SESSION 1910-1911

President: Sir David Gill, K.C.B., F.R.S., etc.

Discussion on "The Telemotor."

By Mr. W. G. GIBBONS (Member).

Monday, November 7, 1910.

Chairman : Mr. JOHN McLAREN (Member of Council).

Chairman : We have before us to-night a paper on "The Telemotor," which was read at the Engineering Exhibition at Olympia. Mr. Gibbons will be very pleased to answer questions on any points which require explaining, and I shall be pleased if some members will now open the discussion.

Mr. Jas. Howie : Perhaps Mr. Gibbons will further enlighten us as to the arguments for and against the side and central springs. There are little difficulties in connexion with the different systems, and I do not think it would be out of place to receive a few hints on the good points of each. The by-pass is an important part, and it would be useful if we had a few more details about it.

Mr. A. P. Williams : In the event of a breakdown in this Telemotor arrangement, say a burst pipe, is there any method of finding where the leak is in a few hundred feet of piping ? In a recent case we had to stop the telemotor and use the hand gear until we had the casing down to find the leak. We discovered it eventually by the water dripping out of the casing on deck.

Chairman : There is a point in connexion with the springs which is not quite clear to me, and that is the question of the helm and the cylinders centring themselves throughout,

That is an important point and Mr. Gibbons will perhaps explain it further.

Mr. HOWIE : In the event of there being no glycerine available, I presume the arrangement would work very well with fresh water only.

Mr. G. W. NEWALL : I understand the glycerine would be used in cold weather to prevent freezing.

Mr. GIBBONS : Yes, in cold weather.

The HON. SECRETARY : I think most of those present are under the disadvantage of not having had experience with the telemotor. I saw one of the first that was used, and, as Mr. Gibbons explained in his paper, it has been very much improved since then. One great disadvantage at first was that the quarter-masters were a little at sea in the using of it ; the action was easy, and the response quick compared with the old gear ; then the by-pass cock-lever was very often used as a foot-stool inadvertently, with the result that the telemotor got out of gear altogether. That has been rectified in the more recent developments, and in the last few years it has worked exceedingly well, and given no trouble on certain ships I am acquainted with. I should say it is very rare to have an experience of a burst pipe. The pipes leading aft are usually exposed, so that, in the event of a leak occurring between the telemotor on the bridge and the gear aft, it would at once show itself. The pipes are not enclosed, but simply run along the pipe line on deck. The telemotor might be used for a variety of purposes apart altogether from the steering engine. It might be a means for actuating machinery of all kinds, and it is a great contrast to the shaft and pinion gear with the rods led from the bridge, down through the bunkers possibly, and along a circuitous path to the steering engine, with multiplication of pinions and risk of material, including rats and coal, getting about the gear to jamb it. From the first it was a great improvement over the old gear, with the rods and mitre wheels, and from experience of the telemotor of recent years, I should say it is a very great improvement. The glycerine used is the commercially pure glycerine, mixed with pure water, preferably distilled. Glycerine is, of course, quite essential in frosty weather, but I apprehend that clean water

would do equally well in the event of there being no liability to frost in the latitudes the ship was going in.

Mr. WILLIAMS : I do not quite see from the paper whether there is any initial pressure on the whole system before the handle is moved either way, or whether the motion of the piston transmitting gear is relied upon only. I should also like Mr. Gibbons to explain how, when the quartermaster lets go of the wheel, the tiller returns to the mid-position.

Mr. BOWIE : I have had experience of two jobs with the telemotor, and have never had any trouble with it. The only point where there was the slightest difficulty was in returning the piston to the central position. In cold weather like that experienced in the Strait of Magellan, there is a tendency for the machine to become sluggish, and there is a slight difficulty in it having a tendency to return to the mid-position when putting the wheel "hard over," but I think that was partly due to the springs becoming compressed, and if the load on the springs is reduced when fully compressed, that difficulty would be done away with. The only real trouble I have had is with people who do not understand the telemotor interfering with it. There is always a certain amount of leakage with the pistons at the engine, but not much. It would be a good thing, in connexion with the pins for the disconnecting gear, if one pin only could be supplied instead of two. Otherwise I have no fault to find with the arrangement at all; it works very well indeed.

CHAIRMAN : Personally I should like to hear from Mr. Gibbons about the pipe leads in some of the ships fitted up with this instrument, because sometimes there is a great deal of twisting from the wheel house to right aft. Even with glycerine and water, with a hard frost I should think there would be trouble.

Mr. BOWIE : There is only one thing I would like to point out. In charging the system care has to be taken that all air is eliminated from the pipes. It should be worked freely until the air bubbles out. If any air gets in at the bends there is trouble sometimes. I would suggest that perhaps small air cocks would be beneficial.

CHAIRMAN : When you consider the different climates the

ship passes through and the different expansions of the glycerine, it would seem to be rather hard to expel all the air and leave the glycerine solid.

Mr. BOWIE : This is partly made up. There is always a slight leakage and it only requires to open the cock on the tank for a few minutes to get over that. When the arrangement gets slack there is a backlash on the piston, so, if cocks were fitted on I do not think there would be any trouble.

CHAIRMAN : Another point is to keep the pistons tight. I should think that would want close attention.

Mr. BOWIE : It runs very well with leathers.

CHAIRMAN : I will now ask Mr. Gibbons to reply to the various points that have been raised.

Mr. GIBBONS : There are no very serious questions to be considered. Mr. Howie remarked about the springs. The original telemotor had two springs, as shown in the first illustration. That was in use up to about three and a half years ago, and the reason we dropped it and adopted the one central spring, was the difficulty in getting two springs to give equal resistances under very heavy loads. A large number of springs were ordered together and put in the shop. They were then tested one with another until they were paired off as nearly as possible. Occasionally they broke, and then the trouble was to get a suitable one to match the unbroken one. The factor of safety with the two springs was about two, while in the new arrangement the factor of safety is over eight. With the two springs the standard compression at midships in a large ship was 1,000 lb. and with the new one-spring arrangement it is the same ; while at hard-over it was 2,000 lb., and with the new single spring it is 1,400 lb., a reduction of 600 lb., thus considerably reducing the pull on the wheel and, of course, the hydraulic pressure. It represents 260 lb. per sq. in. to put the gear hard over, whereas it used to be 380 lb. In the case of small ships the spring is only compressed to 675 lb. now, and the hydraulic pressure is of course reduced in proportion.

With regard to the by-pass, Fig. 9 shows the arrangement in use up to about three years ago. The trouble with it was that an opening of $\frac{1}{32}$in. extended right round the cylinder,

with a radius on the corner, and the leathers tended to get in due to the fluid passing through. If the piston is out of position there is a tendency for the fluid to flow through and turn the leathers in to the by-pass opening. About three years ago we made the by-pass consisting of parallel rows of small holes $\frac{1}{16}$in. diameter and $\frac{1}{4}$ in. pitch. We have kept in touch with 120 of these and there has not been a leather changed up to the present, so far as we can hear. We asked all those in charge to let us know how they went on, and there was only one who reported having changed the leathers, and he, after it had been running for about eighteen months, changed them because he thought it better, as the old ones had been in long enough. Another point about it is that it enables the cylinder to be made in one piece. With the old arrangement there were one or two joints and occasionally people put a joint in and were not careful in doing so, with the result that the cylinder was thrown out of alignment. With reference to working with water, condensed steam is the very best thing to use, and glycerine is only used when there is a danger of freezing. Condensed steam is preferable to fresh water. We always recommend a proportion of one of glycerine to two of distilled water. That mixture will work very well down to about 12° F., that is 20° below freezing point. On the Russian ice-breaker, the *Ermack*, they use 40 degrees glycerine and the pipes are on deck. They used it for two years, and said the mixture was never frozen. I do not know what temperature they had it down to, but it was very low. With reference to doing without glycerine, that would be all right except where the pipes were on deck in frosty weather. Many people only use 25 per cent. glycerine. We supply a glycerometer and thermometer, so that one may test what proportion there is. These instruments were supplied because we sometimes had complaints that the instruments worked stiffly, and on investigating the matter it was found that the pipes contained nearly pure glycerine. They were always putting in glycerine, and as the mixture was coming out and the pure glycerine going in, the mixture in time became much too stiff. Nowadays, with the glycerometer, there is no reason for getting either too much or too little glycerine in the pipes. With regard to the position of leaks in pipes, I do not know of any way to find them except by pumping water through and looking to see where the leak shows itself. But I think

that cases of burst pipes are very rare ; we hardly ever hear of any.

Mr. WILLIAMS : The case I referred to happened to be a lateral burst.

Mr. GIBBONS : Was it broken or damaged from outside causes ?

Mr. WILLIAMS : It was through the action of the gear itself. The pipes were protected in a wooden casing. We put a new section of pipe in.

Mr. GIBBONS : The pipes we supply are very much heavier than others we have heard of. We have had a pressure of over 5,500 lb. per sq. in. upon our pipes, and could not burst them, although it burst the pump and gauges. The working pressure under the worst conditions is about 300 lb. The pipes are only $\frac{3}{8}$ in. bore and over $\frac{1}{16}$ in. thick, so that you can estimate their strength. There have been pipes broken in two. In the case of a new ship one of the pipes was broken. In the drawing the pipe was shown in a loop about 15 in. high to allow for an expansion joint in the ship, but in fixing it up it was stretched tight across the expansion joint.

Mr. WILLIAMS : The burst occurred just after heavy weather.

Mr. GIBBONS : I do not think it would be broken by working it even under heavy weather conditions, except through there not being enough length of pipe allowed for the working of the ship in bad weather. With regard to the initial pressure in the system ; of course when the telemotor transmitter on the bridge is in the mid-position, the pressure is equal on both sides, but you may have a pressure of 50 to 60 lb. on the system. That is due to the relief valve being set on the pipe up to 200 lb. pressure. The telemotor always slightly overcharges itself, due to the compression of the fluid on one side when working. Water is slightly compressible, and the pipes, etc., expand slightly. That is why the two valves were placed on the by-pass. You will notice on the original telemotor shown in Fig. 3 those two valves were placed at each end of the transmitter. The function of these valves really is to allow the excessive pressure to get out and the fluid to come in when wanted. Now we put the valves on to the by-pass, so that

when the piston passes out of the by-pass, the valves are cut off, so that they do not affect the working in any way. In fact it does not matter whether the valves are there or not except when charging up, provided the supply tank is placed well above the highest point of the system. The cock at the bottom of the tank should be kept open all the time, except when charging.

Mr. BOWIE: I have found it shut on several occasions.

Mr. GIBBONS: It is very essential that it should be kept open. In the original design there was a by-pass cock which the present by-pass valve replaces. This by-pass cock was originally fitted so that should the receiving cylinder get back to its midship position through leakage while the transmitter on the bridge was put hard-over, it would be possible by opening the by-pass cock, to bring the transmitter back to its central position without temporarily putting the steering gear over the opposite way. This latter would take place owing to the piston in the receiving cylinder being forced from its central position (to which it had leaked back) by the transmitting piston on its way to its central position. When the automatic by-pass was opened the receiving cylinder and its gear would be correctly centred to midship position by the large springs. Now we have on the by-pass a strong valve. On Figs. 7, 8 and 11 you will see a wheel on the by-pass with the inscription upon it, "Keep this valve shut." I have never heard of a case where it has had to be used owing to the leakage and getting out of correspondence. If people are allowed on the bridge they sometimes tamper with the valve, so that many take the wheel off altogether. The only time it is useful is when in port, when it may be opened and left so. Then should any one pull round the wheel for cleaning or other purposes nothing is moved aft. Mr. Adamson spoke of the pipes being exposed. We always recommend to lead them through passages where they can be seen. Mr. Bowie referred to the disconnecting pins. Only one is supplied, but some engineers make a spare one, which is rather a bad thing, we consider, as if there are two pins one is liable to be placed in the telemotor control lever and the other in the mechanical standard control lever, with the result that the gear would be locked. There is never any trouble with air in the

pipes, provided of course the charging tank is kept so full that the pump cannot get air when charging up. With the large pump now supplied you get over any air trouble. With reference to the pipe leads, that is a point which, with the telemotor, does not matter so long as they are reasonably accessible and protected from damage and great heat. They may be twisted and bent round in any position. In the case of the *Lusitania*, there is a length of 810 ft. from the transmitter to aft, and a boy eight years old was able to put the steering gear hard-over when going at full speed. I may say that a leaky pipe or joint is nearly unknown and with the large number of telemotors we put out now (upwards of 100 this year) we have not heard of three cases of joints or pipes giving way and leaking in the last five years.

The HON. SECRETARY: It would probably be interesting if the author described the process of charging up.

Mr. GIBBONS: In charging up the apparatus on a new ship we always recommend to put clean water in the charging tank; disconnect the pipe where it goes into the transmitter on the bridge, and pump through. Then connect up to the transmitter and disconnect the pipe leading from it to the receiving cylinder aft, and pump through to take the dirt out. Then connect up, drain out the water, put in the fluid and pump through. It is quite a simple thing. With the transmitter on the bridge the leathers can be changed without any recharging whatever. It will charge itself, in fact some of our men never use a charging pump when changing leathers.

The HON. SECRETARY: Is your new pump a lever pump?

Mr. GIBBONS: Yes. It is fixed up against the receiving cylinder aft and it is the same pump that is used for the reversing engines. It is arranged so that an ordinary man can put on a pressure of 600 lb. per square inch.

CHAIRMAN: In pumping up a new machine is there any difficulty in getting the air out.

Mr. GIBBONS: None whatever. The pipes are only $\frac{3}{8}$-in. bore and the pumps are so large. As a matter of fact we use the same pump for $\frac{5}{8}$-in. pipes, and never have any trouble. Each stroke of the pump accounts for 5 ft. 6 in. of the $\frac{3}{8}$-in.

bore pipe and will carry the fluid right past the bends. In some of the ships the pipes rise and fall 40 ft. and go up and down and bend in all directions. When the *Lusitania* and *Mauretania* were first fitted up, it took under an hour to charge each of the two sets used. In each of these vessels there is a lead of piping on each side and two telemotors on the bridge. The Admiralty requirements are that there shall be two independent means of steering.

The HON. SECRETARY: Does it obviate the necessity of having two engines? I presume not.

Mr. GIBBONS: It only means duplicating the control. In the *Lusitania* there are two steering gears, and either of the forward telemotors will do for either of the steering gears. It is only necessary to make the change from one to the other. There are two duplicate telemotors, either of which can control the steering gear. In warships such as the *Dreadnoughts* there are sometimes three telemotors, two steering engines and two aft receiving cylinders against each steering engine.

The HON. SECRETARY: Is it used for any other purpose?

Mr. GIBBONS: Only for working the helm signals. One great difficulty we have is to persuade people that the telemotor does not steer the ship. It only controls the steering engine and makes it do the work.

Mr. HOWIE: In charging these pipes is there not a cock needed to let the air out.

Mr. GIBBONS: The only air outlet necessary is the screw on the top of the transmitter, when the receiving cylinder is placed horizontally, as it practically always is in the mercantile marine.

Mr. WILLIAMS: With regard to the pipes transmitting to the receiving cylinders, are these supplied solely by the makers or are other firms allowed to supply them.

Mr. GIBBONS: On two occasions only other firms have supplied them to our telemotor, but since these we prefer to supply them ourselves.

Mr. G. W. NEWALL: Might I ask how, in the by-pass arrangement, you manage to drill the holes from the inside?

Mr. GIBBONS: It is done by a special machine with a special spacing arrangement.

Mr. NEWALL: What is the diameter of the cylinder?

Mr. GIBBONS: The diameter of the present telemotor is $2\frac{3}{4}$ in.

Mr. NEWALL: Might I suggest that the instructions for charging up be printed along with the discussion. As there are many ships which appear to have the arrangement on board, I think it would be of value to include that. [These instructions are appended.]

The meeting concluded with a vote of thanks to Mr. Gibbons, on the proposal of Mr. Howie, seconded by Mr. Newall.

Contributed by Mr. W. W. ADAMSON (Associate):—

It has been said that "the function of history is to forecast the future," and interesting as is the evolution of the telemotor, it would have enhanced the value of this paper if the author could have given some experiences of the device as it has been applied to electric steering gear. This need for a good electric steering gear has been put forward as the principal engineering objection to gas engine electrically driven auxiliaries, and the telemotor appears to be especially fitted to act as a motor control. Although the telemotor is so sensitive in its action, its application to the engine room telegraph is somewhat delayed, notwithstanding its adaptability for registering the signalling at any part of the ship and for doing so on a time card recorder for steering and manœuvring purposes. It is gratifying to think that the embargo placed upon a too eager probing into the science of telemotoring is more stated than implied in the remark that "the invention was at first regarded as altogether too scientific and refined, *and not* to be understood by the average sea-going engineer."

Mr. GIBBONS: With reference to the telemotor being used for controlling an electrical or other gear, this can be quite easily done. In fact we have an experimental electrical steering gear in our works that is arranged for control and is being controlled when experimenting by a telemotor. Hydraulic steering gear, as will be well known to some of you, has been controlled by telemotor for a considerable number of

years, and there are still some ships running that were fitted with this upwards of twenty years ago. With regard to the working of engine room telegraphs, etc., by telemotor, a British warship was fitted a considerable number of years ago with our late Principal's "Telemotor Engine-Room Telegraph," and this I believe worked quite successfully for a time, but the indicator in the engine-room had a tendency to leak back to the central position. I believe it is quite possible with our present knowledge and appliances for making gear of this description, to produce a telegraph worked by telemotor, that would be much more reliable than the one supplied then, but as there is always the probability of the receiving gear tending to leak back to its central position when allowed to stand over long periods, such as telegraphs do, I fear there is not much chance of getting it adopted again. In the case of the steering gear, the wheel is always more or less passing about its central position, so that the gear is being automatically corrected, whereas an engine-room telegraph often stands for days, in some cases weeks, at one position. It is possible there may be developments in this direction before very long, but I am unable to say more on this matter in the meantime.

INSTRUCTIONS FOR CHARGING, ADJUSTING, AND WORKING.

IT is of the utmost importance that all joints be water-tight, as any leakage will empty the small tank. After all the pipes are coupled and the connexions made to cylinders and to tank in wheelhouse, close the cock underneath the tank and fill to about one-third full with fresh water. For cold climates, add 30 per cent. glycerine, which keeps the parts lubricated, and will resist frost to about zero Fahrenheit. (See table of freezing temperatures of various mixtures of water and glycerine at end.) Put the hand wheel in mid-gear, which will be seen by the pointer coming between the two zero marks on indicator. This opens the by-pass between the top and bottom ends of the cylinder, and allows the whole system to be charged by one operation from the after part of the ship.

Open the cocks on the side of the cylinder K or motor cylinder, and see that cocks J^3 and J^4 are open. When pumping, great care should be taken that the liquid in tank Z never gets so low as to allow the pump to draw air, as the good working of the gear depends upon the air being expelled. The liquid will shortly be seen to run from the small pipe back into the tank Z, but the pumping must be continued for some time, say three times as long as it took to come back. By this time the air should nearly all have been driven out, and each stroke

of the pump should show a corresponding rush, and not a continuous flow back through the return pipes to the tank.

Being satisfied as to this, the air cock J^1 on the top of the cylinder should be closed, and a slight but continuous strain kept on the pump. Now, go forward to the wheelhouse, and on the valve casing cover on the transmitting cylinder A will be seen a brass plug W^1; remove it, and press down the spindle of the inlet valve, which is immediately underneath, when the liquid will rush up owing to the pressure being kept on by the pump from aft. When the casing is quite full, and no more air bubbles up screw in the plug W^1; also the plug A^1 on the top of the transmitting cylinder should be slacked back to allow any air imprisoned in the cylinder to escape, afterwards tighten up the plug, close the cock J^2 on the under side of the motor cylinder K, when the installation will be fully charged; open the cock V underneath the tank U, and all is ready for use. The tank U in wheelhouse should be kept half full.

The gear may now be tried by putting the wheel over to port and starboard, and noticing aft if a corresponding movement takes place in the piston of the motor in cylinder. Should it not respond on one side or the other, then an internal leakage may be suspected; in which case, examine the leathers in the telemotor and motor cylinder.

To take out for examination or renewal the leathers on the piston B (a section of this piston with its leathers, springs, nuts, etc., is shown to a larger scale in Fig. 7), it is only necessary to remove the cylinder cover and turn the wheel so as to bring the piston up. The rack is sufficiently long to enable the piston to be run up right out of the cylinder and so be easily got at. If the by-pass, valve T, is opened, and the cover left on until the piston comes against it, this can be done with little, if any, loss of fluid. To get at the leathers in the after cylinder K (Fig. 8 shows the piston with its leathers, springs, nuts, etc., to a larger scale), it is necessary to shut valve J^4, remove the cylinder cover, slack off and remove the two large nuts that bear on the top yoke P, when the piston rod, etc., can be drawn sufficiently far out to examine or renew the leathers. As soon as the piston comes out of the cylinder, valve J^3 should be shut, so that no more fluid may be lost. It should not be closed before the piston is out, or difficulty may be experienced in getting it so. All the leathers used for the two pistons (four in all) are exactly alike, which is a great advantage, as only one size of leather has to be carried as spare instead of two sizes as in the older designs. Care should be taken that any new leathers obtained are the proper depth, as the action of the automatic by-pass on the cylinder A may be rendered inoperative, if they are too deep and cover the holes. The leathers in the pistons themselves will not cause any trouble until actually worn out, and even when in a leaky condition will work quite well and keep in correspondence with the gear aft, in virtue of the spring always putting the rudder in a fore and aft central position when the piston enters the by-pass portion of the cylinder.

The inlet and relief valves in valve-box W are not working, but automatic, valves; they merely open and shut as occasion requires, to allow for expansion and contraction of the fluid in the pipes due to change of temperature.

After having made any repairs that may have been necessary, and before recharging, it is advisable to clean out the pocket underneath these valves, the purpose of which is to collect any dirt or sediment that may have been in the liquid. This is done by removing the brass plug in the bottom, when the small quantity of liquid that flows out of the pocket will carry anything with it.

When first charging up after erection or after any repairs or alterations to pipes, etc., it is advisable to disconnect the pipes from both cylinders and force clean water through them, so as to wash out any dirt or other foreign matter that may be in the pipes, and so prevent it getting into the cylinders and valve boxes.

In addition to the stuffing box of the valve T, there are only three more—one on the cylinder on the bridge and two aft—and as the water pressure need never exceed 250 lb. per square inch, there is no reason for any serious loss of the fluid in the tank. Keep the stuffing boxes *full* of greasy cotton packing, and screw up as lightly as is necessary to secure *tightness*, but not *stiffness*. It is advisable to occasionally examine the leathers in the telemotor and motor cylinder aft when the ship is in port. The necessity for this can be ascertained by pulling the steering wheel hard over to port and securing it there. The motor cylinder will be found to have responded to same extent. If the gear is now left, say for half-an-hour, the spring in the motor-cylinder will have moved the piston towards midship position if there is any leakage in the port leather. A similar trial may be made to starboard, which will test these leathers.

It need not be expected that these leathers should be quite tight, but the motor piston should remain over for say ten minutes without any serious movement toward midship position, that being about the maximum time that, in practice, a helm would be held hard-over ; and so any little deviation due to leaky leathers would be at once adjusted when the steering wheel is let go, the motor springs running it back to zero, and the by-pass allowing the free circulation of the fluid.

Fig. 5 is a section of the telemotor through the centre of the shaft, and shows a screwed plug X. When it is desired to take out the shaft E (the indicator being at zero), this plug is withdrawn and the other end screwed into the cylinder until its point enters a recess in the rack C. The rack is thus kept in its central position until the shaft and the pinion are replaced.

Care should be taken to lubricate with good oil the various working parts of the gear.

A Glycerometer and Thermometer are supplied with each installation, so that it is possible to test the actual proportion of glycerine in the fluid at any time when the gear is not in use, by drawing some of the fluid out of the circuit and testing in a similar manner to that adopted for ascertaining the density of the water in boilers, the Glycerometer reading right off the percentage of glycerine.

NON-FREEZING FLUID FOR TELEMOTORS.

Water containing Refined Glycerine.	Safe to Work to Fahrenheit.
25 per cent.	+ 18°
33 ,,	+ 10°
50 ,,	− 20°
60 ,,	− 30°, getting thick.
70 ,,	Too thick to work at −25

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ROSEBANK IRONWORKS,
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