of Great Britain, Ireland and the British Dominions beyond the Seas King, Defender of the Faith, Emperor of India: To all to whom these presents shall come greeting:

WHEREAS Carl Joseph Crane and Raymond Keith Stout, both citizens of the United States of

America, and both of Wright Field, Dayton, State of Ohio, United States of America, \_\_\_\_\_

(hereinafter referred to as the said applicants) have declared that they have made application abroad for protection of their invention of Improvements for automatically keeping a vehicle or vessel on a given course \_\_\_\_\_

and that the said invention was not in use within the United Kingdom of Great Britain and Northern Ireland, and the Isle of Man, by any other person before the date hereunder written of these presents to the best of their knowledge and belief:

AND WHEREAS the said applicants have humbly prayed that a patent might be granted unto them in priority to other applicants for the sole use and advantage of their said invention:

AND WHEREAS the said applicants have by and in their complete specification particularly described the nature of their invention:

AND WHEREAS We, being willing to encourage all inventions which may be for the public good, are graciously pleased to condescend to their request:

KNOW YE, THEREFORE, that We, of our especial grace, certain knowledge, and mere motion do by these presents, for Us, our heirs and successors, give and grant unto the said applicants as joint tenants our especial license, full power, sole privilege, and authority, that the said applicants, and the survivors and survivor of them, and the executors or administrators of such survivor, their or his assigns (all of which persons or person are hereinafter referred to as the said patentees) by themselves, their agents, or licensees, and no others, may at all times hereafter during the term of years herein mentioned, make, use, exercise, and vend the said invention within our United Kingdom of Great Britain and Northern Ireland, and the Isle of Man, in such manner as to them may seem meet, and that the said patentees shall have and enjoy the whole profit and advantage from time to time accruing by reason of the said invention during a term beginning on the date hereunder written of these presents and ending at the expiration of sixteen years from the date the eighth day of April one thousand nine hundred and thirty-eight: AND to the end that the said patentees may have and enjoy the sole use and exercise and the full benefit of the said invention, We do by these presents for Us, our heirs and successors, strictly command all our subjects whatsoever within our United Kingdom of Great Britain and Northern Ireland, and the Isle of Man, that they do not at any time during the continuance of the said term either directly or indirectly make use of or put in practice the said invention, or any part of the same, nor in anywise imitate the same, nor make or cause to be made any addition thereto or subtraction therefrom, whereby to pretend themselves the inventors thereof, without the consent, license or agreement of the said patentees in writing under their hands and seals, on pain of incurring such penalties as may be justly inflicted on such offenders for their contempt of this our Royal command, and of being answerable to the patentees according to law for their damages thereby occasioned:

PROVIDED ALWAYS that these letters patent shall be revocable on any of the grounds from time to time by law prescribed as grounds for revoking letters patent granted by Us, and the same may be revoked and made void accordingly: PROVIDED ALSO, that if the said patentees shall not pay all fees by law required to be paid in respect of the grant of these letters patent, or in respect of any matter relating thereto at the time or times, and in manner for the time being by law provided; and also if the said patentees shall not supply or cause to be supplied, for our service all such articles of the said invention as may be required by the officers or commissioners administering any department of our service in such manner, at such times, and at and upon such reasonable prices and terms as shall be settled in manner for the time being by law provided, then, and in any of the said cases, these our letters patent, and all privileges and advantages whatever hereby granted shall determine and become void notwithstanding anything herein-before contained: PROVIDED ALSO that nothing herein contained shall prevent the granting of licences in such manner and for such considerations as they may by law be granted: AND lastly, We do by these presents for Us, our heirs and successors, grant unto the said patentees that these our letters patent shall be construed in the most beneficial sense for the advantage of the said patentees.

IN WITNESS whereof We have caused these our letters to be made patent and to be sealed as of the tenth day of April one thousand nine hundred and thirty-seven.



# PATENT No. 515205

Carl Joseph Crane  
and  
Raymond Keith Stout

Date of Patent 10 April 1937

Date of Sealing 22 FEBRUARY 1940  
(see Sections 26 and 27 of the Patents and Designs Acts, 1907 to 1938).

NOTE.—The continuance of this Patent is conditional on the payment (by way of Patents Form No. 14) of the prescribed fees, which, under the Rules at present in force, are :—

Before the expiration of the 4th year from the date of the Patent (and not from the date of sealing) and in respect of the 5th year										£	s.	d.
"	"	"	"	"	"	"	"	"	"	5	0	0
"	"	"	"	"	"	"	"	"	"	6	0	0
"	"	"	"	"	"	"	"	"	"	7	0	0
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"	"	"	"	"	"	"	"	"	"	16	0	0

One moiety only of these fees is payable if, and so long as, this Patent is indorsed "Licences of Right"—see Section 24 of the Acts.

As the payment of renewal fees is regulated by Act of Parliament, such fees cannot ordinarily be accepted a single day after the due date; but, if the payment has in fact been omitted, application may be made to the Comptroller, on Patents Form No. 15, for an enlargement of time to make such payment, and for this enlargement the fee payable is £2 for one month, £4 for two months, or £6 for three months, but no enlargement can be allowed beyond three months.

\*Patents Forms Nos. 14 and 15 may be purchased on personal application at the Inland Revenue Stamp Office (Room No. 28), Patent Office, 25, Southampton Buildings, London, W.C.2. Alternatively, they may be obtained at a few days' notice at any Money Order Office in Great Britain or Northern Ireland, upon prepayment of the value of the Stamp, or may be ordered by post from the Controller of Stamps, Bush House, South West Wing, Strand, London, W.C.2.



# PATENT SPECIFICATION

Convention Date (United States): April, 10, 1937.

515,205

Application Date (In United Kingdom): April 8, 1938. No. 10822/38.

Complete Specification Accepted: Nov. 29, 1939.

## COMPLETE SPECIFICATION

### Improvements for Automatically Keeping a Vehicle or Vessel on a Given Course

We, CARL JOSEPH CRANE and RAYMOND KEITH STOUT, both citizens of the United States of America, and both of Wright Field, Dayton, State of Ohio, United

5 States of America, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

10 This invention relates to apparatus for automatically keeping a vehicle or vessel on a given course, in which the steering means of the vehicle is controlled by a reversible motor, and the motor is  
15 governed by a directional device responsive to received radio electrical radiations. The present invention has for an object to provide an improved apparatus of this kind, and to this end  
20 and in accordance with the invention the directional device actuates a shutter controlling two orifices through which energy can pass to two energy-responsive means adapted to open and close two  
25 electrical relays respectively for selectively controlling the circuit of the motor in accordance with the response of the directional device, and the arrangement is such that whenever the apparatus  
30 is operative to correct the direction of travel of the vehicle, the shutter is positioned by the directional device to prevent passage of energy through one orifice and permit energy to pass through the other  
35 orifice.

The energy which brings about the operation of the motor as a result of the shutter moving so that one orifice is closed and the other is open, may be heat energy,  
40 light energy or pneumatic energy.

Various forms of the invention are illustrated by the accompanying drawings wherein like reference numerals refer to like parts throughout the several views.

45 In the drawings,

Figure 1 is a front elevation of a vertical pointer type indicator of a radio compass which can be employed in the present invention;

50 Figure 2 is a front elevation of the same type of indicator having a slight modification;

Figure 3 is a diagrammatic representa-

tion, partly in section, of one embodiment of the invention illustrating the use of 55 pneumatic control energy for operating a relay.

Figure 4 is a diagrammatic representation of another embodiment of the invention illustrating the use of light energy  
60 to actuate a control unit;

Figure 5 is a diagrammatic representation of another embodiment of the invention illustrating the use of heat energy to actuate a control unit; and  
65

Figure 6 is a similar diagrammatic representation of another embodiment of the invention using thermal energy to actuate a control unit.

Referring now to Figure 1, 8 designates  
70 the right-left indicator of an ordinary radio compass, not shown. Indicator 8 may be of the usual galvanometer or dynamometer type, having a moving coil or moving magnet 9 driving a pointer 10.  
75 The pointer carries a shutter 11 which registers with ports 12 and 13, to be described hereafter, when the pointer swings to the right or left in response to deviations of the vessel from its course.  
80

In the embodiment of the invention shown in Figure 3, a conventional radio compass or direction finder and antenna 15 is connected to the moving coil 9 of right-left indicator 8 of Figure 1. The ports  
85 12 and 13 form the ends of air ducts 16 and 17 to which are connected collapsible corrugated relay members 18 and 19 commonly known in the art as "sylphons". These members 18 and 19 are sealed at  
90 their outer ends and carry movable contacts 20 and 21, respectively, adapted to engage stationary contacts 22 and 23, respectively, to close a normally open electrical circuit, as will be described.  
95 Contacts 22 and 23 are connected by means of a common conductor 24 to one side of a battery 25 which provides energy for relay coils 26 and 27, having a common armature 28. Armature 28  
100 actuates a single-pole, double-throw switch 29 to close a circuit through either contacts 30 and 31 or 31 and 32 to a reversible motor 33. Motor 33 is drivably connected by a shaft 34 with a  
105 unit 35 which represents the steering

means of the vehicle and may comprise the rudder. Suitable evacuating means 36 and 37 are attached to branches 38 and 39 of the ducts 16 and 17 to draw air through these ducts in the direction indicated by the two curved arrows.

In the operation of this device, when pointer 10 moves off vertical, indicating a deviation from the course, it will close one of the ports 12 or 13 such, for example, as the port 13, thereby shutting off flow of air through said port and causing the pressure in duct 16 to be considerably lowered and the sylvphon 18 to collapse. Upon collapse of sylvphon 18, contact 20 is brought into engagement with contact 22, thereby closing the circuit of relay 26 and causing the relay switch 29 to close the contacts 30 and 31, thereby rotating the motor 33 in a direction suitable to cause adjustment of the automatic pilot or steering device 35 to bring the vessel or craft back on its course.

The evacuating means 36 and 37 are arranged to be interrupted periodically, so that the suction does not prevent the free movement of the pointer 10.

In Figure 4 there is shown another embodiment of the invention which employs light-sensitive devices, such as photo-electric cells of any suitable type. Two suitable light sources 47 and 48 are positioned to throw parallel beams through two ports 12 and 13 in the face of right-left indicator 8, which indicator may be of the type shown in Figure 1. Pointer 10 is shown in its on-course position midway between the two ports allowing light beams 49 and 50 to be directed upon photo-electric cells 51 and 52, which are connected to electrical circuits including batteries 57 and 58 to actuate sensitive relays 53 and 54 having armatures 55 and 56. Armatures 55 and 56 are shown in their operated position with their contacts 59 and 60 open. The contacts 59 and 60 are adapted to close the circuits for power relays 26 and 27, respectively, which operate as described in connection with Figure 3 to close the circuit to the reversible motor 33 for actuating the unit 35. The relays 26 and 27, switch 29, motor 33, unit 35, and associated mechanism are similar to those described above and are given like reference characters.

In this embodiment, when pointer 10 moves to right or left, it intercepts one of the beams of light, such as beam 49, thereby causing a change in the electrical resistance of photo-electric cell 51 and causing sensitive relay 53 to release its armature 55 and thereby close the circuit of relay 26, which in turn closes contacts 30 and 31 and causes the motor 33 to

operate in a direction suitable to effect the desired correction in the unit 35.

In Figure 2 is shown the same type of indicator 8 as is illustrated in Figure 1, but having a pointer 10 which carries an elongated shutter 14 adapted to close the ports 12 and 13 when pointer 10 is in its vertical or on-course position. This device is particularly adapted to use in the embodiments shown in Figures 5 and 6.

Two embodiments of the invention employing thermal means for actuating suitable relays are shown in Figs. 5 and 6 respectively. In Fig. 5 a source of heat 62 is energized by suitable means, such as battery 63 and, by means of the reflector 64, the heat is directed against the screen 14 of the vertical pointer 10 which is shown in more detail in Fig. 2. Thermostatic or heat sensitive switches 65 and 66, composed of abutting and coextensive strips of dissimilar metals, as is understood in the art, are positioned to receive heat through the ports 12 and 13. These switches 65 and 66 carry contacts 67 and 68, which are normally open but which are adapted to close against contacts 69 and 70, respectively. The two switches 65 and 66 are separated by means of a shield or screen 71, the function of which will be described presently. Switches 65 and 66 are in circuit with power relays 26 and 27, respectively, which are similar to those shown in Fig. 3 and actuate a similar reversible motor 33 and unit 35.

Upon deflection of screen 14, indicating a deviation from the course, heat will be allowed to impinge upon either of the thermostatic switches 65 or 66, depending upon the direction of deflection. Screen 71 effectively prevents heat, which may be directed against switch 65, for example, from being transmitted across to switch 66. Upon closing of either of the switches, the proper power relay will be operated and the unit 35 will be operated in the same manner as described in connection with Fig. 3.

Fig. 6 shows a similar heat source 62, energized by battery 63 and having its rays directed against screen 14 by means of the reflector 64. Instead of the thermostatic switches just described, the circuit of Fig. 6 employs two coils 72 and 73 which may be composed of wire having either a positive or negative temperature-resistance coefficient, as desired. These coils are connected to sources of potential, such as batteries 57 and 58, for energizing the relays 53 and 54 in circuit therewith. These relays are similar to those shown in Fig. 5 and actuate relays 26 and 27 to control the reversible motor 33 and unit 35 in the manner above described. When

screen 14 is deflected, heat will be thrown upon either coil 72 or 73 and will cause the resistance of that coil, for example, coil 72, to either increase or decrease. If  
 5 the wire of coil 72 has a positive temperature-resistance coefficient, then the sensitive relay 53 will be normally operated as shown in the drawing, and as the heat increases the resistance of the wire,  
 10 the energizing current for relay 53 will decrease to a value such that armature 55 will be released, thus closing the circuit of power relay 26 through contact 59 and causing rotation of motor 33 which in turn  
 15 will effect the desired correction of unit 35.

The ports 12 and 13 shown in Figs. 1 and 2 have been shown as being circular. They may, however, be of any shape  
 20 desired, and the shutters 11 and 14 carried by pointer 10 may be made of any desired shape, such as rectangular. In Fig. 3, the sylphons 18 and 19 have been shown as connected to electrical contact arms 20  
 25 and 21 which in turn are connected in an electrical circuit.

For simplicity, the light beams in Fig. 4 have been shown as operating directly upon the photo-electric cells 51 and 52  
 30 without the use of any focusing system. Suitable lenses may, however, be interposed if desired. In some instances, the intermediate or sensitive relays 53 and 54 can be dispensed with and the photo-  
 35 electric cells connected to directly actuate the power relays 26 and 27. Interception of the light is effected by means of a shutter 11 on the vertical pointer 10.

Coils 72 and 73 of Fig. 6 have been  
 40 described as having positive temperature-resistance coefficients. They may, however, have a negative coefficient, and in that case the relays and the circuit with coils 72 and 73 may be arranged to be  
 45 normally released and to be operated by increased current flow when the heat is directed upon the proper coil.

While certain specific embodiments of the invention have been illustrated and  
 50 described, it is to be expressly understood that the invention is not limited thereto and that various changes may be made in the construction and arrangement of parts, as will occur to those skilled in the  
 55 art. Particular attention has been called to the use of the invention in connection with aircraft and marine vessels, but the invention is not limited to use thereon, since it is readily adaptable for use on  
 60 land vehicles, such as war tanks.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we  
 65 claim is:—

1. An apparatus for automatically keeping a vehicle or vessel on a given course in which the steering means of the vehicle is controlled by a reversible motor, and the motor is governed by a direc-  
 70 tional device responsive to received radio electric radiations, wherein the directional device actuates a shutter controlling two orifices through which energy can pass to  
 75 two energy-responsive means adapted to open and close two electrical relays respectively for selectively controlling the circuit of the motor in accordance with the response of the directional device, and the arrangement is such that whenever the  
 80 apparatus is operative to correct the direction of travel of the vehicle, the shutter is positioned by the directional device to prevent passage of energy  
 85 through one orifice and permit energy to pass through the other orifice.

2. Apparatus according to Claim 1, wherein energy flows through both orifices except when the apparatus is operative to change the direction of travel of the  
 90 vehicle.

3. Apparatus according to Claim 2, and in which the energy is pneumatic energy, wherein the two orifices are connected by  
 95 two passages to two collapsible sylphons respectively, each sylphon carrying a movable contact of two switches and being normally extended by the air pressure and collapsing when the air pressure is removed by the shutter covering the  
 100 appropriate orifice, to cause the closing of the corresponding switch to modify the corresponding one of a pair of electrical circuits for the reversible motor.

4. Apparatus according to Claims 1 and  
 105 2 and in which the energy is light energy, wherein each orifice is disposed in front of one of a pair of photoelectric cells each of which latter is in an independent circuit having a sensitive relay adapted to  
 110 modify power relays which in turn modify the electrical circuits of the reversible motor.

5. Apparatus according to Claim 1 and in which the energy is heat energy which  
 115 flows through one orifice at a time and only when the apparatus is operative, wherein the shutter which normally covers both orifices is disposed between said orifices and a source of heat, and  
 120 wherein each orifice is in line with one of a pair of thermostatic switches adapted to modify the electrical circuits of the reversible motor.

6. Apparatus according to Claim 1 and  
 125 in which the energy is heat energy, which flows through one orifice at a time and only when the apparatus is operative, wherein the shutter which normally closes the two orifices is disposed between said  
 130

orifices and a source of heat, and wherein each orifice is in line with one of a pair of coils having a positive or negative temperature resistance coefficient, so that upon a change of temperature the corresponding coil will modify a relay circuit which in turn will modify the corresponding one of a pair of electrical circuits for the reversible motor.

7. Apparatus for automatically keeping a vehicle on a given course, substan-

tially as illustrated by any of Figures 3 to 7 of the accompanying diagrammatic drawings and described with reference thereto.

Dated this 8th day of April, 1938.

For the Applicants,  
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Chancery Lane, London, W.C.2.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1939.

[This Drawing is a reproduction of the Original on a reduced scale.]

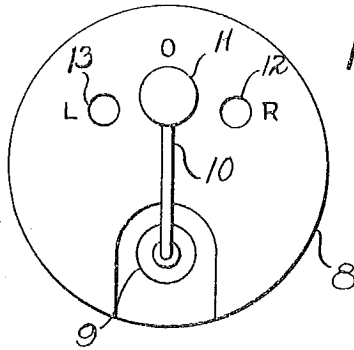


Fig 1

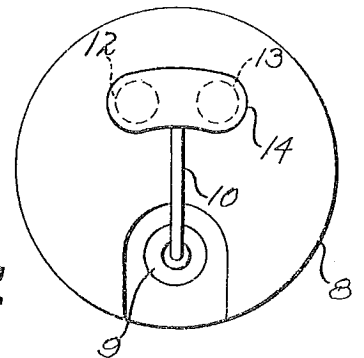


Fig 2

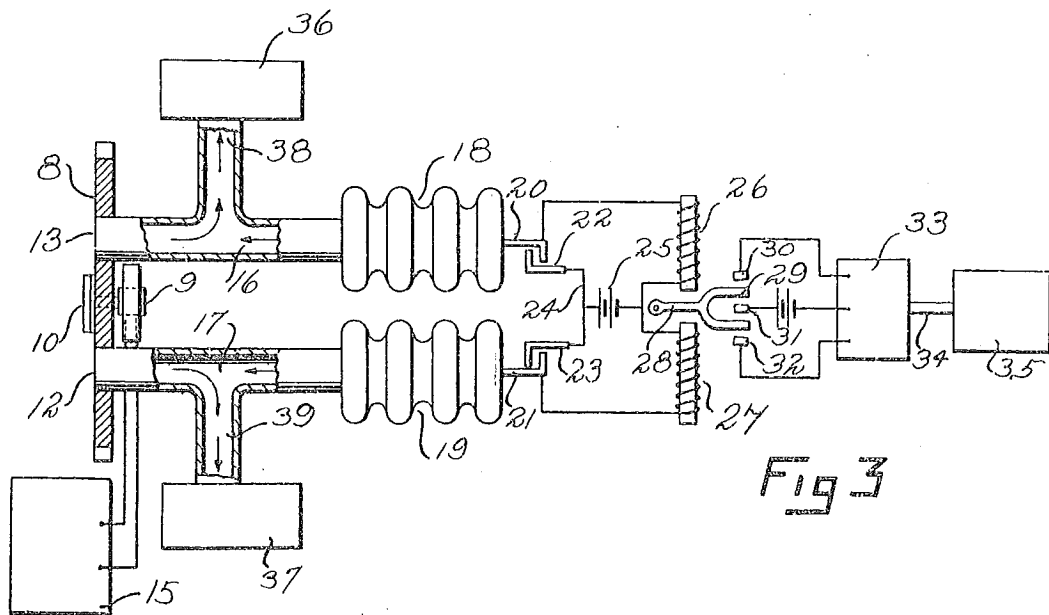


Fig 3



