The bracket contains the sum of sines of angles in A.P.
1st angle $=(w/v_{so})\,l_o$; common difference $=(2w/v_{so})\,l_o$; number of terms $=n/2$.
Hence the sum of the series
$$=[\sin (w/v_{so})\,l_o\,\{\,1+\tfrac{1}{2}\,(n/2-1)\times 2\,\}\,\sin (w/v_{so})\,(n/4)\,2l_o]/\sin (w/v_{so})\,l_o$$
$$=\{\,\sin^2 (w/v_{so})\,(n/2)\,l_o\,\}\,/\,\{\,\sin (w/v_{so})\,l_o\,\}\,.$$
From this, the unital strain is
$$e_n=-(2C/v_{so})\cos (w/v_{so})\,l_o\,(1-x/l_o)\,\{\,\sin^2 (w/v_{so})\,(nl_o/2)/\sin (w/v_{so})\,l_o\,\} \qquad (13)$$
Let the period of the S.H.M. be m times the period of the spring vibration, then since the period of the spring vibration is $2\,(l_o/v_{so})$
$$(2l_o/v_{so})\,m=2\pi/w$$
$$\therefore wl_o/v_{so}=\pi/m \qquad (14)$$
Substituting this in equations (12) and (13) gives
$$V_n=C\sin (\pi/m)\,(1-x/l_o)\,\{\,\sin n\,(\pi/m)/\sin \pi/m)\,\} \qquad (15)$$
and
$$e_n=-(2C/v_{so})\cos (\pi/m)\,(1-x/l_o)\,\{\,\sin^2 (n/2)\,(\pi/m)/\sin (\pi/m)\,\} \qquad (16)$$
If m is greater than 1, $\sin \pi/m$ cannot be zero for finite values of m, so the maximum amplitude is limited. The maximum possible value of V_n is
$$V_n=C\,\{\,\sin (\pi/m)\,(1-x/l_o)\,\}\,/\,\{\,\sin (\pi/m)\,\}\,.$$
It is obvious that when m is greater than 2, the speed of wire movement can never exceed C the maximum velocity of the S.H.M.

To get a just basis of comparison for unital strain, the amplitude of the S.H.M. should be independent of frequency. This condition is fulfilled by writing $A/m=C$ in equation (16). If m is greater than 1, the maximum possible value of unital strain is
$$e_n=-(2A/mv_{so})\,\{\,\cos (\pi/m)\,(1-x/l_o)\,\}\,/\,\{\,\sin \pi/m\,\}\,.$$
It can be shown from this that the maximum unital strain decreases as m increases.

Hence if m is greater than 1, that is, if the period of the S.H.M. is greater than the period of the spring vibration, the speed of wire movement and the unital strain are not excessive, no matter how long the end movement is continued.

The critical conditions arising from resonance are found when the period of the S.H.M. is an exact submultiple of the period of vibration of the spring, that is, when $m=\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$, etc. When this occurs, it can be shown from equation (15) that V_n has the following values with continued motion of the end of the spring.

n	2	4	6
V_n	$2C\sin (\pi/m)\,(1-x/l_o)$	$4C\sin (\pi/m)\,(1-x/l_o)$	$8C\sin (\pi/m)\,(1-x/l_o)$

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$$16C\sin (\pi/m)\,(1-x/l_o).$$

The effect gradually increases, indicating that this is the condition for severe surge.

CORRESPONDENCE

To the Editor of the JOURNAL OF THE ROYAL AERONAUTICAL SOCIETY.

Dear Sir,—I notice that Colonel Lahm, in his recent Wilbur Wright Lecture, refers to the Wright brothers as the " inventors of the airplane " (*sic*).

The achievements of the Wright brothers in the field of artificial flight have always been regarded with the utmost admiration in this country. Their fame, as the first to produce a power-driven, man-lifting aeroplane is undying, and the ingenuity, skill, courage and patience they displayed in their undertaking are object lessons to us all.

But they are not the inventors of the aeroplane. If it had been possible for the Wright aeroplane engine to have been produced in the year 1848, the English-

man, Stringfellow, could have produced the man-lifting aeroplane and human flight would have followed inevitably. Sir George Cayley was acquainted with the properties of the aeroplane even before Stringfellow.

The Wright brothers are, unquestionably, the pioneers " par excellence " of the man-lifting aeroplane and will be always held in honour for their achievements, but I am sure that they would be the first to disclaim the title of inventors of the aeroplane.

Yours faithfully,

W. O. MANNING, F.R.Ae.S.

31st May, 1933.

REVIEWS

Lubricating and Allied Oils

By Elliott A. Evans, F.C.S., M.I.P.T. Published price 9/6.

Mr. Elliott is chief chemist to Messrs. C. C. Wakefield and Co., Ltd., and this book, as might be expected, contains a large amount of information on oils. It starts with some interesting information on the history of the subject, contains chapters on Physical Tests, Chemical Tests, Decomposition of Petroleum, Oleography, Selection of Lubricants, etc.

As might be expected, much of the information is of more interest to the chemist rather than to the engineer, but the latter will be all the better for full information on such tests as viscosity tests and flash point as he will be better able to judge the value of such tests on the oils that he is using. Chemical tests are of less direct interest, but they are of importance when such matters as sludging may cause trouble, or in connection with deposits in the cylinders or on the pistons of internal combustion engines, etc. The only question that will arise is how far the working conditions can be considered as being represented in the laboratory tests.

The engineer will naturally turn with interest to the chapters on the employment of oil. These chapters are, perhaps unavoidably, less informative than might be hoped. The reason seems to be that lubrication is almost entirely an experimental science and that no satisfactory theory as to why one chemical liquid lubricates and why another does not has ever been developed. That it has something to do with the shape and size of the molecule seems certain, but the exact connection has yet to be traced. Viscosity is of unquestionable importance, but many viscous liquids are useless as lubricants.

Oils for aero engines are discussed in a short paragraph, and it is clear that the author prefers an oil containing castor for this purpose owing to the high loads on the bearings and the great reliability required. His remark that a plain mineral oil causes more dirt in an engine than castor oil is not consistent with earlier experience. Those who have had to run them will remember the caking caused by castor oil on engines of the Gnome type. Mineral oils have been extensively used in aero engines in America, with satisfactory results. They have the advantage of being cheaper than oils containing castor and are more easily obtainable in out of the way places. It is inconvenient to be tied to a particular brand of oil now that aeroplanes can fly to all parts of the world.

The book is one that should be read by all users of lubricants.

Simplified Aerial Navigation

J. A. McMullen. Chas. Griffin, London. 1933. 5/-.

This is an excellent little book which deals in a clear and comprehensive way with Aerial Navigation by Dead Reckoning. Compass deviations are explained in the opening chapters and the methods of adjusting these instruments and of