THE STANDARDISATION OF RIMS.

A NOTE ON THE STANDARDISATION OF RIMS FOR PNEUMATIC TYRES.

By T. H. WOOLLEN, M.I.Mech.E.
(MEMBER OF COUNCIL).

AN attempt to standardise wheel rims for motor cars was made some years ago, but failed because those most interested declined to consider a give-and-take policy; in other words each rim maker stood out for the acceptance of his own rim contours and measurements by the others, and none would give way.

In the present case the first aim was to find out exactly what the rim makers of England, France and Germany were supplying to our Home market as distinct from what they illustrated in their various catalogues—no working drawings or blue prints being available at that time.

Full sets (four to the set, and ranging from 650 mm. by 65 mm. to 965 mm. by 175 mm.) of all the well known makes were purchased in the open market by my firm, The Palmer Tyre, Ltd. In some few cases the sets were duplicated to prove certain points. That the rims as placed on the market and supposed to be of the same section varied very much from each other may be seen from the sections shown in Figs. 1 to 5. These are drawings of some of the actual rims as purchased in the open market.

WOOLLEN.

P P

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIGS. 1 TO 5.—Rims of nominally the same section but supplied by different makers.

FIG. 6.

FIG. 7.

FIGS. 6 AND 7.—105 mm. rims of nominally the same section supplied by the same makers.

FIG. 8.

Dotted line represents section of 105 mm. Rim purchased.
Full line " " " Steel Wheel purchased.

FIG. 9.

Dotted line represents Standard section of 105 mm. Rim.
Full line represents Steel Wheel of too deep section obtained by purchase.

P P 2

$65^M/M - 75^M/M$

FIG. 10.

$90^M/M$

FIG. 11.

FIG. 12.

Fig. 13.

Figs. 6 and 7, which were obtained under the same conditions, show that even the same makers could not be depended upon for the maintenance of the same section throughout their deliveries.

Fig. 8 shows that with steel wheels the variations might even

be greater still, while Fig. 9 shows how far this particular steel wheel differed from the standard which has now been adopted.

The total number of rims purchased was 412. From 117 of these rims 630 sections, maximum, minimum, and mean, were cut for distribution. Sixty-eight visits were made to tyre makers. The magnitude of the work of getting out averages will be under-

stood from the fact that 1,940 separate micrometer measurements were taken; 1,628 calculations were made, based on these measurements; 3,568 conversions were made from French into English

FIG. 15.

measurements (third decimal); 9,070 measurements were recorded, and the number of averages worked out totalled 1,934.

The measurements were summarised and compared with the

"standards" recognised by the different rim and tyre makers, and a method or series of proportions was sought which would provide a basis on which to design any section of rim.

FIG. 16.

In the main, the nominal sizes of rims advance in steps of 15 mm., namely, 90 mm., 105 mm., 120 mm., 135 mm., and this pointed to a possible basis.

It was hoped that it would be possible to make the width between the lips some proportion of the nominal size, but whilst in some cases the result approximated to the average dimensions, in others the difference was great enough to cause considerable difficulty with security bolts and even air tubes. It was therefore decided to accept practically the average measurements for the width.

It was then found that the average depths increased in steps of approximately 2 mm. for the smaller sections and 1 mm. for the larger sizes. For instance:—

The depth of the 65 mm. rim was found to be 10 mm.					
„	„	90 mm.	„	„	12 mm.
„	„	105 mm.	„	„	14 mm.
„	„	120 mm.	„	„	16 mm.
„	„	135 mm.	„	„	17 mm.
„	„	150 & 175 mm.*	„	„	18 mm.
					2 mm. increase.
					1 mm. increase.

* NOTE.—The 150 mm. and 175 mm. are of identical section.

The depths shown above were thereupon taken as a basis, and it will be observed that the length of heel, radius of heel and length of sole are all proportionate to the depth, so that provided the width and depth be given it is an easy matter to design a rim which shall in every other respect be proportionate to the measurements standardised.

At the end of 1911, the Society of Motor Manufacturers and Traders divided the Tyre and Accessory Section into two, forming the tyre-makers only into a Tyre Section or Committee. The first meeting was held in January, 1912, when the first question raised was the standardisation of rims. All the above information, which had been collected by the experimental department of the Palmer Tyre, Ltd., was placed at the disposal of the new Tyre Committee, together with a set of drawings (see Figs. 1—9) showing the variations in rims intended for the same size of tyre, together with sample sections cut from rims as previously mentioned. It will be seen that in some cases these variations in individual makes were very great, showing that the standardisation of rims was a pressing necessity.

The Committee, appreciating the amount of work which had already been done, and which was freely placed at the disposal of the members, decided to ask every tyre maker to submit drawings of rims which they considered most satisfactory for use

S.M.M.T. STANDARD RIMS, PROPORTIONS.

SIZE	WIDTH A	DEPTH V	EXTREME WIDTH E $A + 1.4V$	LENGTH OF HEEL D $.7V$	RADIUS OF HEEL H $.326V$	LENGTH OF SOLE K $1.09V$	RADIUS OF SOLE S	RADIUS OF ANCHORAGE N
65 (or 75)	38.5	10	52.5	7.0	3.26	10.9	35.79	1.75
90	51.5	12	68.3	8.4	3.91	13.08	42.92	2.0
105	62.5	14	82.1	9.8	4.56	15.26	50.05	2.0
120	67.5	16	89.9	11.2	5.22	17.44	57.32	2.25
135	77.0	17	100.8	11.9	5.54	18.53	60.82	2.5
150	90.5	18	115.7	12.6	5.86	19.62	64.42	2.5
175	90.5	18	115.7	12.6	5.86	19.62	64.42	2.5

ALL DIMENSIONS ARE IN MILLIMETRES.

FIG. 17

in conjunction with their respective tyres. The various makers, great and small, with one exception, sent in these drawings, from which it was at once seen that their ideas as to the most suitable

rim differed in some cases very greatly. After several consultations, and having grasped the desires of the members, I submitted

S. M. M. T. STANDARD RIMS.

LIMITS OR TOLERANCES ALLOWABLE

FIG. 18.

a drawing of a formula and distributed blue prints showing the contour of all sizes of rims worked out on this formula.

In carrying through this work, I always had the idea in my

mind that standards could be made on a mathematical progression, which would not cause a single tyre mould to be discarded, and I have since been informed that this happy result has been attained.

At this stage fractions of a millimetre were talked about as if they were inches, but, feeling sure that, if the tyre makers could see sections of their tyres fitted to the proposed contours, the

FIG. 19.—Gauge for Standard 65—75 mm. Rims.

ground would be cleared of opposition, I produced hand-made rim sections, standard maximum and minimum, from $\frac{1}{4}$ in. metal and interviewed all the tyre makers who were taking an interest in the proposals. Although the sections fitted all tyres, it was considered that some alteration in contour—not measurement—was required to meet the wire wheel makers, so a second formula was produced and again submitted, together with a further set

of hand-made rim sections. These were generally approved, but in the cases where I found opposition I purchased samples of the objector's tyres and first proved to myself that the rims were correct, and then set out to overcome the opposition. This work was very slow, necessitating many repeat visits, but, as in every case I was met as one trying to benefit the great industry, it was pleasurable.

FIG. 20.—Gauge for Standard 90 mm. Rims.

At a period when only two tyre makers remained outside, I was unfortunate enough to meet with an accident which laid me aside for some five months, and the Chairman of the Committee, Capt. J. Sealy Clarke, kept up the diplomatic relations. On recovery, I suggested that, having proceeded so far, there was only one course to pursue—it was useless to discuss fractions of a millimetre. I therefore proposed that I should have a rim of each section, 65 mm., 90 mm., 105 mm., 120 mm., 135 mm., and 175 mm.,

Fig. 24.—Gauge for Standard 150 and 175 mm. Rims.

WOOLLEN.

90

Expert and Technical Committee of the Royal Automobile Club, the Engineering Standards Committee (Sub-Committee H. on wheels and dimensions of tyres), and approved by them.

They were also submitted to the Union Internationale des Constructeurs d'Automobiles on January 16th, 1914, and were unanimously accepted by that body as the standards of Europe.

The Council of the Society decided that a set of sectional gauges for 65 mm., 90 mm., 105 mm., 120 mm., and 135 mm., together with a steel tape for each of the 19 circumferences, should be presented to every rim, tyre, or chassis maker among the members of the Society. The order was placed with Messrs. H. Terry & Sons, Ltd., of Redditch, who undertook to make the gauges to a tolerance of 0.002 in. plus and minus, and the tapes to 0.005 in. plus and minus.

In the past several sectional gauges have been used to check the different measurements of the same rim; it will be noticed that the accepted sectional gauges are in one piece, and I have drawn up the following notes to enable them to be used properly.

In order to prove whether a motor rim is correct to the S. M. M. T. standard measurements it must be gauged for:—(1) cross section; (2) circumference.

To enable this work to be carried out expeditiously and with certainty, the set of sectional gauges and the circumferential gauges (steel tape) issued by the Society of Motor Manufacturers and Traders should be used.

It will be obvious that it is impossible to make rims commercially which will absolutely agree with the standard measurements, and to allow for the slight variations which must necessarily occur in manufacture, certain limits or tolerances have been fixed. The gauges and tapes are arranged to show whether a rim does or does not come within these prescribed limits.

In the case of the cross section it is necessary to check:—(1) the width between the lips; (2) the depth; (3) the space for the bead under the lips.

The gauge, Fig. 25, has two portions marked "width," the part marked "to go" being 1 mm. under the standard width, and the part marked "not to go" being 1 mm. over the standard width. If a rim is to be accepted it must be sufficiently wide to allow the "to go" portion to enter, yet not wide enough to permit the entrance of the "not to go" portion. The depth is tested in a similar way, whilst to ensure that there is sufficient room for

both of the tyre beads it is necessary to see that the lips of the rim touch the "to go" part of the gauge at "A" and "B" alternately.

It is important that the section of each rim should be tested all round the circumference, because rims get dented in transit and are often crushed or dented when run with the tyre deflated.

Having checked the cross section of the rim as illustrated in the drawings (Figs. 26 to 34), it is now necessary to test the circumference by means of one of the steel tape circumferential gauges.

Provided that a rim is not more than 3 mm. over or 3 mm. under the standard circumference it may be accepted. For instance, the standard circumference of the 815 by 105 mm. rim

FIG. 25.—Sample Gauge.

is 1,924 mm., but a rim not more than 1,927 mm. could be passed, or a rim not less than 1,921 mm. One end of the tape has an oval-shaped opening on which are two marks representing respectively the maximum and minimum circumferences. After laying the tape carefully round the bed of the rim (in centre), the other end should come somewhere between these two marks as in Fig. 35, otherwise the rim is too large or too small, as the case may be, and must be rejected.

If a rim be incorrect in any one or more of the foregoing respects it should be immediately rejected. Otherwise the user may have serious tyre trouble, responsibility for which will be repudiated by the tyre manufacturer.

Q Q 2

Gauging Width.

FIG. 26.—**Correct Rim.** Gauge will not enter when at right angles to edge of Rim.

FIG. 27.—**Incorrect Rim.** Gauge enters too freely when at right angles to edges of Rim. Rim too wide,

Gauging Depth.

FIG. 28.—**Correct Rim.** Gauge cannot be brought into vertical position.

FIG. 29.—**Incorrect Rim.** Gauge can be brought to vertical position. Rim too deep.

Gauging Width and Depth.

FIG. 30.—**Correct Rim.** Gauge will enter at right angles to edges of Rim and in vertical position.

Gauging Width.

FIG. 31.—**Incorrect Rim.** Gauge will not enter at right angles to edges of Rim. Rim too narrow.

Gauging Depth.

FIG. 32.—**Incorrect Rim.** Gauge cannot be brought into vertical position. Rim too shallow.

Gauging Space under Lips.

FIG. 33 — **Correct Rim.** Gauge will touch Rim at A when at right angles to edges of Rim and in vertical position. If gauge will touch at B in like manner, the Rim has sufficient space for beads.

FIG. 34. — **Incorrect Rim.** Gauge will not touch Rim at A — not sufficient space for beads.

Gauging the Circumference.

FIG. 35.—**Correct Rim.** Plain end of tape shows between the two marks. If the end of the tape comes outside either of the two marks the Rim is either too large or too small.

A separate gauge is used for checking each sectional size of rim, viz., 65 mm., 90 mm., 105 mm., 120 mm., 135 mm., 150 and 175 mm. Each sectional size of rim is, however, made in several circumferences, and a separate steel tape is therefore supplied for each circumferential size.

LIST OF CIRCUMFERENCES STANDARDISED.

65 or 75 mm.	105 mm.	135 mm.
650 mm.	765 mm.	895 mm.
700 „	815 „	935 „
750 „	875 „	
	915 „	
90 mm.	120 mm.	150 mm.
710 mm.		900 mm.
760 „		1000 „
810 „	820 mm.	
870 „	850 „	
910 „	880 „	
1010 „	920 „	
		175 mm.
		915 mm.
		965 „

The standardisation of rims will be of inestimable advantage to the rim maker, the tyre maker, the chassis maker, and the private owner. The rim maker will only have one section to produce for any given size, and he will therefore be able to make great savings in his works owing to the abolition of the multiplicity of dies, rolls or press tools which have hitherto been necessary. The tyre maker will benefit in that, when getting out a new tyre, he will have a definite base already decided for him, and he will share enormously in the benefit which will be elaborated later in connection with the private owner. The chassis maker will be able to purchase his rims more cheaply owing to the reduction in the expenses of production by the rim maker, and he will find that many complaints that individual cars are hard on tyres have disappeared. The private owner will benefit even more still, as he will be sure of being able without any difficulty to replace a damaged rim by one which will be certain to fit his tyres, or he will be able to fit a new tyre of the same or other make in the certainty that it will be of suitable section and size for any of his rims. Above all this,

he will benefit from the very fact that the standards which have been set up are such that they will really fit his tyres and therefore enable the tyres to wear very much better than they would do with a rim of unsuitable size or section. That this is not an imaginary claim can be seen on reference to the diagrams, Figs. 36 to 41, where the effect on tyres of badly fitting rims is clearly shown. For instance, Fig. 36 shows a tyre before inflation fitted in a rim which is too deep in section, and as will be seen in Fig. 37

FIG. 36.

when this tyre is inflated the inner edge of the bead will be pressed down by the tube, which will cause a stretching action of the fabric at A with a corresponding slackness at B; the stretching action on the fabric alone is, of course, very bad for the tyre, while the slackness at B will cause a rubbing action against the lips of the rim which often shows itself in the form of a cut right round the tyre. If, however, this tyre should be run in an under-inflated condition, a still more serious state of affairs will develop, as indicated in Fig. 38. Here the rocking

motion at A accelerates the cutting action round the rim, while, in addition, the tube is liable to be cut by the action of the edge of the bead at B; this action is taking place on one side or the other at all corners.

In Fig. 39 the effect of the rim being too shallow is shown; the beads cannot get properly under the lip, so that in that part of the tyre which is at any given moment compressed by the weight of the car, the beads tend to lift against the tube at B from the

FIG. 37.

point A, which acts as a fulcrum. This will allow the tube to get under the edge of the tyre at B and be nipped, or at all events the movement of the tyre at this point will bring about a chafing action on the tube. Figs. 40 and 41 show the injurious effect on the tyre of a rim which is either too wide or too narrow between the lips. In Fig. 40 the rim is too wide, so that the security bolts when hard down cannot grip the beads and so are useless, and the tyre will creep and be cut by the rim. If the rim is too narrow, as in Fig. 41, the security bolts cannot be screwed

home, and the flat part of the head of the bolt will not rest on the surface of the rim as it ought to do. This leaves a recess under the head of the bolt into which the tube will be forced when

FIG. 38.

inflated, and the edge of the head will almost inevitably cut the tube under these circumstances.

Thus it will clearly be seen that any inaccuracy in the size or

FIG. 39.

shape of the rim must have a very serious effect on the durability of the tyre, and the above causes are only examples of what may happen and of what has, in fact, been happening with the very varied rim sections which have hitherto been supplied to the

motorist. During the course of the investigations which have been necessary in connection with this work of standardisation, a very large number of causes of trouble with tyres which the tyre makers had hitherto been quite unable to account for, have been clearly traced to faulty rim sections, and I have no hesita-

FIG. 40.

tion in saying that when rims are all made to the standards shown in the course of these notes, troubles of this nature at all events will be entirely eliminated.

In conclusion, I wish to place on record my great appreciation of the able assistance given me by my Palmer Tyre friends, Mr.

FIG. 41.

T. Sloper, Mr. H. Parsons and Mr. W. E. F. Currer, and the kind consideration given to all my proposals by the chiefs of the tyre companies, and last, but by no means least, the Chairman of the Tyre Committee, Capt. J. Sealy Clarke, who has always supported me in a very generous spirit.