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INSTITUTE OF MARINE ENGINEERS
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SESSION



1896-7.

President—SIR EDWYN S. DAWES, K.C.M.G.

Volume VIII.

SIXTY-SECOND PAPER

(OF TRANSACTIONS)

The Application of White Metal
to Wearing Surfaces,

BY

MR. ROBERT DAVISON

(MEMBER).

READ AT

THE UNIVERSITY COLLEGE, CARDIFF,

WEDNESDAY, MARCH 4TH.

THE INSTITUTE PREMISES, 58, ROMFORD ROAD, STRATFORD

MONDAY, APRIL 27TH.

THE ARTS' SOCIETY HALL, SOUTHAMPTON,

WEDNESDAY, APRIL 29TH, 1896.

PREFACE.

35, STACEY ROAD,

CARDIFF.

A well attended meeting of the Bristol Channel Centre was held at the University College, Cardiff, on Wednesday, 4th March, 1896, presided over by Professor A. C. ELLIOTT, D.Sc.

Mr. ROBERT DAVISON, Member, B.C.C., read a paper on "The Application of White Metal to Wearing Surfaces," which was favourably received, and a spirited discussion resulted.

GEO. SLOGGETT,

Hon. Secretary, B.C.C.

INSTITUTE OF MARINE ENGINEERS INCORPORATED.

SESSION



1896-7.

President:—SIR EDWYN S. DAWES, K.C.M.G.

THE APPLICATION OF WHITE METALS TO WEARING SURFACES.

READ AT THE UNIVERSITY COLLEGE, CARDIFF.

ON WEDNESDAY, MARCH 4TH, 1896.

CHAIRMAN:

PROF. A. C. ELLIOTT, D.Sc.

READ AT

THE INSTITUTE PREMISES, 58, ROMFORD ROAD, STRATFORD

ON MONDAY, APRIL 27TH.

CHAIRMAN:

MR. T. F. AUKLAND (*Hon. Member*).

READ AT THE ARTS' SOCIETY HALL, SOUTHAMPTON,

ON WEDNESDAY, APRIL 29TH, 1896.

CHAIRMAN:

MR. C. S. DUSAUTOY (*Local President*).

OF recent years there has been considerable modification in the uses to which different materials have been put in the various working parts of the marine engine. The conditions under which the marine engine has to work, are, perhaps, more trying than in any other type. The main shafting, for instance, between the cranks and the propeller, has to encounter in bad weather

the stresses of torsion, bending, and compression, either singly or all at one time, and its after end has that pernicious evil, corrosion, to contend with. The troubles arising from friction caused by the motion and working of the ship, also by corrosion, are so numerous, that the marine engineer has to be constantly experimenting and devising means to meet and overcome them. A great deal depends on the materials which form the frictional or bearing surfaces of the moving parts of the engine, and in trying to surmount one difficulty another may be brought about. The application of brass, as an example, in certain localities may become a source of annoyance.

I propose to deal briefly with the application of white metals to bearings, guides, eccentrics, valve faces, paddle wheel bushes, and pins, and such like, in accordance with what is now the *recognised* practice in regard to them.

White metal has come into very extensive use and is applied with advantage to nearly all wearing surfaces, particularly crank and main shaft bearings, guides, and valve faces. In some cases, however, such as in crosshead and pump-link brasses, it does not appear to give such satisfactory results. This may, possibly, be accounted for by the comparatively small amount of movement in the latter cases, and consequent incomplete lubrication. In white metalling a new bearing, a good plan is to have the bearing cast with longitudinal recesses or channels about $\frac{3}{4}$ in. apart, and a circumferential recess at each end of the brass of the same depth as the other recesses and into which they lead. The bearing should be well heated and the white metal poured into the channels so as to fill them and stand $\frac{1}{32}$ in. above when finished. It will now be seen that the white metal in the end channels serves to keep the lubricant from running out of the bearing (see Fig. 1). The bearing is then bored and dressed up in the usual way. One of the smoothest bearings I have ever seen was that of a crank shaft fitted with brasses hexagonally shaped on the outsides to fit the ordinary pedestal

and cap. These brasses, no doubt, from a point of economy, had been cast with these rectangular holes in the top half brass, as shown in Fig. 2. I remember having to assist in stripping this shaft, and, on removing the cap, a small quantity of oil was found retained in each of the holes mentioned. This, I think, goes to prove, when sufficient bearing surface is provided, it is of advantage when metalling to keep the recesses closed, by forming the circumferential end channel described above. With old worn bearings in which the thickness will not permit of recesses being formed, the first step is to have them thoroughly cleaned and tinned. This cannot be done too carefully in order to obtain a satisfactory job. The metal may then be applied in strips, or to the whole surface, if deemed necessary. It is usual to well heat the bearing in all cases when applying the white metal, to avoid the risk of the metal getting loose when cooling. If this is done, and proper precaution is taken in the tinning, I am confident that there is no likelihood of this taking place, and consequently see no necessity for drilling dowel holes, as is sometimes done, with the object of drawing the metals well together. Those who are inclined to be timid in trusting to tinning operations alone, may possibly be relieved of their doubts by the following instance. A large wrought iron half strap for a paddle wheel was tinned on its inner surface, afterwards laid in loam, and white metal poured from a ladle into the space prepared for it. It was then taken out of the mould and left to cool. When preparing it for machining, the points of the straps were found to have closed towards each other to such an extent, that it was necessary to take a cut over the face of the joint to make it straight. This alteration in shape can only be accounted for by the cooling process. The white metal being so much hotter than the strap had contracted to a greater extent and so caused the deflection. This also, I think, goes to show that the tenacity of the white metal to that to which it may be affiliated is very great. With cast iron blocks, it may be prudent to have a shoulder on the sides next the joint to support the white metal, or even to drill dowel holes. Tunnel

bearings, which have not been previously fitted with white metal, can be dealt with in a similar manner to worn brass bearings.

ECCENTRIC STRAPS.—There is, undoubtedly, no better material for eccentric straps than cast iron, provided they are designed with ample wearing surfaces. I know of one case where cast iron straps were fitted on a tug boat, which were running over nine years, and needed closing once only during that period. In metal-ling worn brass straps, they may be treated similarly to worn bearings. The thickness and strength at the crown of the strap may be thus maintained; and here another example is furnished of the benefits derived from having a substance so readily applicable as white metal.

GUIDES.—A good effect has often resulted from the use of white metal on guides. I am, however, a strong advocate for ample oil channels in the guide faces, having had considerable trouble at sea from heating, with those not so provided, and particularly so in short connecting-rod engines. In all cases where the oil channels have been thoroughly and properly cut the trouble has ceased.

SLIDE VALVES.—A series of zig-zag holes should be drilled in the face of the valve, and slightly widened at the bottom, into which the white metal should be run. The rows of holes should be sufficiently close to allow the edge of one row to overlap that of the next in the line of travel. By this means the wearing of the cylinder face into ridges is prevented. I believe cylinder faces cast of white metal have been fitted working with cast iron slide valves.

TAIL SHAFTS.—There is no reason why white metal should not be applied to tail shafts between the sleeves. A lot of corrosion goes on here, and it might be much reduced, if not entirely prevented. In one case, where the shaft was slightly corroded at the fore end of

forward liner, this was done as follows:—The old liner was cut off, and the shaft, where corroded, cleaned thoroughly and heated, whilst being turned round in a lathe. It was then tinned, the white metal applied, and turned up the same diameter as that part of the shaft where the old brass liner had been fitted. The new liner was made long enough to cover the white metal. Unfortunately, there is no record of how this answered, as the vessel was lost shortly afterwards.

PADDLE WHEELS.—The feathering gear eccentric straps are generally made of wrought iron with a brass liner fitted inside. Water finds its way between the brass and iron, so that eventually the brass works loose on the pins which secure it. White metal comes in again here as an excellent substitute for the brass, the strap being cleaned, tinned, and lined in the usual way. The pins which formerly held the brass liner may be utilized to give additional support to the white metal. When stripping paddle wheels, the paddle pins, when of wrought iron and cased with brass, are often found to be similarly affected, and the iron is so much worn out of shape as to be unfit for re-casing with brass. When their strength is sufficient, the white metal is applied and answers well. The brass bushes in the rods connected to the paddle pins, after being worn, have been lined with white metal, and pins, lined also with white metal, fitted in them; that is, white metal working on white metal. The result has been anything but satisfactory, and it has been found better to retain the bush of brass, and white metal the pin only.

In the foregoing remarks, I have strictly refrained from referring to, or offering any comments upon, white metals of one particular make. The makers of each kind, as a rule, put the public in possession of the chief advantages of their special production. There is much similarity between the various kinds, though, of course, every engineer has his own special liking in regard to them. A discussion will perhaps be more suitable for bringing out information in regard to them, and for

the expression of views that cannot very well be put down here. In fact, when I consented to undertake this subject, my idea was to promote a discussion, knowing that all marine engineers would be able to dilate freely and feelingly on such a topic. For who amongst them does not know of the annoyance of heated bearings, and what a boon to most of them this white metalling has been? If the experiences I have given should have this result, I shall be more than satisfied at having been induced to place this before you.

—:O:—

DISCUSSION

HELD AT

THE UNIVERSITY COLLEGE, CARDIFF.

On WEDNESDAY, MARCH 4th, 1896.

CHAIRMAN:

PROFESSOR A. C. ELLIOTT, D.Sc. (*President of B.C.C.*)

The CHAIRMAN (Dr. Elliott): I should like to have heard Mr. Davison's experience with piston rings treated with white metal. I shall be very pleased to furnish members of the Institute with tests of any specimens they may submit to me.

Mr. W. SIMPSON (Member): I think our thanks are due to Mr. Davison for his very practical paper, and I think as a practical engineer, it is a subject that we may all take part in. At the present time I can say very little on it, as I practically agree with Mr. Davison in what he has said. I am quite convinced that white metal in main bearings is far better than anything else we can have. Like Mr. W. Davison, I am not in a position to advocate any particular kind; but there are white metals and white metals, as well as engineers and engineers. If a crank shaft bearing has sufficient bearing, and properly fitted and looked after, I do not think there could be anything better than white metal, but I do not

agree with Mr. Davison's plan of fitting the white metal bearings. If white metal strips are only left $\frac{1}{8}$ inch above the flush of the brass, or whatever metal the bearing is composed of, I do not consider that end strips are advisable. When the white metal has worn down to the same level as the other metal I have found that the other metal cuts into the pin or bearing. My experience is that white metal ought to be fitted in strips with sufficient bearing and the ends left free. I have never found any trouble about the lubricating oil doing its work. I have had bottom ends running for two East India voyages with white metal, and a tin liner could not then be taken out. After Mr. Davison's explanation on his drawing, the style that he proposes is better than I thought; but I do not agree with it now, as it is simply an entire white metal bearing, and if such a bearing does get hot it is entirely useless until it is again run up with metal. This is rather an expensive job if the shaft has to be lifted before the bearing can be run up, and probably a ship may be detained a considerable time, either at sea or in a foreign port, as it is practically impossible to run without each bearing doing its work. But, as I propose, white metal strips of sufficient bearing, or, should the bearing get heated, the brass strips with ends are quite sufficient, it will be found, with care, that the bearing will run. I quite agree with Mr. Davison that the bearing should be heated before the white metal is run in; but if to be done in the manner he suggests, I should prefer an entire bearing of white metal with a few oil channels. I do not agree that white metal in slide valves is a good thing. If there is any trouble with a slide valve I should prefer to drill a few holes (but not have them filled with white metal), or else cut a few oil channels. My experience is that there is nothing better than cast iron to cast iron. The case Mr. Davison gives us in regard to tail shafts is exceptional, and I do not see that the white metal that was applied could have done much good, as the shaft had been reduced, and applying white metal would not strengthen it, and this is a very exceptional place to have corrosion. In regard to corrosion

between the sleeves of a tail shaft, if white metal could be put on to prevent corrosion and at the same time it could be seen in the shaft (when the shaft was drawn in) whether there was anything wrong with it, it would be a good thing. But I think that the sudden breaks at the ends of the liners will have to be done away with, and if white metal is to be used it ought to be put on to form liners, as well as to protect the shaft. We should then have the same difficulty as we have at the present time with the long liners, and when the shaft had to be seen the whole of the metal would have to be taken off.

Mr. J. CHELLEW (Member) had found the white metal to become pitted sometimes when it retained grit, and the pin was scored. He would like to know the cause of the pitting and how it could be prevented.

Mr. JOHN BROCK (Member): In the course of his paper Mr. Davison mentions that white metal has not given good results when fitted in cross-head and pump-link bearings, accounting for this by the limited amount of motion preventing complete and perfect lubrication. It seems to me that the character of the metal used for these purposes would have more to do with the unsatisfactory results. Some white metals are very soft, and consequently unfitted to withstand the thumping motion inseparable from such bearings. By the addition of certain ingredients, this softness and ductility can be overcome, and the resulting mixture made hard and tough enough to stand the hammering. I have seen white metal used with satisfactory results, in lever-link, and Gudgeon bearings, and I have known numerous vessels fitted in this way, no complaints regarding which ever came to my knowledge. Regarding Mr. Davison's remarks as to the best way of fitting "white metal" into bearings, it seems to me that the feature of primary importance in all bearings is to get the greatest possible amount of rubbing surface. I see no necessity whatever for having recesses in white metal bearings, more than in any other bearings. I always keep the entire surface of the metal as a rubbing surface, allowing the crank-pin,

or shaft, to sweep round the lubricant in the usual way, and have always had satisfactory results. In all cases where such is at all possible, the shell should be carefully tinned before being filled with "white metal," which is the only really effective way to prevent subsequent looseness; the shells also should be very carefully heated. It is further of vital importance not to over-heat the alloy, as by so doing its composition may be completely changed. As regards the amount of wear which may be expected from "white metal" when properly applied, I have known a vessel's crank shaft $13\frac{1}{2}$ inches diameter only worn down $\frac{1}{32}$ inch after eight years' constant wear. One chief engineer had been in charge all this time, and such results are only possible when great care is exercised, though it clearly proves that such results are possible. In some cases brass or gun-metal and white metal are made to run at the same level—the shaft resting and rubbing equally on both. This should never be attempted, as the results are fair to neither; either one metal or the other should receive the entire friction of the journal, otherwise perfect satisfaction need not be expected. There is no doubt whatever that the extended use of "white metal" has been a great boon both to the shipowner and the sea-going engineer, as the life of shafts has been greatly prolonged by the absence of heating, and for the same reason the engineer on watch has an immunity from anxiety hitherto unknown.

Mr. T. W. WAILES (Member) said he had found that the demand was just as great for one kind of white metal as another from those who issued instructions to the ship-repairers. He would like to have heard the author's opinion as to re-melting the metal—that is using it a second time. Personally he was not in favour of this practice, but it was a matter of necessity sometimes when vessels were away on a long voyage. There was without doubt a great difference in this respect in the value of the white metals offered to the public, some being of no use whatever for re-melting.

Mr. SYDNEY WALKER (Member) said he had seen white metal applied occasionally in dynamos, but never with any great amount of success. Personally he was not in favour of its adoption by the electrical engineer for very high speeds, believing that the wearing of the white metal is often responsible for accidents to the armatures.

Mr. A. KENDRICK (Member) said he did not altogether approve of applying white metal in the manner suggested by Mr. Davison. He considered that holes drilled in the bearing and filled with the metal like dowels preferable to the strips. Any engineer could so apply it, no tinning being required, the metal simply wanting to be well hammered out into the hole.

Mr. DAVISON, in the course of his reply to the various speakers, said he had not dealt with pistons, as he understood a paper was in course of preparation on the subject. Referring to the remarks of Mr. Simpson and Mr. Brock, he said he was not speaking of the composition of the different metals, but of their durability. He had found them all to wear well and give satisfactory results. The corrosion of the shaft was caused by the cooling cock above the gland having been left slightly open, as was often done. The white metal was applied in that case to prevent further corrosion. The small holes in the metal mentioned by Mr. Chellew might be the result of faulty workmanship, and air being confined in the mould. When applied in the way he had described in the paper and the metal well worked and spread with a greased stick, the gases were eliminated and the metal found quite sound after machining. He agreed with Mr. Wailes that re-melting the metal was a bad practice, and unless otherwise specially requested he used only virgin metal.

On the motion of Mr. SIMPSON, seconded by Mr. WAILES, a very hearty vote of thanks was accorded Mr. Davison for his interesting paper.

The meeting terminated with a vote of thanks to the Chairman.

PREFACE.

—
58, ROMFORD ROAD,

STRATFORD, E.,

April 27th, 1896.

A meeting of the Institute of Marine Engineers was held here this evening, when a paper, contributed by Mr. ROBERT DAVISON (Member, Bristol Channel Centre), on "The Application of White Metals to Wearing Surfaces," was read by the Hon. Secretary, in the unavoidable absence of the author.

Only a brief discussion ensued after the paper was read, as this evening closed the first part of the session; it was felt, however, that the subject should be revived before the close of the winter session, so that the discussion might be made more general. It is hoped that this view will be met.

Mr. T. F. AUKLAND presided.

JAS. ADAMSON,

Hon. Secretary.

INSTITUTE OF MARINE ENGINEERS INCORPORATED.

SESSION



1896-7.

President—SIR EDWYN S. DAWES, K.C.M.G.

THE APPLICATION OF WHITE METAL TO WEARING SURFACES.

DISCUSSION

AT

58, ROMFORD ROAD, STRATFORD.

MONDAY, APRIL 27th, 1896.

CHAIRMAN :

MR. T. F. AUKLAND (*Honorary Member*).

MR. H. C. WILSON (Member) said that in a drawing of main bearing brasses given by the author with his paper, the white metal was fitted in a very different manner from that adopted in main bearing brasses with which he had been shipmates. At the close of the paper the author, after speaking of the annoyance caused by heated bearings, remarked, "and what a boon to most of them this white metalling has been," but if this remark was also intended to apply to main bearings he did not agree with it at all. He had been shipmates with ordinary brasses, and also with brasses with white metal,

and the bane of his existence at the time was the white metal. This, he thought, was principally owing to the white metal having been put in the bearings in an improper manner. No doubt the proper method was shown by the author in his drawing; but in the bearings of which he had had experience, the manner of fitting the white metal was just the other way on, and after three years' experience in running those bearings he came to the conclusion that white metal under such conditions was anything but an advantage. The trouble was caused by the slight amount of knock which took place in all bottom ends, and this had the effect of loosening the strips of metal in the slips provided for them. He often had reason to feel very sorry that he was not back again with his old solid brasses. Many engineers declared that the running of white metal bearings in water not only spoilt the bearings, but that it was impossible to use it so. He had had experience with white metal bearings, which ran better with water, and salt water too, than without it. The water was used with the best castor-oil, and appeared to have the effect of keeping the bearings cool. In using white metal for purposes of this kind a vast deal depended upon the quality of the white metal that was put in, and much also depended upon what engineers usually understood as the working temperature of the brasses. He never liked to find everything too cold. It was only by practice and experience that they could attain the right working heat, but when it was attained they stood a much better chance of obtaining good results from white metal bearings than if they were stone cold.

Mr. J. R. RUTHVEN (Member of Council) said they were told in the paper that white metal did not prove satisfactory at the top end of the connecting rod, but he thought this was chiefly due to the design. It had been the custom to make this bearing very small, and the fault was more in the small amount of surface than in the white metal. A great deal of trouble had arisen in former years owing to engineers having been too economical with the surfaces, and the tendency of more

recent times to increase the surfaces had, he thought, been advantageous all round. It was not a great while ago that a vessel was said to have caught fire through one of the bearings getting hot, and it was said at the time that this was due to the small surface of the bearing.

MR. J. H. THOMSON (Chairman of Council) said that his experiences during the early days of white metal were somewhat similar to those of Mr. Wilson, and he related several instances of the troubles and difficulties that had to be overcome. Since that time there had been great improvements in the method of white metalling, and also in the mixtures of the metal. He cited cases where white metal had been employed to undoubted advantage, and emphasised the importance of some of the points urged by the author of the paper with regard to the application of white metal to wearing surfaces.

MR. JAMES ADAMSON (Hon. Secretary) said that most engineers had had peculiar experiences with different kinds of white metal. He had known one steamer which required to have the main bearings filled up with new white metal within nine months. In this case the original white metal was analysed, when the component parts were found to be of such a quality that the builders had evidently not used this particular metal on the ground of cheapness, as it appeared to have been an expensive metal which more nearly approached what was generally used for quick-running and light shafting, and, although good metal for that purpose, it proved unsuitable for the heavy bearings. Cases could be cited where steamers had been on constant service for 10, 12, and 15 years after leaving the builders' hands, without requiring the main shafting to be lined up. When they found such different results as these they were a little at a loss to know why it was that one steamer ran only two years, while another vessel, under conditions which appeared to be exactly similar, ran for 15 years. He had found from experience that a hydro-carbon oil ran better with white metal bearings than ordinary engine oil, and in the case of one steamer that ran for 12 years without

her bearings having to be lined up, nothing but hydrocarbon oil was used from the time she left the builders' hands. With regard to Mr. Ruthven's remarks, he was inclined to agree with Mr. Davison that it was the peculiar motion of cross heads and pump links that rendered white metal unfit for these purposes. Another point that occurred to him in regard to the use of white metal had reference to the method of lubrication adopted. In the course of one of the discussions, reference was made to a patent system of lubrication where solid grease was used, and it would be very interesting to learn whether, in steamers where this system was employed, the white metal bearings wore more quickly than when oil was used. With regard to the ship referred to by Mr. Wilson, perhaps he would inform them whether, after the white metal was introduced, he continued to use the same oil as had formerly been used with the brasses.

Mr. WILSON said he found the white metal in the ship, and could only run it with the best castor oil and a little water. The moment the water was taken off trouble ensued. That only referred to the bottom ends; the main bearings ran better.

Mr. ADAMSON, continuing, gave an instance where white metal had been applied to eccentric straps which had been lined with brass, with good results. These straps had previously given trouble, and in one voyage the brass had worn down $\frac{3}{16}$ of an inch. White metal was then put on the straps in place of the brass, and they had run for years without giving any trouble. There were six of these eccentric straps, and they were treated with three different kinds of white metal as an experiment, and all of them had done equally well. He did not approve of using white metal instead of *lignum vitæ* for propeller shafts. Rudder pintles were sometimes run up with white metal, but he thought this was often because of the difficulty of getting the job properly done with brass or *lignum vitæ*, owing to urgency in the matter of time, as he did not think that white metal did well, as a rule, with water, especially salt water, still, the

different experiences of members on the point might probably be due to the differences in the composition of the white metal.

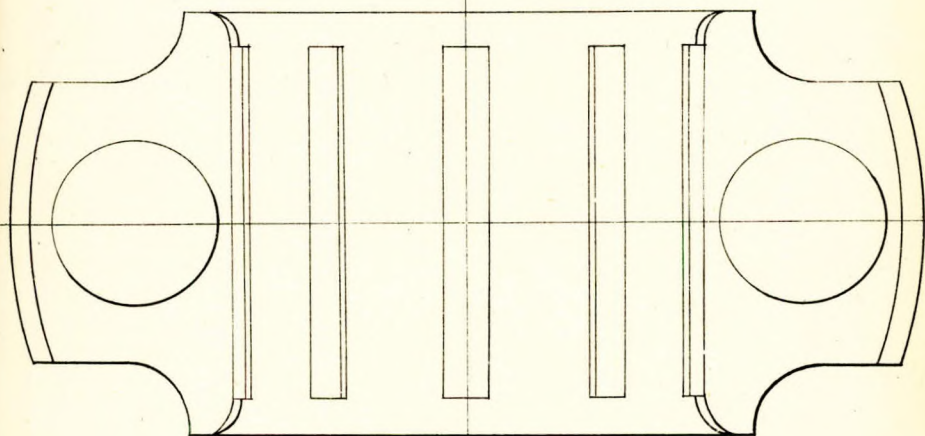
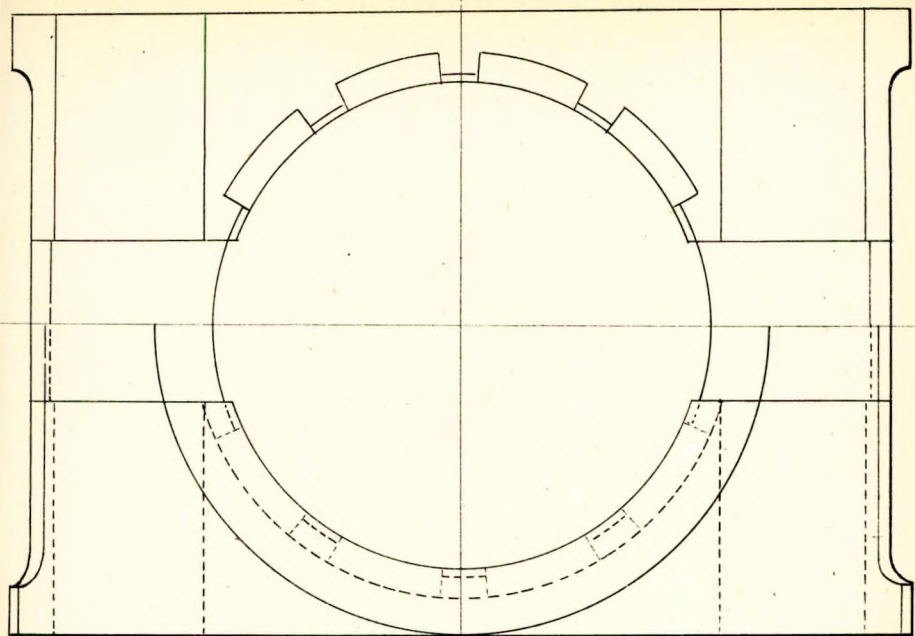
Mr. J. B. JOHNSON (Member) agreed that white metal did not run satisfactorily in conjunction with water, and that therefore it was not likely to answer in the place of *lignum vitæ* for outside bearings. But with regard to internal bearings, there were very few engineers now sailing with a good job, where the bearings were fitted with white metal, who would change it for gun metal, or any other metal. Where they had got a good bearing surface and good lubrication, there was nothing superior to white metal in his opinion.

Several other members gave their views in the same direction, Mr. ATKINS (Associate Member) and Mr. J. T. SMITH (Member of Council), each testifying to the great superiority of good white metal, and the absence of the trouble which had been experienced in the past with hot bearings, a change for the better which had been doubtless due to some extent to greater accuracy being exercised in the bedding of the bearings, and also in the better proportions of the surfaces.

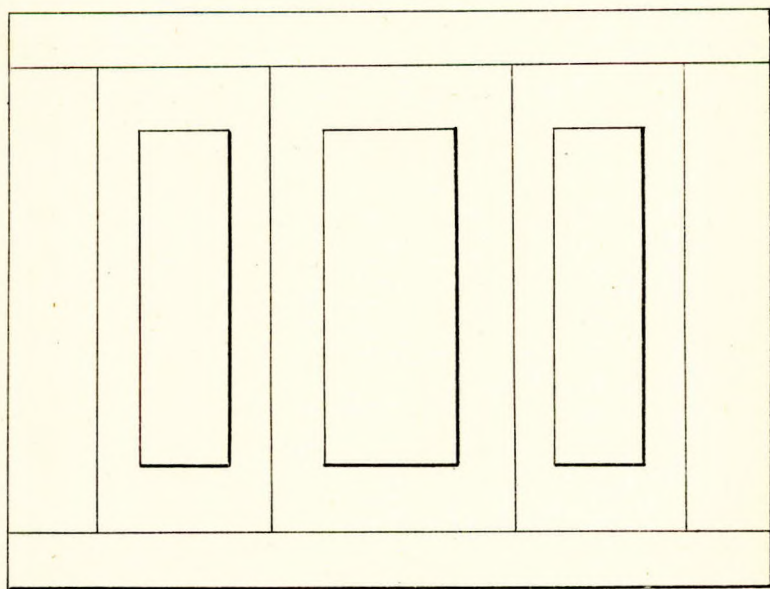
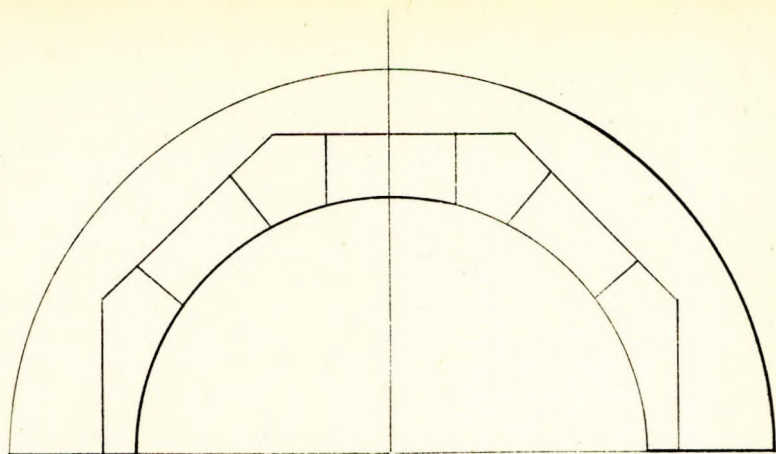
The CHAIRMAN, in closing the discussion, remarked upon the very interesting criticisms and experiences which the paper had elicited, and proposed a hearty vote of thanks to the author.

The motion was carried by acclamation, and at the instance of Mr. J. T. SMITH, seconded by Mr. WILSON, a hearty vote of thanks to the Chairman was also unanimously accorded.

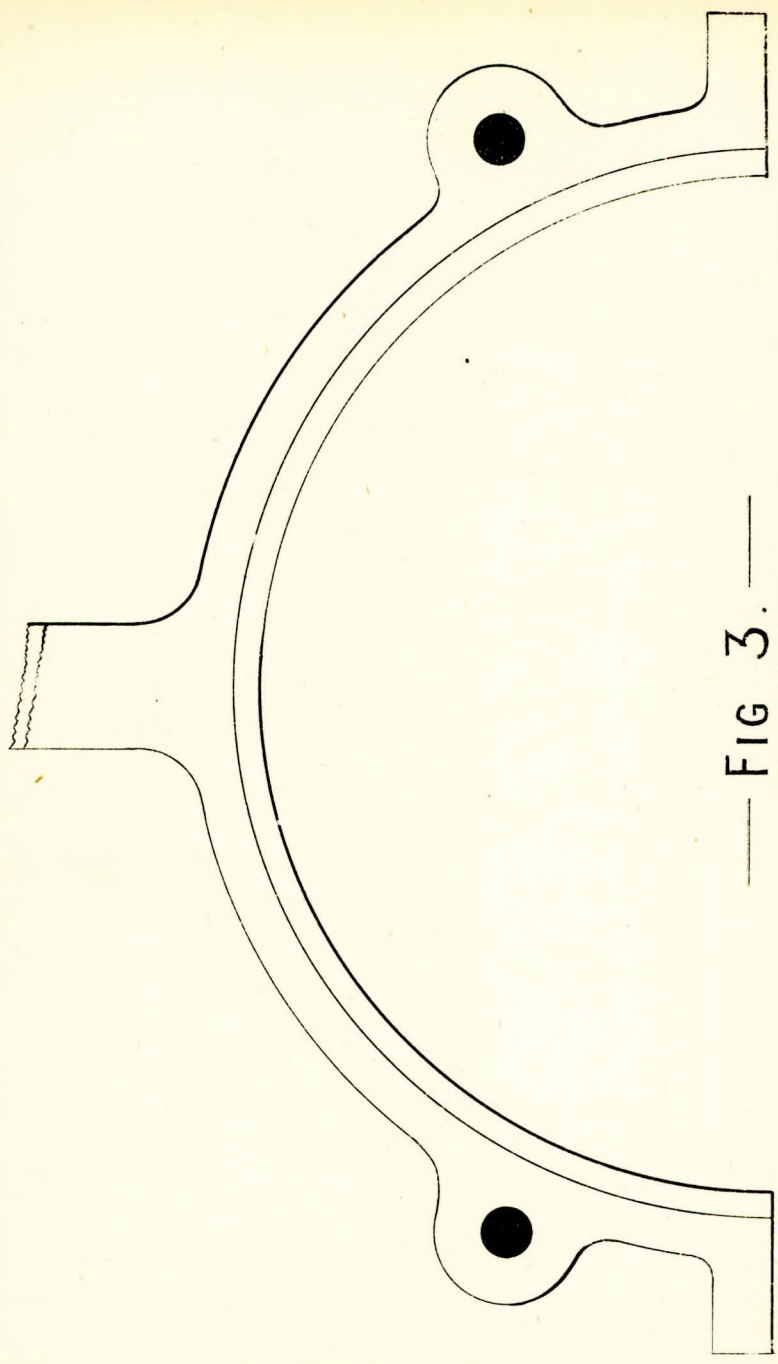
The HON. SECRETARY announced that this meeting concluded the present half of the session, and in the absence of any special reasons for reading a paper in the interim there would be no further meeting until September. The Annual Dinner of the Institute would, however, be held in the King's Hall, at the Holborn Restaurant, on June 17th, and it was hoped that there would be a large gathering of members to meet the President and the guests of the Institute.



— FIG. I. —



— FIG 2. —



— FIG 3. —

— FIG 4. —

