|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| GF feet. | AB inches. | Magnifying. | Extending | ACB. |
| 1 | 6,8 | 42,6 |  | 0  24.53 |
| 2 | 9,3 | 77,8 | 8,8 | 18.23 |
| 3 | **11,2** | 112,4 | 10,6 | 15.18 |
| 4 | 12,8 | 146,6 | 12,1 | 13.24 |
| 5 | 14,2 | 180,4 | 13,4 | 12.04 |
| 6 | 15,5 | 214,2 | 14,6 | 11.05 |
| 7 | 16,6 | 247,7 | 15,7 | 10.18 |
| 8 | 17,7 | 281,3 | 16,8 | 9.40 |
| 9 | 18,8 | 314,6 | 17,7 | 9.08 |
| **10** | 19,8 | 347,7 | 18,6 | 8.42 |
| **I I** | 20,7 | 380,9 | 19,5 | 818 |
| **12** | 21,5 | 414,6 | 20,4 | 7.58 |
| **15** | 24, | 513,6 | 22,7 | 7,09 |
| 18 | 26,2 | 612,3 | 24,7 | 6.33 |
| **2 I** | 28,3 | 711,2 | 26,6 | 6.05 |
| 24 | 30,2 | 810,1 | 28,5 | 5.42 |
|  |  | ED in all is = | 1,5. |  |

The two last columns are conſtructed on the following conſiderations : We conceive the hearer placed within the cylindrical ſpace whoſe diameter is BA. In this ſituation he receives an echo coming apparently from the whole ſur­face TGV ; and we account the effect of the trumpet as equivalent to the united voices of as many mouths as would cover this surface. Therefore the quotient obtained by di­viding the ſurface of the hemiſphere by that of the mouth­piece will express the magnifying power of the trumpet. If the chords *g*E, *g*T, be drawn, we know that the ſphe­rical ſurfaces TgV, EgD, are reſpectively equal to the circles deſcribed with the radii T*g,* Ey, and are therefore as Tg2 and Eg2. Therefore the audibility or the trumpet, when compared with a ſingle voice, may be expreſſed by Tg2/Eg2.

. Now the ratio of T*g2* to Eg2 is eaſily obtained. For if Ef be drawn parallel to the axis, it is plain that Bf = (BA — ED)/2, and that Ef is to fB as radius to the tangent of BCF ; which angle we may call *a.* Therefore a = (*y — m)/2x,* and thus we obtain the angle *a.* But if the radius CE be accounted 1, Tg is = √ 2, and Eg is *= 2* sin. a/2. Therefore = Tg/Eg = √2/(2 sin. a/2), and the magnifying power of the trumpet is = , ≡ —. The numbers, therefore, in the third column of the table are

each = .

**r a**

2 sin.1—

a

But the more uſual way of conceiving the power of the trumpet is, by conſidering how much farther it will enable us to hear a voice equally well. Now we ſuppoſe that the audibility of sounds varies in the inverſe duplicate ratio of the diſtance. Therefore if the diſtance d, at which a man may be diſtinctly heard, be increaſed to *z,* in the propor­tion of EG to Tg, the sound will be leſs audible, in the proportion of T*g2* to EG2. Therefore the trumpet will be as well heard at the diſtance *z* as the ſimple voice is heard at the diſtance *d.* Therefore will expreſs the *tending power* of the trumpet, which is therefore = ∙ ~ 2 sin. - ’2

In this manner were the numbers computed for the fourth column of the table.

When the angle BCA is ſmall, which is always the caſe in ſpeaking trumpets, we may, without any ſenſible error, consider EG as = ED/2 = m/2. And TG = TC × √2, = AB/2, AB *y rnk. . f* √ 2 = -7-^ = ~τ~∙ This gives a very easy computation of the extending and magnifying powers of the trumpet.

The extending power is = *^∕ 2~*Λ∙

The magnifying power is = 2

We may alſo eaſily deduce from the premiſes, that if the mouth-piece be an inch and a half in diameter, and the length x be meaſured in inches, the extending power is very nearly *— V ∙∣ x* ∣ and the magnifying power = 8/3*x.*

An inconvenience ſtill attends the trumpet of this construction. Its complete audibility is confined to the cylin­drical ſpace in the direction of the axis, and it is more faintly heard on each side of it. This obliges us to direct the trumpet very exactly to the ſpot where we wiſh it to be heard. This is confirmed by all the accounts we have of the performance of great ſpeaking trumpets. It is evident, that by lengthening the trumpet, and therefore enlarging its mouth, we make the lines TBt and VAv expand (fig. 4.) ; and therefore it will not be so difficult to direct the trumpet.

But even this is confined within the limits of a few degrees. Even if the trumpet were continued without end, the sounds cannot be reinforced in a wider ſpace than the cone of the trumpet. But it is always advantageous to in­creaſe its length ; for this makes the extreme tangents em­brace a greater portion of the sonorous ſphere, and thus increases the sound in the ſpace where it is all reflected. And the limiting tangents TB, VA, expand ſtill more, and thus the ſpace of full effect is increaſed. But either of theſe augmentations is very ſmall in comparison of the aug­mentation of ſize. If the trumpet of fig. 5. were made an hundred times longer, its power would not be increaſed one half.

We need not therefore aim at much more than to pro­duce a cylindrical ſpace of full effect; and this will always be done by the preceding rules, or table of conſtructions. We may give the trumpet a third or a fourth part more length, in order to ſpread a little the ſpace of its full effect, and thereby make it more eaſily directed to the intended object. But in doing this we muſt be careful to increaſe the diameter of the mouth as much as we increaſe the length ; otherwiſe we produce the very oppoſite effect, and make the trumpet greatly inferior to a ſhorter one, at all diſtances beyond a certain point. For by increasing the length while the part CG remains the ſame, we cauſe the tangents TB and VA to meet on ſome diſtant point, be­yond which the sound diffuſes prodigiously. The construction of a ſpeaking trumpet is therefore a problem of ſome nicety ; and as the trials are always made at ſome considerable diſtance, it may frequently happen that a trumpet, which is not heard at a mile’s diſtance, may be made very audible two miles off by cutting off a piece at its wide end.

After this minute consideration of the conical trumpet, we might proceed to conſider thoſe of other forms. In par­ticular, the hyperbolic, propoſed by Caſſegrain, and the