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(71) Applicant: **Eggleton, Frederick**
10 Every Street
Nelson Lancashire BB9 7LZ(GB)

Applicant: **Fenwick, Constance Clare**
The Stone House Poole in Wharfdale
West Yorkshire, LS2I IJZ(GB)

Applicant: **Trafford, Judith Caroline**
4 Betton Rise East Ayton
Scarboruogh North Yorkshire, YOI3 9HU(GB)

(72) Inventor: **Eggleton, Frederick**
10 Every Street
Nelson Lancashire BB9 7LZ(GB)
Inventor: **Fenwick, Constance Clare**
The Stone House Poole in Wharfdale
West Yorkshire, LS2I IJZ(GB)
Inventor: **Trafford, Judith Caroline**
4 Betton Rise East Ayton
Scarboruogh North Yorkshire, YOI3 9HU(GB)

(54) Axial compressor rotor blades specifically shaped to confine the existence of the energy designated esp. to within their axial working length defined by the dimension L (I.3).

(57) An AXIAL FLOW AIR COMPRESSOR DESIGN SYSTEM to produce a compressor in which AIR SPRING ENERGY DESIGNATED Esp(1.2). which is generated between PLANES 1. & 2. is fully used between PLANES 2. & 3. The the blade arc width being such that the blades give full static coverage to its OUTLET PLANE 4. The lamina air flow through each FULL STAGE being as follows:-

PLANE 1.- $W(1.3). + (va1^{2}. + vcm1^{2}.)/2.g. + y.p1.v1./(y-1.). =$

PLANE 2.- $W(2.3). + (va2^{2}). + vcm1^{2}.)/2.g. + y.p2.v2./(y-1.). + Esp(1.2). =$

Plane 3.- $(va3^{2}. + vcm1^{2}.)/2.g. + y.p2.v2./(y-1.). =$

PLANE 4.- $(va3^{2}. + vcm1^{2}.)/2.g. + y.p2.v2./(y-1.).$ - End of Rotor. Start of STATORS.

PLANE 5.- $y.p2.v2./(y-1.). + (va3^{2}. + vcm1^{2}.)/2.g. =$

PLANE 6.- $y.p2.v2./(y-1.). + (va6^{2}. + vcm6^{2}.)/2.g.$

PLANE 7.- ALL VALUES EXACTLY AS ON PLANE 6.

PLANE 8.- $y.p8.v8./(y-1.). + (va8^{2}. + vcm8^{2}.)/2.g.$

NOTE:- p. = Air pressure EXCLUSIVE of that due to the presence of Esp(1.2) at PLANE 2.

WHILE NOT BEING STIPULATED, the Mean Mass Flow Values have been arranged such that sets of lamina values become also Mean Mass Flow Values, for EXAMPLE $Esp(1.2)_{r=x/2}. = m\ Esp(1.2)_{r=x}.$ & $va2_{r=x/2}. = m\ va2_{r=x}.$ etc.

Also:- $va8_{r=Max.No./2}.$ and $vcm8_{r=Max.No./2}. = va1_{r=Max.No./2}.$ and $vcm1_{r=Max.No./2}.$ and are constant values for all stages of a compressor.

And $(va6_{r}./vcm6_{r}.) = (va7_{r}./vcm7_{r}.) = (va8_{r}./vcm8_{r}.)$.

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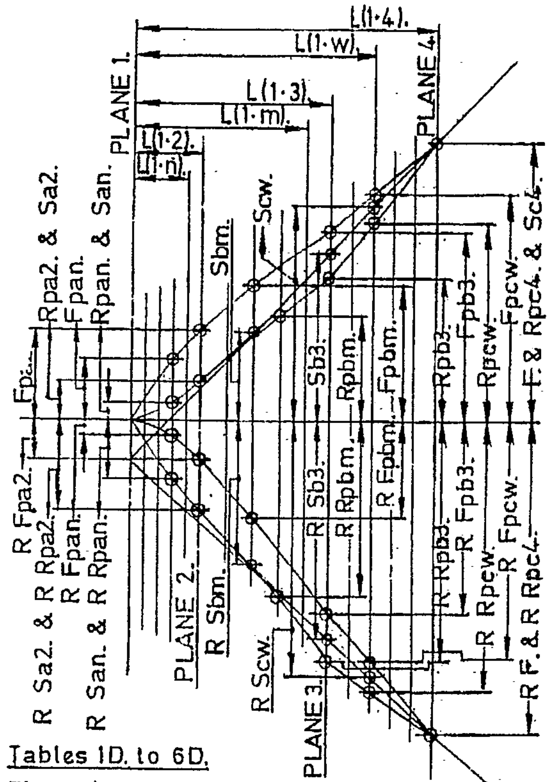
Figure 1. of 1. Sheet.



Tables 1D. to 6D.

Dimensions used to produce blade profile & air flow path on streamline surface.

Not to scale

F Eggleton

AXIAL COMPRESSOR ROTOR BLADES SPECIFICALLY SHAPED TO CONFINE THE EXISTENCE OF THE ENERGY DESIGNATED ESP. TO WITHIN THEIR AXIAL WORKING LENGTH DEFINED BY THE DIMENSION L(I.3).

Multi stage axial flow compressors are used to effect the compression of large air mass flows to high pressures. Each individual stage comprising of a ring of rotor blades followed with running clearance between by a ring of stator blades. The rotor blade ring is required to add kinetic energy alone or kinetic and heat energy to the air while the stator ring of blades change the surplus whirl velocity kinetic energy into heat energy. The blade shape and speed of rotation being arranged also to maintain a constant value axial air velocity along all streamlines but not necessarily all of the same value.

Thus the difference between each stage inlet and outlet plane is that at the outlet plane of a stage the area of flow is reduced relative to the reduced specific volume of the air and the temperature increased relative to the energy added. A truly designed rotor blade is thus only required to add two forms of energy to the air thus:-

Kinetic: - $(va4^2. - va1^2.)/2.g.$ & Heat: - $C.(T4. - T1.)/(y-1.)$.

Where va4. & va1. = Outlet and Inlet Air Whirl Velocities.

Where T4. & T1. = Outlet and Inlet Air Temperatures.

Where g. = Acceleration Rate due to Gravity.

Where y. = Ratio of the two Specific Heats of Air.

Where C. = The Gas Constant for Air.

However the use of circular arc cambered aerofoil sections for the rotor blades in engines to obtain higher output has resulted in the blades allowing a third form of energy intermingled with the heat energy to pass the rotor outlet plane. This third form of energy for which I have used the definition letters Esp. (Air Spring Energy) is generated together with the heat energy between the Inlet Plane and Plane 2. whichis the plane where the blade attains its maximum thickness and if unused between Plane 2. and the Outlet Plane cannot be changed by the following Stators into Heat Energy. The only way this unwanted energy can dissipate itself is by causing the blades it passes between and other components (Combustion chambers etc.) to vibrate. A result of which is that they either fail because of fatigue or have to be given a limited "service life" to prevent them failing.

The unwanted form of energy Esp. is made to exist whenever the plane which divides the airflow into two equal mass flow halves is made to move away from its normal central position and to illustrate this:-

Consider a cylinder containing one pound of air at normal temperature, pressure and specific volume divided by a piston in the mid position into two equal halves. The piston being integral with a rod in the axial position which extends through both cylinder end plates fitted with air seals, the only constraint to axial movement being the air at each side of the piston. Secure the cylinder to prevent axial movement and then by force move the piston from its central position the distance D.

If one now calculates the specific volume of the two halves, add together and divide by two to get the mean value it will be seen to be unchanged from its original value. Calculate the temperature similarly, add and divide and again no change. Calculate the pressure similarly, add and divide and this time the mean air pressure is greater than the original value, and this is the only indication of the presence of the energy Esp. When the piston is released it will spring back and beyond the central position and oscillate until the energy is dissipated in the form of heat caused by friction between the rubbing surfaces.

In the compressor it will be the stators which are caused to vibrate and the heat generated will be at the root of the blades the strumming of which will also cause unwanted sound. The heat causing the degeneration of the blade material and thus failure at a much lower stress than that which it was designed to withstand. This form of energy exists in both piston and turbine motivated engines but whereas in the former it exerts itself in line with the gas flow and is thus innocuous in the latter is transverse to it and malignant.

Thus it will be seen that if the Esp(1.2). is used to help drive the second portion of the rotor blade ring, besides being more efficient in compressing the air will be better from a structural point of view.

A specific embodiment of the invention is thus rotor blade rings, each blade of which has a precisely calculated shape such that the energy Esp(1.2). generated in the air through the first portion of the blade ring is constructively used to help drive the second portion thus eliminating itself from the air flow. The Bernoulli type equation which identifies the various forms of energy involved in the action between the inlet plane (Plane 1.) and the plane which terminates the working length of the blade (Plane 3.) is given below:-

(Plane 1.) $W(1.3). + (va1^2. + vcm1^2.)/2.g. + y.C.T1./(y-1.). =$

(Plane 2.) $W(2.3). + (va2^2. + vcm1^2.)/2.g. + y.C.T2./(y-1.). + Esp(1.2). =$

(Plane 3.) $(va3^2. + vcm1^2.)/2.g. + y.C.T2./(y-1.)$.
Where W(1.3). = The energy per unit air mass flow required to drive the Plane 1. to 3. portion of the rotor blade ring.
Where W(2.3). = The energy - Ditto - Plane 2. to 3. - Ditto.
Where y., C., g., T., and Esp(1.2). are as previously stated.
Where vcm1. = Axial Air Velocity.

The above equation with suffices (r=0.) up to (r= Max.No.) apply to lamina streamline values. That is the mean of unit air mass flow if it was disposed equally above and below the lamina streamline.

Similarly with suffices (r= 1.) up to (r= Max.No.) it applies to the mean values of the air mass flowing between the common outer boundary streamline (r= 0.) and the streamline whose designation is used as the suffix. To distinguish between the two sets of values, those of the latter equations have m. positioned one letter space between in front thus:- m W(1.3)., m va2., m v2., m C3., m p2., m T2. etc.

To show the development of the design system used for the calculation of the rotor blade profile it is necessary to postulate the four boundary surfaces and two end planes which together form the absolute shape of an individual air stream flowing between a single pair of blades. All six are of a different shape, so to simplify a little, for an example will use that of a compressor having a constant value outside diameter, thus:-

The inlet and outlet plane outer edges are both equal in radius and angular extent. That at the outlet plane due to the air whirl velocity being angularly ahead in the direction as of the rotation of the blades, of the inlet plane. Similarly the inside edges are both arcs, that of the outlet plane being angularly ahead for the same reason as the outer arc. Both arcs are equal in angular extent but the arc at the outlet plane is at a larger radius than that at the inlet plane. Dependent on the type of blade used to provide for reason of material stress a sectional area decreasing radially outwards, the inside arcs can be at an equal, greater, or lesser axial distance apart than the outer arcs. Thus the axial projection of both end planes are sectors of their respective annulus.

The outer boundary surface that joins the two above planes together is of constant arc radius but not of angular extent, the latter being of minimum extent at Plane 2. The surface also spiralling at a varying rate from inlet to outlet plane.

The inner boundary surface joining the two inner arcs, for reason that the compression of the air should be done by the force used to accelerate the air in a tangential direction only, is of a constant arc radius from Plane 1. to Plane 2., (optionally to Plane 3.). Plane 2. being position of minimum angular extent. From Plane 2. to Plane 4. (Outlet plane) both angular extent and arc radius increase at rates which are related to each other to maintain from Plane 2. a constant cross sectional area airstream to the outlet plane. Additional to the foregoing and similarly to the outer surface it spirals in the same direction.

If we now look on the inlet plane of a compressor whose direction of rotation is anti-clockwise and visualise the airstream described above to be situated on the top half of the vertical centre line, the surface of the airstream to the left would be the rear absolute profile of the blade to the left and the airstream surface to the right would be the front absolute profile of the blade to the right of the airstream. The reasoning of which could apply to the airstream to the right of the stipulated one. Thus if we use the left side of the airstream to the right and the right side of the stipulated one, together they delineate the absolute shape of the blade to be dimensioned from which is developed the relative shape of the rotor blade (As manufactured).

As it is required for purposes other than aerodynamic (To stack the centroids of all the lamina blade sections on or near a straight line which is offset to the rear of a true radial line which intersects the rotor axis) the airstream is divided by intermediate streamlines into lasser portions of the full air mass flow. For convenience the radial depth on Plane 1. is divided into an even number of equal portions. The outer boundary one is designated (r=0.) and the inner one (r=Max.No.), the inner ones having intermediate numbers. The air mass flowing between the common outer boundary and any one of the others is calculated for Plane 1. and is retained by the streamline to the outlet plane.

At this stage it is necessary to explain the action between the blade (Solid body) and the air passing between the blades during the period of time it takes the air to travel from Plane 1. to Plane 3. which terminates the working length of the rotor blades, and for this purpose have supplied Drawings Figures 1/2. & 2/2. which illustrate two analogies. In both analogies the air container at all positions should be axially in line but have been drawn offset to allow dimensioning.

In both analogies the air container weight and the atmosphere's resistance to movement of the two bodies has been ignored. Each cylinder contains one pound of air at normal static conditions and the solid bodies weigh less than one pound, having velocities much higher than that of the cylinders. The single difference between the two analogies is that the cylinder of the 2nd. Analogy has an open rear end fitted with a piston and rod, the latter's purpose being to prevent the solid body making contact with the cylinder. The piston being fitted with a mechanism to allow only irreversible movement up the cylinder so that any compression of the air effected between Positions 1. & 2. is retained. The conditions are recorded in Bernoulli type equations at three positions which are 1. The instant of time when the solid body makes contact with the cylinder or rod. 2. The instant of time when the cylinder and solid body attain an identical speed. 3. The instant of time that the cylinder or rod lose contact with the solid body, thus:-

1. (va1^2. + b.vb1^2.)/2.g. + p1.v1./(y-1.). =
2. (va2^2. + b.vb2^2.)/2.g. + p2.v2./(y-1.). + (E-(1.2). -(p2.v2.- p1.v1.)/(y-1.).) =
3. (va3^2. + b.vb3^2.)/2.g. + p3.v3./(y-1.).

1st. Analogy :- E(1.2). = vb1.- va1.)(va2.- va1.)-/2.g. = Esp(1.2). Where p2. = p1. = p3. and v2. = v1. = v3. (Exclusive of air pressure due to presence of Esp(1.2). See Figure 1/2.

2nd. Analogy :- E(1.2). = (vb1.- va1.)(va2.- va1.)-/2.g. = ((p2.v2.-p1.v1.)/(y-1.). + Esp(1.2).). (Exclusive of air pressure due to presence of Esp(1.2).). See Figure 2/2 .

Where p2. = p3. and v2. = v3. and the ratio (Esp(1.2)./E(1.2).) = ((va3.- va2.)/(va2.- va1.))^2. = (C3.- 1.)^2. and the ratio (Ep(1.2)./E(1.2).) = (1.- (-(va3.- va2.)/(va2.- va1.))^2.).

Where E(1.2). = (1. + 1/b)(va2.- va1.)^2./2.g.

Where Ep(1.2). = (1. + 1/b)((va2.- va1.)^2.- (va3.- va2.)^2.)/2.g.

Where Ep(1.2). = ((v1./v2.)$^{(y-1.)}$.- 1.).T1.C./(y-1.).

Where E(1.2). = ((v1./vr2.)$^{(y-1.)}$.- 1.).T1.C./2.(y-1.).

Where vr2. = Specific Volume of the air mass in the rear portion of the cylinder (Adjacent to piston).

Where va2. = va1. + (b.(vb1.- va1.)/(1. + b.)) = vb2. and vb2. = vb1.- ((vb1.- va1.)/(1. + b.)) = va2.

Where va3. = C3.(va2.- va1.). + va1. and vb3. = vb1.- (va3.- va1.)/b.

Where Am(1.2). = (va2.- va1.)/t(1.2). = Abm(1.2). = b.(vb1. -vb2.)/t(1.2).

and Am(2.3). = (va3.- va2.)/t(2.3). = Abm(2.3). = b.(vb2.-vb3.)/t(2.3).

Where b. = (va2.- va1.)/(vb1.- vb2.). Where va2. = vb2.

Where C3. = (1. + (Esp(1.2)./E(1.2).)$^{1/2}$.). = (va3.- va1.)/(va2.- va1.).

Where t(1.2). = 2.P1.(1.- v2./v1.)/(vb1.- va1.).

and t(2.3). = P1.(1.- v2./v1.)/(va3.- vb3.).

Where P1. = Inside length of cylinder at Position 1. of Analogy. (Cylinder head to inside face of Piston).

At this time it is necessary to single out the value C3. which has a unique part to play in the design of an axial compressor rotor blade which uses up the malignant Air Spring Energy Esp(1.2). for it is this value which links up all the different kinds of energy.

To bridge the differences between the formulae of the 2nd. Analogy and the new design system it is first necessary to account for the extra power required for full cycle operation. The second requirement is to provide for specified air mass flows, and thirdly to connect the foregoing with the tangential blade velocity, and finally to streamline the blank end of the blade which in the analogy would be (P1. - P2) wide at position 3. of the analogy.

The first being satisfied by adding the value (Ba1.- b.) to b. of the analogy at Position 1. which would disappear at Position 2. The second by changing the straight line operation of the analogy to circular, which allows area's to be specified between concentric lamina streamlines which together with the addition of axial air velocity defines air mass flow. The third by linking the axial and tangential air velocities together and to the tangential blade velocity, thus the Bernoulli type equation of the analogy becomes:-

1.- (va1^2. + vcm1^2. + Ba1.vb1^2.)/2.g. + y.p1.v1./(y-1). =
2.- (va2^2. + vcm1^2. + b.vb2^2.)/2.g. + y.p2.v2./(y-1). + Esp(1.2). =
3.- (va3^2. + vcm1^2. + b.vb3^2.)/2.g. + y.p2.v2./(y-1.). And as (Ba1.vb1^2.- b.vb2^2.)/2.g. = W(1.2).

And as b.(vb2^2.- vb3^2.)/2.g. = W(2.3).

1.- W(1.3)$_r$. + (va1_r^2. + vcm1_r^2.)/2.g. + y.p1_r.v1_r./(y-1.). =
2.- W(2.3)$_r$. + (va2_r^2. + vcm1_r^2.)/2.g. + y.p2_r.v2_r./(y-1.). + Esp(1.2)$_r$. =
3.- (va3_r^2. + vcm1_r^2.)/2.g. + y.p2_r.v2_r./(y-1.).

Where W(1.2)$_r$. = y.Ep(1.2)$_r$. + Esp(1.2)$_r$. + (va2_r^2.- va1_r^2.)/2.g.

Where w(2.3)$_r$. + Esp(1.2)$_r$. = (va3_r^2.- va2_r^2.)-/2.g. = Ek(2.3)$_r$.

Where (y-1.).Ep(1.2)$_r$. = Ei(1.2)$_r$. = (Ba1_r.- b$_r$.)-.vb1_r^2./2.g.

And the formula which connects the tangential blade velocity to the air velocities on the Root Streamline are:-

V1_R. = m vb(1.3)$_R$. + Maximum m vcm(1.3)$_R$. See Figure 1/9.

vcm3_R. = (va3_R.(V1_R.- va3_R.))$^{1/2}$. See Figure 1/9.

In the example Tables 1D. to 6D. a constant value vcm1_R. has been used which is slightly less than both the two values above.

Where m vb(1.3)$_R$. = m va(1.3)$_R$. + X2_R./2.t(1.3)$_R$.

Where m va(1.3)$_R$. = ((t(1.2)$_R$.(va1_R. + va2_R.)) + (t-(2.3)$_R$.(va2_R. + va3_R.)))./2.t(1.3)$_R$.

m va(1.3)$_R$. = C4_R.(va3_R.- va1_R.). + va1_R.

Limited Angle C°. is taken to be 45°. and the value of the angular difference between the absolute and Relative centre lines of the tail portions (Plane 3. to Plane 4.) is 90°. See Figure 1/9.

It is also of importance that on the root streamline where V1_R. has the minimum velocity, that vb1_R. should have a value not exceeding (V1_R. +

$va1_{R}.)$.

With reference to surge conditions it should be noted that the rotor blade shape (As manufactured) when stationary is also its absolute shape. Thus in the run up to the designed speed (V1.) the rotor blade absolute shape continuously in contact with its relative shape on Plane 1. appears to move in an anti-clockwise direction like a pointer of a clock until at the designed speed it reaches the designed speed position. Intermediate to the two positions described above the absolute shape passes through a third position where it is disposed axially. This is the position where surge conditions would arise if the relative blade shapes did not give full static coverage to the inlet plane. Thus in a front view of a compressor the rotor blade at all radii should have a minimum arc length of one blade pitch.. (See Figure 9/9.)

It will also be seen that for industrial use where protection can be given to prevent ingestation of foriegn bodies it would be advantageous to use finer pitched blades than would be used for aircraft engines.

With regard to streamlining it should be noted that as in the analogy where the piston is locked tothe cylinder at Position 2. to retain the compression of the air to Position 3. so also does the blade of the compressor attain its maximum thickness at Plane 2. and in the example given retains this thickness to Plane 3. from which it is streamlined to a point at Plane 4. It should be noted however that if required it could have been commenced at Plane 2. If the Synopsis 1A. had been used for the example the starting plane of the streamlining would have been prior to Plane3.

The absolute lamina blade circular arc dimensions are measured from an axial line which passes through the blade point at Plane 1. and the axial length dimensions from Plane 1. along the line. Note also that all streamlines in the Synopsis are at a constant radius thus r(1.3).

Front profile dimension designations are prefixed by the letters Fp and rear profile dimensions Rp. The mean centre line of air mass flow moved circumferentially one half blade pitch so that it can be dimensioned from the above axial line uses the prefix S.

The blade length is divided into three sections a., b., c. which represent (Plane 1. to 2.)., (Plane 2. to 3.) and (Plane 3. to 4.) and thus:-

$Fpa1_{r}. =$ Zero. $Fpa2_{r}. = t(1.2)_{r}.(vb1_{r}. + vb2_{r}.)/2.$

$Sa1_{r}. =$ Zero. $Sa2_{r}. = t(1.2)_{r}.(va1_{r}. + va2_{r}.)/2.$

$Rpa1_{r}. =$ Zero. $Rpa2_{r}. = t(1.2)_{r}.(va1_{r}. + va2_{r}.)/2.$

$Fpb3_{r}. = Fpa2_{r}. + t(2.3)_{r}.(vb2_{r}. + vb3_{r}.)/2.$

$Sb3_{r}. = Sa2_{r}. + t(2.3)_{r}.(va2_{r} + va3_{r}.)/2.$

$Rpb3_{r}. = Rpb2_{r}. + t(2.3)_{r}.(vb2_{r}. + vb3_{r}.)/2.$

And in the intermediate positions:-

$Fpan_{r}. = t(1.n)_{r}.(vb1_{r}. + vbn_{r}.)/2.$

$San_{r}. = t(1.n)_{r}.(va1_{r}. + van_{r}.)/2.$

$Rpan_{r}. = t(1.n)_{r}.(va1_{r}. + van_{r}.)/2.$

$Rpbm_{r}. = Rpa2_{r}. + t(2.m)_{r}.(vb2_{r}. + vbm_{r}.)/2.$

$Sbm_{r}. = Sa2_{r}. + t(2.m)_{r}.(va2_{r}. + vam_{r}.)/2.$

$Fpbm_{r}. = Fpa2_{r}. + t(2.m)_{r}.(vb2_{r}. + vbm_{r}.)/2.$

And for blade section c.

$Sc4_{r}. = Sb3_{r}. + t(3.4)_{r}.va3_{r}.$ $Scw_{r}. = Sb3_{r}. + t(3.w)_{r}.va3_{r}.$

$Fpc4_{r}. = Sc4_{r}. = Rpc4_{r}.$

$Fpcw_{r}. = Scw_{r}. + Xw_{r}./2.$ $Rpcw_{r}. = Scw_{r}. - Xw_{r}./2.$

$Fpb3_{r}. = Sb3_{r}. + X2_{r}./2$ $Rpb3_{r}. = Sb3_{r}. - X2_{r}./2.$

Where $Xw_{r}. = 2.((RF_{r}^{2}.- L(3.w)_{r}^{2}.)^{1/2}.-(RF_{r}^{2}.- L(3.4)_{r}^{2}.)^{1/2}.$

And $RF_{r}. =$ Blade Form Radius $= (L(3.4)_{r}^{2}./X3_{r}.) + X3_{r}./4.$

And $X3_{r}. = X2_{r}.$

And for axial lengths.

$L(1.2)_{r}. = t(1.2)_{r}.vcm1_{r}.$ & $L(1.n)_{r}. = t(1.n)_{r}.vcm1_{r}.$

$L(1.3)_{r}. = t(1.3)_{r}.vcm1_{r}.$ & $L(1.m)_{r}. = t(1.m)_{r}.vcm1_{r}.$

$L(1.4)_{r}. = t(1.4)_{r}.vcm1_{r}.$ & $L(1.w)_{r}. = t(1.w)_{r}.vcm1_{r}.$

And for relative Blade Shape Dimensions.

$R\ Fpa2_{r}. = Fpa2_{r}.- t(1.2)_{r}.V1_{r}.$ & $R\ Fpan_{r}. = Fpan_{r}.- t(1.n)_{r}.V1_{r}.$

$R\ Fpb3_{r}. = Fpb3_{r}.- t(1.3)_{r}.V1_{r}.$ & $R\ Fpbm_{r}. = Fpbm_{r}.- t(1.m)_{r}.V1_{r}.$

$R\ Fpc4_{r}. = Fpc4_{r}.- t(1.4)_{r}.V1_{r}.$ & $R\ Fpcw_{r}. = Fpcw_{r}.- t(1.w)_{r}.V1_{r}.$

$R\ Rpc4_{r}. = Rpc4_{r}.- t(1.4)_{r}.V1_{r}.$ & $R\ Rpcw_{r}. = Rpcw_{r}.- t(1.w)_{r}.V1_{r}.$

$R\ Rpb3_{r}. = Rpb3_{r}.- t(1.3)_{r}.V1_{r}.$ & $R\ Rpbm_{r}. = Rpbm_{r}- t(1.m)_{r}.V1_{r}.$

$R\ Rpa2_{r}. = Rpa2_{r}.- t(1.2)_{r}.V1_{r}.$ & $R\ Rpan_{r}. = Rpan_{r}.- t(1.n)_{r}.V1_{r}.$

To relate all the above dimensions together a Drawing has been provided:- Figure 1/1.

Axial Flow Air Compressor Design Procedure - Rotor Blades.

Notes:

- A Synopsis is not compiled for any specific air mass flow but to provide relationships between the dimensions of the air duct and rotor blades to the large number of different air and blade velocities and air conditions which simplify the design of a compressor having a specific air mass flow.

Thus a first requirement before compilation is to know whether it is for airplane or industrial use. If the former, to facilitate maximum blade loading, the area contained within the rotor blade profile is made to increase in a direction radially outwards as on Synopsis Table 1A. The decrease in material sectional area in the same direction for reason of material stress being effected by coring which would be facilitated by making the blades in halves and fusing together.

For industrial use due to the high material and manufacturing costs of the former it is usual to use solid blades decreasing in sectional area radially outwards as on Synopsis Table 1D.

A study of both the above Synopses shows that to obtain the maximum air mass flow through a given area inlet plane, the axial air velocity on the root streamline should be the maximum value and the air whirl velocity a minimum value. The resultant energy of both causing the drop in air pressure from static to inlet plane.

As values which are the mean over various portions of the airflow are required, to simplify their calculation, products $(r1_r.vcm1_r.)$ and $(r1_r.vcm1_r.W(1.3)_r.)$ have been made to vary at a constant rate radially across the inlet plane. Thus for example m $W(1.3)_{r=4}. = W(1.3)_{r=2}.$, m $C3_{2=3}. = C3_{r=1.1/2}.$, etc. This however is not mandatory and could be different providing the resultant air pressure drop is a constant value over the whole inlet plane.

If in the case of the example it is required to reduce the axial length of the rotor blade, the way to do it is either increase the number of blades in the ring or alternatively reduce $r(1.3)_0.$ or do both, but certainly not the axial length alone even though it appears uselessly too long.

If the Synopsis 1A. had been used for the example the blade thickness would have increased radially outwards thus necessitating a longer length for streamlining at all radii except at the root. The starting positions of the tapering could with advantage be moved up to Plane 2. while still retaining the same circular arc pitch length as Synopsis 1D. Thus the formulae for $Fpbm_r.$ and $Rpbm_r.$ would require modification to take the streamlining into account thus:-

$Fpb3_r. = Fpa2_r. + t(2.3)_r.(vb2_r. + vb3_r.)/2. - (X2_r.-X3_r.)/2.$

$Rpb3_r. = Rpa2_r. + t(2.3)_r.(vb2_r. + vb3_r.)/2. + (X2_r.-X3_r.)/2.$

$Rpbm_r. = Rpa2_r. + t(2.m)_r.(vb2_r. + vbm_r.)/2. + (X2_r.- Xm_r.)/2.$

$Fpbm_r. = Fpa2_r. + t(2.m)_r.(vb2_r. + vbm_r.)/2. - (X2_r.-Xm_r.)/2.$

$R\ Fpb3_r. = Fpb3_r.- t(1.3)_r.V1_r.$

$R\ Rpb3_r. = Rpb3_r.- t(1.3)_r.V1_r.$

$R\ Rpbm_r. = Rpbm_r.- t(1.m)_r.V1_r.$.

$R\ Fpbm_r. = Fpbm_r.- t(1.m)_r.V1_r.$

$Sb3_r. = Sa2_r. + t(2.3)_r.(va2_r. + va3_r.)/2.$ (Unchanged)

$Sbm_r. = Sa2_r. + t(2.m)_r.(va2_r. + vam_r.)/2.$ (Unchanged)

$R\ Sbm_r. = Sbm_r. - t(1.m)_r.V1_r.$

$R\ Sb3_r. = Sb3_r. - t(1.3)_r.V1_r.$

Note:

- The above dimensions give the blades position and shape on cylinders of constant $r1_r.$ radius which when looking down the stacking line are identical to the blade shapes on the streamlines.

Computation of Stage 1. Synopsis Values.

The first requirement is the choice of the following values:-$V1_0.$, $r(1.3)_0.$, $r(1.3)_r.$, No. of blades in ring., Ratios $(P2_r./Z2_r.)$., ICAC Standard Atmosphere air conditions., a stipulation of the value of $va1_R.$, a stipulation of the value of the Ratio $(vcm1_R./Max.vcm1_R.)$ From which are derived all other values on either Synopsis 1A. or 1D. (1D. used in example):-

Root Streamline Column applicable to Synopsis 1A. or 1D.

Ref.No. 9 .- $C3_R. = (1.+((B.- A.)/B.)^{1/2}.)$

Where A. $= ((P2_R./Z2_R.)^{(y-1.)}.- 1.)$

Where B. $= (((P2_R./(2.Z2_R.- P2_R.))^{(y-1.)}.- 1.)/2.)$

Where $(P2_R./(2.Z2.- P2_R.)) = (1./2.Z2_R./P2_R.- 1.))$

Ref.No.10 .- $C4_R. = (3.C3_R.- 1.)/(4.C3_R^2.-2.C3_R.)$

Ref.No.11 .- $b_R. = (1./(D.+(D^2.+ 1.)^{1/2}.))$

Where D. $= ((y-1.)(1.- (C3_R.- 1.)^2.)/2.)$

Ref.No.14. - $vcm1_R. = Ratio-(vcm1_R./Max.vcm1_R.).Max.vcm1_R.$

Where $Max.vcm1_R. = C3_R.C4_R.V1_R./(1.+ b_R.)$

See also Sheet 9.

Ref.No.15. - $T1_r. = T.-(y-1.)(va1_R^2.+ vcm1_R^2.)/2.g.y.C.$

Ref.No.16. - $p1_r. = p.(T1_R./T.)^{y/(y-1.)}.$

Ref.No.17. - $V1_r. = v.(T./T1_R.)^{1/(y-1.)}.$

Ref.No.31. - $Ep(1.2)_R. =$ (Ref.No.9.- A.)$.C.T1_r./(y-1.)$

Ref.No.30. - $E(1.2)_R. =$ (Ref.No.9.- B.)$.C.T1_r./(y-1.)$

Ref.No.32. - $Ei(1.2)_R. = (y-1.).Ep(1.2)_R.$

Ref.No.12. - $Ba1_R. = b_R.+ Ei(1.2)_R.2.g./vb1_R^2.$

Ref.No.20. - $vb1_R. = V1_R.+ va1_R.$

Ref.No. 5. - $V1_R. = r(1.3)_R.V1_0./r(1.3)_0.$

Ref.No.33. - $Esp(1.2)_R. = E(1.2)_R.-Ep(1.2)_R.$

Ref.No.18. - $va2_R. = E(1.2)_R.2.g./(vb1_R.-va1_R.). + va1_R.$

Ref.No.34 .- $Ek(1.2)_R. = (va2_R^2.- va1_R^2.)/2.g.$

Ref.No.19. - $va3_R. = C3_R.(va2_R.- va1_R.). + va1_R.$

Ref.No.36 .- $Ek(1.3)_R. = (va3_R^2.- va1_R^2.)/2.g.$

Ref.No.21. - $vb3_R. = vb1_R.- (va3_R.- va1_R.)/b_R.$

Ref.No.26. - m $va(1.3)_R. = C4_R.(va3_R.- va1_R.). + va1_R.$

m $va(1.3)_R. = ((t(1.2)_R.(va1_R.+ va2_R.)) + (t(2.3)_R.(va2_R.+ va3_R.)))/2.(t(1.2)_R.+ t(2.3)_R.).$

Ref.No.27. - m $vb(1.3)_R. =$ m $va(1.3)_R.+ X2_R./2.t(1.3)_R.$

Ref.No.28. - $t(1.2)_R. = 2.X2_R./(vb1_R.- va1_R.).$

Ref.No.29. - t(2.3)$_{R}$. = X2$_{R}$./(va3$_{R}$.- vb3$_{R}$.).
Ref.No.38. - T2$_{R}$. = T3$_{R}$. = (Ep(1.2)$_{R}$.(y-1.)./C.) + T1$_{R}$.
Ref.No.39. - p2$_{R}$. = p3$_{R}$. = p1$_{r}$.(T2$_{R}$./T1$_{r}$.)$^{y/(y-1.)}$.
Ref.No.40. - v2$_{R}$. = v3$_{R}$. = v1$_{r}$.(T1$_{r}$./T2$_{R}$.)$^{1/(y-1.)}$.
Ref.No.35. - W(1.2)$_{R}$. = (Ba1$_{R}$.vb1$_{R}^{2}$. -b$_{R}$.vb2$_{R}^{2}$.)/2.g.
Ref.No.37. - W(1.3)$_{R}$. = (Ba1$_{R}$.vb1$_{R}^{2}$. -b$_{R}$.vb3$_{R}^{2}$.)/2.g.
Ref.No.49. - Angle A$_{R}$. = Tan.$^{-1}$(va3$_{R}$./vcm1$_{R}$.).
Ref.No.50. - Angle B$_{R}$. = Tan.$^{-1}$((V1$_{R}$.-va3$_{R}$.)/vcm1$_{R}$.).
Ref.No.51. - Angle C$_{R}$. = Tan.$^{-1}$((V1$_{R}$.- m vb(1.3)$_{R}$.)/vcm1$_{R}$.).
Ref.No.53. - (1.x 14.x 37.)$_{R}$ = (r(1.3)$_{R}$.vcm1$_{R}$.W(1.3)$_{R}$.).
Ref.No.54 .- (1.x 14.)$_{R}$. = (r(1.3)$_{R}$.vcm1$_{R}$.)

Continuation - Outer Streamline Column - Synopses Table 1D. & 1A.

Ref.No. 9. and 10. - Values C3$_{0}$. and C4$_{0}$. Use formulae given for same values on Root Streamline.
Ref.No.11. - b$_{0}$. Note :- Root Streamline value used for convenience such that Ref.No.12.- Ba1$_{0}$. is below unity.
Ref.No.12. - Ba1$_{0}$. = b$_{0}$. + Ei(1.2)$_{0}$.2.g./vb1$_{0}^{2}$.
Ref.No.13. - va1$_{0}$. = V1$_{0}$.- V1$_{R}$.)/2. + va1$_{0}$.
Value chosen to keep the value va3$_{0}$. reasonable low.
Ref.No.14. - vcm1$_{0}$. = (va1$_{R}^{2}$. + vcm1$_{R}^{2}$.-va1$_{0}^{2}$.)$^{1/2}$.
Ref.Nos. 6., 7., 8., 15., 16., 17. , Values T., p., v., T1., P1., and v1. are of the same value as on the Root and all other streamline columns of the same Synopsis.
Ref.Nos.30. to 33. - E(1.2)$_{0}$., Ep(1.2)$_{0}$., Ei(1.2)$_{0}$., Esp(1.2)$_{0}$.,
Use formulae given for same values on Root Streamline.
Ref.No.18. - va2$_{0}$. = vb2$_{0}$. = (E(1.2)$_{0}$.2.g./(1.+1.b$_{0}$.))$^{1/2}$. + va1$_{0}$.
Ref.No.19. - va3$_{0}$. = C3$_{0}$.(va2$_{0}$.- va1$_{0}$.) + va1$_{0}$.
Ref.No.20. - vb1$_{0}$. = ((va2$_{0}$.- va1$_{0}$.)/b$_{0}$.) + va2$_{0}$.
Ref.No.21. - vb3$_{0}$. = vb1$_{0}$.- (va3$_{0}$.- va1$_{0}$.)/b$_{0}$.
Ref.Nos.26., 27., 28., 29., 34., 35., 36., 37., 38., 39., 40., 49., 50., & 51. Values m va(1.3)., m vb(1.3)., t(1.2)., t(2.3)., Ek(1.2)., W(1.2)., Ek(1.3)., W(1.3)., T2. = T3., p2. = p3., v2. = v3., Angle A., Angle B., Angle C.
Use formulae given for same values on Root Streamline.
Ref.No.53. - (1.x 14.x 37.) = r(1.3)$_{0}$.vcm1$_{0}$.W(1.3)$_{0}$.
Ref.No.54. - (1.x 14.) = r(1.3)$_{0}$.vcm1$_{0}$.

Continuation - Intermediate Streamline Column - Synopsis Tables 1D. and 1A.

Ref.Nos. 9. & 10. - Values C3$_{r}$. and C4$_{r}$. Use formulae given for same values as on Root Streamline.
Ref.No.54.-(r(1.3)$_{r}$.vcm1$_{r}$.). = (Max.Stre.No. - Stre.No.)(r(1.3)$_{0}$.vcm1$_{0}$.- r(1.3)$_{R}$.vcm1$_{R}$.)/(Max.Stre.No.) + (r(1.3)$_{R}$.vcm1$_{R}$.).
Ref.No.14. - vcm1$_{r}$. = (r(1.3)$_{r}$.vcm1$_{r}$.)/r(1.3)$_{r}$.
Ref.No.13 .- va1$_{r}$. = (va1$_{R}^{2}$. + vcm1$_{R}^{2}$.-vcm1$_{r}^{2}$.)$^{1/2}$.
Ref.No.53 .- (1.x 14.x 37.)$_{r}$. = (Max.Stre.No.-Stre.No.)(r(1.3)$_{0}$.vcm1$_{0}$.W(1.3)$_{0}$.- r(1.3)$_{R}$.vcm1$_{R}$.W(1.3)$_{R}$.)/(Max.Stre.No.). + (r(1.3)$_{R}$.vcm1$_{R}$.W(1.3)$_{R}$.)
Ref.No.37 .- W(1.3)$_{r}$. = .(1.x 14.x 37.)$_{r}$./(r(1.3)$_{r}$.vcm1$_{r}$.).
Ref.Nos. 6.,7.,8.,15.,16.,17 .- Values T.,p.,v.,T1.,p1.,v1. are of the same value as on the Root Streamline Column of the same Synopsis.
Ref.Nos.30 to 33 .- Values E(1.2)$_{r}$.,Ep(1.2)$_{r}$.,Ei(1.2)$_{r}$.,Esp(1.2)$_{r}$.
Use formulae given for the same values on the Root Streamline.
Ref.No.36 .- Ek(1.3)$_{r}$. = W(1.3)$_{r}$.- (y.Ep(1.2)$_{r}$.).
Ref.No.19 .- va3$_{r}$. = ((Ek(1.3)$_{r}$.2.g. + va1$_{r}^{2}$.)$^{1/2}$.
Ref.No.18 .- va2$_{r}$. = ((va3$_{r}$.-va1$_{r}$.)/C3$_{r}$.) + va1$_{r}$.
Ref.No.34 .- Ek(1.2)$_{r}$. = (va2$_{r}^{2}$.- va1$_{r}^{2}$.)/2.g.
Ref.No.20 .- vb1$_{r}$. = ((E(1.2)$_{r}$.2.g./(va2$_{r}$.-va1$_{r}$.)) + va1$_{r}$.
Ref.No.11 .- b$_{r}$. = (va2$_{r}$.-va1$_{r}$.)/(vb1$_{r}$.- vb2$_{r}$.)
Ref.Nos.35.,37.,38.,39.,40.,49.,50.,51 .-Values W(1.2)$_{r}$.,W(1.3)$_{r}$., Angle A., Angle B., Angle C. Use formulae for the same values given for the Root Streamline.

Continuation - Air Mass Flow Mean Values - Synopses Tables 1D. & 1A.

Note:

- The suffixes applicable to the example would be (r = 1.) to (r = 4.).
Ref.No.41 .- Ar1$_{r}$. = Pi.(r(1.3)$_{(r=0.)}^{2}$. -r(1.3)$_{r}^{2}$.)
Ref.No.42 .- m vcm1$_{r}$. = m vcm1$_{(r=x.)}$. = vcm1$_{(r=x/2)}$.
Ref.No.43 .- M1$_{r}$. = Ar1$_{r}$.m vcm1$_{r}$./v1$_{r}$.
Ref.No.44 .- m Ek(1.3)$_{r}$. = m Ek(1.3)$_{(r=x.)}$. = Ek(1.3)$_{(r=x/2.)}$.
Ref.No.45 .- m Ep(1.2)$_{r}$. = m Ep(1.2)$_{(r=x.)}$. = Ep(1.2)$_{(r=x/2.)}$.
Ref.No.46 .- m Ei(1.2)$_{r}$. = m Ei(1.2)$_{(r=x.)}$. = Ei(1.2)$_{(r=x/2.)}$.
Ref.No.47 .- m W(1.3)$_{r}$. = m W(1.3)$_{(r=x.)}$. = W(1.3)$_{(r=x/2.)}$.
Ref.No.48 .- m T2$_{r}$. = m T3$_{r}$. = m T2$_{(r=x.)}$. =

$T2_{(r=x/2.)}$.

NOte: - The mean values for m $p2_{r.}$ and m $v2_{r.}$ can be calculated from the above temperature if required.

Ref.No.52. - Horse Power = $H.P._{r.} = M1_r.m\ W\text{-}(1.3)_{r.}/550.$

End of Procedure for Stage 1. Synopses Tables 1D. & 1A.

Computation of Plane n. values intermediate between Planes 1. & 2. All Streamline Columns - Blade Section a. Tables 2D. & 3D.

Ref.No.54. - $van_{r.} = va1_{r.} + n.(va2_{r.}\text{-}va1_{r.})/N.\ va\text{-}(n=0.)_{r.} = va1_{r.}$

Ref.No.55. - $vbn_{r.} = vb1_{r.}\text{-}\ n.(vb1_{r.}\text{-}vb2_{r.})/N.\ vb\text{-}(n=0.)_{r.} = vb1_{r.}$

Ref.No.56 .- $Ek(1.n)_{r.} = (van_r^2.\text{-}\ va1_r^2.)/2.g.$

Ref.No.57. - $E(1.n)_{r.} = (((2.vb1_{r.}) + ((1/b_{r.}\text{-}1.)\text{-}va1_{r.})\text{-}\ ((1/b_{r.} + 1.)van_{r.}))(van_{r.}\text{-}\ va1_{r.}))/2.g.$

Ref.No.58 .- $Ep(1.n)_{r.} = E(1.n=x.)_{r.} + W(2.m=\text{-}(M\text{-}x.))_{r.}\text{-}\ Ek(2.m=(M\text{-}x.))_{r.}$

Where M.No.of Planes = N.No.of Planes...

Also $Ep(1.n)_{r.} = E(1.n)_{r.}(1.\text{-}\ (C3_{r.}\text{-}\ 1.)^2.)$

Ref.No.59. - $Esp(1.n)_{r.} = E(1.n)_{r.}(C3_{r.}\text{-}\ 1.)^2.$

Ref.No.60. - $Ei(1.n)_{r.} = (y.\text{-}\ 1.).Ep(1.n)_{r.}.$

Ref.No.61 .- $W(1.n)_{r.} = (Ba1_{r.}vb1_r^2.\text{-}Ban_{r.}vbn_r^2.)\text{-}/2.g.$

Ref.No.62 .- $Ban_{r.} = ((Ba1_{r.}vb1_r^2.\text{-}(2.g.(E(1.n)_{r.} + Ei(1.n)_{r.} + Ek(1.n.)_{r.})))/vbn_r^2.$

Ref.No.63 .- $t(1.n)_{r.} = ((1.\text{-}\ (T1_{r.}/(T1_{r.} + (y\text{-}1.).Ep\text{-}(1.n)_{r.}/C.))^{1/(y\text{-}1.)}.).2.P2_{r.}/((vb1_{r.} + vbn_{r.})\text{-}(va1_{r.} + van_{r.})))$

Ref.No.64 .- $L(1.n)_{r.} = t(1.n)_{r.}vcm1_{r.}$

Ref.No.65. - $Fpan_{r.} = t(1.n)_{r.}(vb1_{r.} + vbn_{r.})/2.$

Ref.No.66. - $San_{r.} = t(1.n)_{r.}(va1_{r.} + van_{r.})/2.$

Ref.No.67 .- $Rpan_{r.} = t(1.n)_{r.}(va1_{r.} + van_{r.})/2.$

Ref.No.86. - R $Fpan_{r.} = Fpan_{r.}\ \text{-}\ t(1.n)_{r.}V1_{r.}$

Ref.No.87 .- R $San_{r.} = San_{r.}\ \text{-}\ t(1.n)_{r.}V1_{r.}$

Ref.No.88 .- R $Rpan_{r.} = Rpan_{r.}\ \text{-}\ t(1.n)_{r.}V1_{r.}$

Computation of Plane m. values intermediate between Planes 2. & 3. All Streamline Columns - Blade Section b. Tables 3D., 4D. & 5D.

Re.No.68 .- $vam_{r.} = va2_{r.} + m.(va3_{r.}\text{-}\ va2_{r.})/M.$

Ref.No.69 .- $vbm_{r.} = vb2_{r.} + m.(vb2_{r.}\text{-}\ vb3_{r.})/M$

Ref.No.70 .- $Ek(2.m)_{r.} = (vam_r^2.\text{-}\ va2_r^2.)/2.g.$

Ref.No.71 .- $Esp(2.m)_{r.} = Ek(2.m)_{r.}\ \text{-}\ W(2.m)_{r.}$

Ref.No.72 .- $W(2.m)_{r.} = b_{r.}(vb2_r^2.\text{-}\ vbm_r^2.)/2.g.$

Ref.No.75 .- $Espm_{r.}$ = Residual Air Spring Energy existing at Plane m. = $Esp(1.2)_{r.} = Esp\text{-}(2.m)_{r.}$

Ref.No.73 .- $t(2.m)_{r.} = L(2.m)_{r.}/vcm1_{r.}$

Ref.No.74 .- $L(2.m)_{r.} = D_{r.}((Sin.(Tan.^{\text{-}1}\text{-}(vam_{r.}/vcm1_{r.}))\ \text{-}(Sin.(Tan.^{\text{-}1}(va2_{r.}/vcm1_{r.}))).$

Ref.No.74A .- $D_{r.}$ (Radius) = $L(2.3)_{r.}/(Sin.\text{-}(Tan.^{\text{-}1}(va3_{r.}/vcm1_{r.}))\ \text{-}(Sin.^{\text{-}1}(Tan.^{\text{-}1}\text{-}(va2_{r.}/vcm1_{r.})).$

Ref.No.76 .- $Fpbm_{r.} = Fpa2_{r.} + t(2.m)_{r.}(vb2_{r.} + vbm_{r.})/2.$

Ref.No.77. .- $Sbm_{r.} = Sa2_{r.} + t(2.m)_{r.}(va2_{r.} + vam_{r.})/2.$

Ref.No.78 .- $Rpbm_{r.} = Rpb2_{r.} + t(2.m)_{r.}(vb2_{r.} + vbm_{r.})/2.$

Ref.No.90 .- R $Fpbm_{r.} = Fpbm_{r.}\text{-}\ t(1.m)_{r.}V1_{r.}$

Ref.No.91 .- R $Sbm_{r.} = Sbm_{r.}\text{-}\ t(1.m)_{r.}V1_{r.}$

Ref.No.92 .- R $Rpbm_{r.} = Rpbm_{r.}\text{-}\ t(1.m)_{r.}Vl_{r.}$

Ref.No.89 .- $L(1.m)_{r.} = L(1.2)_{r.} + L(2.m)_{r.}$

Computation of Plane w. values intermediate between Planes 3. & 4. All Streamline Columns - Blade Section c. Tables 5D. & 6D.

Ref.No.79 .- $L(1.w)_{r.} = L(1.3)_{r.} + w.L(3.4)_{r.}/W.$

Ref.No.79A .- $L(3.4)_{r.} = L(1.4)_{r.}\text{-}\ L(1.3)_{r.}$

Ref.No.79B .- $L(1.4)_{r.} = vcm1_{r.}t(1.4)_{r.}$

Ref.No.79C .- $t(1.4)_{r.} = (P1_{r.}\text{-}\ t(1.3)_{r.}(va3_{r.}\text{-}\ m\ va\text{-}(1.3)_{r.}))/(V1_{r.}\text{-}\ va3_{r.}).$

Ref.No.83 .- $rw_{r.} = b./2.a. + ((b./2.a.)^2. + c./a.)^{\text{-}1/2}.$

Where a. = 2.Pi./No. of Blades.

Where b. = $(Xw_{outer.} + Xw_{inner.})$ Where inner & outer refer to two adjacent streamlines which enclose an area.

Where c. = $(2.Pi.rw_{outer}^2./No.\ \text{-}\ (Ar_{inner.}\text{-}Ar_{outer.})\text{-}.2./No.\ \text{-}\ b.rw_{outer.}).$

Commence with the outer pair of which the outer $Ar_{r=0.}$ = Zero. and continue inwards using the first calculated inner radius as the outer of the next pair and so on. The individual area of the first set is:-

$(Ar2_{r=1.}\ \text{-}\ Ar_{r=0.}).$

Ref.No.80 .- $Fpcw_{r.} = Fpb3_{r.} + w.t(3.4)_{r.}va3_{r.}/W.\ \text{-}\ (X3_{r.}\text{-}\ Xw_{r.})/2.$

Ref.No.81 .- $Scw_{r.} = Sb3_{r.} + w.t(3.4)_{r.}va3_{r.}/W.$

Ref.No.82 .- $Rpcw_{r.} = Rpb3_{r.} + w.t(3.4)_{r.}va3_{r.}/W.\ + (X3_{r.}\text{-}\ Xw_{r.})/2.$

Ref.No.96 .- R $Rpcw_{r.} = Rpcw_{r.}\text{-}\ (V1_{r.}/vcm1_{r.}).L\text{-}(1.w)_{r.}$

Ref.No.95 .- R $Scw_{r.} = Scw_{r.}\text{-}\ (V1_{r.}/vcm1_{r.}).L\text{-}(1.w)_{r.}$

Ref.No.94 .- R $Fpcw_{r.} = Fpcw_{r.}\text{-}\ (V1_{r.}/vcm1_{r.}).L\text{-}(1.w)_{r.}$

Ref.No.84 .- $Xw_{r.} = 2.((RF_r^2.\text{-}\ L(3.w)_r^2.)^{1/2}.\text{-}\ (RF_r^2.\text{-}L(3.w)_r^2.)^{1/2}.).$

Ref.No.93 .- $RF_{r.}$ = Form Radius = $(L(3.4)\text{-}_r^2./X3_{r.}) + X3_{r.}/4.$

Where in the example $X3_{r.} = X2_{r.}$

Computation of Plane w. values intermediate between Planes 3. & 4. All Streamline Columns - Blade Section c. Tables 5D. & 6D.

Note:

- In the example the streamlining of all blade sections start at Plane 3. Thus with the exception of the energy value $Ei(1.2)_r$. and the introduction of the value $(Ba1_r.- b_r.)$ to take it into account which does not affect the blade absolute and relative profile dimensions, the formulae of the analogy and those up to Plane 3. used for the example are alike. However particularly in the case of Synopsis 1A. it could start earlier with Plane 2. being a maximum upstream position.

In the case of Synopsis 1A. it would be advantageous for reason of material stress to use the same root section as for 1D. but on the blade tip section use Plane 2. as the starting position of the streamlining. In between it could be varied from the plane of one to the other.

The streamlining will not affect the energy change between Plane 2. and Plane 3. providing the value $(X2_r.- Xb_r.)/2$ is subtracted from the front and added to the rear profile through blade section b. similarly as is due on section c.

Rotor Blade Design Procedure applicable to Rotors which follow Stators. - Synopsis Stage 2. Tables17D.

Notes:

- To provide for the matching of the airflow through a multiple number of stages it will be noted that the Stage 1. Synopsis has made the two products $(r(1.3)_r.vcm1_r.W(1.3)_r.)$ and $(r(1.3)_r.vcm1_r.)$ to vary in value at a constant rate radially across the inlet plane, such that the mean streamline values are also the mean values of the air mass flows which at the inlet plane are symetrically disposed on the plane. Thus $W(1.3)_{r=x/2}$. equals m $W(1.3)_{r=x}$., $Ek(1.2)_{r=x/2}$. equals m $Ek(1.2)_{r=x}$. etc.

This provision is made to apply to all stages with a further proviso that the two values va1. and vcm1. on the mean streamline of the full air mass flow are the same for all stages. However due to the repositioning of the full air mass mean streamline each stage the values of the lesser portions do change slightly each stage.

The following formulae have been provided to calculate the new values:-

Ref.No.41 .- $Ar1_R$. = Stage 1. $Ar8_R$. & $r(1.3)_R$. = Stage 1. $r8_R$.

Ref.No.41 .- $Ar1_r$. = $Pi.(r(1.3)_O. - r(1.3)_r^2.)$.

Ref.No. 1 .- $r(1.3)_R$. = $(r(1.3)_O{}^2.-$ Stage $1.Ar8_R./Pi.)^{1/2}$.

Ref.No. 1 .- $r(1.3)_r$. = $r(1.3)_O$. - (Str.No.)$(r(1.3)_O. -r(1.3)_R.)$/(Max.Str.No.).

Ref.No. 5 .- $V1_r$. = $r(1.3)_r.V1_O./r(1.3)_O$.

Ref.No.43 .- $M1_r$. = $Ar1_r$.m $vcm1_r$./m $v1_r$.

Ref.Nos. 9.,10.,30.,31.,32.,33.,35.,38.,39., & 40. - $C3_r.,C4_r.$, $E(1.2)_r.$, $Ep(1.2)_r.$, $Ei(1.2)_r.$, $Esp(1.2)_r.$, $W(i.2)_r.$, $T2_r.$, $p2_r.$, $v2_r.$, Formulae for their derivation are as used for Stage 1. Synopsis.

Rotor Blade Design Procedure applicable to Rotors which follow Stators. - Synopsis Stage 2. Table 17D.

Ref.No.54 .- Stage 2.$(1.x\ 14.)_O$. = $r8_O.vcm8_O$.

Stage 2.$(1.x\ 14.)_R$. = $r8_Rvom8_R$.

Stage 2.$(1.x\ 14.)_{r=M.No./2}$. = $r(1.3)_{r=M.No./2}.vcm1_{r=M.No./2}$.

Ref.NO.54 .- Stage 2.$(1.x\ 14)_r$.= $(1.x\ 14.)_O$. - $((r(1.3)_O. -r(1.3)_r.)((1.x\ 14.)_O. - (1.x\ 14.)_R.)/(r(1.3)_O. -r(1.3)_R.))$.

Ref.No.14 .- $vcm1_r$. = $(1.x\ 14.)_r./r(1.3)_r$.

Ref.No.13 .- $va1_r$. = (Stage $1.(va1_r^2.+ vcm1_r^2.) -vcm1_r^2.)^{1/2}$.

Ref.Nos.15.,16.and 17 .- $T1_r.$,$p1_r$.and $v1_r$. = $T8_r.$,$p8_r$.and $v8_r$.

Note: - It has been assumed that the blade strength is capable taking an equal load as the 1st.Stage so $W(1.3)_{RMR}$. of the 2nd.Stage has been made equal to that of the 1st.Stage. $W(1.3)_O$. of the 2nd.Stage has olso been made equal to $W(1.3)_O$. of the 1st.Stage. Thus:-

Ref.No.37 .- $W(1.3)_r$. = $(1.x\ 14.x\ 37.)_r./(1.x\ 14.)_r$.

Ref.No.53 .- $(1.x\ 14.x\ 37.)_r$. = $(1.x\ 14.x\ 37.)_O.+ (r(1.3)_O.- r(1.3)_r.)(2.((1.x\ 14.x\ 37.)_O.- (1.x\ 14.x\ 37.)_{RMR}.)/(r(1.3)_O. -r(1.3)_R.)$.

Where $(1.x\ 14.x\ 37.)_O$. = $r(1.3)_O.vcm1_O$.Stage $1.W(i.3)_O$.

And $(1.x\ 14.x\ 37.)_{RMR}$.= $r(1.3)_{RMR}.vcm1_{RMR}$.Stage $1.W(1.3)_{RMR}$.

Ref.No.36 .- $Ek(1.3)_r$. = $W(1.3)_r.- y.Ep(1.2)_r$.

Ref.No.19 .- $va3_r$. = $(Ek(1.3)_r.2.g. + va1_r^2.)^{1/2}$.

Ref.No.18 .- $va2_r$. = $(va3_r.- Va1_r.)/C3_r. + va1_r$.

Ref.No.34 .- $Ek(1.2)_r$. = $(va2_r^2.- Va1_r^2.)/2.g$.

Ref.No.11 .- b_r. = $(va3_r.- va1_r.)/(vb1_r.- vb3_r.)$

Ref.No.12. - $Ba2_r$. = $b_r. + Ei(1.2)_r.2.g./vb1_r^2$.

Ref.No.20. - $vb1_r$. = $(E(1.2)_r.2.g./(va2_r.- va1_r.)) + va1_r$.

Ref.No.21. - $vb3_r$. = $vb2_r.- (va3_r.- va2_r.)/b_r$.

Ref.No.26. - m $va(1.3)_r$. = $((va3_r.- va1_r.).C4_r.) + va1_r$.

Ref.No.27. - m $vb(1.3)_r$. = m $va(1.3)_r. +X2_r./2.t(1.3)_r$.

Ref.No.28 .- $t(1.2)_r$. = $2.X2_r./(vb1_r.- va1_r.)$.

Ref.No.29. - $t(2.3)_r$. = $X2_r./(va3_r.- vb3_r.)$.

Ref.No.42. - m $vcm1_{r=x}$. = $vcm1_{r=x/2}$.

Ref.No.44. - m $Ek(1.3)_{r=x}$. = $Ek(1.3)_{r=x/2}$.

Ref.No.45. - m $Ep(1.2)_{r=x}$. = $Ep(1.2)_{r=x/2}$.

Ref.No.46. - m $Ei(1.2)_{r=x}$. = $Ei(1.2)_{r=x/2}$.

Ref.No.47 .- m $W(1.3)_{r=x}$. = $W(1.3)_{r=x/2}$.

Ref.No.48 .- $m\ T2_{r=x}. = T2_{r=x/2}.$

Ref.No.49. - Angle $A_r. = Tan.^{-1}(va3_r./vcm1_r.)$

Ref.No.50. - Angle $B_r. = Tan.^{-1}((V1_r.- va3_r.)/vcm1_r.)$

Ref.No.51 .- Angle $C_r. = Tan.^{-1}((V1_r.- m\ vb(1.3)_r.)/vcm1_r.)$

Ref.No.52. - Horse Power $= M1_{r=x}.m\ W(1.3)_{r=x}./550.$

Axial Flow Air Compressor Design Procedure.

Stator Blade Design Procedure - Notes. Tables 7D. to 16D.

The axial length of the stators is divided into two parts by a short length interposed for the adjustment of total length for mechanical reasons. The basic planes being as follows:-

Inlet Plane 5.

This plane except for being divided by a different number of blades is exactly as the preceding rotor outlet plane.

Planes 6. & 7.

Air conditions at these two planes are exactly alike. Except for allowing for the rotation of the air, dimensions are also alike.

Outlet Plane 8.

Except for differences in the radial positions of the intermediate streamlines and number of blades the dimensions of this plane are identical to the following Rotor Blade Plane 1. Thus before calculating any Stator conditions it is required first to compile the Stage 2. Synopsis.

Planes intermediate between the above planes.

The planes which divide the length $L(5.6)_r.$ are designated by the letter m.

The planes which divide the length $L(7.8)_r.$ are designated by the letter n.

The function of the first portion of the blades is to move the streamlines radial position so that at Plane 6. they are axially in line with their position on Plane 8. A second requirement is to change the proportions of va5 and vcm5. such that the ratios $va6_r./vcm6_r.$, $va7_r./vcm7_r.$ and $va8_r./vcm8_r.$ are of the same value.

The function of the rear portion of the blades is to reduce the air velocities $va7_r./vcm_r.$ via $van_r./vcmn_r.$ to $va8_r./vcm8_r.$ while changing the surplus of kinetic energy into heat energy. by diffusion.

An assumption has been made that the levelling out of air temperature radially outwards is effected between Planes 7. & 8. which though not exactly true is only untrue quantitatively.

StatOr Blade Design Procedure - Continued.

Outlet Plane 8. . Tables 8D. & 16D.

Ref.No.3 .- $m\ T8_r. = m\ T2_R. + m\ Ek(1.3)_r.(y-1)./y.C.$

Ref.No. 4 .- $m\ p8_r. = m\ p2_R.(m\ T8_r./m\ T2_R.)^{y/(y-1)}.$

Ref.No. 5. - $m\ v8_r. = m\ v2_R.(m\ T2_R./m\ T8_r.)^{1/(y-1)}.$

Ref.No.22 .- $T8_r. = m\ T8_r.$ Ref.No.23 .- $p8_r. = m\ p8_r.$

Ref.No.24 .- $v8_r. = m\ v8_r.$

Ref.No.37 .- $r8_r. = (r8_0{}^2.- Ar8_r./Pi.)^{1/2}.$

Ref.No. 7. - $Ar8_r. = M8_r.m\ v8_r./m\ vcm8_r. = m\ Z8_r.H8_r.No.$

Ref.No.63 .- $(37.x\ 21.)_0. = r8_0.vcm8_0.$

Where $vcm8_0. = (vcm1_0.- vcm1_{RMR}.)(r8_0.- RM8_R.)/(r1_0.- RM1_R.). + vcm1_{RMR}.$

Ref.No.63 .- $(37.x\ 21.)_R. = 2.(vcm1_{RMR}.RM8_R.). - (37.x\ 21.)_0.$

REf.No.63 .- $(37.x\ 21.)_r. = ((37.x\ 21.)_0 - (37.x\ 21.)_R.)(r8_r.-r8_R.)/(r8_0.- r8_R.). + (37.x\ 21.)_R.$

Ref.No.21 .- $vcm8_r. = (37.x\ 21.)_r./r8_r.$

Ref.No.62 .- $(41.x\ 2.)_{RMr}. = ((37.x\ 21.)_0. + (37.x\ 21.)_r.)/2.$

Ref.No. 2 .- $m\ vcm8_r. = (41.x\ 2.)_{RMr}./RM8_r.$

Ref.No.20 .- $va8_r. = ((va1_r{}^2. + vcm1_r{}^2.).- vcm8_r{}^2.)^{1/2}.$

Ref.No. 1 .- $m\ va8_r. = ((va1_r{}^2. + vcm1_r{}^2.).- m\ vcm8_r{}^2.)^{1/2}.$

Ref.No.41 .- $RM8_r. = (r8_0. + r8_r.)/2.$

Ref.No.17 .- $m\ P8_r. = 2.RM8_r.Pi./No.$ = Ref.No.18 .- $m\ Z8_r.$

Ref.No.34 .- $P8_r. = 2.r8_r.Pi./No.$ = Ref.No.35 .- $Z8_r.$

Ref.No.58 .- $Rv8_r. = (va1_r{}^2. + vcm1_r{}^2.)^{1/2}.$ = Ref.No.5 8.- $m\ Rv8_r.$

Ref.No.56 .- $L(7.8)_r. = X7_r./2.Tan.\emptyset(7/8)_r.$

Ref.No.52 .- $\emptyset(7/8)_r. = (Cos^{-1}((1. + (1. + z(7/8)_r.)Rt(7/8)_r./2)/(1. + Rt(7.8)_r.))/2.$

Ref.No.50 .- $z(7.8)_r. = ((1/y) + (1/Rt(7/8)_r{}^2.) -- (1/y.Rt(7/8)_r{}^2.))^{1/2}.$

Ref.No.49 .- $Rt(7/8)_r. = Rv7_r./Rv8_r.$

Ref.No.58. - $Rv8_r. = (va8_r{}^2. + vcm8_r{}^2.)^{1/2}.$

Ref.No.58 .- $m\ Rv8_r. = (m\ va8_r{}^2./+ m\ vcm8_r{}^2.)$-

$^{1/2}$.

Ref.No.57 .- $L(5.8)_{r.} = (L(5.7)_{r.} + L(7.8)_{r.}$

Ref.No.55 .- $t(7.8)_{r.} = L(7.8)_{r.}/m\ vcm(7.8)_{r.}$

Ref.No.59 .- $m\ vcm(7.8)_{r.} = (vcm7_{r.} + vcm8_{r.})/2.$

Ref.No.60 .- $M8_{r.}$ = As Stage 1. Rotor Plane 1.

Ref.No.43. - $m\ Q8_{r.} = Tan^{-1}(m\ va8_{r.}/m\ vcm8_{r.})$

Ref.No.44. - $Q8_{r.} = Tan^{-1}(va8_{r.}/vcm8_{r.})$

Ref.No.53 .- $SFp8_{r.} = Tan.Q8_{r}.L(5.8)_{r.} + X7_{r.}/2.$

Ref.No.54. - $SRp8_{r.} = SFp8_{r.}$

Ref.No.61. - $Ry_{r.} = L(7.8)_{r.}/Sin.(2.\emptyset(7/8)_{r.})$

Ref.No.62 .- $(41.x\ 2.)_{r.} = RM8_{r}.m\ vcm8_{r.}$

Ref.No.63 .- $(37.x\ 21.)_{r.} = r8_{r}.vcm8_{r.}$

Note:

- The slight difference in the values of $va8_{r.}$, $vcm8_{r.}$ to the values of $va1_{r.}$, $vcm1_{r.}$ on the Stage 2. Synopsis is accounted for by the slight changes of air mass flow governed by the intermediate streamlines.

Inlet Plane 5. Tables 7D. & 9D.

Note:

- Plane 5. outer and inner boundary radii together with the radial positions of the intermediate streamlines are exactly the same as on Plane 4. of the preceding rotor blades.

Ref.No.2. - $m\ vcm5_{r.}$ = As Ref.No.42. of the Stage Synopsis.

Ref.No. 1. - $m\ va5_{r=No.} = (m\ EK(1.3)_{r=No.}.2.g. + Va1_{\ r=No./2.}{}^{2}.)^{1/2}.$

Ref.No. 1. - $m\ va5_{r=No.} = va3_{r=No./2.}$

Ref.No. 3. - $m\ T5_{r.}$ = As Ref.No.48. of the Stage Synopsis.

Ref.No. 4. - $m\ p5_{r.} = m\ p5_{r=No.} = p1_{r}.(m\ T2_{r=No.}/T1_{r.})^{y/(y-1.)}.$

Ref.No. 5. - $m\ v5_{r.} = m\ v5_{r=No.} = v1_{r}.(T1_{r.}/T\ T5_{r=No.})^{1/(y-1.)}.$

Ref.No. 7. - $Ar5_{r.} = M1_{r}.m\ v5_{r.}/m\ vcm5_{r.}$

REF.No.37. - $r5_{r.} = (r5_{0}{}^{2}.- Ar5_{r.}/Pi.)^{1/2.}.$

Ref.No.41. - $RM5_{r.} = (r5_{0}. + r5_{r.})/2.$

Ref.No.17. $m\ P5_{r.} = 2.Pi.RM5_{r.}/No.$ Ref.No.18 .- $m\ Z5_{r.} = m\ P5_{r.}$

Ref.No.34. - $P5_{r.} = 2.Pi.r5_{r.}/No.$ Ref.No.35. -$Z5_{r.} = P5_{r.}$

Ref.No.36. - $X5_{r.}$ = Zero. Ref.No.19. - $X5_{r.}$ = Zero.

Ref.No.42. - $H5_{r.} = (r5_{0}.- r5_{r.})$

Ref.No.43. - $m\ Q5_{r.} = Tan.^{-1}(m\ va5_{r.}/m\ vcm5_{r.})$

Ref.No.44. - $Q5_{r.} = Tan.^{-1}(va5_{r.}/vcm5_{r.})$

Ref.No.53. - $SFp5_{r.}$ = Zero. Ref.No.54 .- $SRp5_{r.}$ = Zero.

Ref.No.33. - $m\ vcm(5.m)_{r.} = vcm5_{r.}$

Ref.No.58 - $Rv5_{r.} = (va5_{r}{}^{2}. + vcm5_{r}{}^{2}.)^{1/2}.$

Ref.No.58. - $m\ Rv5_{r.} = (m\ va5_{r}{}^{2}. + m\ vcm5_{r}{}^{2}.)^{1/2}.$

Ref.No.58. - $Rvx5_{r.} = Rv5_{r.}$

Ref.No.58. - $m\ Rvx5_{r.} = m\ Rv5_{r.}$

Plane 6. & 7. - Tables 8D. & 13D.

Ref.No.58 .- $Rv6_{r.} = (va6_{r}{}^{2}. + vcm6_{r}{}^{2}.)^{1/2}. = Rv7_{r.} = Rv5_{r.}$

Ref.No.58 .- $m\ Rv6_{r.} = (m\ va6_{r}{}^{2}. + m\ vcm6_{r}{}^{2}.)^{1/2}. = m\ Rv7_{r.} = mRv5_{r.}$

Ref.Nos.43. & 44 .- $m\ Q6_{r.}$ & $m\ Q7_{r.}$ & $Q6_{r.}$ & $Q7_{r.}$ are exactly as $m\ Q8_{r.}$ & $Q8_{r.}$

Ref.No. 1 .- $m\ va6_{r.} = m\ va7_{r.} = Sin.m\ Q8_{r}.m\ Rv6_{r.}$

Ref.No. 2 .- $m\ vcm6_{r.} = m\ vcm7_{r.} = Cbs.m\ Q8_{r}.m\ Rv6_{r.}$

Ref.No.20 .- $va6_{r.} = va7_{r.} = Sin.Q8_{r}.Rv6_{r.}$

Ref.No.21 .- $vcm6_{r.} = vcm7_{r.} = Cos.Q8_{r}.Rv6_{r.}$

Ref.No.2 .- $T6_{r.} = T7_{r.} = T5_{r.}$ R ef.No.2 3 .- $p6_{r.} = p7_{r.} = p5_{r.}$

Ref.No.24 .- $v6_{r.} = v7_{r.} = v5_{r.}$

Ref.No.37 .- $r6_{r.} = r7_{r.} = r8_{r.}$ Ref.No.41 .- $RM6_{r.} = RM7_{r.} = RM8_{r.}$

Ref.No.34 .- $P6_{r.} = P7_{r.} = P8_{r.}$ Ref.No.17 .- $m\ P6_{r.} = m\ P7_{r.} = m\ P8_{r.}$

Ref.No. 7 .- $Ar6_{r.} = Ar7_{r.} = M5_{r}.m\ v5_{r.}/m\ vcm6_{r.}$

Let RMR. = (r = Max.No.__2.)

Ref.No.35 .- $Z6_{RMR.} = Z7_{RMR.} = v6_{RMR}.vcm8_{RMR}.P6_{RMR}./vcm6_{RMR}.v8_{RMR}.$

Ref.No.35 .- $Z6_{RMR-1.} = 2.((Ar6_{RMR}.-Ar6_{RMR-1.})-/(r6_{RMR-1.}-r6_{RMR}.).No.) - Z6_{RMR}.$

Ref.No.35 .- $Z6_{RMR-2.} = 2.((Ar6_{RMR-1.}- Ar6_{RMR-2.})/(r6_{RMR-2.}-r6_{RMR-1.}).No.) - Z6_{RMR-1.}$

Ref.No.35 .- $Z6_{RMR+1.} = 2.((Ar^{6}_{R}\ {}_{MR+1.}- Ar6_{RMR}.)/(r6_{RMR}.-r6_{RMR+1.}).No.) - Z6_{RMR}.$

Ref.No.35 .- $Z6_{RMR+2.} = 2.((Ar^{6}_{R}\ {}_{MR+2.}- Ar6_{RMR+1.})/(r6_{RMR+1.}-r6_{RMR+2.}).No.) - Z6_{RMR+1.}$

Ref.No.35 .- All values of Z6 apply to Z7. with identical suffices.

Ref.No.18 .- $m\ Z6_{r.} = m\ Z7_{r.} = Ar6_{r.}/No.H6_{r.}$

Ref.No.17 .- $m\ P6_{r.} = m\ P8_{r.}$

Ref.No.19 .- $m\ X6_{r.} = m\ X7_{r.} = m\ P6_{r.}- m\ Z6_{r.}$

Ref.No.39 .- $L(5.6)_{r.} = X6_{r.}/(((vcm6_{r.}- vcm5_{r.})-/(va5_{r.}- va6_{r.})) -(va8_{r.}/vcm8_{r.})).$

Ref.No.39 .- $L(5.6)_{r.} = Rp_{r.}(Sin.Q5_{r.}- Sin.Q6_{r.}).$

Ref.No.64 .- $Rp_{r.} = (X6_{r.}/(((vcm6_{r.}- vcm5_{r.})/(va5_{r.}- va6_{r.}))-- (va8_{r.}/vcm8_{r.}))(Sin.Q5_{r.}- Sin.Q6_{r.}))$

Ref.No.38 .- $t(5.6)_{r.} = L(5.6)_{r.}/m\ vcm(5.6)_{r.}$

Ref.No.33 .- $m\ vcm(5.6)_{r.} = (((Rv5_{r}{}^{2}./2.)(U6_{r.}- U5_{r.}) + (Rv5_{r}{}^{2}./4.)(Sin.(2.U5_{r.}) - Sin.(2.U6_{r.})-)/(va5_{r.}- va6_{r.})).$

Where $U6_{r.} = ((Pi./2) - Q6_{r.})$ and $U5_{r.} = ((Pi./2) - Q5_{r.})$

Where $Q6_{r.}$ and $Q5_{r.}$ are in Radians.

Where $Rv5_{r.} = (va5_{r}{}^{2}. + vcm5_{r}{}^{2}.)^{1/2}.$

Ref.No.31 .- $L(6.7)_{r.}$ This length is optional.

Ref.No.30 .- $t(6.7)_r. = L(6.7)_r./vcm6_r.$
Ref.No.39 .- $L(5.7)_r. = L(5.6)_r. + L(6.7)_r.$
Ref.No.38 .- $t(5.7)_r. = t(5.6)_r. + t(6.7)_r.$
Ref.No.53 .- $SFp6_r. = Tan.Q6_r.L(5.6)_r.$
Ref.No.53 .- $SFp7_r. = Tan.Q6_r.L(5.7)_r.$
Ref.No.54 .- $SRp7_r = SFp7_r. + X6_r.$ Where $X6_r. = Z7_r.$
Ref.No.54 .- $SRp6_r. = SFp6_r. + X6_r.$
Ref.No.36 .- $X6_r. = X7_r. = (P6_r. - Z6_r.)$

Tables 7D & 9D to 12D. Planes m. - Intermediate between Planes 5. & 6.

Note:

- There are two ways of plotting the inner lamina profiles of the various areas of airflow, the first of which is to arrange a constant rate of change of the values m $Qm_r.$ and $Qm_r.$ and a constant rate of change of the value $Xm_r.$ in a radial direction. It is then possible using the required areas of airflow in a Quadratic Equation to calculate the exact values of $rm_r.$ to enable the inner lamina profiles to be plotted. Initially this was done but the curves were inconsistant in form and for that reason were discarded.

The second method which was applied to the example is to use the values m $Qm_r.$, $Qm_r.$, and $Xm_r.$ as befcre and arrange a curve of constant arc radius whose radius centre would lie on a radial line intercepting Plane 6. of the inner streamline, and in a similar way for the other streamlines. The latter curves are thus the mean of the calculated ones. The effect of of the latter when the area $Arxm_r.$ is greater is to slow down the value of m $Rvxm_r.$ to m $Rvm_r.$ and if less to speed up the value m $Rvxm_r.$ to the value of m $Rvm_r.$ And as m $vcmxm_r.$ = m $vcm5_r.Ar5_r./Arm_r.$ (Where $Arm_r.$ = $No.Hm_r.$m $Zm_r.$), m $vaxm_r.$ = Tan.m $Qm_r.$m $vcmxm_r.$

Ref.No.43. - m $Qm_r.$ = m $Q5_r.$ - m(m $Q5_r.$ - m $Q6_r.)/M.$
Ref.No.44. - $Qm_r. = Q5_r. - Q6_r.)/M.$ Where $Qm_r. = Tan^{-1}.(vam_r./vcmm_r.)$
Ref.No. 1. - m $vam_r.$ = Sin.m $Qm_r.$m $Rv5_r.$ Where m $Qm_r. = Tan^{-1}.$(m $vam_r.$/m $vcmm_r.$).
Ref.No. 2. - m $vcmm_r.$ = Cos.m $Qm_r.$m $Rv5_r.$ Where m $Rv5_r.$ = (m $va5_r^2.$ + m $vcm5_r^2.)^{1/2.}$
Ref.No.20. - $vam_r. = Sin.Qm_r.Rv5_r.$
Ref.No.21. - $vcmm_r. = Cos.Qm_r.Rv5_r.$ Where $Rv5_r. = (va5_r^2. + vcm5_r^2.)^{1/2.}$
Ref.No.2A. - m $vcmxm_r.$ = m $vcm5_r.Ar5_r./No.Hm_r.$m $Zm_r.$
Ref.No.1A. - m $vaxm_r.$ = Tan.m $Qm_r.$m $vcmxm_r.$
Ref.No. 7. - $Arm_r. = No.Hm_r.$m $Zm_r.$

Planes m. - Intermediate between Planes 5. & 6. Tables 12D. to 9D.

Ref.No.20A .- $vaxm_r. = Sin.Qm_r.Rvxm_r.$
Ref.No.21A .- $vcmxm_r. = Cos.Qm_r.Rvxm_r.$ Where $Rvxm_r.$ = $Rvm_r.$m $Rvxm_R./$m $Rvm_R.$ Where R. = (r = Max.No.)
Ref.No.37. - $rm_r. = (Rx_r^2. - (L(5.6)_r. - L(5.m)_r.)^2.)^{1/2.} + (r6_r. - Rx_r.)$. Where $Rx_r. = (L(5.6)_r^2./2.(r6_r. - r5_r.).) + (r6_r. - r5_r.)/2.$
Ref.No.39. - $L(5.m)_r. = L(5.6)_r.(va5_r. - vam_r.)/(va5_r. - va6_r.).$
Ref.No.39. - $L(5.m)_r. = (Rp_r.(va5_r. - vam_r.))/Rv5_r.$ Where $Rp_r. = L(5.6)_r.Rv5_r./(va5_r. - va6_r.).$
Ref.No.36. - $Xm_r. = (Rp_r.(Cos.Qm_r. - Cos.Q5_r.)) - (L(5.m)_r.Tan.Q6_r.).$
Ref.No.17. - m $Pm_r. = RMm_r.2.Pi./No.$
Ref.No.41. - $RMm_r. = (rm_0. + rm_r.)/2.$
Ref.No.34. - $Pm_r. = rm_r.2.Pi./No.$ Ref.No.35. - $Zm_r. = (Pm_r. - Xm_r.).$
Ref.No.18. - m $Zm_{r=4}. = (Zm_0. + Zm_{r=4}.)/8. + (Zm_{r=1}. + Zm_{r=2}. + Zm_{r=3})/4.$
m $Zm_{r=3}. = (Zm_0. + Zm_{r=3}.)/6. + (Zm_{r=1}. + Zm_{r=2}.)/3.$
m $Zm_{r=2}. = (Zm_0. + Zm_{r=2}.)/4. + (Zm_{r=1}.)/2.$
m $Zm_{r=1}. = (Zm_0. + Zm_{r=1}.)/2.$
Ref.No.19. - m $Xm_r.$ = m $Pm_r.$ - m $Zm_r.$
Ref.No.33 .- m $vcm(5.m)_r. = ((Rv5_r^2./2.)(Um_r. - U5_r.). + (Rv5_r^2./4.)(Sin.(2.U5_r.) - Sin.(2.Um_r.))/(va5_r. - vam_r.).$
Where $Um_r. = ((Pi./2) - Qm_r.).$ and $U5_r. = ((Pi./2) - Q5_r.)$
Where $Qm_r.$ and $Q5_r.$ are in Radians.
Ref.No.38. - $t(5.m)_r. = L(5.m)_r./$m $vcm(5.m)_r.).$
Ref.No. 7. - $Arm_r. = No.Hm_r.$m $Zm_r.$ and Ref.No.43. - $Hm_r. = (rm_0. - rm_r.)$
Ref.No.53. - $SFpm_r. = Sin.Q6_r.L(5.m)_r.$
Ref.No.54. - $SRpm_r. = SFpm_r. + Xm_r.$

Planes n. - Intermediate between Planes 7. & 8. Tables 8D.,14D.,15D.

Ref.No.58. - $Rvn_r. = Rv7_r. - n.(Rv7_r. - Rv8_r.)/N.$
Ref.No.58 .- m $Rvn_r.$ = m $Rv7_r.$ - n.(m $Rv7_r.$ - m $Rv8_r.$)/N.
Ref.No. 1 .- m $van_r.$ = m $va7_r.$ - n.(m $va7_r.$ - m $va8_r.$)/N.
m $van_r.$ = Sin.m $Q8_r.$m $Rvn_r.$
Ref.No. 2 .- m $vcmn_r.$ = m $vcm7_r.$ - n.(m $vcm7_r.$ - m $vcm8_r.$)/N.
m $vcmn_r.$ = Cos.m $Q8_r.$m $Rvn_r.$
Ref.No.20 .- $van_r. = va7_r. - n.(va7_r. - va8_r.)/N.$ =

$Sin.Q8_r.Rvn_r.$

Ref.No.21 .- $vcmn_r. = vcm7_r. - n(vcm7_r. - vcm8_r.)/N. = Cos.Q8_r.Rvn_r.$

Ref.No.22 .- $Tn_{r=M.No./2.} = Tn_{RMR.} = T7_{RMR.} + (y-1.)(Rv7_{RMR}^2.-Rvn_{RMR}^2.)/y.2.g.C.$
Ref.No. 3 .- m $Tn_{r=M.No.} = Tn_{RMR.}$
Ref.No.22 x.- $Txn_{r.} = T7_{r.} + (y-1.)(Rv7_r^2.- Rvn_r^2.)/y.2.g.C.$

Ref.No.3x.- m $Txn_{r=x.} = Txn_{r=x/2.}$

Note: - For streamlines whose number is less than the Streamline (r = M.No./2) = RMR. the value n.($Tn_{RMR.}$- $Txn_{r.}$)/N. should be added to $Txn_{r.}$ For streamlines whose number is greater the value n.($Txn_{r.}$- $Tn_{RMR.}$)/N. should be subtracted from the value $Txn_{r.}$ It will thus be seen that in the temperature levelling out the surplus heat is presumed to move radially outwards between Planes 7. and 8.

Ref.No.22. - $Tn_{r.} = Txn_{r.} + n.(Tn_{RMR.}- Txn_{r.})/N.$
Ref.No. 3. - m $Tn_{r.}$ = m $Tn_{r=x.} = Tn_{r=x/2.}$
Ref.No. 4 .- m $pn_{r.}$ = m $p7_{r.}$(m $Tn_{r.}$/m $T7_{r.})^{y/(y-1.)}$.
Ref.No. 5 .- m $vn_{r.}$ = m $v7_{r.}$(m $T7_{r.}$/m $Tn_{r.})^{1/(y-1.)}$.
Ref.No.23 .- $pn_{r.} = p7_{r.}(Tn_{r.}/T7_{r.})^{y/(y-1.)}$.
Ref.No.24. - $vn_{r.} = v7_{r.}(T7_{r.}/Tn_{r.})^{1/(y-1.)}$.

Planes n. - Intermediate between Planes 7. & 8.
Tables 14D. & 15D.

Ref.No. 3. - m $Tn_{r.}$ = m $Txn_{r.}$ + n.(m $Tn_{2.RMR.}$ - m $Txn_{r.}$)/N.
Ref.No.22. - $Tn_{r.} = Txn_{r.} + n.(Tn_{RMR.} - Txn_{r.})/N.$
Ref.No.23. - $pn_{r.} = p7_{r.}(Tn_{r.}/T7_{r.})^{y/(y-1.)}$.
Ref.No.24. - $vn_{r.} = v7_{r.}(T7_{r.}/Tn_{r.})^{1/(y-1.)}$.
Ref.No. 4 .- m $pn_{r.}$ = m $p7_{r.}$(m $Tn_{r.}$/m $T7_{r.})^{y/(y-1.)}$.
Ref.No. 5. - m $vn_{r.}$ = m $v7_{r.}$(m $T7_{r.}$/m $Tn_{r.})^{1/(y-1.)}$.
Ref.No. 7. - $Arn_{r.} = M5_{r.}$m $vn_{r.}$/m $vcmn_{r.}$ Where $M5_{r.} = M4_{r.}$
Ref.No.37. - $rn_{r.} = r7_{r.} = r8_{r.}$
Ref.No.42. - $Hn_{r.} = H7_{r.} = H8_{r.}$
Ref.No.35. - $Zn_{RMR.} = Zn_{r=M.No/2.} = z7_{RMR}.vcm7_{RMR}.vn_{RMR}./vcmn_{RMR}.v7_{RMR}.$
Ref.No.35. - $Zn_{r=1.} = 2.((Arn_{r=2.}- Arn_{r=1.})/No.-(Hn_{r=2.}-Hn_{r=1.})) - Zn_{RMR.}$
Ref.No.35 .- $Zn_{r=0.} = 2.(Arn_{r=1.}/No.Hn_{r=1.})- Zn_{r=1.}$
Ref.No.35. - $Zn_{r=3.} = 2.((Arn_{r=3.}- Arn_{r=2.})/No.-(Hn_{r=3.}-Hn_{r=2.})) - Zn_{r=2.}$
Ref.No.35. - $Zn_{r=4.} = 2.((Arn_{r=4.}- Arn_{r=3.})/No.-(Hn_{r=4.}-Hn_{r=3.})) - Zn_{r=3.}$
Ref.No.36. - $Xn_{r.} = Ph_{r.}- Zn_{r.}$ Ref.No.34. - $Pn_{r.}$ = 2.Pi.$rn_{r.}$/No.
Ref.No.52. - $\emptyset(7/n)_{r.}$ = Tan.$^{-1}$.($A_{r.}$/($Ry_{r.}$.2.$A_{r.}$- $A_r^2.)^{-1/2.}$).
Where $Ry_{r.} = L(7.8)_{r.}/Sin.(2.\emptyset(7/8)_{r.})$.
And $A_{r.} = (X7_{r.}- Xn_{r.})/2.$
Ref.No.56. - $L(7.n)_{r.} = Ry_{r.}.Sin.(2.\emptyset(7/n)_{r.})$.
Ref.No.55 .- $t(7.n)_{r.} = L(7.n)_{r.}$/m $vcm(7.n)_{r.}$

Ref.No.59 .- m $vcm(7.n)_{r.} = (vcm7_{r.} + vcmn_{r.})/2.$
Ref.No.17 .- m $Pn_{r.}$ = 2.Pi.$RMn_{r.}$/No.
Ref.No.18 .- m $Zn_{r.} = Arn_{r.}/No.Hn_{r.}$
Ref.No.19 .- m $Xn_{r.}$ = m $Pn_{r.}$- m $Zn_{r.}$
Ref.No.57 .- $L(5.n)_{r.} = L(7.n)_{r.} + L(5.7)_{r.}$
Ref.No.53 .- $SFpn_{r.}$ = Tan.$Q7_{r.}$.$L(5.n)_{r.}$ + ($X7_{r.}$-$Xn_{r.}$)/2.

Ref.No.54.- $SRpn_{r.} = SFpn_{r.} + Xn_{r.}$

Ref.No.41. - $RMn_{r.} = RM7_{r.} = RM8_{r.}$

Claims

1. The COPYRIGHT FOR THE BLADE SHAPE DESIGN SYSTEM described on Sheets i3. to 37., Tables 1.A., & 1.D. to 20.D. and Figures of the PATENT SPECIFICATION OF A REPEATABLE AXIAL COMPRESSOR STAGE OF COMPRESSION which LIMITS THE EXISTENCE OF THE ENERGY DESIGNATED Esp. to the AXIAL WORKING LENGTH defined by the DIMENSION DESIGNATED L(1.3).
2. The PATENT reserving to us the SOLE RIGHT TO DESIGN, MANUFACTURE, AND USE ROTOR BLADES HAVING SHAPES which are defined by SETS OF DIMENSIONS OBTAINED BY USE OF THE ABOVE SYSTEM which can be identified by the SUDDEN CHANGE IN DIRECTION OF THE BLADE CENTRE LINE AT PLANE 3. which using a SYNOPSIS AS TABLE 1.D. is at a maximum on the ROOT STREAMLINE decreasing with the decreasing thickness of the blade on PLANE 2. radially outwards, and if using SYNOPSIS as TABLE 1.A. would be the same as TABLE 1.D. on the ROOT STREAMLINE but depending on the rate of taper of blade thickness on PLANE 2. could increase or decrease up the blade.

TABLE 1A.

Compressor Stage 1. Synopsis.				
	Values	r = 0.	r = 1.	r = 2.
1	γ(1·3).	·8333333333	·7903149436	·7472965540
2	P1. P2. P3.	·2493327503	·2364616782	·2235906061
3	Z2. Z3.	·2183721335	·2070993124	·1958264914
4	X2. X3.	·0309606168	·0293623657	·0277641147
5	V1.	959·0011294	909·4955083	859·9898871
6	STATIC T.	288·160	=	=
7	" p.	1896·000515	=	=
8	" v.	14·59037578	=	=
9	C3.	1·315527641	=	=
10	C4.	·6866256344	=	=
11	b.	·8356277485	·7700848583	·7430536518
12	Ba1.	·9599552970	·8917388831	·8660710808
13	va1.	114·0112423	101·8909391	86·19338484
14	vcm1.	340·7454132	344·5638352	348·8218749
15	T1.	282·1780004	=	=
16	p1.	1762·009909	=	=
17	v1.	15·37397032	=	=
18	va2. vb2.	460·4294484	442·3919284	421·4221658
19	va3.	569·7339678	549·8294024	527·1961123
20	Vb1.	874·9898871	884·5522769	872·5723354
21	vb3.	329·6241711	302·8781166	279·0718170
22	(va3.−va1.)	455·7227255	447·9384633	441·0027275
23	(va2.−va1.)	346·4182061	340·5009893	335·2287810
24	(vb1.−va1.)	760·9786448	782·6613378	786·3789505
25	(va3.−vb3.)	240·1097967	246·9512858	248·1242953
26	m va(1·3).	426·9221478	409·4569706	388·9971624
27	m vb(1·3).	500·5278440	485·1598877	465·0596656
28	t(1·2).	·0000813705	·0000750321	·0000706125
29	t(2·3).	·0001289435	·0001188994	·0001118959
30	E(1·2).	4096·737381	=	=
31	Ep(1·2).	3688·875662	=	=
32	Ei(1·2)	1479·239140	=	=
33	Esp(1·2).	407·8617190	=	=
34	Ek(1·2).	3092·508208	2880·102799	2644·485333
35	W(1·2)	8668·484729	8456·079320	8220·461854
36	Ek(1·3).	4842·391849	4536·747191	4203·804955
37	W(1·3).	10010·50665	9704·861993	9371·919757
38	T3.=T2.	297·5867414	=	=
39	p3.=p2.	2121·684888	=	=
40	v3.=v2.	13·46492466	=	=
41	Ar1.	—	·2194299874	·4272324256
42	m vcm1.	—	342·6040399	344·5638352
43	M1.	—	4·889927493	9·575200161
44	m Ek(1·3).	—	4692·767503	4536·747191
45	m Ep(1·2).	—	3688·875662	=
46	m Ei(1·2).	—	1479·239140	=
47	m W(1·3).	—	9860·882306	9704·861993
48	m T2.&3.	—	297·5867414	=
49	ANGLE A.	59·11728002	57·92569412	56·50919209
50	" B.	48·80268545	46·22852453	43·65294572
51	" C.	53·37961908	50·92313204	48·54746836
52	HORSE POWER	—	87·67090817	168·9563566
53	(1.x14.x37.)	2842528·521	2642769·284	2443010·047
54	(1.x14.)	283·9545110	272·3139480	260·6733851

TABLE 1A.

Compressor Stage 1. Synopsis.				
	Values	r = 3.	r = 4.	Units
1	r(1·3).	·7042781643	·6612597746	FT.
2	P1. P2. P3.	·2107195340	·1978484619	FT.
3	Z2. Z3.	·1845536703	·1732808493	FT.
4	X2. X3.	·0261658636	·0245676125	FT.
5	V1.	810·4842660	760·9786448	FT./SEC.
6	STATIC T.	≡	288·160	KELVIN
7	" p.	≡	1896·000515	LB./FT^{2}.
8	" v.	≡	14·59037578	FT^{3}./LB.
9	C3.	≡	1·315527641	FACTOR
10	C4.	≡	·6866256344	FACTOR
11	b.	·7218388883	·8356277485	LB./LB.
12	Ba1.	·8515012049	·9937066480	LB./LB.
13	va1.	63·81987593	15·000	FT./SEC.
14	vcm1.	353·6000897	359·000	FT./SEC.
15	T1.	≡	282·1780004	KELVIN
16	p1.	≡	1762·009909	LB./FT^{2}.
17	v1.	≡	15·37397032	FT^{3}./LB.
18	va2. vb2.	396·2577302	361·4182061	FT./SEC.
19	va3.	501·1510622	470·7227255	FT./SEC.
20	vb1.	856·8007401	775·9786448	FT./SEC.
21	vb3	250·9436806	230·6129288	FT./SEC.
22	(va3.−va1.)	437·3311863	455·7227255	FT./SEC.
23	(va2.−va1.)	332·4378543	346·4182061	FT./SEC.
24	(vb1.−va1.)	792·9808642	760·9786448	FT./SEC.
25	(va3.−vb3)	250·2073816	240·1097967	FT./SEC.
26	m va(1·3).	364·1026792	327·9109055	FT./SEC.
27	m vb(1·3).	440·8037895	401·5166129	FT./SEC.
28	t(1·2).	·0000659936	·0000645684	SECOND
29	t(2·3).	·0001045767	·0001023182	SECOND
30	E(1·2).	≡	4096·737381	FT.LB./LB.
31	Ep(1·2).	≡	3688·875662	FT.LB./LB.
32	Ei(1·2)	≡	1479·239140	FT.LB./LB.
33	Esp(1·2).	≡	407·8617190	FT.LB./LB.
34	Ek(1·2).	2376·875928	2026·451789	FT.LB./LB.
35	W(1·2).	7952·852449	7602·428310	FT.LB./LB.
36	Ek(1·3).	3839·737219	3489·965256	FT.LB./LB.
37	W(1·3).	9007·852022	8608·080059	FT.LB./LB.
38	T3.= T2.	≡	297·5867414	KELVIN
39	p3.= p2.	≡	2121·684888	LB./FT^{2}.
40	v3. = v2.	≡	13·46492466	FT^{3}./LB.
41	Ar1.	·6234073156	·8079546569	FT^{2}.
42	m vcm1.	346·6332906	353·4756354	FT./SEC.
43	M1.	14·05581803	18·57635209	LB./SEC.
44	m Ek(1·3).	4373·911838	4080·416898	FT.LB./LB.
45	m Ep(1·2).	≡	3688·875662	FT.LB./LB.
46	m Ei(1·2).	≡	1479·239140	FT.LB./LB.
47	m W(1·3).	9542·026640	9371·919757	FT.LB./LB.
48	m T2 & 3.	297·5867414	297·5867414	KELVIN
49	ANGLE A.	54·79412956	52·66879028	DEGREES
50	" B.	41·17978735	38·95596575	DEGREES
51	" C.	46·27362269	45·03684841	DEGREES
52	HORSE POWER	243·8563456	312·3708751	H.P.
53	(1.x14.x37.)	2243250·810	2043491·572	PRODUCT
54	(1.x14.	249·0328221	237·3922591	PRODUCT

TABLE 1D.

	Compressor Stage 1. Synopsis.			
	Values	r = 0.	r = 1.	r = 2.
1	r(1·3).	·8333333333	·7903149436	·7472965540
2	P1. P2. P3.	·2493327503	·2364616782	·2235906061
3	Z2. Z3.	·2341327503	·2189197751	·2037067998
4	X2. Z3.	·01520	·0175419031	·0198838062
5	V1.	959·0011296	909·4955083	859·9898871
6	STATIC T.	288·160	=	=
7	" p.	1896·000515	=	=
8	" v.	14·59037578	=	=
9	C3."	1·213306772	1·237010416	1·261637459
10	C4.	·7625772734	·7434085469	·7245505214
11	b.	·8356277485	·7970186924	·7605442075
12	Ba1.	·9516381041	·9178901406	·8859344252
13	va1.	114·0112483	101·8909391	86·19338484
14	vcm1.	340·7454132	344·5638352	348·8218749
15	T1.	282·1780004	=	=
16	p1.	1762·009909	=	=
17	v1.	15·37397032	=	=
18	va2. vb2.	344·1346242	355·1205233	363·1587213
19	va3.	393·2214999	415·1385724	435·6232281
20	vb1.	619·5244522	672·8415338	727·3260289
21	vb3.	285·3921090	279·8173345	267·8789123
22	(va3.−va1.)	279·2102576	313·2476333	349·4298433
23	(va2.−va1.)	230·1233819	253·2295842	276·9653364
24	(vb1.−va1.)	505·5132099	570·9505947	641·1326441
25	(va3.−vb3.)	107·8293909	135·3212379	167·7443158
26	m va(1·3).	326·9306392	334·7619070	339·372960
27	m vb(1·3).	364·7227251	380·6639991	394·4333873
28	t(1·2).	·0000601369	·0000614480	·0000620271
29	t(2·3).	·0001409634	·0001296315	·0001185363
30	E(1·2).	1807·832558	2246·869859	2759·549923
31	Ep(1·2).	1725·576577	2120·654332	2570·647248
32	Ei(1·2)	691·9562074	850·3823871	1030·829546
33	Esp(1·2).	82·25598149	126·2155268	188·9026750
34	Ek(1·2).	1638·435945	1798·483598	1934·092082
35	W(1·2).	4138·224711	4895·735844	5724·471546
36	Ek(1·3).	2200·916650	2516·912271	2833·628042
37	W(1·3).	4618·449435	5487·948990	6435·104837
38	T3.=T2.	289·3858776	291·0361503	292·9158082
39	p3.=p2.	1924·330613	1962·943982	2007·594662
40	v3.=v2.	14·43673143	14·23345275	14·00677045
41	Ar1.	—	·2194299874	·4272324256
42	m vcm1.	—	342·6040399	344·5638352
43	M1.	—	4·889927493	9·575200161
44	m Ek(1·3).	—	2358·522717	2516·912271
45	m Ep(1·2).	—	1916·901393	2120·654332
46	m Ei(1·2).	—	768·6774586	850·3823871
47	m W(1·3).	—	5044·101569	5487·948990
48	m T2. & 3.	—	290·1850573	291·0361503
49	ANGLE A.	49·08949068	50·30742327	51·31427348
50	" B.	58·94120257	55·12373314	50·58040112
51	" C.	60·17104369	56·91346663	53·24352147
52	HORSE POWER	—	44·84598353	95·54220010
53	(1.x14.x37.)	1311429·551	1494445·056	1677460·561
54	(1x14.)	283·9545110	272·3139480	260·6733851

TABLE 1D.

Compressor Stage 1. Synopsis.				
REF. №	Values	r = 3.	r = 4.	Units
1	r(1·3).	·7042781643	·6612597746	FT.
2	P1. P2. P3.	·2107195340	·1978484619	FT.
3	Z2. Z3.	·1884938246	·1732808493	FT.
4	X2. X3.	·0222257093	·0245676125	FT.
5	V1.	810·4842660	760·9786448	FT./SEC.
6	STATIC T.	=	288·160	KELVIN
7	" p.	=	1896·000515	LB./FT^2.
8	" v.	=	14·59037578	FT^3./LB.
9	C3.	1·287638535	1·315527641	FACTOR
10	C4.	·7057122131	·6866256344	FACTOR
11	b.	·7379482981	·8356277485	LB./LB.
12	Ba1.	·8695594070	·9937066480	LB./LB.
13	va1.	63·81987593	15·000	FT./SEC.
14	vcm1.	353·6000897	359·000	FT./SEC.
15	T1.	=	282·1780004	KELVIN
16	p1.	=	1762·009909	LB./FT^2.
17	v1.	=	15·37397032	FT^3./LB.
18	va2. vb2.	367·1027939	361·4182061	FT./SEC.
19	va3.	454·3386481	470·7227255	FT./SEC.
20	vb1.	778·0840494	775·9786448	FT./SEC.
21	vb3.	248·8887477	230·6129288	FT./SEC.
22	(va3.−va1.)	390·5187722	455·7227255	FT./SEC.
23	(va2.−va1.)	303·2829180	346·4182061	FT./SEC.
24	(vb1.−va1.)	714·2641734	760·9786448	FT./SEC.
25	(va3.−vb3.)	205·4499004	240·1097967	FT./SEC.
26	m va(1·3).	339·4137429	327·9109055	FT./SEC.
27	m vb(1·3).	404·6245153	401·5166129	FT./SEC.
28	t(1·2).	·0000622338	·0000645684	SECOND
29	t(2·3).	·0001081806	·0001023182	SECOND
30	E(1·2).	3366·446863	4096·737381	FT. LB./LB.
31	Ep(1·2).	3087·920760	3688·875662	FT. LB./LB.
32	Ei(1·2).	1238·256225	1479·239140	FT. LB./LB.
33	Esp(1·2).	278·5261029	407·8617190	FT. LB./LB.
34	Ek(1·2).	2031·010828	2026·451789	FT. LB./LB.
35	W(1·2).	6635·713916	7602·428310	FT. LB./LB.
36	Ek(1·3).	3144·629680	3439·965256	FT. LB./LB.
37	W(1·3).	7470·806664	8608·080059	FT. LB./LB.
38	T3 = T2.	295·0765027	297·5867414	KELVIN
39	p3. = p2.	2059·811569	2121·684888	LB./FT^2.
40	v3. = v2.	13·75239595	13·46492466	FT^3./LB.
41	Ar1.	·6234073156	·8079546569	FT^2.
42	m vcm1.	346·6332906	348·8218749	FT./SEC.
43	M1.	14·05581803	18·33178108	LB./SEC.
44	m Ek(1·3).	2675·516898	2833·628042	FT. LB./LB.
45	m Ep(1·2).	2338·092054	2570·647248	FT. LB./LB.
46	m Ei(1·2).	937·5749137	1030·829546	FT. LB./LB.
47	m W(1·3).	5951·183866	6435·104836	FT. LB./LB.
48	m T2.&3.	291·9444058	292·9158082	KELVIN.
49	ANGLE A.	52·10729521	52·66879028	DEGREES
50	" B.	45·20549247	38·95596575	DEGREES
51	" C.	48·93641182	45·03684841	DEGREES
52	HORSE POWER	152·088650	214·4853329	H.P.
53	(1.x14.x37.)	1860476·067	2043491·572	PRODUCT
54	(1.x14.)	249·0328221	237·3922591	PRODUCT

TABLE 2D.

Plane 1., Plane (n=1.)., (n=2.)., (n=3.).				
	Values	r = 0.	r = 1.	r = 2.
54	van=0.	114·0112423	101·8909391	86·19338484
55	vbn=0.	619·5244522	672·8615338	727·3260289
54	van=1.	160·0359187	152·5368559	141·5864521
55	vbn=1.	564·4464866	609·2973317	654·4925674
56	Ek(1·n=1.)	196·0112498	200·2506517	196·0810566
57	E(1·n=1.)	650·8197211	808·8731496	993·4379718
58	Ep(1·n=1.)	621·2075684	763·4355605	925·4330069
62	Ban=1.	·9250711049	·8913532314	·8596484978
63	t(1·n=1.)	·0000123682	·0000127169	·0000129273
64	L(1·n=1.)	·0042144074	·0043818115	·0045093344
65	Fpan=1.	·0073217946	·0081524158	·0089315917
86	R Fpan=1.	–·0045393231	–·0034135476	–·0021857555
66	San=1.	·0016947350	·0016177664	·0014722891
87	R San=1.	–·0101663827	–·0099481970	–·0096450581
67	Rpan=1.	·0016947350	·0016177664	·0014722891
88	R Rpan=1.	–·0101663827	–·0099481970	–·0096450581
54	van=2.	206·0605951	203·1827728	196·9795194
55	vbn=2.	509·3685210	545·7531296	581·6591059
56	Ek(1·n=2.)	457·8604694	480·2243379	487·5307931
57	E(1·n=2.)	1157·012838	1437·677288	1766·084504
58	Ep(1·n=2.)	1104·369010	1357·218774	1645·214236
62	Ban=2.	·8974083251	·8632269632	·8311251357
63	t(1·n=2.)	·0000244342	·0000248848	·0000253888
64	L(1·n=2.)	·0083258415	·0085744162	·0088561917
65	Fpan=2.	·0137917983	·0151622678	·0166168238
86	R Fpan=2.	–·0096406270	–·0074703466	–·0052172874
66	San=2.	·0039103496	·0037958554	·0035947194
87	R San=2.	–·0195220758	–·0188367584	–·0182393918
67	Rpan=2.	·0039103496	·0037958554	·0035947194
88	R Rpan=2.	–·0195220758	–·0188367584	–·0182393918
54	van=3.	252·0852714	253·8286896	252·3725867
55	vbn=3.	454·2905554	482·2089275	508·8256443
56	Ek(1·n=3.)	785·5476578	839·9210573	874·3492094
57	E(1·n=3.)	1518·579350	1887·370683	2318·021935
58	Ep(1·n=3.)	1449·484326	1781·349640	2159·343687
62	Ban=3.	·8701473859	·8346716244	·801536664
63	t(1·n=3.)	·0000363332	·0000371823	·0000375973
64	L(1·n=3.)	·0123803712	·0128116913	·0131147879
65	Fpan=3.	·0195075677	·0214737423	·0232380309
86	R Fpan=3.	–·0153360121	–·0123433925	–·0090952668
87	San=3.	·0066507289	·0066132449	·0063645964
87	R San=3.	–·0281928509	–·0272038899	–·0259687013
67	Rpan=3.	·0066507289	·0066132449	·0063645964
88	R Rpan=3.	–·0281928509	–·0272038899	–·0259687013

TABLE 2D.

Plane 1., Plane (n=1.)., (n = 2.)., (n = 3).				
REF. No.	Values	r = 3.	r = 4.	Units
54	van=0.	63·81987593	15·000	FT./SEC.
55	vbn=0.	778·0840494	775·9786448	FT./SEC.
54	van=1.	124·4764595	84·28364122	FT./SEC.
55	vbn=1.	695·8877983	693·0665570	FT./SEC.
56	Ek(1·n=1.)	177·4944428	106·8989274	FT.LB./LB.
57	E(1·n=1.)	1211·920870	1474·825457	FT.LB./LB.
58	Ep(1·n=1.)	1111·651474	1327·995238	FT.LB./LB.
62	Ban=1.	·8432528403	·9624523572	LB./LB.
63	t(1·n=1.)	·0000130743	·0000136894	SECOND
64	L(1·n=1.)	·0046230736	·0049144946	FT.
65	Fpan=1.	·0096355753	·0100551736	FT.
86	R Fpan=1.	−·0009609391	−·0003621674	FT.
66	San=1.	·0012309213	·0006795667	FT.
87	R San=1.	−·0093655931	−·0097377743	FT.
67	Rpan=1.	·0012309213	·0006795667	FT.
88	R Rpan=1.	−·0093655931	−·0097377743	FT.
54	van=2.	185·1330431	153·5672824	FT./SEC.
55	vbn=2.	613·6915472	610·1544693	FT./SEC.
56	Ek(1·n=2.)	469·3427470	362·9935697	FT.LB./LB.
57	E(1·n=2.)	2154·525992	2621·917923	FT.LB./LB.
58	Ep(1·n=2.)	1976·269287	2360·880423	FT.LB./LB.
62	Ban=2.	·8141119557	·9276719323	LB./LB.
63	t(1·n=2.)	·0000255864	·0000266808	SECOND
64	L(1·n=2.)	·0090473533	·0095784072	FT.
65	Fpan=2.	·0178052635	·0184915702	FT.
86	R Fpan=2.	−·0029321111	−·0018119488	FT.
66	San=2.	·0031849044	·0022487549	FT.
87	R San=2.	−·0175524702	−·0180547641	FT.
67	Rpan=2.	·0031849044	·0022487549	FT.
88	R Rpan=2.	−·0175524702	−·0180547641	FT.
54	van=3.	245·7896267	222·8509237	FT./SEC
55	vbn=3.	531·4952961	527·2423815	FT./SEC
56	Ek(1·n=3.)	875·5449125	768·2839279	FT.LB./LB.
57	E(1·n=3.)	2827·815364	3441·259401	FT.LB./LB.
58	Ep(1·n=3.)	2593·853439	3098·655557	FT.LB./LB.
62	Ban=3.	·7830784411	·8904141526	LB./LB.
63	t(1·n=3.)	·0000377961	·0000393012	SECOND
64	L(1·n=3.)	·0133647043	·0141091308	FT.
65	Fpan=3.	·0247484959	·0256090751	FT.
86	R Fpan=3.	−·0058846484	−·0042982988	FT.
66	San=3.	·0058510158	·0046739133	FT.
87	R San=3.	−·0247821285	−·0252334606	FT.
67	Rpan=3.	·0058510158	·0046739133	FT.
88	R Rpan=3.	−·0247821285	−·0252334606	FT.

TABLE 3D.

Plane (n= 4.). Plane 2., Plane (n= 5.).				
REF. No.	Values	r = 0.	r = 1.	r = 2.
54	van=4.	298·1099478	304·4746065	307·7656540
55	vbn=4.	399·2125898	418·6647254	435·9921828
56	Ek(1·n=4.)	1179·072817	1279·340811	1356·536306
57	E(1·n=4.)	1735·519257	2156·995066	2649·167925
58	Ep(1·n=4.)	1656·553515	2035·828160	2467·821357
62	Ban=4.	·8468032025	·8095062229	·7745022536
63	t(1·n=4.)	·0000481928	·0000492623	·0000497666
64	L(1·n=4.)	·0164214755	·0169740348	·0173596787
65	Fpan=4.)	·0245478952	·0268850984	·0289471960
86	R'Fpan=4.	–·0216690544	–·0179187421	–·0138515767
66	San=4.	·009930637	·0100092671	·0098030009
87	R San=4.	–·0362863126	–·0347945734	–·0288627687
67	Rpan=4.	·009930637	·0100092671	·0098030009
88	R'Rpan=4.	–·0362863126	–·0347945734	–·0288627687
54	van=5.	344·1346242	355·1205233	363·1587213
55	vbn=5	344·1346242	355·1205233	363·1587213
56	Ek(1·n=5.)	1638·435945	1798·483598	1934·092082
57	E(1·n=5.)	1807·832558	2246·869861	2759·549923
58	Ep(1·n=5.)	1725·576577	2120·654334	2570·647248
62	Ban=5.	·8356277485	·7970186924	·7605442075
63	t(1·n=5.)	·0000601369	·0000614480	·000062027 1
64	L(1·n=5.)	·0204913728	·0211727585	·0216364093
65	Fpan=5.	·0289757347	·0315831062	·0338198033
86	R'Fpan=5.	–·0286956203	–·0243035737	–·0195228754
66	San=5.	·0137757360	·0140412201	·0139360040
87	R San=5.	–·0438956190	–·0418454598	–·0394066747
67	Rpan=5.	·0137757360	·0140412201	·0139360040
88	R'Rpan=5.	–·0438956190	–·0418454598	–·0394066747
Plane (m= 1.).				
68	vam=1.	353·9519993	367·1241331	377·6516227
69	vbm=1.	332·3861212	340·0598855	344·1027595
70	Ek(2·m=1.)	106·5049145	134·7290209	166·8504269
71	Esp(2·m=1.)	3·2902392	5·0686206	7·5561073
72	W(2·m=1.)	103·2146753	129·6804003	159·2943196
73	t(2·m=1.)	·0000306743	·000028690	·0000267274
74	L(2·m=1.)	·0104521283	·0098855369	·0093231081
89	L(1·m=1.)	·0309435011	·0310582954	·0309595174
76	Fpbm=1.	·0393516348	·0415554691	·0432714335
90	R'Fpbm=1.	–·0477364085	–·0404246370	–·0330565389
77	Sbm=1.	·0244823953	·0244018197	·0238359711
91	R Sbm=1.	–·0626056480	–·0575782864	–·0524920013
78	Rpbm=1.	·0241516362	·0240135830	·0233876342
92	R'Rpbm=1.	–·0629364071	–·0579665231	–·0529403382

TABLE 3D.

Plane(n=4.). Plane 2. Plane(n=5.).				
REF. No	Values	r = 3.	r = 4.	Units
54	van=4.	306·4462103	292·1345649	FT./SEC.
55	vbn=4.	449·2990450	444·3302937	FT./SEC.
56	Ek(1·n=4.)	1396·100939	1322·770001	FT.LB./LB.
57	E(1·n=4.)	3231·788988	3932·867886	FT.LB./LB.
58	Ep(1·n=4.)	2964·403931	3541·320635	FT.LB./LB.
62	Ban=4.	·7537365697	·8549128348	LB./LB.
63	t(1·n=4.)	·0000499378	·0000518397	SECOND
64	L(1·n=4.)	·0176580105	·0186104746	FT.
65	Fpan=4.	·0306464057	·0316302246	FT.
86	R'Fpan=4.	−·0098273954	−·007818680	FT.
66	San=4.	·0092451368	·0079608818	FT.
87	R San=4.	−·0312286643	−·0314880228	FT.
67	Rpan=4.	·0092451368	·0079608818	FT.
88	R Rpan=4.	−·0312286643	−·0314880228	FT.
54	vam=0.	367·1027939	361·4182061	FT./SEC.
55	vbm=0.	367·1027939	361·4182061	FT./SEC.
56	Ek(1·2).	2031·010828	2026·451789	FT.LB./LB.
57	E(1·2).	3366·446862	4096·737381	FT.LB./LB.
58	Ep(1·2).	3087·920761	3688·875662	FT.LB./LB.
62	Ba2.=b	·7379482991	·8356277485	LB./LB.
63	t(1·2)	·0000622338	·0000645684	SECOND
64	L(1·2)	·0220058772	·0231800556	FT.
65	Fpa2.	·0356346644	·0367199474	FT.
86	R'Fpa2.	−·0148048513	−·0124152261	FT.
66	Sa2.	·0134089776	·0121523606	FT.
87	R Sa2.	−·0370305381	−·0369828129	FT.
67	Rpa2.	·0134089776	·0121523606	FT.
88	R'Rpa2.	−·0370305381	−·0369828129	FT.
Plane(m=1.).				
68	vam=1.	384·5499647	383·2791110	FT./SEC.
69	vbm=1.	343·4599847	335·2571494	FT./SEC.
70	Ek(2·m=1.)	203·8014245	252·9955315	FT.LB./LB.
71	Esb(2·m=1.)	11·1410439	16·3144687	FT.LB./LB.
72	W(2·m=1.)	192·6603806	236·6810628	FT.LB./LB.
73	t(2·m=1.)	·0000249209	·0000243279	SECOND
74	L(2·m=1.)	·0088120478	·0087337319	FT.
89	L(1·m=1.)	·0308179250	·0319137875	FT.
76	Fpbm=1.	·0444885963	·0451942715	FT.
90	R'Fpbm=1.	−·0261489167	−·0224539144	FT.
77	Sbm=1.	·0227373265	·0212108215	FT.
91	R Sbm=1.	−·0479001865	−·0464373644	FT.
78	Rpbm=1.	·0222629095	·0206266847	FT.
92	R Rpbm=1.	−·0483746035	−·0470215012	FT.

TABLE 4D.

Plane (m=2.). Plane (m=3.). & (m=4.).				
REF No.	Values	r= 0.	r= 1.	r= 2.
68	vam=2.	363·7693745	379·1277429	392·1445240
69	vbm=2.	320·6376181	324·9992478	325·0467977
70	Ek(2·m=2.)	216·0054431	273·9363984	340·2292355
71	Esp(2·m=2.)	13·1609571	19·1944840	30·22442709
72	W(2·m=2.)	202·8444860	253·7419144	310·0048084
73	t(2·m=2.)	·0000600521	·0000559222	·0000518450
74A	L(2·m=2.)	·0204625043	·0192687839	·0180846840
74	L(1·m=2.)	·0409538771	·0404415424	·0397210933
76	Fpbm=2.	·0489362192	·0506000031	·0516598108
90	R Fpbm=2.	−·0663251675	−·0796599444	−·0462690436
77	Sbm=2.	·0350312969	·0345716093	·0335153523
91	R Sbm=2.	−·0802300898	−·0956883382	−·0644135021
78	Rpbm=2.	·0337362206	·0330581170	·0317760115
92	R Rpbm=2	−·0815251661	−·0972018305	−·0661528429
68	vam=3.	373·5867496	391·1313528	406·6374254
69	vbm=3.	308·8891151	309·938610	305·9908359
70	Ek(2·m=3.)	328·5015836	417·6221339	520·1364282
71	Esp(2·m=3.)	29·61215320	45·4375900	68·0049619
72	W(2·m=3.)	298·8894304	372·1845439	452·1314663
73	t(2·m=3.)	·0000881901	·0000817742	·0000754551
74A	L(2·m=3.)	·0300503796	·0281764409	·0263204212
74	L(1·m=3.)	·0505417524	·0493491994	·0479568305
76	Fpbm=3.	·0577708491	·0587754454	·0590651766
90	R Fpbm=3.	−·0844749114	−·0714845021	−·0591681250
77	Sbm=3.	·0454236959	·0445532951	·0429785266
91	R Sbm=3.	−·0968220646	−·0857066524	−·075254775
78	Rpbm=3.	·0425708505	·0412335593	·0391813773
92	R Rpbm=3.	−·099674910	−·0890263882	−·0790519243
68	vam=4.	383·4041248	403·1349626	421·1303267
69	vbm=4.	297·1406120	294·8779723	286·9348741
70	Ek(2·m=4.)	443·9933384	565·7862249	706·5720024
71	Esp(2·m=4)	52·6438283	80·7779377	120·8977091
72	W(1·m=4.)	391·3495101	485·0082872	585·6742933
73	t(2·m=4.)	·0001151428	·0001063202	·0000976550
74A	L(2·m=4.)	·0392344111	·0366341230	·0340642014
74	L(1·m=4.)	·0597257839	·0578068815	·0557006107
76	Fpbm=4.	·0658948478	·0661370912	·0655622483
90	R Fpbm=4	−·1021985825	−·0864473331	−·0717627428
77	Sbm=4.	·0556611604	·0543501575	·0522308774
91	R Sbm=4.	−·1124322699	−·0982342668	−·0850941137
78	Rpbm=4.	·0507107109	·0485952051	·0456784490
92	R Rpbm=4	−·1173827194	−·1039892192	−·0916465421

TABLE 4D.

Plane(m=2.). Plane(m=3,). & (m=4.).				
REF. No.	Values	r=3.	r=4.	Units
68	vam=2.	401·9971356	405·1400139	FT./SEC.
69	vbm=2.	319·8171754	309·0960932	FT./SEC.
70	Ek(2·m=2.)	417·0640228	520·8446442	FT.LB./LB.
71	Esp(2·m=2)	44·5641762	65·2678760	FT.LB./LB.
72	W(2·m=2.)	372·4998466	455·5867682	FT.LB./LB.
73	t(2·m=2.)	·0000480702	·0000465370	SECOND
74A	L(2·m=2.)	·0169976519	·0167067845	FT.
74	L(1·m=2.)	·0390035291	·0398868401	FT.
76	Fpbm=2.	·0521448545	·0523218093	FT.
90	R Fpbm=2.	-·0372548019	-·0322270274	FT.
77	Sbm=2.	·0318943713	·0299890205	FT.
91	R Sbm=2.	-·0575052851	-·0545598162	FT.
78	Rpbm=2.	·0299191677	·0277542225	FT.
92	R Rpbm=2	-·0594804887	-·0567946142	FT.
68	vam=3.	419·4443064	427·0009177	FT./SEC.
69	vbm=3.	296·1743662	282·9350396	FT./SEC.
70	Ek(2·m=3.)	639·7877927	803·5473366	FT.LB./LB.
71	Esp(2·m=3.)	100·2693963	146·8302186	FT.LB./LB.
72	W(2·m=3.)	539·5183964	656·7171180	FT.LB./LB.
73	t(2·m=3.)	·0000695812	·0000668211	SECOND
74A	L(2·m=3.)	·0246039508	·0239887775	FT.
74	L(1·m=3.)	·0466098280	·0471688331	FT.
76	Fpbm=3.	·0587104747	·0582481437	FT.
90	R Fpbm=3.	-·0481235088	-·0417364599	FT.
77	Sbm=3.	·0407734231	·0384938771	FT.
91	R Sbm=3.	-·0660605604	-·0614907265	FT.
78	Rpbm=3.	·0364847879	·0336805569	FT.
92	R Rpbm=3	-·0703491956	-·0663040467	FT.
68	vam=4.	436·8914773	448·8618216	FT./SEC.
69	vbm=4.	272·5315569	256·7739840	FT./SEC.
70	Ek(2·m=4.)	871·9727365	1101·1036110	FT.LB./LB.
71	Esp(2·m=4.)	178·2567050	261·0315003	FT.LB./LB.
72	W(2·m=4.)	693·7160315	840·0721107	FT.LB./LB.
73	t(2·m=4.)	·0000895791	·0000853598	SECOND
74A	L(2·m=4.)	·0316751891	·0306441884	FT.
74	L(1·m=4.)	·0536810663	·0538242440	FT.
76	Fpbm=4.	·0642835991	·0631043282	FT.
90	R Fpbm=4	-·0587583677	-·0509878302	FT.
77	Sbm=4.	·0494195192	·0467350311	FT.
91	R Sbm=4.	-·0736224476	-·0673571273	FT.
78	Rpbm=4.	·0420579123	·0385367414	FT.
92	R Rpbm=4	-·0809840545	-·0755554170	FT.

TABLE 5D.

Plane(m=5.). & Plane 3.				
REF. No	Values	r = 0.	r = 1.	r = 2.
68	Vam=5.	393·2214999	415·1385724	435·6232281
69	Vbm=5.	285·3921090	279·8173345	267·8789123
70	Ek(2·m=5.)	562·4807051	718·4286726	899·5359608
71	Esb(2·m=5)	82·25598149	126·2155268	188·9026714
72	W(2·m=5.)	480·2247236	592·2131458	710·6332894
73	t(2·m=5.)	·0001409634	·0001296315	·0001185363
74.	L(2·m=5.)	·0480326319	·0446663268	·0413480544
89	L(1·m=5.)	·0685240047	·0658390853	·0629844637
76	Fpbm=5.	·0733458490	·0727370796	·0712202364
90	R'Fpbm=5.	-·1195095658	-·1010488674	-·0840624615
77	Sbm=5.	·0657458492	·0639661410	·0612783323
91	R Sbm=5.	-·1271095656	-·1098198060	-·0940043656
78	Rpbm=5.	·0581458504	·0551951935	·0513364371
92	R'Rpbm=5.	-·1347095644	-·1185907535	-·1039462609
Plane(w=1.).,(w=2.).,(w=3.).				
79	L(1·w=1.)	·0832492018	·0834928065	·0848342376
80	Fpcw=1.	·0900378619	·0936591664	·0981126011
94	R'Fpcw=1.	-·1442604601	-·1267247646	-·1110388073
81	Scw=1.	·0827387825	·0852357574	·0885652364
95	R Scw=1.	-·1515595395	-·1351481736	-·120586172
82	Rpcw=1.	·0754397031	·0768123484	·0790178717
96	R'Rpcw=1.	-·1588586189	-·1435715826	-·1301335367
83	rw=1.	·8333333333	·7904413069	·7475863738
84	Xw=1.	·0145981588	·0168468180	·0190947296
79	L(1·w=2.)	·0979743990	·1011465277	·1066840115
80	Fpcw=2.	·1061265211	·1138845447	·1242143426
94	R'Fpcw=2.	-·1696147087	-·1530973705	-·1388057763
81	Scw=2.	·0997317160	·1065053739	·1158521405
95	R Scw=2.	-·1760095138	-·1604765413	-·1471679784
82	Rpcw=2.	·0933369107	·0991262031	·1074899384
96	R'Rpcw=2.	-·1824043191	-·1678557121	-·1555301805
83	rw=2.	·8333333333	·7908164537	·7484433598
84	Xw=2.	·0127896104	·0147583416	·0167244046
79	L(1·w=3.)	·1126995962	·1188002489	·1285337855
80	Fpcw=3.	·1216072512	·1334082970	·1495207879
94	R'Fpcw=3.	-·1955768864	-·1801716023	-·1673680417
81	Scw=3.	·1167246494	·1277749904	·1431390446
95	R Scw=3.	-·2004594882	-·1858049089	-·173749785
82	Rpcw=3.	·1118420476	·1221416838	·1367573013
96	R'Rpcw=3.	-·205342090	-·1914382155	-·1801315283
83	rw=3.	·8333333333	·7914288788	·7498363954
84	Xw=3.	·0097652036	·0112666132	·0127634884

TABLE 5D.

REF. No.	Values	r = 3.	r = 4.	Units
Plane(m=5.). & Plane 3.				
68	va3.	454·3386481	470·7227255	FT./SEC.
69	vb3.	248·8887477	230·6129288	FT./SEC.
70	Ek(2·3).	1113·6188520	1413·513467	FT.LB./LB.
71	Esp(2·3).	278·5261029	407·8617190	FT.LB./LB.
72	W(2·3).	835·0927506	1005·651748	FT.LB./LB.
73	t(2·3).	·0001081806	·0001023182	SECOND
74	L(2·3).	·0382526698	·0367322338	FT.
89	L(1·3).	·0602585470	·0599122894	FT.
76	Fpb3.	·0689538316	·0670077274	FT.
90	R'Fpb3.	-·0691643583	-·0599122894	FT.
77	Sb3.	·0578409916	·0547239417	FT.
91	R Sb3.	-·0802771983	-·0722731970	FT.
78	Rpb3.	·0467281448	·0424401406	FT.
92	R'Rpb3.	-·0913900451	-·0845569981	FT.
Plane(w=1.)., (w=2.)., (w=3.).				
79	L(1·w=1.)	·0861605456	·0909755757	FT.
80	Fpcw=1.	·1017937765	·1072496769	FT.
94	R'Fpcw=1.	-·095694201	-·085592858	FT.
81	Scw=1.	·0911223153	·0954542893	FT.
95	R Scw=1.	-·1063656622	-·0973882463	FT.
82	Rpcw=1.	·0804508540	·0836589017	FT.
96	R'Rpcw=1.	-·1170371235	-·1091836340	FT.
83	rw=1.	·7047762048	·6620221502	FT.
84	Xw=1.	·0213429225	·0235907752	FT.
79	L(1·w=2.).	·1120625443	·1220388621	FT.
80	Fpcw=2.	·1337493789	·1465133172	FT.
94	R'Fpcw=2	-·1231083867	-·1121746157	FT.
81	Scw=2.	·1244036390	·1361846370	FT.
95	R Scw=2.	-·1324541266	-·1225032959	FT.
82	Rpcw=2.	·1150578991	·1258559568	FT.
96	R'Rpcw=2	-·1617998665	-·1328319761	FT.
83	rw=2.	·7062454029	·6642634968	FT.
84	Xw=2.	·0186914798	·0206573604	FT.
79	L(1·w=3.).	·1379645429	·1531021484	FT.
80	Fpcw=3.	·1648160024	·1847942925	FT.
94	R'Fpcw=3	-·1514115511	-·1397390378	FT.
81	Scw=3.	·1576849627	·1769149847	FT.
95	R.Scw=3.	-·1585425908	-·1476183451	FT.
82	Rpcw=3.	·1505539230	·1690356769	FT.
96	R'Rpcw=3	-·1656736305	-·1554976529	FT.
83	rw=3.	·7086195641	·6678597151	FT.
84	Xw=3.	·0142620794	·0157586156	FT.

TABLE 6D.

Plane(w=4.). & Plane 4.				
REF No.	Values	r = 0.	r = 1.	r = 2.
79	L(1·w=4.)	·1274247933	·1364539701	·1503835594
80	Fpcw=4.	·1364722959	·1522221573	·1740240471
94	R' Fpcw=4.	−·2221547493	−·2079557262	−·1967334930
81	Scw=4.	·1337175828	·1490446068	·1704259487
95	R Scw=4.	−·2249094624	−·2111332767	−·2003315914
82	Rpcw=4	·1309628697	·1458670563	·1668278503
96	R Rpcw=4	−·2276641755	−·2143108272	−·2039296898
83	rw=4.	·8333333333	·7922604193	·751715130
84	Xw=4.	·0055094263	·0063551011	·0071961969
79B	L(1·w=5.)	·1421499905	·1541076913	·1722333333
80	Fpcw=5.	·1507105162	·1703142233	·1977128528
94	R' Fpcw=5.	−·2493594368	−·2364616444	−·2269133978
81	Scw=5.	·1507105162	·1703142233	·1977128528
95	R Scw=5.	−·2493594368	−·2364616444	−·2269133978
82	Rpcw=5.	·1507105162	·1703142233	·1977128528
96	R Rpcw=5	−·2493594368	−·2364616444	−·2269133978
83	rw=5.	·8333333333	·7932876451	·7540163958
84	Xw=5.	0	0	0
7	Ar4.	—	·2046406958	·3955381997
3	m T4.	—	290·1854573	291·0361503
4	m p4.	—	1942·970942	1962·943983
5	m v4.	—	14·33778501	14·23345275
1	m va4.	—	404·3447683	415·1385724
2	m vcm4	—	342·6040399	344·5638352
20	va4.	393·2214999	415·1385724	435·6232281
21	vcm4	340·7454132	344·5638352	348·8218749

Miscellaneous Values				
93	FR	·3604306438	·4485417774	·6052240112
74A	Radius D.	1·064173702	·8624752086	·6962492229
	t(3·4).	·0002160733	·0002561749	·0003131938
	L(3·4).	·0736259858	·0882686060	·1092488696
4	X2	·01520	·0175419031	·0198838062
	Ar/(r=1.) — Ar/(r=0.)		·2046406958	—
	Ar/(r=2.) — Ar/(r=1.)		—	·1908975039
	Ar/(r=3.) — Ar/(r=2.)		—	—
	Ar/(r=4.) — Ar/(r=3.)		—	—
79C	t(1·4).	·0004171735	·0004472543	·0004937572
	M1. = M4.	—	4·889927493	9·575200161

TABLE 6D.

Plane (w=4.). & Plane 4.				
REF. No.	Values	r=3.	r=4.	Units
79	L(1·w=4.)	·1638665416	·1841654348	FT.
80	Fpcw=4.	·1949858045	·2220852365	FT.
94	R Fpcw=4.	–·1806115371	–·1682934905	FT.
81	Scw=4.	·1909662864	·2176453323	FT.
95	R Scw=4.	–·1846310552	–·1727333947	FT.
82	Rpcw=4.	·1869467683	·2132054283	FT.
96	R Rpcw=4.	–·1886505733	–·1771742987	FT.
83	rw=4.	·7117955914	·6726236158	FT.
84	Xw=4.	·0080390362	·0088798081	FT.
79B	L(1·4).	·1897685402	·2152287211	FT.
80	Fpc4.	·2242476101	·258375680	FT.
94	R Fpc4.	–·2107195194	–·197848444	FT.
81	Sc4.	·2242476101	·258375680	FT.
95	R Sc4.	–·2107195194	–·197848444	FT.
82	Rpc4.	·2242476101	·258375680	FT.
96	R Rpc4.	–·2107195194	–·197848444	FT.
83	r4.	·7156470890	·6783327949	FT.
84	X4.	0	0	FT.
7	Ar4.	·5726925122	·7361036335	FT^{2}.
3	m T4.	291·9444058	292·9158082	KELVIN
4	m p4.	1984·429808	2007·594663	LB./FT^{2}.
5	m v4.	14·12328259	14·00677045	FT^{3}./LB.
1	m va4.	425·5766949	435·6232282	FT./SEC.
2	m vcm4	346·6332906	348·8218749	FT./SEC.
20	va4.	454·3386481	470·7227255	FT./SEC.
21	vcm4.	353·6000897	359·000	FT./SEC.

Miscellaneous Values				
93	FR	·7602157326	·9880522925	FT.
74A	Radius D.	·5549178585	·4287794451	FT
	t(3·4).	·0003662612	·0004326363	SECOND
	L(3·4).	·1295099932	·1553164317	FT.
4	X2.	·0222257093	·0245676125	FT.
		—	—	FT^{2}.
		—	—	FT^{2}.
		·1771543125	—	FT^{2}.
		—	·1634111213	FT^{2}.
79C	t(1·4).	·0005366755	·0005995229	
	M1 = M4	14·05581803	18·33178108	LB./SEC.

TABLE 7D.

Plane 5. to Plane (m=7.). Mean Values.				
REF No.	Values	r = 0.	r = 1.	r = 2.
7	Ar5.	—	·2046406958	·3955381997
3	mT5.	—	290·1854573	291·0361503
4	mp5.	—	1942·970942	1962·943983
5	mv5.	—	14·33778501	14·23345275
1	mva5.	—	404·3447683	415·1385724
2	mvcm5.	—	342·6040399	344·5638352
7	Ar(m=1.)	—	·1892154984	·3646296058
1	mva(m=1.)	—	378·8427439	388·2382341
2	mvcm(m=1.)	—	370·6081423	374·6135934
1A	mvax(m=1.)	—	378·7667037	387·3655262
2A	mvcmx(m=1.)	—	370·5337549	373·7715119
58	mRvxm.	—	529·8674168	538·2909938
7	Ar(m=2.).	—	·1757720466	·3377426197
1	mva(m=2.)	—	351·4057424	359·1682219
2	mvcm(m=2.)	—	396·7193265	402·5698190
1A	mvax(m=2.)	—	353·3134497	360·0219251
2A	mvcmx(m=2.)	—	398·8730317	403·5266831
58	mRvx(m=2.)	—	532·8509021	540·7860672
7	Ar(m=3).	—	·1643601430	·3149043597
1	mva(m=3.)	—	322·1739007	326·6428131
2	mvcm(m=3.)	—	420·8042270	429·3818154
1A	mvax(m=3.)	—	326·5865047	331·5505609
2A	mvamx(m=3.)	—	426·5677057	432·7922268
58	mRvx(m=3.)	—	537·2324940	545·1925098
7	Ar(m=4.)	—	·1550054481	·2961813193
1	mva(m=4.)	—	291·2965236	295·1802251
2	mvcm(m=4.)	—	442·7398278	451·5893107
1A	mvax(m=4.)	—	297·5940409	300·7766155
2A	mvcmx(m=4.)	—	452·3113863	460·1510972
58	mRvx(m=4.)	—	541·4312545	549·7323027
7	Ar(m=5.)	—	·1477179627	·2816009834
1	mva(m=5.)	—	258·9313202	260·6198382
2	mvcm(m=5.)	—	462·4140906	472·3786307
1A	mvax(m=5.)	—	265·7692315	267·0183980
2A	mvcmx(m=5.)	—	474·6256165	483·9761474
58	mRvx(m=5.)	—	543·9694479	552·7492525
7	Ar(m=6.)	—	·1425008317	·2712196410
1	mva(m=6.)	—	225·2435993	224·6029743
2	mvcm(m=6.)	—	479·7265270	490·528057
1A	mvax(m=6.)	—	231·0073558	230·0851759
2A	mvcmx(m=6.)	—	492·0022450	502·5010672
58	mRvx(m=6.)	—	543·5352864	552·6721548
7	Ar(m=7.)	—	·1393588374	·2648958621
1	mva(m=7.)	—	190·4054241	187·3309139
2	mvcm(m=7.)	—	494·5887122	505·9361615
1A	mvax(m=7.)	—	193·6801371	190·5007463
2A	mvcmx(m=7.)	—	503·0949620	514·4971234
58	mRvx(m=7.)	—	539·0886164	548·6326862

TABLE 7D.

Plane 5. to Plane(m=7.). Mean Values.				
REF. No	Values.	r = 3.	r = 4	Units.
7	Ar5	·5726925122	·7361036335	FT².
3	m T5.	291·9444058	292·9158082	KELVIN.
4	m p5.	1984·429808	2007·594663	LB./FT².
5	m v5.	14·12328259	14·00677045	FT³·/LB.
1	m va5.	425·5766949	435·6232282	FT./SEC.
2	m vcm 5.	346·6332906	348·8218749	FT./SEC.
7	Ar(m=1.)	·5263511296	·6744739818	FT².
1	m va(m=1.)	397·2142984	405·7147553	FT./SEC.
2	m vcm(m=1.)	378·8020096	383·1968615	FT./SEC.
1A	m vax(m=1.)	395·4839057	403·0661542	FT./SEC.
2A	m vcmx(m=1.)	377·1518267	380·6952625	FT./SEC.
58	m Rvx(m=1.)	546·4897255	554·4287218	FT./SEC.
7	Ar(m=2.)	·4862131127	·6214718799	FT².
1	m va(m=2.)	366·4269117	373·1016983	FT./SEC.
2	m vcm(m=2.)	408·6581453	415·0173732	FT./SEC.
1A	m vax(m=2.)	366·17439010	371·4344141	FT./SEC.
2A	m vcmx(m=2.)	408·2865822	413·1627799	FT./SEC.
58	m Rvx(m=2)	548·4356090	555·5780833	FT./SEC.
7	Ar(m=3.)	·4520900738	·5763546082	FT².
1	m va(m=3.)	333·4024915	338·0014630	FT./SEC.
2	m vcm(m=3.)	436·0194262	444·0712875	FT./SEC.
1A	m vax(m=3.)	335·7606563	339·0929730	FT./SEC.
2A	m vcmx(m=3.)	439·1034033	445·5053294	FT./SEC.
58	m Rvx(m=3.)	552·7630750	559·8741313	FT./SEC.
7	Ar(m=4.)	·4241080158	·5393350829	FT².
1	m va(m=4.)	298·3426517	300·6480337	FT./SEC.
2	m vcm(m=4.)	460·7188118	470·1649255	FT./SEC.
1A	m vax(m=4.)	303·1061170	304·4332933	FT./SEC.
2A	m vcmx(m=4.)	468·0748362	476·0844560	FT./SEC.
58	m Rvx(m=4.)	557·6444839	565·0982563	FT./SEC.
7	Ar(m=5.)	·4023226186	·5105162288	FT².
1	m va(m=5.)	261·4614322	261·2904214	FT./SEC.
2	m vcm(m=5.)	482·6055126	493·1243383	FT./SEC.
1A	m vax(m=5.)	267·3207574	266·5018159	FT./SEC.
2A	m vcmx(m=5.)	493·4206550	502·9596222	FT./SEC.
58	m Rvx(m=5.)	561·1811919	569·2025996	FT./SEC.
7	Ar(m=6)	·3868466074	·4900253047	FT².
1	m va(m=6.)	222·9839928	220·1909879	FT./SEC.
2	m vcm(m=6.)	501·5459105	512·7964764	FT./SEC.
1A	m vax(m=6.)	228·1476378	224·9980083	FT./SEC.
2A	m vcmx(m=6.)	513·1602196	523·9914084	FT./SEC.
58	m Rvx(m=6.)	561·5912710	570·2552935	FT./SEC.
7	Ar(m=7.)	·3773906405	·4775720408	FT².
1	m va(m=7.)	183·1452377	177·6237127	FT./SEC.
2	m vcm(m=7.)	517·4243744	529·0501999	FT./SEC.
1A	m vax(m=7.)	186·18701820	180·5127327	FT./SEC.
2A	m vcmx(m=7.)	526·0180532	537·6551130	FT./SEC.
58	m Rvx(m=7.)	557·9969516	567·1488933	FT./SEC.

TABLE 8D.

REF. No.	Values.	r=0.	r=1.	r=2.
7	Ar6. & 7.	—	·1383059932	·2628423027
1	m va6.&7.	—	154·5947341	149·0119525
2	m vcm6. & 7.	—	506·9247360	518·5168356
3	m T6. & 7.	—	290·1854573	291·0361503
4	m p6. & 7.	—	1942·970942	1962·943983
5	m v6. & 7.	—	14·33778501	14·23345275
7	Ar(n=1.)	—	·1447572566	·2761666328
1	m va(n=1.)	—	144·6383083	139·0581613
2	m vcm(n=1.)	—	474·2770619	483·8806322
3	m T(n=1.)	—	292·6368173	293·3424793
4	m p(n=1.)	—	2000·921969	2017·830168
5	m v(n=1.)	—	14·04009496	13·95601999
7	Ar(n=2.)	—	·1523964332	·2920021032
1	m va(n=2.)	—	134·6818826	129·1043702
2	m vcm(n=2.)	—	441·6293876	449·2444288
3	m T(n=2.)	—	294·9806194	295·5284560
4	m p(n=2.)	—	2057·474057	2070·855136
5	m v(n=2.)	—	13·76354631	13·70000792
7	Ar(n=3.)	—	·1614919495	·3109475687
1	m va(n=3.)	—	124·7254568	119·1505790
2	m vcm(n=3)	—	408·9817136	414·6082254
3	m T(n=3.)	—	297·2164629	297·5940807
4	m p(n=3.)	—	2112·475820	2121·867710
5	m v(n=3.)	—	13·50679623	13·46409657
7	Ar(n=4.)	—	·1724070725	·333823650
1	m va(n=4.)	—	114·7690311	109·1967879
2	m vcm(n=4.)	—	376·3340395	379·9720220
3	m T(n=4.)	—	299·3443481	299·5393534
4	m p(n=4.)	—	2165·788959	2170·722264
5	m v(n=4.)	—	13·26863233	13·24710139
7	Ar8.	—	·1856447732	·3617835743
1	m va8.	—	104·8126053	99·24299669
2	m vcm8.	—	343·6863654	345·3358186
3	m T8.	—	301·3642739	301·3642739
4	m p8.	—	2217·279232	2217·279232
5	m v8.	—	13·04795980	13·04795980
58	m Rv8.	—	359·3132338	359·3132338
58	m Rv6. m Rv7.	—	529·9737916	539·5037264
58	m Rv(n=0.)	—	529·9737916	539·5037264
58	m Rv(n=1.)	—	495·841680	503·4656279
58	m Rv(n=2.)	—	461·7095685	467·4275294
58	m Rv(n=3.)	—	427·5774569	431·3894308
58	m Rv(n=4.)	—	393·4453454	395·3513323
58	m Rv(n=5.)	—	359·3132338	359·3132338

TABLE 8D.

	Values	r = 3.	r = 4.	Units
7	Ar6. & 7.	.3744535495	.4739384925	FT^2.
1	m va6. & 7.	142.1883825	133.8723585	FT./SEC.
2	m vcm6. & 7.	530.1439665	541.7771581	FT./SEC.
3	m T6. & 7.	291.9444058	292.9158082	KELVIN
4	m p6. & 7.	1984.429808	2007.594663	LB./FT^2.
5	m v6. & 7.	14.12328259	14.00677045	FT^3./LB.
7	Ar(n=1.)	.3949433832	.5017742821	FT^2.
1	m va(n=1.).	132.366830	124.3365638	FT./SEC.
2	m vcm(n=1.).	493.5246821	503.1861015	FT./SEC.
3	m T(n=1.).	294.0947880	294.8983696	KELVIN
4	m p(n=1.)	2035.968092	2055.470422	LB./FT^2.
5	m v(n=1.).	13.86716214	13.77312132	FT^3./LB.
7	Ar(n=2.)	.4193864213	.5351063451	FT^2.
1	m va(n=2.)	122.5452774	114.8007690	FT./SEC.
2	m vcm(n=2.)	456.9053977	464.5950448	FT./SEC.
3	m T(n=2.)	296.1119658	296.7344969	KELVIN
4	m p(n=2.)	2085.175738	2100.531793	LB./FT^2.
5	m v(n=2.).	13.63278318	13.56157131	FT^3./LB.
7	Ar(n=3.).	.4487730953	.5753755717	FT^2.
1	m va(n=3.).	112.7237249	105.2649743	FT./SEC.
2	m vcm(n=3)	420.2861134	426.0039882	FT./SEC.
3	m T(n=3.).	297.9959395	298.424190	KELVIN
4	m p(n=3.).	2131.895203	2142.618423	LB./FT^2.
5	m v(n=3.).	13.41886325	13.37089327	FT^3./LB.
7	Ar(n=4.).	.4844771169	.6246038717	FT^2.
1	m va(n=4.).	102.9021724	95.72917957	FT./SEC.
2	m vcm(n=4.)	383.6668290	387.4129315	FT./SEC.
3	m T(n=4.).	299.7467088	299.9674490	KELVIN
4	m p(n=4.).	2175.976799	2181.580485	LB./FT^2.
5	m v(n=4.).	13.22426050	13.20000582	FT^3./LB.
7	Ar8.	.5284571277	.6857148585	FT^2.
1	m va8.	93.08061983	86.19338484	FT./SEC.
2	m vcm8.	347.0475446	348.8218749	FT./SEC.
3	m T8.	301.3642739	301.3642739	KELVIN
4	m p8.	2217.279232	2217.279232	LB./FT^2.
5	m v8.	13.04795980	13.04795980	FT^3./LB.
	m Rv8.	359.3132338	359.3132338	FT./SEC.
	m Rv6. m Rv7.	548.8808262	558.0719464	FT./SEC
58	m Rv(n=0.)	548.8808262	558.0719464	FT./SEC.
58	m Rv(n=1.)	510.9673077	518.3202039	FT./SEC.
58	m Rv(n=2.)	473.0537892	478.5684613	FT./SEC.
58	m Rv(n=3.)	435.1402708	438.8167188	FT./SEC.
58	m Rv(n=4.)	397.2267523	399.0649763	FT./SEC.
58	m Rv(n=5.)	359.3132338	359.3132338	FT./SEC

TABLE 9D.

REF. No.	Values	r = 0.	r = 1.	r = 2.
	Plane 5 & Plane (m = 0.)			
17	m P5.	—	·0896522897	·0874878289
18	m Z5.	—	·0896522897	·0874878289
19	m X5.	—	0	0
20	va5.	393·2214999	415·1385724	435·6232281
21	vcm5.	340·7454132	344·5638352	348·8218749
22	T5.	289·3858776	291·0361503	292·9158082
24	v5.	14·43673143	14·23345275	14·00677045
34	P5.	·0918594343	·0874451451	·0831162235
35	Z5.	·0918594343	·0874451451	·0831162235
36	X5.	0	0	0
37	r5.	·8333333333	·7932876451	·7540163958
38	t(5·m)	0	0	0
39	L(5·m).	0	0	0
41	RM5.	—	·8133104892	·7936748646
42	H5.	—	·0400456882	·0798169375
43	m Q5.	—	49·72516952	50·30742327
44	Q5.	49·08949068	50·30742327	51·31427348
53	SFp5.	0	0	0
54	SRp5	0	0	0
33	m vcm(5·m)	340·7454132	344·5638352	348·8218749
58A	Rvx5.	520·3177727	539·5037264	558·0719463
58	Rv5.	520·3177727	539·5037264	558·0719463
	Plane (m = 1.)			
17	m Pm.	—	·0896925825	·0875619304
18	m Zm.	—	·0844360044	·0820419194
19	m Xm.	—	·0052565781	·0055200111
20	vam.	369·0699963	388·2324388	405·6812438
21	vcmm.	366·7668502	374·6195994	383·2323390
20A	vaxm.	366·6606208	385·6979663	403·0328615
21A	vcmxm.	364·3725101	372·1739948	380·7305084
34	Pm.	·0918594343	·0875257308	·0832644265
35	Zm.	·0869353713	·0819366375	·0773590315
36	Xm.	·0049240629	·0055890932	·0059053949
37	rm.	·8333333333	·7940187048	·7553608691
38	t(5·m)	·0000183915	·0000187109	·0000178460
39	L(5·m).	·0065115730	·0067353664	·0065406087
41	RMm.	—	·8136760191	·7943471012
42	Hm.	—	·0393146285	·0779724642
43	m Qm.	—	45·62951281	46·02320188
44	Qm.	45·17933340	46·02231551	46·62993836
53	SFpm.	·0020916694	·0019347147	·0016113207
54	SRpm.	·0070157323	·0075238080	·0075167156
33	m vcm(5·m)	354·0529730	359·9687258	366·5006388
58A	Rvxm.	516·9210162	535·9817195	554·4287217
58	Rvm.	520·3177727	539·5037264	558·0719463

TABLE 9D.

REF. No.	Values	r = 3.	r = 4.	Units
	Plane 5. & Plane (m = 0.)			
17	m P5.	·0853730792	·0833164772	FT.
18	m Z5.	·0853730792	·0833164772	FT.
19	m X5.	0	0	FT.
20	va5.	454·3386481	470·7227255	FT./SEC.
21	vcm5	353·6000897	359·000	FT./SEC.
22	T5.	295·0765027	297·5867414	KELVIN.
24	v5.	13·75239595	13·46492466	FT^3./LB.
34	P5.	·0788867241	·0747735201	FT.
35	Z5.	·0788867241	·0747735201	FT.
36	X5.	0	0	FT.
37	r5.	·7156470890	·6783327949	FT.
38	t(5·m).	0	0	SECOND
39	L(5·m).	0	0	FT.
41	RM5.	·7744902112	·7558330641	FT.
42	H5.	·1176862443	·1550005384	FT.
43	m Q5.	50·83709727	51·31427348	DEGREES
44	Q5.	52·10729521	52·66879028	DEGREES
53	SFp5.	0	0	FT.
54	SRp5.	0	0	FT.
33	m vcm(5·m)	353·6000897	359·000	FT./SEC.
58A	Rvx5.	575·7227029	591·9973685	FT./SEC.
58	Rv5.	575·7227029	591·9973685	FT./SEC.
	Plane (m = 1.)			
17	m Pm.	·0854738811	·0834360075	FT.
18	m Zm.	·0797034639	·0774241702	FT.
19	m Xm.	·0057704170	·0060118377	FT.
20	vam.	420·8165225	432·3123615	FT./SEC.
21	vcmm	392·8995865	404·4340569	FT./SEC.
20A	vaxm.	418·0693335	429·4901256	FT./SEC.
21A	vcmxm	390·3346458	401·7938165	FT./SEC.
34	Pm.	·0790883279	·0750125808	FT.
35	Zm.	·0726940745	·0684785033	FT.
36	Xm.	·0063942533	·0065340774	FT.
37	rm.	·7174760056	·6805015129	FT.
38	t(5·m).	·0000174791	·0000160038	SECOND
39	L(5·m).	·0065345004	·0061213138	FT.
41	RMm.	·7754046695	·7569174231	FT.
42	Hm.	·1158573277	·1528318204	FT.
43	m Qm.	46·35918348	46·63494877	DEGREES
44	Qm.	46·96493036	46·90824665	DEGREES
53	SFpm.	·0012664356	·0007065756	FT.
54	SRpm.	·0076606891	·0072406531	FT.
33	m vcm(5·m)	373·8453066	382·4893761	FT./SEC.
58A	Rvxm	571·964250	588·1326708	FT./SEC.
58	Rvm.	575·7227029	591·9973685	FT./SEC.

TABLE 10D.

REF No	Values	r = 0.	r = 1.	r = 2.
	Plane (m= 2.)			
17	mPm.	—	·0897312710	·0876337202
18	mZm.	—	·0798628897	·0772833466
19	mXm.	—	·0098683812	·0103503735
20	vam.	343·2002547	359·1557661	373·0291075
21	vcmm.	391·0807714	402·5809316	415·0826209
20A	vaxm.	341·6665914	357·5508022	371·3621476
21A	vcmxm.	389·3331439	400·7819131	413·2277360
34	Pm.	·0918594343	·0876031070	·0834080061
35	Zm.	·0826204878	·0771052916	·0723023156
36	Xm.	·0092389464	·0104978153	·0111056904
37	rm.	·8333333333	·7947206544	·7566633989
38	t(5·m).	·0000367418	·0000373688	·0000356294
39	L(5·m).	·0134867063	·0140140805	·0136732304
41	RMm.	—	·8140269939	·7949983661
42	Hm.	—	·0386126789	·0766699344
43	mQm.	—	41·53385611	41·73898049
44	Qm.	41·26917613	41·73720775	41·94560324
53	SFpm.	·0043321489	·0040255045	·0033684876
54	SRpm.	·0135710954	·0145233205	·0144761781
33	m'vcm(5·m)	367·0588738	375·0207359	383·7625498
58A	Rvxm.	517·9926221	537·0928393	555·5780832
58	Rvm.	520·3177727	539·5037264	558·0719463
	Plane (m = 3.)			
17	mPm.	—	·0897670672	·0877005652
18	mZm.	—	·0759554238	·0732155932
19	mXm.	—	·0138116433	·0144849719
20	vam.	315·7327136	328·0711168	337·8849516
21	vcmm.	413·5739814	428·2915048	444·1599450
20A	vaxm.	316·7523111	329·1305587	338·9760854
21A	vcmxm.	414·9095382	429·674589	445·5942732
34	Pm.	·0918594343	·0880869808	·0835416961
35	Zm.	·0789348720	·0729759756	·0679755501
36	Xm.	·0129245622	·0151110051	·0155661460
37	rm.	·8333333333	·7953701289	·7578762122
38	t(5·m).	·0000550292	·0000559476	·0000533226
39	L(5·m)	·0208920280	·0217954474	·0213502158
41	RMm.	—	·8143517311	·7956047728
42	Hm.	—	·0379632044	·0754571211
43	mQm.	—	37·43819940	37·26126812
44	Qm.	37·35901885	37·45209998	37·26126812
53	SFpm.	·0067110076	·0062606801	·0052597620
54	SRpm.	·0196355700	·0209594045	·0208259081
33	m'vcm(5·m)	379·6530602	389·5682938	400·3972297
58A	Rvxm.	521·9980378	541·2459488	559·8741312
58	Rvm.	520·3177727	539·5037264	558·0719463

TABLE 10D.

REF. No.	Values	r=3.	r=4.	Units
	Plane (m=2.)			
17	m Pm.	·0855724241	·0835540377	FT.
18	m Zm.	·0747795187	·0723537872	FT.
19	m Xm.	·0107929053	·0112002504	FT.
20	vam.	383·9068778	389·5356986	FT./SEC.
21	vcmm.	429·0362919	445·7833822	FT./SEC.
21A	vaxm.	382·1913084	387·7949756	FT./SEC.
21A	vcmxm.	427·1190521	443·7913044	FT./SEC.
34	Pm.	·0792854139	·0752486411	FT.
35	Zm.	·0672414106	·0629117745	FT.
36	Xm.	·0120440032	·0123368665	FT.
37	rm.	·7192639364	·6826430122	FT.
38	t(5·m).	·0000348829	·0000319223	SECOND
39	L(5·m).	·0137293334	·0129384681	FT.
41	RMm.	·7762986349	·7579881728	FT.
42	Hm	·1140693969	·1506903211	FT.
43	m Qm.	41·88126968	41·95562407	DEGREES
44	Qm.	41·82256551	41·14770302	DEGREES
53	SFpm.	·0026608488	·0014934714	FT.
54	SRpm.	·0147048521	·0138303379	FT.
33	m'vcm(5-m).	393·5827710	405·3105032	FT./SEC.
58A	Rvxm.	573·1499637	589·3519025	FT./SEC.
58	Rvm.	575·7227029	591·9973685	FT./SEC.
	Plane (m=3.)			
17	m Pm.	·0856647198	·0836652093	FT.
18	m Zm.	·0705673599	·0680114524	FT.
19	m Xm.	·0150973598	·0156537568	FT.
20	vam.	343·9068321	342·8247755	FT./SEC.
21	vcmm.	461·7193103	482·6303530	FT./SEC.
20A	vaxm.	345·0174123	343·9318615	FT./SEC.
21A	vcmxm.	463·2103431	484·1889139	FT./SEC.
34	Pm.	·0794700062	·0754709843	FT.
35	Zm.	·0625662360	·0581212241	FT.
36	Xm.	·0169037701	·0173497601	FT.
37	rm.	·7209385262	·6846600732	FT.
38	t(5·m).	·0000521825	·0000477285	SECOND
39	L(5·m).	·0215265812	·0203826105	FT.
41	RMm.	·7771359298	·7589967033	FT.
42	Hm.	·1123948071	·1486732601	FT.
43	m Qm.	37·40335589	37·27629936	DEGREES
44	Qm.	36·68020066	35·38715939	DEGREES
53	SFpm.	·0041720146	·0023627396	FT.
54	SRpm.	·0210757847	·0197024997	FT.
33	m'vcm(5·m).	412·5244591	427·0526007	FT./SEC.
58A	Rvxm	577·5818875	593·9091090	FT./SEC.
58	Rvm.	575·7227029	591·9973685	FT./SEC.

TABLE 11D.

REF No.	Values	r = 0.	r = 1.	r = 2.
	Plane (m=4.).			
17	mPm.	—	·0897987212	·0877599277
18	mZm.	—	·0727326795	·0698596231
19	mXm.	—	·0170660416	·0179003046
20	vam.	286·7952502	295·1522799	300·4835565
21	vcmm.	434·1417615	451·6075757	470·2700602
20A	vaxm.	290·4260970	298·8683445	304·2667436
21A	vcmxm.	439·6077495	457·2934641	476·1909154
34	Pm.	·0918594343	·0877380081	·0836604211
35	Zm.	·0758956827	·0695696762	·0644034574
36	Xm.	·0159637515	·0181683318	·0192569636
37	rm.	·8333333333.	·7959444780	·7589532656
38	t(5·m).	·0000732474	·0000744338	·0000709234
39	L(5·m).	·0286939606	·0300359636	·0295202786
41	RMm.	—	·8146388906	·7961432995
42	Hm.	—	·0373688855	·0743800677
43	mQm.	—	33·34254269	33·17053772
44	Qm.	33·44886148	33·16699222	32·5769330
53	SFpm.	·0092171709	·0086277448	·0072725092
54	SRpm.	·0251809224	·0267960767	·0265294729
33	m vcm(5·m)	391·7397802	403·4787324	416·2270928
58A	Rvxm.	526·8687451	546·2962563	565·0982562
58	Rvm.	520·3177727	539·5037264	558·0719463
	Plane (m=5.).			
17	mPm.	—	·0898250501	·0878094317
18	mZm.	—	·0702102473	·0672324656
19	mXm.	—	·0196148027	·0205769660
20	vam.	256·5225874	260·5832986	261·0747822
21	vcmm.	452·6883550	472·3987884	493·2385380
20A	vaxm.	261·6388882	265·7805897	266·2818758
21A	vcmxm.	461·7171498	481·8207045	503·0760995
34	Pm.	·0918594343	·0877906659	·0837594293
35	Zm.	·0735170691	·0669034256	·0616059425
36	Xm.	·0183423651	·0208872403	·0221534867
37	rm.	·8333333333	·7964221515	·7598514510
38	t(5·m)	·0000914002	·0000928629	·0000884448
39	L(5·m)	·0368558814	·0386895577	·0381288388
41	RMm.	—	·8148777424	·7965923920
42	Hm.	—	·0369111818	·0734818823
43	mQm.	—	29·24688598	28·88631633
44	Qm.	29·5387043	28·88188446	27·89259788
53	SFpm.	·0118389706	·0111134651	·0093932831
54	SRpm.	·0301813357	·0320007054	·0315467699
33	m vcm(5·m)	403·2359760	440·3259640	457·5167333
58A	Rvxm.	530·6954251	550·2640395	569·2025995
58	Rvm.	520·3177727	539·5037264	558·0719463

TABLE 11D.

REF. No.	Values.	r=3.	r=4.	Units
	Plane (m=4.).			
17	m Pm.	·0857469652	·0837645031	FT.
18	m Zm.	·0670903360	·0644237010	FT.
19	m Xm.	·0186566291	·0193408020	FT.
20	vam.	301·1383804	292·6513666	FT./SEC.
21	vcmm.	490·6855474	514·6028196	FT./SEC.
20A	vaxm.	304·9298119	296·3359439	FT./SEC.
21A	vcmxm.	496·8634403	521·0818389	FT./SEC.
34	Pm.	·0796344953	·0756695718	FT.
35	Zm.	·0587000661	·0541475265	FT.
36	Xm.	·0209344291	·0215220452	FT.
37	rm.	·7224307511	·6864616255	FT.
38	t(5·m).	·0000693802	·0000634339	SECOND
39	L(5·m).	·0298634771	·0283792781	FT.
41	RMm.	·7778820422	·7598974794	FT.
42	Hm.	·1109025822	·1468717078	FT.
43	m Qm.	32·92544210	32·59697466	DEGREES
44	Qm.	31·53783581	29·62661576	DEGREES
53	SFpm.	·0057877681	·0032757851	FT.
54	SRpm.	·0267222015	·0247978304	FT.
33	m'vcm(5·m).	430·4315403	447·3830760	FT./SEC.
58A	Rvxm.	582·9712416	599·4508107	FT./SEC.
58	Rvm.	575·7227029	591·9973685	FT./SEC.
	Plane (m=5.).			
17	m Pm.	·085815650	·0838473689	FT.
18	m Zm.	·0643673540	·0616119894	FT.
19	m Xm.	·0214482959	·0222353795	FT.
20	vam.	255·9458034	239·5222183	FT./SEC.
21	vcmm.	515·7018289	541·3778636	FT./SEC.
20A	vaxm.	261·0506003	244·2994496	FT./SEC.
21A	vcmxm.	525·9874171	552·1755561	FT./SEC.
34	Pm.	·0797718657	·0758353036	FT.
35	Zm.	·0556683192	·0510234721	FT.
36	Xm.	·0241035464	·0248118314	FT.
37	rm.	·7236769453	·6879651161	FT.
38	t(5·m).	·0000864958	·0000790617	SECOND
39	L(5·m).	·0386729101	·0368455470	FT.
41	RMm.	·7785051393	·7606492247	FT.
42	Hm.	·109656388	·1453682172	FT.
43	m Qm.	28·44752830	27·91764995	DEGREES
44	Qm.	26·39547095	23·8660723	DEGREES
53	SFpm.	·0074951031	·0042530361	FT.
54	SRpm.	·0315986495	·0290648643	FT.
33	m'vcm(5·m).	476·1535992	497·5121130	FT./SEC.
58A	Rvxm.	587·2053975	603·8046587	FT./SEC.
58	Rvm.	575·7227029	591·9973685	FT./SEC.

TABLE 12D.

	Plane(m=6.)			
	Values	r = 0.	r = 1.	r = 2.
17	m Pm.	—	·0898449664	·0876820118
18	m Zm.	—	·0684001772	·0653589635
19	m Xm.	—	·0214447891	·0223230482
20	vam.	225·0556602	224·5574421	219·9218987
21	vcmm.	469·1274181	490·5489028	512·9119376
	vaxm.	229·9688819	229·4597878	224·7230446
	vcmxm.	479·3690047	501·2581448	524·1093902
34	Pm.	·0918594343	·0878304986	·0838816154
35	Zm.	·0718101050	·0649902496	·0596452502
36	Xm.	·0200493292	·0228402489	·0242363651
37	rm.	·8333333333	·7967835071	·7605316897
38	t(5·m).	·0001094978	·0001112223	·0001059078
39	L(5·m).	·0453397919	·0477078489	·0471183869
41	RMm.	—	·8150584202	·7969325165
42	Hm.	—	·0365498262	·0728016336
43	m Qm.	—	25·15122928	24·60209494
44	Qm.	25·62854702	24·59677670	23·20826276
53	SFpm.	·0145642010	·0137039435	·0116079157
54	SRpm.	·0346135302	·0365441925	·0358442810
33	m'vcm(5·m).	414·0700851	428·9411648	444·8998665
	Rvxm.	531·6769031	551·2817081	570·2552934
58	Rvm.	520·3177727	539·5037264	558·0719463
	Plane(m=7.)			
17	m Pm.	—	·0898575035	·0878705249
18	m Zm.	—	·0673109356	·0642127339
19	m Xm.	—	·0225465678	·0236577909
20	vam.	192·5409664	187·2761245	177·2998279
21	vcmm.	483·3824168	505·9564448	529·1588309
	vaxm.	195·6726130	190·3221393	180·1835799
	vcmxm.	491·2445510	514·1857418	537·7655108
34	Pm.	·0918594343	·0878555728	·0838816154
35	Zm.	·0707827374	·0638391337	·0583899311
36	Xm.	·0210766968	·0240164391	·0254916842
37	rm.	·8333333333	·7970109755	·7609599030
38	t(5·m).	·0001275544	·0001295413	·0001233372
39	L(5·m).	·0541061944	·0570404174	·0564288684
41	RMm.	—	·8151721544	·7971466182
42	Hm.	—	·0363223578	·0723734303
43	m Qm.	—	21·05557257	20·31787355
44	Qm.	21·71838975	20·31166893	18·52392764
53	SFpm.	·0173801745	·0163846972	·0139016124
54	SRpm.	·0384568713	·0404011362	·0393932967
33	m'vcm(5·m).	424·1811299	440·3259640	457·5167333
	Rvxm.	528·7806543	548·2786643	567·1488932
58	Rvm.	520·3177727	539·5037264	558·0719463

TABLE 12D.

	Plane(m=6.)			
	Values.	γ=3.	γ=4.	Units
17	mPm.	·0858676577	·0839099459	FT.
18	mZm.	·0624285645	·0596045604	FT.
19	mXm.	·0234390932	·0243053854	FT.
20	vam.	208·6928955	183·9739234	FT./SEC.
21	vcmm	536·5667768	562·6850627	FT./SEC.
20A	vaxm.	213·2488994	187·9902840	FT./SEC.
21A	vcmxm.	548·2806415	574·9691195	FT./SEC.
34	Pm.	·0798758812	·0759604575	FT.
35	Zm.	·0534902825	·0487748142	FT.
36	Xm.	·0263855986	·0271656432	FT.
37	rm.	·7246205567	·6891004909	FT.
38	t(5·m).	·0001035575	·0000946526	SECOND
39	L(5·m).	·0478839654	·0456980677	FT.
41	RMm.	·7789769450	·7612169121	FT.
42	Hm.	·1087127766	·1442328424	FT.
43	mQm.	23·96961451	23·23832524	DEGREES
44	Qm.	21·25310610	18·10552850	DEGREES
53	SFpm.	·0092802754	·0052748716	FT.
54	SRpm.	·0356658741	·0324605149	FT.
33	m vcm(5·m).	462·3900230	482·7972331	FT./SEC.
58A	Rvxm.	588·2913861	604·9213463	FT./SEC.
58	Rvm.	575·7227029	591·9973685	FT./SEC.
	Plane(m=7.)			
17	mPm.	·0859003455	·0839490910	FT.
18	mZm.	·0612366506	·0583772624	FT.
19	mXm.	·0246636948	·0255718285	FT.
20	vam.	159·7600366	126·5675173	FT./SEC.
21	vcmm.	553·1124310	578·3092148	FT./SEC.
20A	vaxm.	162·3585069	128·6261168	FT./SEC.
21A	vcmxm.	562·1087122	587·7153174	FT./SEC.
34	Pm.	·0799412566	·0760387477	FT.
35	Zm.	·0521790368	·0474191590	FT.
36	Xm.	·0277622197	·0286195886	FT.
37	rm.	·7252136312	·6898107270	FT.
38	t(5·m).	·0001205965	·0001102419	SECOND
39	L(5·m).	·0574224951	·0548467086	FT.
41	RMm.	·7792734823	·7615720302	FT.
42	Hm.	·1081197021	·1435226063	FT.
43	mQm.	19·49170071	18·55900054	DEGREES
44	Qm.	16·11074125	12·34498487	DEGREES
53	SFpm.	·0111289147	·0063308876	FT.
54	SRpm.	·0388911346	·0349504767	FT.
33	m vcm(5·m).	476·1535992	497·5121130	FT./SEC.
58A	Rvxm.	585·0867364	601·6261067	FT./SEC.
58	Rvm.	575·7227029	591·9973685	FT./SEC.

TABLE 13D.

	Values	r = 0.	r = 1.	r = 2.
	Plane 6.			
17	mP6.	—	·0898618386	·0878786789
18	mZ6.	—	·0669473789	·0638454479
19	mX6	—	·0229144596	·0240332309
20	va6.	159·1298809	148·9477791	133·4933062
21	vcm6.	495·3869857	518·5352735	541·8706806
34	P6.	·0918594343	·0878642430	·0838979236
35	Z6.	·0704397493	·0634550085	·0579868657
36	X6.	·0214196849	·0244092344	·0259110578
37	r6.	·8333333333	·7970896301	·7611078479
38	t(5·6).	·0001212994	·0001235118	·0001182608
39	L(5·6).	·0631142764	·0666350866	·0659980845
41	RM6.	—	·8152114817	·7972205906
42	H6.	—	·0362437032	·0722254854
43	mQ6.	—	16·95991586	16·03365216
44	Q6.	17·80823247	16·02656117	13·83959252
53	SFp6.	·0202737810	·0191407386	·0162590499
54	SRp6.	·0416934659	·0435499757	·0421701078
33	mvcm(5·6)	433·5180355	450·7196914	468·8727770
64	Rp.	·1402847307	·1350530465	·1219067588
65	Rx.	∝	·7097456579	·3753792538
58	Rv5. to Rv7.	520·3177727	539·5037264	558·0719463
	Plane 7.			
17	mP7.	—	·0898618386	·0878786789
18	mZ6.	—	·0669473789	·0638454479
19	mX7.	—	·0229144596	·0240332309
20	va6.	159·1298809	148·9477791	133·4933062
21	vcm7.	495·3869857	518·5352735	541·8706806
22	T7.	289·3858776	291·0361503	292·9158082
23	p7.	1924·330613	1962·943983	2007·594663
24	v7.	14·43673143	14·23345275	14·00677045
34	P7.	·0918594343	·0878642430	·0838979236
35	Z7.	·0704397493	·0634550059	·0579868657
36	X7.	·0214196849	·0244092371	·0259110579
37	r7.	·8333333333	·7970896301	·7611078479
38	t(5·7).	·0001920560	·00016729617	·0001552779
39	L(5·7).	·0861348511	·0767230642	·0738654892
41	RM7.	—	·8152114817	·7972205906
42	H7.	—	·0362437032	·0722254854
43	mQ7.	—	16·95991586	16·03365216
44	Q7.	17·80823247	16·02656117	13·83959252
53	SFp7.	·0276685279	·0220384813	·0181972355
54	SRp7.	·0490882128	·0464477184	·0441082934
55	t(7·n).	0	0	0
56	L(7·n).	0	0	0
30	t(6·7).	·0000464698	·0000194547	·0000145189
31	L(6·7).	·0230205747	·0100879776	·0078674047

TABLE 13D.

	Values	r = 3.	r = 4.	Units
	Plane 6.			
17	mP6.	·0859116032	·0839625033	FT.
18	mZ7.	·0608751514	·0580315006	FT.
19	mX6.	·0250364517	·0259310026	FT.
20	va6.	109·541130	67·88279563	FT./SEC.
21	vcm6.	565·2056011	588·0925185	FT./SEC.
34	P6.	·0799637877	·0760655722	FT.
35	Z6.	·0531168340	·0496164970	FT.
36	X6.	·0268469535	·0264490751	FT.
37	r6.	·7254180286	·6900540745	FT.
38	t(5·6)	·0001167431	·0001084448	SECOND
39	L(5·6).	·0672117154	·0641990699	FT.
41	RM6.	·7793756104	·7616937039	FT.
42	H6.	·1079153047	·1432792588	FT.
43	mQ6.	15·01378692	13·87967583	DEGREES
44	Q6.	10·96837640	6·584441235	DEGREES
53	SFp6.	·0130261398	·0074104195	FT.
54	SRp6.	·041248468	·0365096047	FT.
33	m vcm(5·6).	488·3424853	510·0686807	FT./SEC.
64	Rp.	·1122261862	·0943443726	FT.
65	Rx.	·2843784168	·2180531987	FT.
58	Rv5. to Rv7.	575·7227029	591·9973625	FT./SEC.
	Plane 7.			
17	mP7.	·0859116110	·0839625033	FT.
18	mZ7.	·0608751514	·0580315006	FT.
19	mX7.	·0250364595	·0259310026	FT.
20	va7.	109·541130	67·88279563	FT./SEC.
21	vcm7.	565·205601	588·0925185	FT./SEC.
22	T7.	295·0765027	297·5867414	KELVIN
23	p7.	2059·811567	2121·684887	LB./FT ^{2}
24	v7.	13·75239595	13·46492466	FT ^{3}/LB.
34	P7.	·0799637876	·0760655722	FT.
35	Z7.	·0517414594	·0469663870	FT.
36	X7.	·0282223281	·0290991852	FT.
37	r7.	·7254180286	·6900540745	FT.
38	t(5·7).	·0001378245	·0001297478	SECOND
39	L(5·7).	·0673203689	·0664834209	FT.
41	RM7.	·7793756810	·7616937039	FT.
42	H7.	·1079153047	·1432792588	FT.
43	mQ7.	15·01378692	13·87967583	DEGREES
44	Q7.	10·96837640	6·584441235	DEGREES
53	SFp7.	·0130471978	·0076740994	FT.
54	SRp7.	·0412695259	·0367732845	FT.
55	t(7·n).	0	0	SECOND
56	L(7·n).	0	0	FT.
30	t(6·7)	·0000001922	·0000038843	SECOND
31	L(6·7)	·0001086535	·0022843510	FT.

TABLE 14D.

REF. No.	Values	r = 0.	r = 1.	r = 2.
	Plane (n = 1.)			
17	m Pn.	—	·0898618386	·0878786789
18	m Zn.	—	·0700701299	·0670819810
19	m Xn.	—	·0197917086	·0207966978
20	van.	149·2818094	138·9982746	123·9845116
21	vcmn.	464·7289696	483·8978385	503·2729623
22	Tn.	291·9737316	293·3424793	294·8983696
23	pn.	1985·126328	2017·830158	2055·470422
24	vn.	14·11974535	13·95601999	13·77312132
34	Pn.	·0918594343	·0878642430	·0838979236
35	Zn.	·0733887018	·0667515579	·0613926033
36	Xn.	·0184707324	·021112685	·0225053202
37	rn.	·8333333333	·7970896301	·7611078479
41	RMn.	—	·8152114817	·7972205906
42	Hn.	—	·0362437032	·0722254854
52	ø(7/n).	2·282362330	2·351730725	2·398651576
53	SFpn.	·0410267452	·0352153507	·0299150054
54	SRpn.	·0594974776	·0563280357	·0524203257
55	t(7·n).	·0000770641	·0000660264	·0000777923
56	L(7·n).	·0369952559	·0401347578	·0406520853
57	L(5·n).	·1231301070	·1168578220	·1145175745
59	m vcm(7·n)	480·0579777	501·2165560	522·5718215
	Plane (n = 2.)			
17	m Pn.	—	·0898618386	·0878786789
18	m Zn.	—	·0737678934	·0709284802
19	m Xn.	—	·0160939451	·0169501987
20	van.	139·4337379	129·0487702	114·4757169
21	vcmn	434·0709535	449·2604035	464·6752440
22	Tn.	294·4654982	295·5284561	296·7344969
23	pn.	2044·948466	2070·855139	2100·531793
24	vn.	13·82366759	13·70000791	13·56157131
34	Pn.	·0918594343	·0878642430	·0838979236
35	Zn.	·0768698062	·0706659805	·0654708158
36	Xn.	·0149896280	·0171982624	·0184271077
37	rn	·8333333333	·7970896301	·7611078479
41	RMn.	—	·8152114817	·7972205906
42	Hn.	—	·0362437032	·0722254854
52	ø(7/n).	3·371272567	3·479362747	3·556961363
53	SFpn.	·0484150585	·0426776846	·0367695050
54	SRpn.	·0634046865	·0598758969	·0551966128
55	t(7·n).	·0001174389	·0001225458	·0001196140
56	L(7·n)	·0545772924	·0592996910	·0601985373
57	L(5·n).	·1407121435	·1360227553	·1340640266
59	m vcm(7·n).	464·7289696	483·8978385	503·2729623

TABLE 14D.

REF. No.	Values	r = 3.	r = 4.	Units
	Plane (n = 1.)			
17	m Pn.	·0859116110	·0839625033	FT.
18	m Zn.	·0642061966	·0614398598	FT.
19	m Xn.	·0217054143	·0225226434	FT.
20	van.	101·3060065	62·54653895	FT./SEC.
21	vcmn.	522·7143658	541·8626513	FT./SEC.
22	Tn.	296·6812511	298·7436258	KELVIN
23	pn.	2099·215226	2150·641994	LB./FT^2
24	vn.	13·56764173	13·33526832	FT^3/LB.
34	Pn.	·0799637876	·0760655722	FT.
35	Zn.	·0553803407	·0506160812	FT.
36	Xn.	·0245834468	·0254494909	FT.
37	rn.	·7254180286	·6900540745	FT.
41	RMn.	·7793756809	·7616937039	FT.
42	Hn.	·1079153047	·1432792587	FT.
52	Ø(7/n).	2·443189182	2·466218544	DEGREES
53	SFpn.	·0231310293	·0143895593	FT.
54	SRpn.	·0477144761	·0398390503	FT.
55	t(7·n).	·0000783922	·0000749924	SECOND
56	L(7·n).	·0426422481	·0423690979	FT.
57	L(5·n)	·1099626170	·1088525188	FT.
59	m vcm(7·n).	543·9599835	564·9775849	FT./SEC.
	Plane (n = 2.)			
17	m Pn.	·0859116110	·0839625033	FT.
18	m Zn.	·0681799169	·0655212115	FT.
19	m Xn.	·0177316941	·0184412918	FT.
20	van.	93·07088301	57·21028227	FT./SEC.
21	vcmn.	480·2231306	495·6327840	FT./SEC.
22	Tn.	298·1124025	299·6998212	KELVIN
23	pn.	2134·807588	2174·787840	LB./FT^2.
24	vn.	13·40579394	13·22942049	FT^3/LB.
34	Pn.	·0799637876	·0760655722	FT.
35	Zn.	·0597644832	·0550515294	FT.
36	Xn.	·0201993043	·0210140427	FT.
37	rn.	·7254180286	·6900540745	FT.
41	RMn.	·7793756809	·7616937039	FT.
42	Hn.	·1079153047	·1432792587	FT.
52	Ø(7/n)	3·629117254	3·672065291	DEGREES
53	SFpn.	·0293166960	·0189875809	FT.
54	SRpn.	·0495160003	·0400016237	FT.
55	t(7·n).	·0001209995	·0001162480	SECOND
56	L(7·n).	·0632482299	·0629904518	FT.
57	L(5·n).	·1305685988	·1294738727	FT.
59	m·vcm(7·n).	522·7143659	541·8626513	FT./SEC.

TABLE 15D.

	Plane (n=3.).			
	Values	r = 0.	r = 1.	r = 2.
17	m Pn.	—	·0898618386	·0878786789
18	m Zn.	—	·0781706019	·0755304096
19	m Xn.	—	·0116912366	·0123482692
20	van.	129·5856665	119·0992657	104·9669223
21	vcmn.	403·4129375	414·6229684	426·0775258
22	Tn.	296·8611773	297·5940807	298·424190
23	pn.	2103·666490	2121·867710	2142·618423
24	vn.	13·54714407	13·46409657	13·37089327
34	Pn.	·0918594343	·0878642430	·0838979236
35	Zn.	·0809970037	·0753442001	·0703977974
36	Xn.	·0108624305	·0125200428	·0135001261
37	rn.	·8333333333	·7970896301	·7611078479
41	RMn.	—	·8152114817	·7972205906
42	Hn.	—	·0362437032	·0722254854
52	ϕ(7/n).	4·321386947	4·469434174	4·582473984
53	SFpn.	·0553861303	·0498287787	·0434763355
54	SRpn.	·0662485608	·0623488215	·0569764617
55	t(7·n).	·000155440	·0001629990	·0001599732
56	L(7·n).	·0698547389	·0760519354	·0774229318
57	L(5·n).	·1559895901	·1527749996	·1512884211
59	m vcm(7·n).	449·3999616	466·5791210	483·9741032
	Plane (n = 4.).			
17	m Pn.	—	·0898618386	·0878786789
18	m Zn.	—	·0834540958	·0810871014
19	m Xn.	—	·0064077427	·0067915775
20	van.	119·7375950	109·1497612	95·45812760
21	vcmn.	372·7549214	379·9855334	387·4798075
22	Tn.	299·1607693	299·5393534	299·9674490
23	pn.	2161·152043	2170·722264	2181·580485
24	vn.	13·28894649	13·24710139	13·20000582
34	Pn.	·0918594343	·0878642430	·0838979236
35	Zn.	·0859233686	·0809848230	·0764209309
36	Xn.	·0059360656	·0068794199	·0074769926
37	rn.	·8333333333	·7970896301	·7611078479
41	RMn.	—	·8152114817	·7972205906
42	Hn.	—	·0362437032	·0722254854
52	ϕ(7/n).	5·235723058	5·429686295	5·587710663
53	SFpn.	·0625487471	·0572913261	·0506236603
54	SRpn.	·0684848127	·0641707459	·0581006530
55	t(7·n).	·0001946330	·0002052552	·0002027450
56	L(7·n)	·0844843407	·0922130563	·0942106354
57	L(5·n).	·1706193919	·1689361206	·1680761246
59	m vcm(7·n)	434·0709536	449·2604035	464·6752441

TABLE 15D.

	Values	r = 3.	r = 4.	Units
	Plane (n=3.).			
17	m Pn.	·0859116110	·0839625033	FT.
18	m Zn.	·0729573272	·0704519856	FT.
19	m Xn.	·0129542837	·0135105176	FT.
20	van.	84·83575952	51·87402559	FT./SEC.
21	vcmn.	437·7318953	449·4029168	FT./SEC.
22	Tn.	299·3699567	300·4553278	KELVIN
23	pn.	2166·436356	2194·002252	LB./FT^{2}.
24	vn.	13·26580204	13·14661889	FT^{3}/LB.
34	Pn.	·0799637876	·0760655722	FT.
35	Zn.	·0651025632	·0605109962	FT.
36	Xn.	·0148612243	·0155545759	FT.
37	rn.	·7254180286	·6900540745	FT.
41	RMn.	·7793756809	·7616937039	FT.
42	Hn.	·1079153047	·1432792587	FT.
52	$\phi(7/n)$.	4·685401855	4·755007674	DEGREES
53	SFpn.	·0355252834	·0238441509	FT.
54	SRpn.	·0503865077	·0409159931	FT.
55	t(7·n).	·0001625454	·0001569470	SECOND
56	L(7·n).	·0815114341	·0814159493	FT.
57	L(5·n).	·1488318031	·1478993702	FT.
59	m vcm(7·n).	501·4687482	518·7477177	FT./SEC.
	Plane (n=4.).			
17	m Pn.	·0859116110	·0839625033	FT.
18	m Zn.	·0787617526	·0764797554	FT.
19	m Xn.	·0071498583	·0074827478	FT.
20	van.	76·60063602	46·53776891	FT./SEC.
21	vcmn.	395·2406601	403·1730495	FT./SEC.
22	Tn.	300·4539139	301·0101454	KELVIN
23	pn.	2193·966181	2208·189589	LB./FT^{2}.
24	vn.	13·14677318	13·08627397	LFT^{3}/LB.
34	Pn.	·0799637876	·0760655722	FT.
35	Zn.	·0716909580	·0673412390	FT.
36	Xn.	·0082728295	·0087243331	FT.
37	rn.	·7254180286	·6900540745	FT.
41	RMn.	·7793756809	·7616937039	FT.
42	Hn.	·1079153047	·1432792587	FT.
52	$\phi(7/n)$.	5·728372903	5·835357886	DEGREES
53	SFpn.	·0422933652	·0293676328	FT.
54	SRpn.	·0505661967	·0380919660	FT.
55	t(7·n).	·0002070617	·0002011195	SECOND
56	L(7·n).	·099435832	·0996814533	FT.
57	L(5·n).	·1667562018	·1661648742	FT.
59	m vcm(7·n).	480·2231306	495·6327840	FT./SEC.

TABLE 16D.

Plane 8. & Plane (n= 5.).				
REF. No.	Values	r = 0.	r = 1.	r = 2.
17	m P8.	—	·0898618386	·0878786789
18	m Z8.	—	·0898618386	·0878786789
19	m X8.	—	0	0
20	va8.	109·8895235	99·20025675	85·94933295
21	vcm 8.	342·0969053	345·3480984	348·8820892
22	T8.	301·3642739	301·3642739	301·3642739
23	p8.	2217·279233	2217·279233	2217·279233
24	v8.	13·04795980	13·04795980	13·04795980
34	P8.	·0918594343	·0878642430	·0838979236
35	Z8.	·0918594343	·0878642430	·0838979236
36	X8.	0	0	0
37	r8.	·8333333333	·7970896301	·7611078479
41	RM8.	—	·8152114817	·7972205906
42	H8.	—	·0362437032	·0722251854
43	m Q8.	—	16·95991586	16·03365216
44	Q8.	17·80823247	16·02656117	13·83959252
49	Rt(7/8)	1·448089644	1·501485823	1·553162794
50	z(7/8).	·9221010975	·9169160016	·9123744375
51	Tan. ø(7/8)	·107953249	·112360743	·116216521
52	ø(7/8).	6·161404716	6·410907495	6·628978634
53	SFp8.	·0702463482	·0654438667	·0586159628
54	SRp8.	·0702463482	·0654438667	·0586159628
55	t(7·8).	·0002369195	·0002514689	·0002502995
56	L(7·8)	·0992081530	·1086199399	·1114775149
57	L(5·8).	·1853430041	·1853430041	·1853430041
58	Rv8.	359·3132338	359·3132338	359·3132338
59	m vcm (7·8).	418·7419450	431·9416860	445·3763849
60	M8.	—	4·889927493	9·575200161
61	Ry.	·4648508273	·4894559121	·4860890679
62	(41. x 14.)	—	280·1770712	275·3088253
63	(1. x 14.)	285·0807544	275·2733880	265·5368961

TABLE 16D.

Plane 8. & Plane (n=5.).				
REF. No.	Values	r=3.	r=4.	Units
17	m P8.	·0859116110	·0839625033	FT.
18	m Z8.	·0859116110	·0839625033	FT.
19	m X8	0	0	FT.
20	va8.	68·36551253	41·20151223	FT./SEC.
21	vcm8.	352·7494248	356·9431823	FT./SEC.
22	T8.	301·3642739	301·3642739	KELVIN
23	p8.	2217·279233	2217·279233	LB./FT^2.
24	v8.	13·04795980	13·04795980	FT^3/LB.
34	P8.	·0799637876	·0760655722	FT.
35	Z8.	·0799637876	·0760655722	FT.
36	X8.	0	0	FT.
37	r8.	·7254180286	·6900540745	FT.
41	RM8.	·7793756810	·7616937039	FT.
42	H8.	·1079153047	·1432792588	FT.
43	m Q8.	15·01378692	13·87967583	DEGREES
44	Q8.	10·96837640	6·584441235	DEGREES
49	Rt(7/8)	1·602286386	1·647580180	RATIO
50	z(7/8)	·9084400457	·9051064850	FACTOR
51	Tan.Ø(7/8),	·119563201	·122409924	RATIO
52	Ø(7/8)	6·818100669	6·978852738	DEGREES
53	SFp8.	·0500320432	·0359435074	FT.
54	SRp8.	·0500320432	·0359435074	FT
55	t(7·8).	·0002571425	·0002515451	SECOND
56	L(7·8).	·1180226352	·1188595832	FT.
57	L(5·8).	·1853430041	·1853430041	FT.
58	Rv8.	359·3132338	359·3132338	FT./SEC.
59	m vcm(7·8).	458·9775130	472·5178504	FT./SEC.
60	M8.	14·05581803	18·33178108	LB./SEC.
	Ry.	·5006131077	·4927729455	FT.
	(41.×14.)	270·4803919	265·6954259	PRODUCT
	(1.×14.)	255·8419107	246·3100973	PRODUCT

TABLE 17 D.

Compressor Stage 2. Synopsis				
	Values	r = 0.	r = 1.	r = 2.
1	r(1·3).	·8333333333	·7975135186	·7616937039
2	P1. P2. P3.	·2094395102	·2004370089	·1914345076
3	Z2. Z3.	·1966715102	·1859357710	·1752000317
4	X2 X3	·0127680	·0145012379	·0162344759
5	V1.	959·0011294	917·7796381	876·5581468
9	C3.	1·213306757	1·233821152	1·254906144
10	C4.	·7625772850	·7459275858	·7296031679
11	b	·6500448371	·696809630	·7290916488
12	Ba1.	·7555168327	·8116479630	·8524554386
13	va1.	109·8895235	99·33847307	86·19338484
14	vcm1.	342·0969053	345·3083662	348·8218749
15	T1.	301·3642739	=	=
16	p1.	2217·279233	=	=
17	v1.	13·04795980	=	=
18	va2. vb2.	331·1249743	347·6474992	361·3938132
19	va3.	378·3159909	405·7074017	431·5440932
20	vb1.	671·4637297	703·9988112	738·8503769
21	vb3.	258·5284180	264·325025	265·1778161
22	(va3 − va1).	268·4264674	306·3689287	345·3507084
23	(va2 − va1).	221·2354508	248·3090261	275·2004284
24	(vb1 − va1).	561·5742062	604·6603381	652·6569921
25	(va3 − vb3).	119·7875729	141·3823767	166·3662771
26	m va(1·3).	314·5854502	327·8675084	338·1623557
27	m vb(1·3)	356·5686608	376·0340074	393·2574044
28	t(1·2).	·0000454721	·0000479649	·0000497488
29	t(2·3)	·0001065886	·0001025675	·0000975827
30	E(1·2).	1930·753445	2333·291162	2791·252002
31	Ep(1·2).	1842·904602	2205·724694	2609·884424
32	Ei(1·2).	739·0047454	884·4956024	1046·563654
33	Esp(1·2).	87·84884300	127·5664677	181·3675784
24	Ek(1·2).	1516·2560020	1724·850057	1914·219379
35	W(1·2)	4186·014193	4942·636821	5752·035035
36	Ek(1·3).	2036·540088	2404·586989	2778·656754
37	W(1·3).	4618·449435	5494·807286	6435·104832
38	T3. = T2.	309·062240	310·5777698	312·2659786
39	p3. = p2.	2421·540473	2463·280985	2510·379262
40	v3. = v2.	12·25252082	12·10396463	11·94143626
41	Ar1.	—	·1835212621	·3589808259
42	m vcm1.	—	343·6673676	345·3083662
43	M1.	—	4·833726498	9·500265511
44	m Ek(1·3).	—	2212·521470	2404·586989
45	Ep(1·2).	—	2024·646031	2205·724694
46	m Ei(1·2).	—	811·8830585	884·4956024
47	m W(1·3).	—	5049·050559	5494·807286
48	m T2.	—	309·8213891	310·5777698
49	angle A.	47·87814802	49·59800959	51·05100675
50	angle B.	59·49654126	56·00682321	51·90906771
51	angle C.	60·40951860	57·48658596	54·18016646
52	horse power	—	44·37405359	94·91296027
53	(1. x 14. x 37.)	1316631·049	1513204·484	1709777·919
54	(1. x 14.)	285·0807544	275·3880901	265·6954259

TABLE 17D.

Compressor Stage 2. Synopsis				
	Values	r=3.	r=4.	Units
1	r(1·3)	·7258738892	·6900540745	FT.
2	P1. P2. P3.	·1824320062	·1734295049	FT.
3	Z2. Z3.	·1644642925	·1537285532	FT.
4	X2. X3.	·0179677137	·0197009516	FT.
5	V1.	835·3366555	794·1151642	FT./SEC.
9	C3.	1·276838636	1·299916591	FACTOR
10	C4.	·7134093157	·6971726478	FACTOR
11	b	·756275810	·8101126637	LB./LB.
12	Ba2.	·8886243726	·956899160	LB./LB.
13	va1.	68·71174045	41·20151223	FT./SEC.
14	vcm1.	352·6821469	356·9431823	FT./SEC.
15	T1.	=	301·3642739	K°
16	p1.	=	2217·279233	LB./FT^2.
17	v1.	=	13·04795980	FT^3./LB.
18	va2. vb2.	371·8864581	377·5194797	FT./SEC.
19	va3.	455·8169334	478·3868181	FT./SEC.
20	vb1.	772·7649652	792·6691034	FT./SEC.
21	vb3.	260·9077990	253·0092197	FT./SEC.
22	(va3 - va1).	387·1051930	437·1853058	FT./SEC.
23	(va2 - va1).	303·1747177	336·3179675	FT./SEC.
24	(vb1 - va1).	704·0532248	751·4675912	FT./SEC.
25	(va3 - vb3).	194·9091344	225·3775984	FT./SEC.
26	m va(1·3).	344·8761913	345·9951495	FT./SEC.
27	m vb(1·3)	407·6013305	416·4330282	FT./SEC.
28	t(1·2).	·0000510407	·0000524332	SECOND
29	t(2·3).	·0000921850	·0000874130	SECOND
30	E(1·2).	3317·137093	3927·582099	FT.LB./LB.
31	Ep(1·2).	3062·912932	3574·296238	FT.LB./LB.
32	Ei(1·2).	1228·228086	1433·292791	FT.LB./LB.
33	Esp(1·2).	254·2241610	353·2858610	FT.LB./LB.
34	Ek(1·2).	2075·872358	2188·465732	FT.LB./LB.
35	W(1·2).	6621·237537	7549·340622	FT.LB./LB.
36	Ek(1·3).	3155·463628	3530·123439	FT.LB./LB.
37	W(1·3).	7446·604646	8537·712469	FT.LB./LB.
38	T3.=T2.	314·1583165	316·2944071	K°
39	p3.=p2.	2563·932556	2625·358283	LB./FT^2.
40	v3. -v2.	11·76286728	11·56575972	FT^3./LB.
41	Ar1.	·5263786915	·6857148588	FT^2.
42	m vcm1.	347·0247625	348·8218749	FT./SEC.
43	M1.	13·99961704	18·33178108	LB./SEC.
44	m Ek(1·3).	2584·540398	2778·656754	FT.LB./LB.
45	Ep(1·2).	2406·847738	2609·884424	FT.LB./LB.
46	m Ei(1·2).	965·1459429	1046·563654	FT.LB./LB.
47	m W(1·3).	5956·534079	6435·104832	FT.LB./LB.
48	m T2.	311·4178775	312·2659786	K°
49	angle A.	52·26957554	53·27193585	DEGREES
50	angle B.	47·09913660	41·4938492	DEGREES
51	angle C.	50·49327289	46·61706788	DEGREES
52	horse power	151·616720	214·4853327	H.P.
53	(1.x 14.x 37.)	1906351·354	2102924·789	PRODUCT
54	(1.x 14.)	256·0027616	246·3100973	PRODUCT

TABLE 18D.

Dimensions of Air Duct and Rotor					
r = 0.	n = 0.	n = 1.	n = 2.	n = 3.	n = 4.
L(1·n).	0	0·0506	0·0999	0·1486	0·1971
San.	0	0·0203	0·0469	0·0798	0·1192
R San.	0	−0·1220	−0·2343	−0·3383	−0·4354
Rpan.	0	0·0203	0·0469	0·0798	0·1192
R Rpan.	0	−0·1220	−0·2343	−0·3383	−0·4354
Fpan.	0	0·0879	0·1655	0·2341	0·2946
R Fpan.	0	−0·0545	−0·1157	−0·1840	−0·2600
Xn.	0	0·0675	0·1186	0·1543	0·1754
rn	10·000	10·000	10·000	10·000	10·000
r = 1.	n = 0.	n = 1.	n = 2.	n = 3.	n = 4.
L(1·n).	0	0·0526	0·1029	0·1537	0·2037
San.	0	0·0194	0·0456	0·0794	0·1201
R San.	0	−0·1194	−0·2260	−0·3264	−0·4175
Rpan.	0	0·0194	0·0456	0·0794	0·1201
R Rpan.	0	−0·1194	−0·2260	−0·3264	−0·4175
Fpan.	0	0·0978	0·1819	0·2577	0·3226
R Fpan.	0	−0·0410	−0·0896	−0·1481	−0·2150
Xn.	0	0·0784	0·1364	0·1783	0·2025
rn.	9·4838	9·4838	9·4838	9·4838	9·4838
r = 2.	n = 0.	n = 1.	n = 2.	n = 3.	n = 4.
L(1·n)	0	0·0541	0·1063	0·1574	0·2083
San.	0	0·0177	0·0431	0·0764	0·1176
R San.	0	−0·1157	−0·2189	−0·3116	−0·3959
Rpan.	0	0·0177	0·0431	0·0764	0·1176
R Rpan	0	−0·1157	−0·2189	−0·3116	−0·3959
Fpan.	0	0·1078	0·1994	0·2788	0·3474
R Fpan.	0	−0·0262	−0·0626	−0·1091	−0·1668
Xn.	0	0·0895	0·1563	0·2025	0·2297
rn.	8·9676	8·9676	8·9676	8·9676	8·9676
r = 3.	n = 0.	n = 1.	n = 2	n = 3.	n = 4.
L(1·n).	0	0·0555	0·1086	0·1604	0·2119
San.	0	0·0147	0·0382	0·0702	0·1109
R San.	0	−0·1124	−0·2106	−0·2974	−0·3747
Rpan.	0	0·0147	0·0382	0·0702	0·1109
R Rpan.	0	−0·1124	−0·2106	−0·2974	−0·3747
Fpan.	0	0·1156	0·2137	0·2976	0·3678
R Fpan.	0	−0·0115	−0·0352	−0·0706	−0·1179
Xn.	0	0·1008	0·1754	0·2268	0·2568
rn	8·4513	8·4513	8·4513	8·4513	8·4513
r = 4.	n = 0.	n = 1.	n = 2.	n = 3	n = 4.
L(1·n).	0	0·0590	0·1149	0·1693	0·2233
San.	0	0·0081	0·0270	0·0561	0·0955
R San.	0	−0·1168	−0·2167	−0·3028	−0·3779
Rpan.	0	0·0081	0·0270	0·0561	0·0955
R Rpan.	0	−0·1168	−0·2167	−0·3028	−0·3779
Fpan.	0	0·1207	0·2219	0·3073	0·3796
R Fpan.	0	−0·0043	−0·0217	−0·0516	−0·0938
Xn	0	0·1125	0·1949	0·2512	0·2840
rn	7·9351	7·9351	7·9351	7·9351	7·9351

TABLE 18D.

Blade Portions 'a' &'b' in Inches.					
PLANE 2.	r = 0.	m = 1.	m = 2.	m = 3.	m = 4.
0·2459	L(1·m)	0·3713	0·4914	0·6065	0·7167
0·1653	Sbm.	0·2938	0·4204	0·5451	0·6679
-0·5268	R Sbm.	-0·6260	-0·9627	-1·1619	-1·3492
0·1653	Rφbm	0·2898	0·4048	0·5108	0·6085
-0·5268	R Rφbm	-0·7552	-0·9783	-1·1961	-1·4086
0·3477	Fφbm	0·4722	0·5872	0·6933	0·7907
-0·3444	R Fφbm	-0·5728	-0·7959	-1·0137	-1·2264
0·1824	Xm.	0·1824	0·1824	0·1824	0·1824
10·000	rm.	10·000	10·000	10·000	10·000
PLANE 2.	r = 1.	m = 1.	m = 2.	m = 3.	m = 4.
0·2541	L(1·m)	0·3727	0·4853	0·5922	0·6937
0·1685	Sbm.	0·2928	0·4149	0·5346	0·6522
-0·5022	R Sbm.	-0·6909	-0·8661	-1·0285	-1·1788
0·1685	Rφbm.	0·2882	0·3967	0·4948	0·5831
-0·5022	R Rφbm	-0·6956	-0·8843	-1·0683	-1·2479
0·3790	Fφbm.	0·4987	0·6072	0·7053	0·7936
-0·2917	R Fφbm	-0·4851	-0·6738	-0·8578	-1·0374
0·2105	Xm.	0·2105	0·2105	0·2105	0·2105
9·4838	rm.	9·4838	9·4838	9·4838	9·4838
PLANE 2.	r = 2.	m = 1.	m = 2.	m = 3.	m = 4.
0·2596	L(1·m)	0·3715	0·4767	0·5755	0·6684
0·1672	Sbm.	0·2860	0·4022	0·5157	0·6268
-0·4729	R Sbm.	-0·6299	-0·7730	-0·9030	-1·0211
0·1672	Rφbm	0·2807	0·3813	0·4702	0·5481
-0·4729	R Rφbm.	-0·6353	-0·7938	-0·9486	-1·0997
0·4058	Fφbm.	0·5193	0·6199	0·7088	0·7867
-0·2343	R Fφbm.	-0·3967	-0·5552	-0·7100	-0·8611
0·2386	Xm.	0·2386	0·2386	0·2386	0·2386
8·9676	rm.	8·9676	8·9676	8·9676	8·9676
PLANE 2.	r = 3.	m = 1.	m = 2.	m = 3.	m = 4.
0·2641	L(1·m)	0·3698	0·4680	0·5593	0·6442
0·1609	Sbm	0·2728	0·3827	0·4893	0·5930
-0·4444	R Sbm	-0·5748	-0·6901	-0·7927	-0·8835
0·1609	Rφbm	0·2672	0·3590	0·4378	0·5047
-0·4444	R Rφbm	-0·5805	-0·7138	-0·8442	-0·9718
0·4276	Fφbm	0·5339	0·6257	0·7045	0·7714
-0·1777	R Fφbm	-0·3138	-0·4471	-0·5775	-0·7051
0·2667	Xm.	0·2667	0·2667	0·2667	0·2667
8·4513	rm.	8·4513	8·4513	8·4513	8·4513
PLANE 2.	r = 4.	m = 1.	m = 2.	m = 3.	m = 4.
0·2782	L(1·m)	0·3830	0·4786	0·5660	0·6459
0·1458	Sbm	0·2545	0·3599	0·4619	0·5608
-0·4438	R Sbm	-0·5572	-0·6547	-0·7379	-0·8083
0·1458	Rφbm	0·2475	0·3330	0·4042	0·4624
-0·4438	R Rφbm	-0·5642	-0·6815	-0·7956	-0·9067
0·4406	Fφbm	0·5423	0·6279	0·6990	0·7573
-0·1490	R Fφbm	-0·2694	-0·3867	-0·5008	-0·6118
0·2948	Xm.	0·2948	0·2948	0·2948	0·2948
7·9351	rm.	7·9351	7·9351	7·9351	7·9351

TABLE 19D.

Dimensions of Air Duct and Rotor					
PLANE 3.	r=0.	w=1.	w=2.	w=3.	w=4.
0.8223	L(1-w)	0.9990	1.1757	1.3524	1.5291
0.7890	Scw.	0.9929	1.1968	1.4007	1.6046
-1.5253	R Scw.	-1.8187	-2.1121	-2.4055	-2.6989
0.6977	Rpcw	0.9053	1.1200	1.3421	1.5716
-1.6165	R Rpcw	-1.9063	-2.1889	-2.4641	-2.7320
0.8801	Fpcw	1.0805	1.2735	1.4593	1.6377
-1.4341	R Fpcw	-1.7311	-2.0354	-2.3469	-2.6659
0.1824	Xw	0.1752	0.1535	0.1172	0.0661
10.000	rw	10.000	10.000	10.000	10.000
0	L(3-w.	0.1767	0.3534	0.5301	0.7068
PLANE 3.	r=1.	w=1.	w=2.	w=3.	w=4.
0.7901	L(1-w)	1.0019	1.2138	1.4256	1.6374
0.7676	Scw.	1.0228	1.2781	1.5333	1.7885
-1.3178	R Scw.	-1.6218	-1.9257	-2.2297	-2.5336
0.6623	Rpcw.	0.9217	1.1895	1.4657	1.7504
-1.4231	R Rpcw.	-1.7229	-2.0143	-2.2973	-2.5717
0.8728	Fpcw.	1.1239	1.3666	1.6009	1.8267
-1.2126	R Fpcw.	-1.5207	-1.8372	-2.1621	-2.4955
0.2105	Xw.	0.2022	0.1771	0.1352	0.0763
9.4838	rw.	9.4853	9.4898	9.4971	9.5071
0	L(3-w)	0.2118	0.4237	0.6355	0.8474
PLANE 3.	r=2.	w=1.	w=2.	w=3.	w=4.
0.7558	L(1-w).	1.0180	1.2802	1.5424	1.8046
0.7353	Scw.	1.0628	1.3902	1.7177	2.0451
-1.1281	R Scw.	-1.4470	-1.7660	-2.0850	-2.4040
0.6160	Rpcw.	0.9482	1.2899	1.6411	2.0019
-1.2474	R Rpcw.	-1.5616	-1.8664	-2.1616	-2.4471
0.8546	Fpcw.	1.1773	1.4906	1.7943	2.0883
-1.0087	R Fpcw.	-1.3325	-1.6657	-2.0084	-2.3608
0.2386	Xw.	0.2291	0.2007	0.1532	0.0864
8.9676	rw.	8.9710	8.9813	8.9980	9.0206
0	L(3-w)	0.2622	0.5244	0.7866	1.0488
PLANE 3.	r=3.	w=1.	w=2.	w=3.	w=4.
0.7231	L(1-w).	1.0339	1.3447	1.6556	1.9664
0.6941	Scw.	1.0934	1.4928	1.8922	2.2916
-0.9633	R Scw.	-1.2764	-1.5894	-1.9025	-2.2156
0.5607	Rpcw.	0.9654	1.3807	1.8066	2.2434
-1.0967	R Rpcw.	-1.4044	-1.7016	-1.9881	-2.2638
0.8274	Fpcw.	1.2215	1.6050	1.9778	2.3399
-0.8300	R Fpcw.	-1.1483	-1.4773	-1.8169	-2.1673
0.2667	Xw.	0.2561	0.2243	0.1711	0.0965
8.4513	rw.	8.4573	8.4749	8.5034	8.5415
0	L(3-w)	0.3108	0.6216	0.9325	1.2433
PLANE 3.	r=4.	w=1.	w=2.	w=3.	w=4.
0.7190	L(1-w)	1.0917	1.4645	1.8372	2.2100
0.6567	Scw.	1.1455	1.6342	2.1230	2.6117
-0.8673	R Scw.	-1.1686	-1.4700	-1.7714	-2.0728
0.5093	Rpcw.	1.0039	1.5103	2.0284	2.5585
-1.0147	R Rpcw.	-1.3102	-1.5940	-1.8660	-2.1261
0.8041	Fpcw.	1.2870	1.7582	2.2175	2.6650
-0.7199	R Fpcw.	-1.0271	-1.3461	-1.6769	-2.0196
0.2948	Xw.	0.2831	0.2479	0.1891	0.1065
7.9351	rw.	7.9443	7.9712	8.0143	8.0715
0	L(3-w)	0.3728	0.7455	1.1183	1.4910

TABLE 19D.

Streamline Portion 'c' in Inches.					
PLANE 4.	Υ = 0.				
1·7058	L(1·4)				
1·8085	Sc4.				
−2·9923	R Sc4.				
1·8085	Rpc4.				
−2·9923	R Rpc4.				
1·8085	Fpc4.				
−2·9923	R Fpc4.				
0	X4.				
10·000	Υ4.				
0·8835	L(3·4)				
PLANE 4.	Υ = 0.				
1·8493	L(1·4).				
2·0438	Sc4.				
−2·8375	R Sc4.				
2·0438	Rpc4.				
−2·8375	R Rpc4.				
2·0438	Fpc4.				
−2·8375	R Fpc4.				
0	X4.				
9·5195	Υ4.				
1·0592	L(3·4).				
PLANE 4.	Υ = 2.				
2·0668	L(1·4)				
2·3726	Sc4.				
−2·7230	R Sc4.				
2·3726	Rpc4.				
−2·7230	R Rpc4.				
2·3726	Fpc4.				
−2·7230	R Fpc4.				
0	X4.				
9·0482	Υ4.				
1·3110	L(3·4)				
PLANE 4.	Υ = 3.				
2·2772	L(1·4).				
2·6910	Sc4.				
−2·5286	R Sc4.				
2·6910	Rpc4.				
−2·5286	R Rpc4.				
2·6910	Fpc4.				
−2·5286	R Fpc4.				
0	X4.				
8·5878	Υ4.				
1·5541	L(3·4)				
PLANE 4.	Υ = 4.				
2·5827	L(1·4).				
3·1005	Sc4.				
−2·3742	R Sc4.				
3·1005	Rpc4.				
−2·3742	R Rpc4.				
3·1005	Fpc4.				
−2·3742	R Fpc4.				
0	X4.				
8·1400	Υ4.				
1·8638	L(3·4)				

TABLE 20D.

Dimensions of Air Duct and Stators

Plane 5. (r = 0.) n.	m=0.	m=1.	m=2.	m=3.	m 4.	m=5.	m=6.
L(5·m)	0	·0781	·1618	·2507	·3443	·4423	·5441
SFp	0	·0251	·0520	·0805	·1106	·1421	·1748
SRp	0	·0842	·1628	·2356	·3022	·3622	·4154
rm. rn.	10·000	10·000	10·000	10·000	10·000	10·000	10·000

Plane 5. (r = 1.) n.	m=0	m=1.	m=2.	m=3.	m=4.	m=5.	m=6.
L(5·m).	0	·0808	·1682	·2615	·3604	·4643	·5725
SFp	0	·0232	·0483	·0751	·1035	·1334	·1644
SRp	0	·0903	·1743	·2515	·3215	·3840	·4385
rm. rn.	9·5195	9·5282	9·5366	9·5444	9·5513	9·5571	9·5614

Plane 5. (r = 2.) n.	m=0.	m=1.	m=2.	m=3.	m=4.	m=5.	m=6.
L(5·m).	0	·0785	·1641	·2562	·3542	·4575	·5654
SFp	0	·0193	·0404	·0631	·0873	·1127	·1393
SRp	0	·0902	·1769	·2499	·3183	·3786	·4301
rm. rn.	9·0482	9·0643	9·0800	9·0945	9·1074	9·1182	9·1264

Plane 5. (r = 3.) n.	m=0.	m=1.	m=2.	m=3.	m=4.	m=5.	m=6.
L(5·m).	0	·0784	·1647	·2583	·3584	·4641	·5746
SFp	0	·0152	·0319	·0501	·0694	·0899	·1114
SRp	0	·0919	·1764	·2529	·3207	·3792	·4280
rm. rn.	8·5878	8·6097	8·6312	8·6513	8·6692	8·6841	8·6956

Plane 5. (r = 4) n.	m=0.	m=1.	m=2.	m=3.	m=4.	m=5.	m=6.
L(5·m).	0	·0734	·1553	·2446	·3405	·4421	·5484
SFp	0	·0085	·0179	·0282	·0393	·0510	·0633
SRp	0	·0869	·1660	·2364	·2976	·3488	·3895
rm. rn.	8·1400	8·1660	8·1917	8·2159	8·2375	8·2556	8·2692

TABLE 20D.

in Inches. See Tables 7D. to 16D.

Plane 6.		Plane 7.				Plane 8.	
m=7.	m=8.	n=0.	n=1.	n=2.	n=3.	n=4.	n=5.
·6493	·7574	1·0336	1·4776	1·6885	1·8719	2·0474	2·2241
·2086	·2433	·3320	·4923	·5810	·6646	·7506	·8430
·4615	·5003	·5890	·7140	·7608	·7950	·8218	·8430
10·000	10·000	10·000	10·000	10·000	10·000	10·000	10·000

Plane 6.		Plane 7.				Plane 8.	
m=7.	m=8.	n=0.	n=1.	n=2.	n=3.	n=4.	n=5.
·6845	·7996	·9207	1·4023	1·6323	1·8333	2·0272	2·2241
·1966	·2297	·2645	·4226	·5121	·5979	·6875	·7853
·4848	·5226	·5574	·6759	·7185	·7482	·7700	·7853
9·5641	9·5651	9·5651	9·5651	9·5651	9·5651	9·5651	9·5651

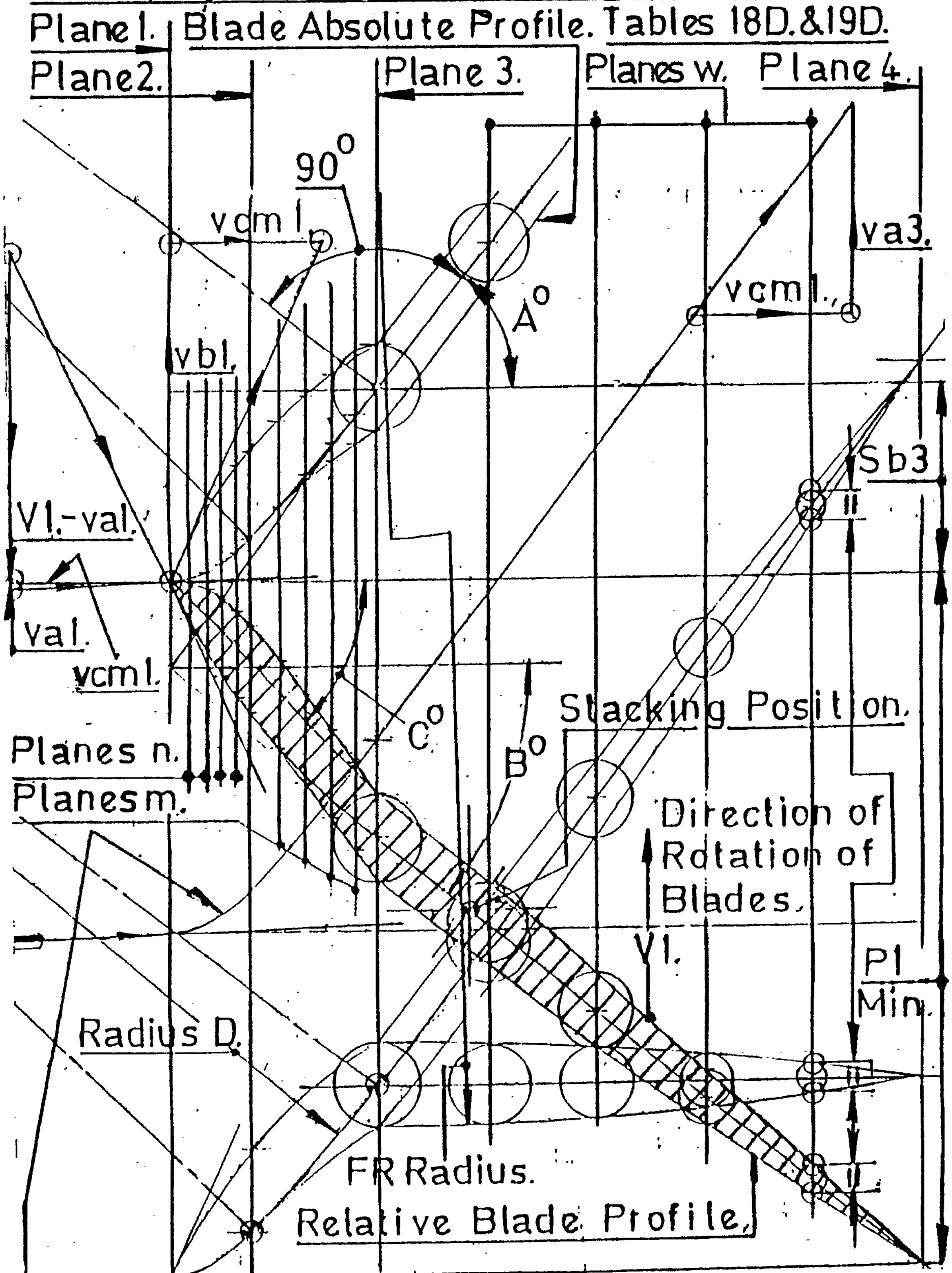
Plane 6.		Plane 7.				Plane 8.	
m=7.	m=8.	n=0.	n=1.	n=2.	n=3.	n=4.	n=5.
·6771	·7920	·8864	1·3742	1·6088	1·8155	2·0169	2·2241
·1668	·1951	·2184	·3590	·4412	·5217	·6075	·7034
·4727	·5060	·5293	·6290	·6623	·6837	·6978	·7034
9·1315	9·1333	9·1333	9·1333	9·1333	9·1333	9·1333	9·1333

Plane 6.		Plane 7.				Plane 8.	
m=7.	m=8.	n=0.	n=1.	n=2.	n=3.	n=4.	n=5.
·6891	·8065	·8078	1·3195	1·5668	1·7860	2·0011	2·2241
·1335	·1563	·1566	·2776	·3518	·4263	·5075	·6004
·4667	·4950	·4952	·5726	·5942	·6046	·6068	·6004
8·7026	8·7050	8·7050	8·7050	8·7050	8·7050	8·7050	8·7050

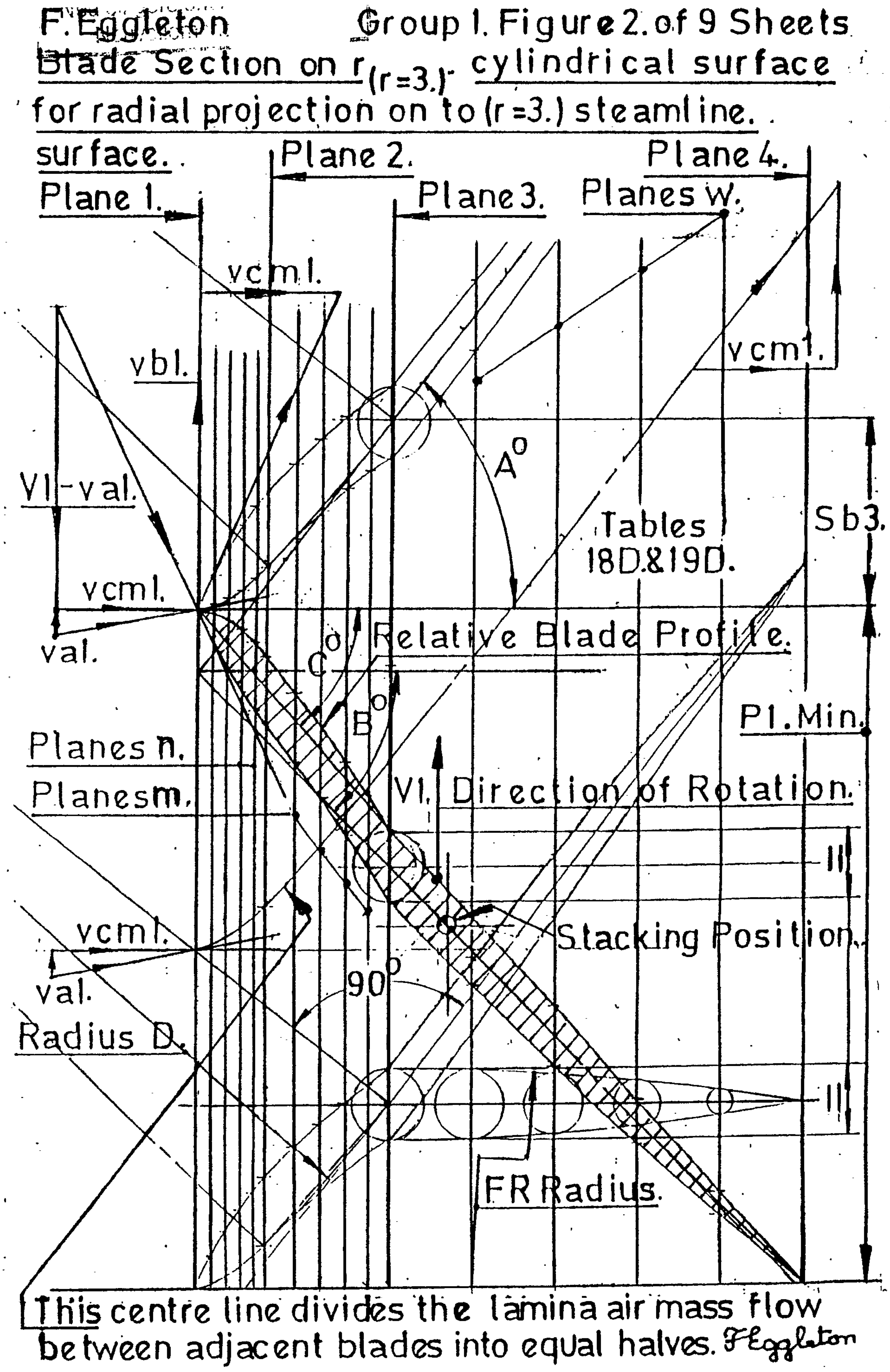
Plane 6.		Plane 7.				Plane 8.	
m=7.	m=8.	n=0.	n=1.	n=2.	n=3.	n=4.	n=5.
·6582	·7703	·7978	1·3062	1·5537	1·7748	1·9940	2·2241
·0760	·0889	·0921	·1727	·2278	·2861	·3524	·4313
·4194	·4381	·4413	·4781	·4800	·4910	·4571	·4313
8·2777	8·2806	8·2806	8·2806	8·2806	8·2806	8·2806	8·2806

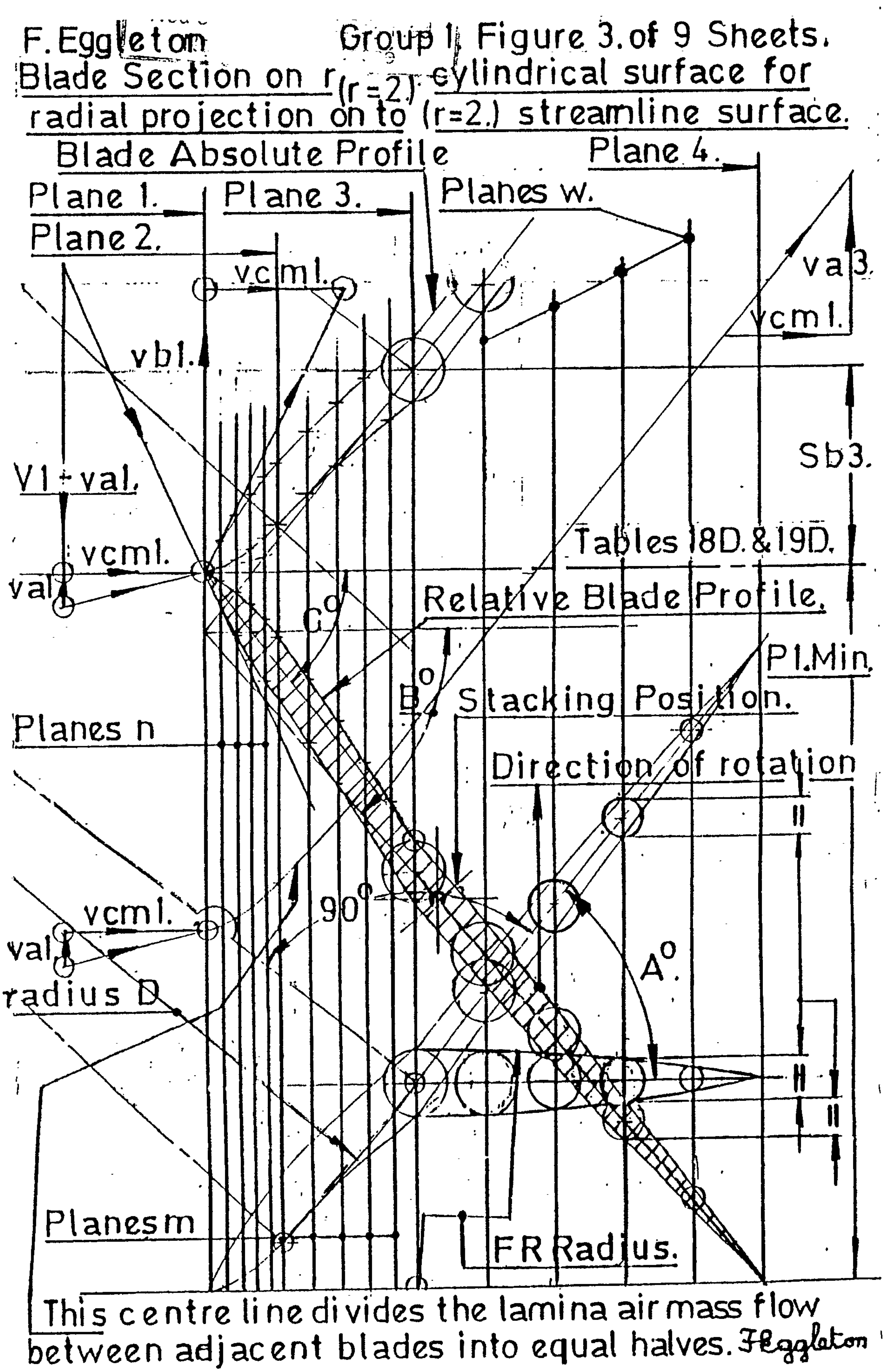
F. Eggleton Group 1. Figure 1. of 9 Sheets

Blade Section on $r_{(r=4.)}$. cylindrical surface for radial projection on to (r=4.) streamline surface.



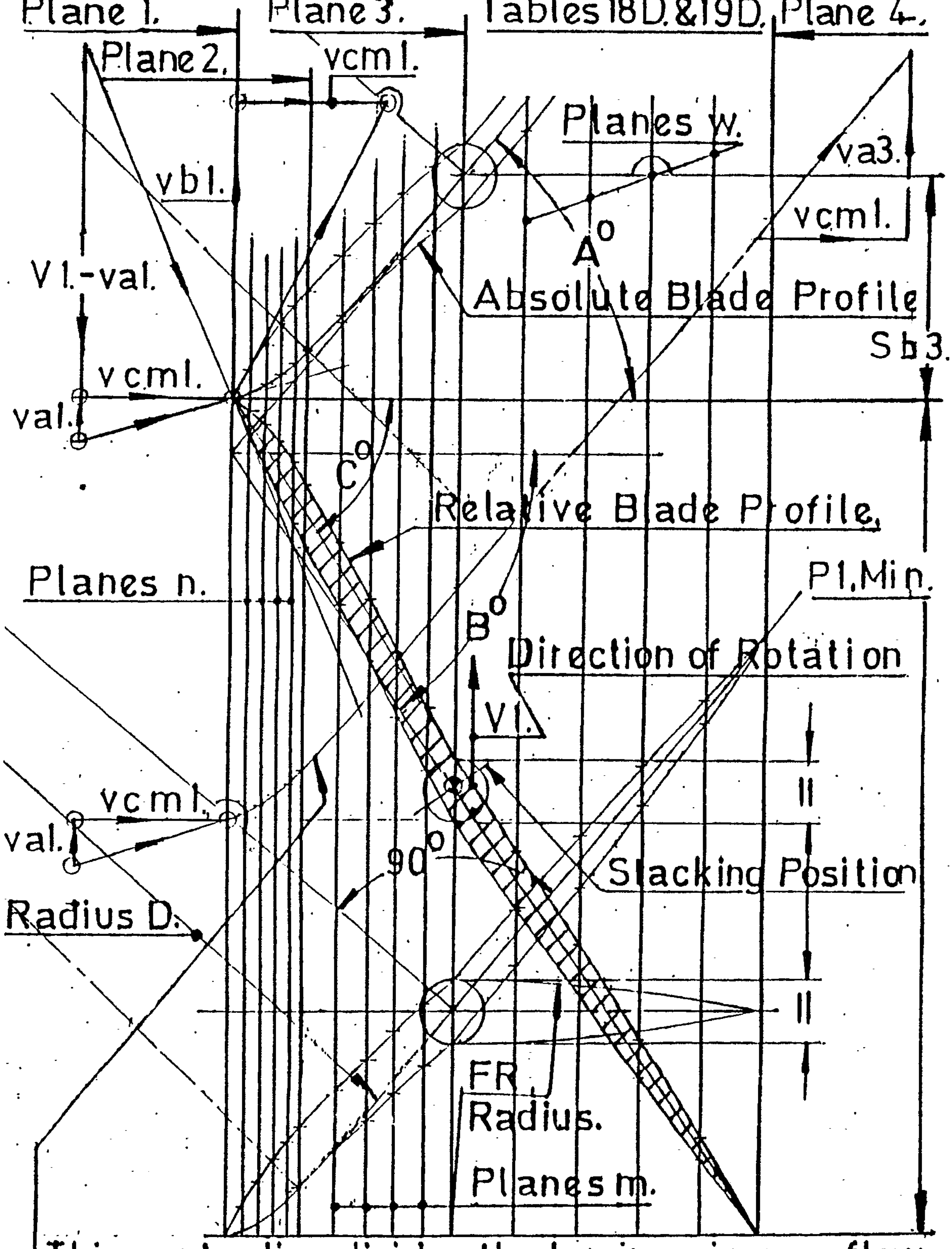
This centre line divides the lamina air mass flow between adjacent blades into equal halves. F. Eggleton


F. Eggleton
Group 1. Figure 2. of 9 Sheets
Blade Section on r(r=3.). cylindrical surface
for radial projection on to (r=3.) steamline.
surface.
Plane 1.
Plane 2.
Plane 3.
Plane 4.
Planes W.
vcml.
vbl.
vcm1.
A°
V1-val.
Tables
18D.&19D.
Sb3.
vcml.
val.
C°
Relative Blade Profile.
B°
P1.Min.
Planes n.
Planes m.
V1.
Direction of Rotation.
vcml.
Stacking Position.
val.
90°
Radius D.
FR Radius.
This centre line divides the lamina air mass flow
between adjacent blades into equal halves. F.Eggleton


F. Eggleton Group 1. Figure 3. of 9 Sheets.
Blade Section on r(r=2) cylindrical surface for radial projection on to (r=2.) streamline surface.
Blade Absolute Profile
Plane 4.
Plane 1.
Plane 3.
Planes w.
Plane 2.
vcml.
va3.
vcml.
vb1.
Sb3.
V1+val.
vcml.
val.
Tables 18D. & 19D.
Relative Blade Profile.
C°
Pl.Min.
B°
Stacking Position.
Planes n
Direction of rotation
90°
vcml.
val.
A°.
radius D
Planesm
FR Radius.
This centre line divides the lamina air mass flow between adjacent blades into equal halves. F.Eggleton

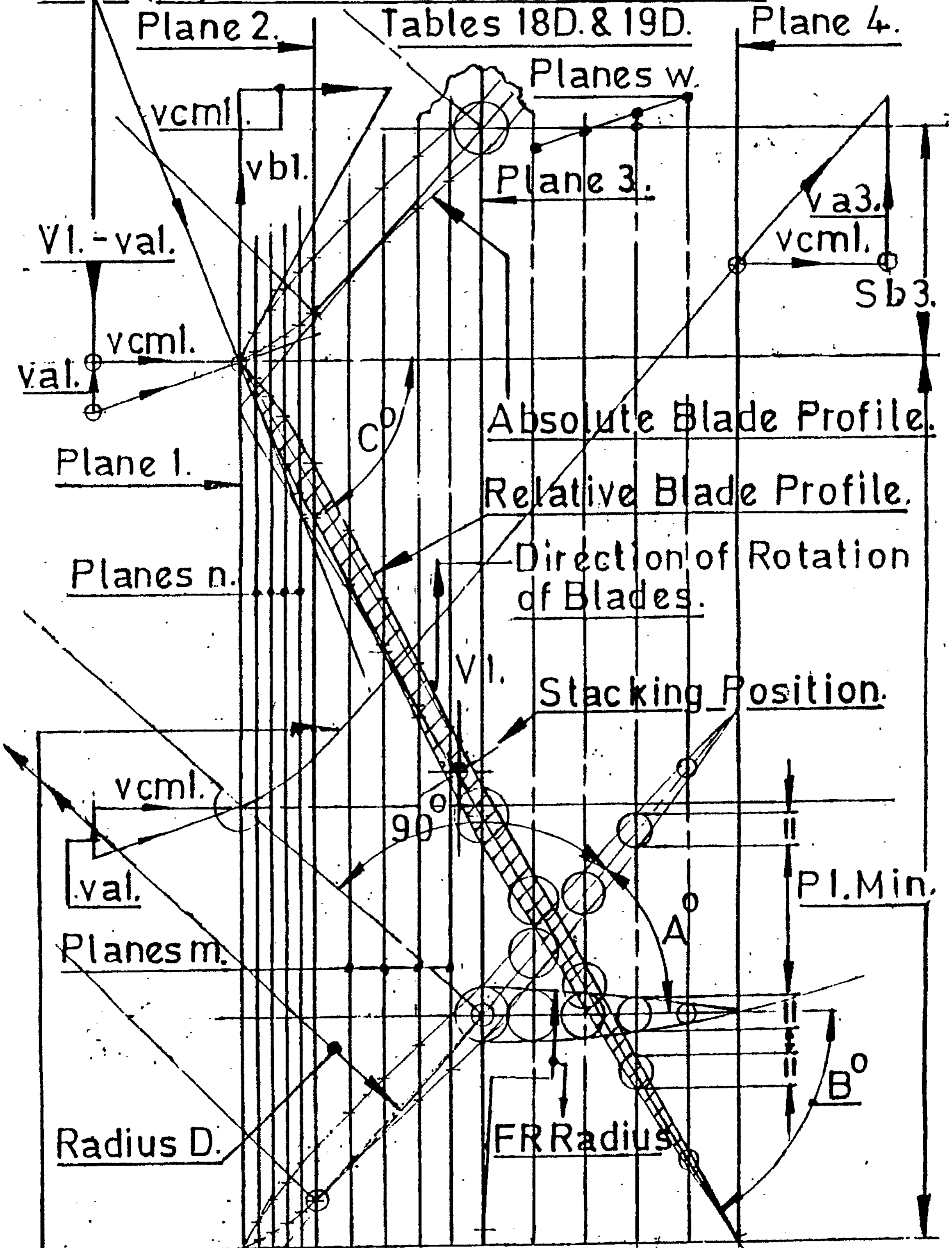
F. Eggleton Group 1. Figure 4. of 9 Sheets.

Blade Section on $r_{(r=1.)}$ cylindrical surface for radial projection on to (r= 1.) streamline surface.



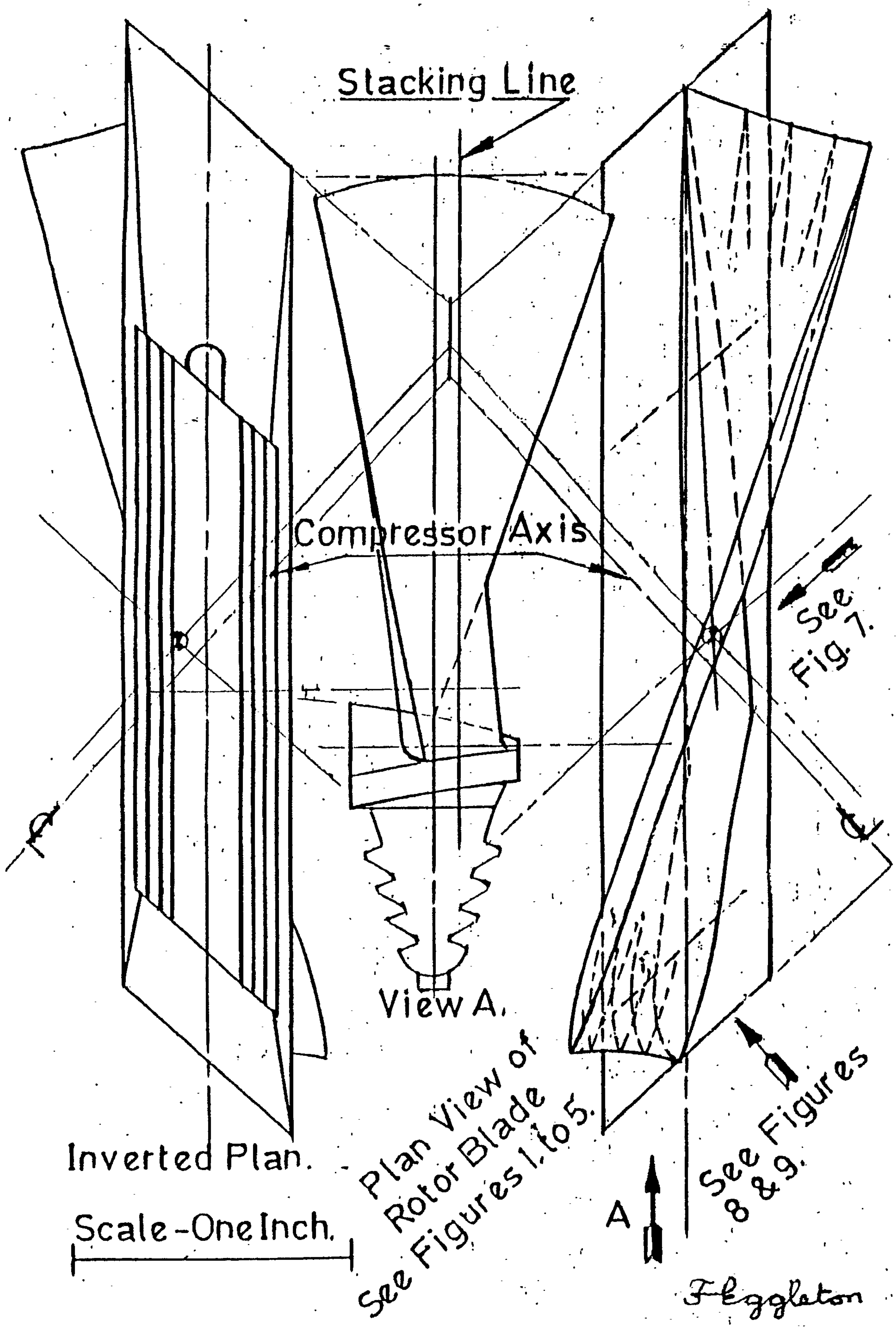
This centre line divides the lamina air mass flow between adjacent blades into equal halves. F.Eggleton

F. Eggleton. Group 1. Figure 5. of 9 Sheets.
Blade Section on $r_{(r=0.)}$ cylindrical surface for radial projection on to streamline surface.



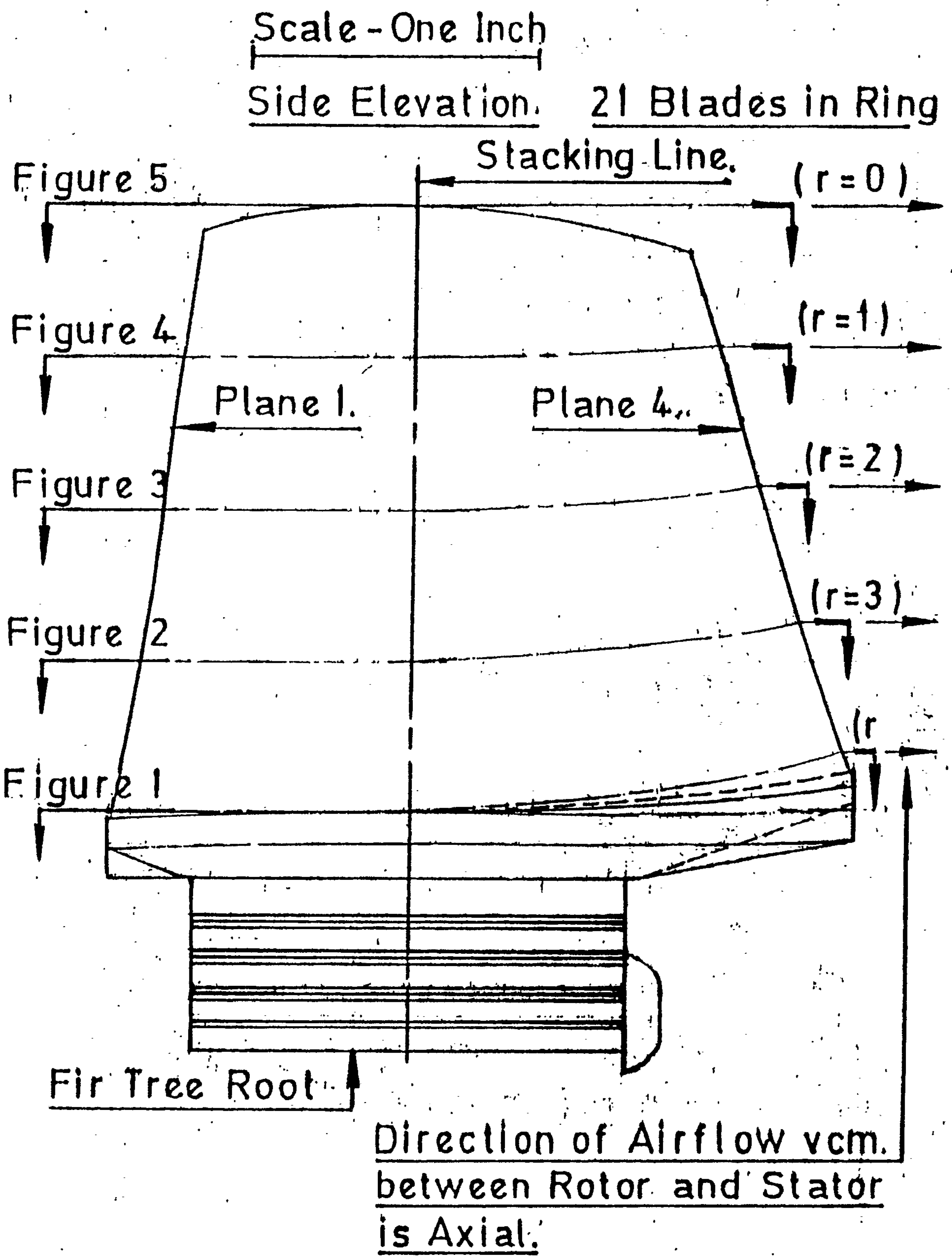
This centre line divides the lamina air mass flow between adjacent blades into equal halves. F.Eggleton

F. Eggleton. Group 1. Figure 6. of 9 Sheets



F Eggleton Group I. Figure 7. of 9 Sheets

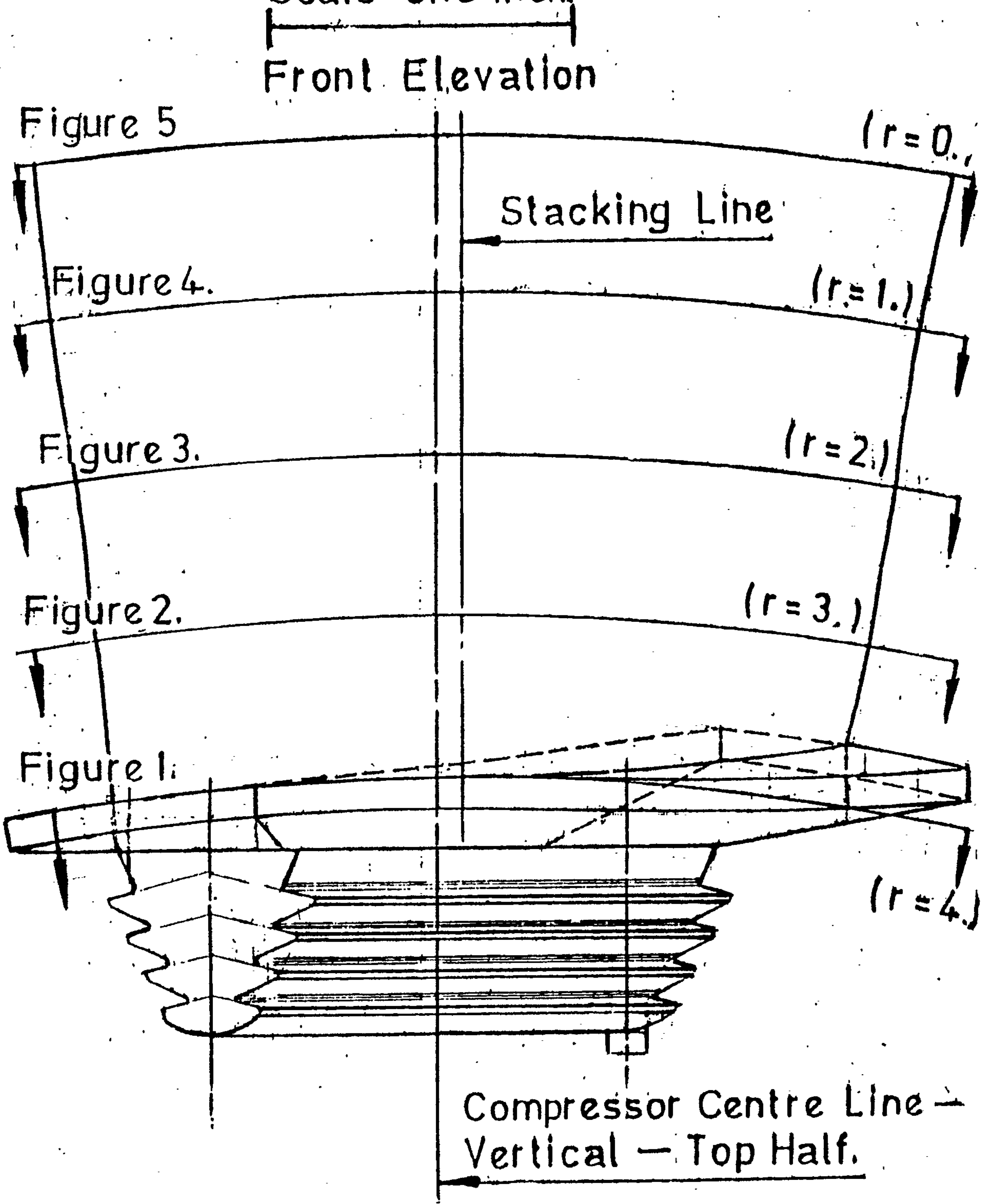
Rotor Blade —— Tables 1D to 6D.



F. Eggleton Group 1. Figure 8. of 9 Sheets

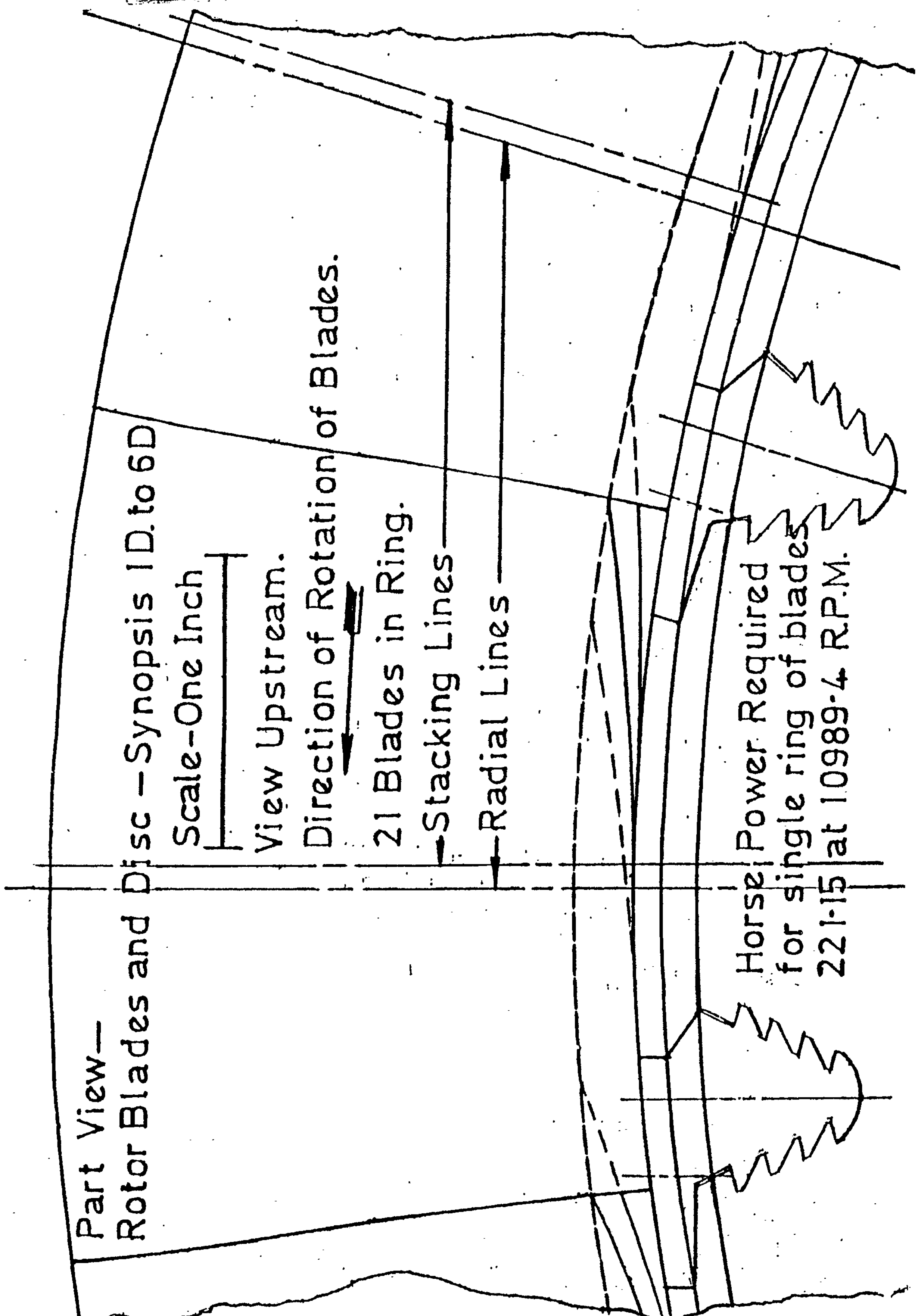
Rotor Blade — Tables 1D to 6D.

Scale - One Inch.



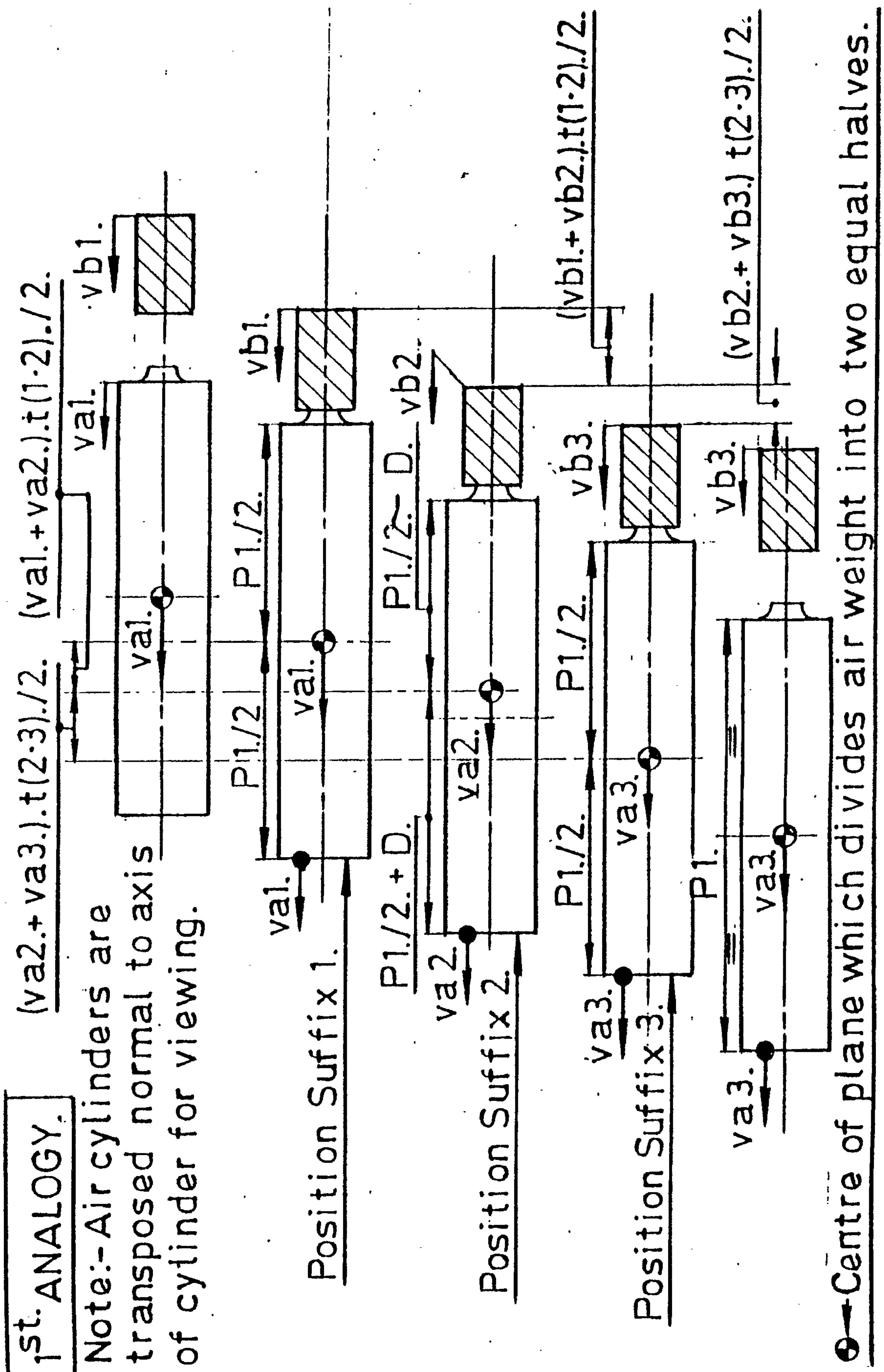
F Eggleton

F.Eggleton Group 1. Figure 9. of 9 Sheets

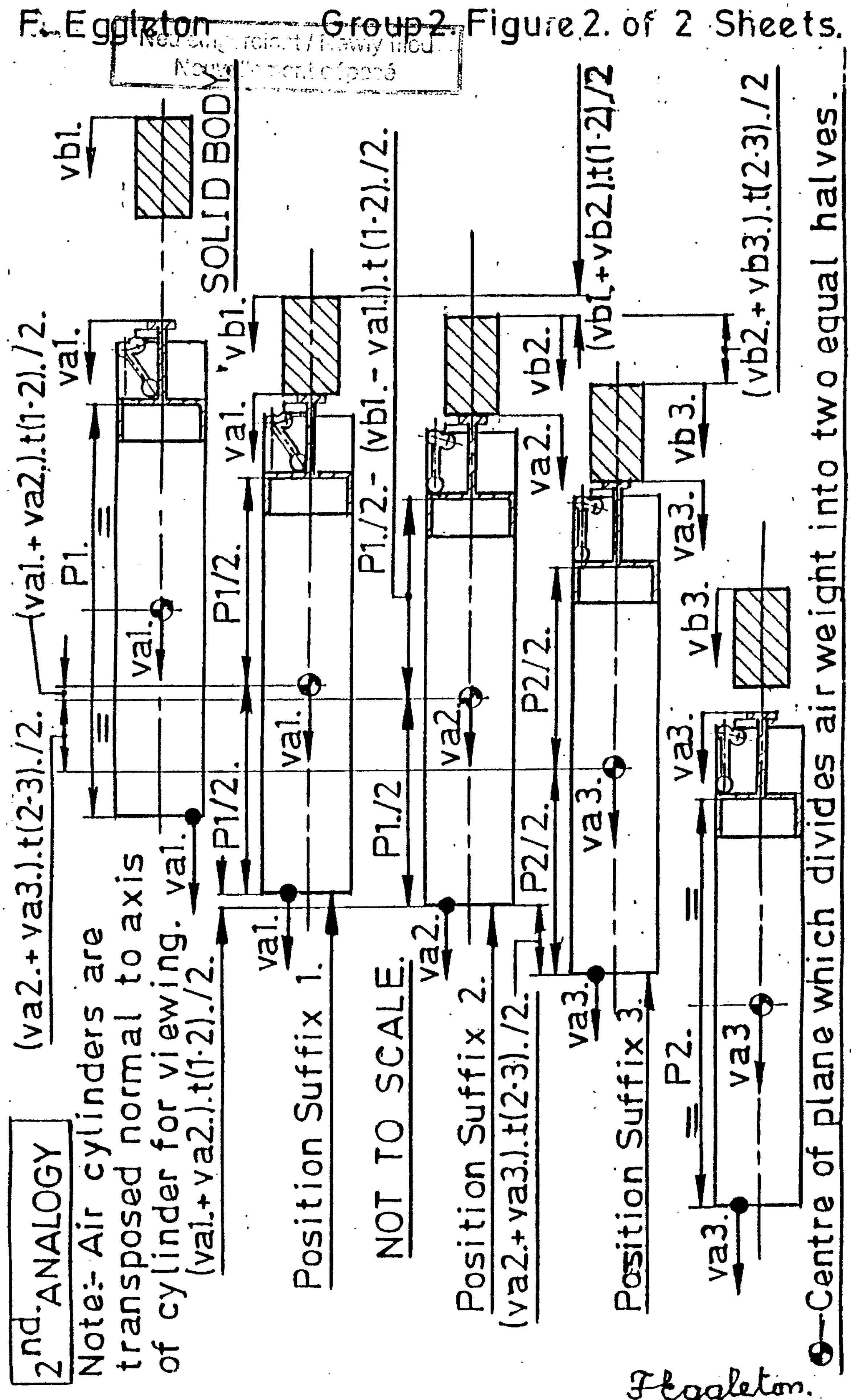


F Eggleton

F. Eggleton Group 2. Figure 1. of 2 Sheets.

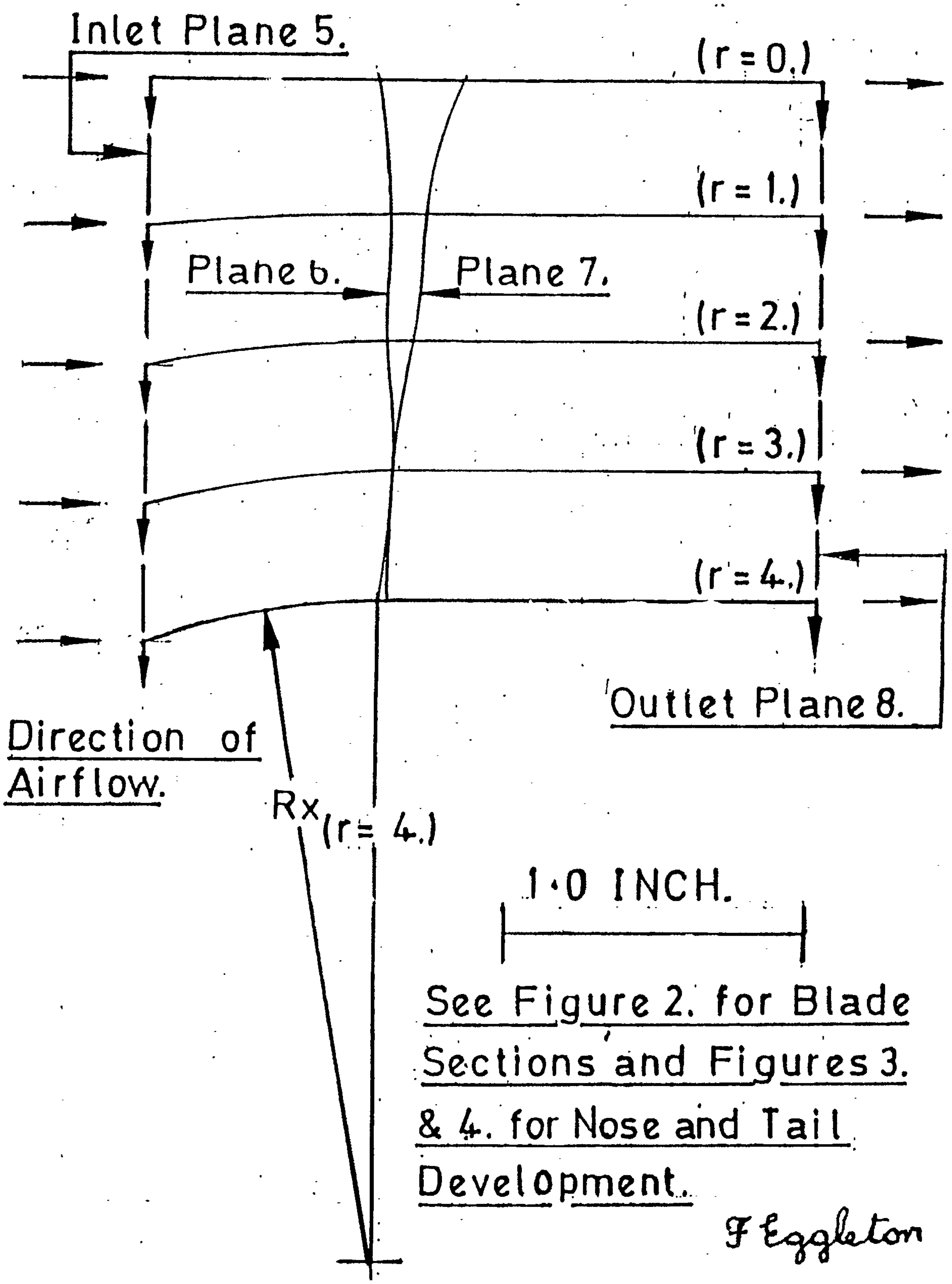


F Eggleton


F. Eggleton Group 2. Figure 2. of 2 Sheets.
2nd. ANALOGY
Note:- Air cylinders are transposed normal to axis of cylinder for viewing.
SOLID BODY
NOT TO SCALE.
Position Suffix 1.
Position Suffix 2.
Position Suffix 3.
Centre of plane which divides air weight into two equal halves.
(va1.+va2.).t(1-2)./2.
(va2.+va3.).t(2-3)./2.
(vb1.-va1.).t(1-2)./2.
(vb1.+vb2.).t(1-2)./2
(vb2.+vb3.).t(2-3)./2
P1.
P1/2.
P2.
P2/2.
va1.
va2.
va3.
vb1.
vb2.
vb3.
F.Eggleton.

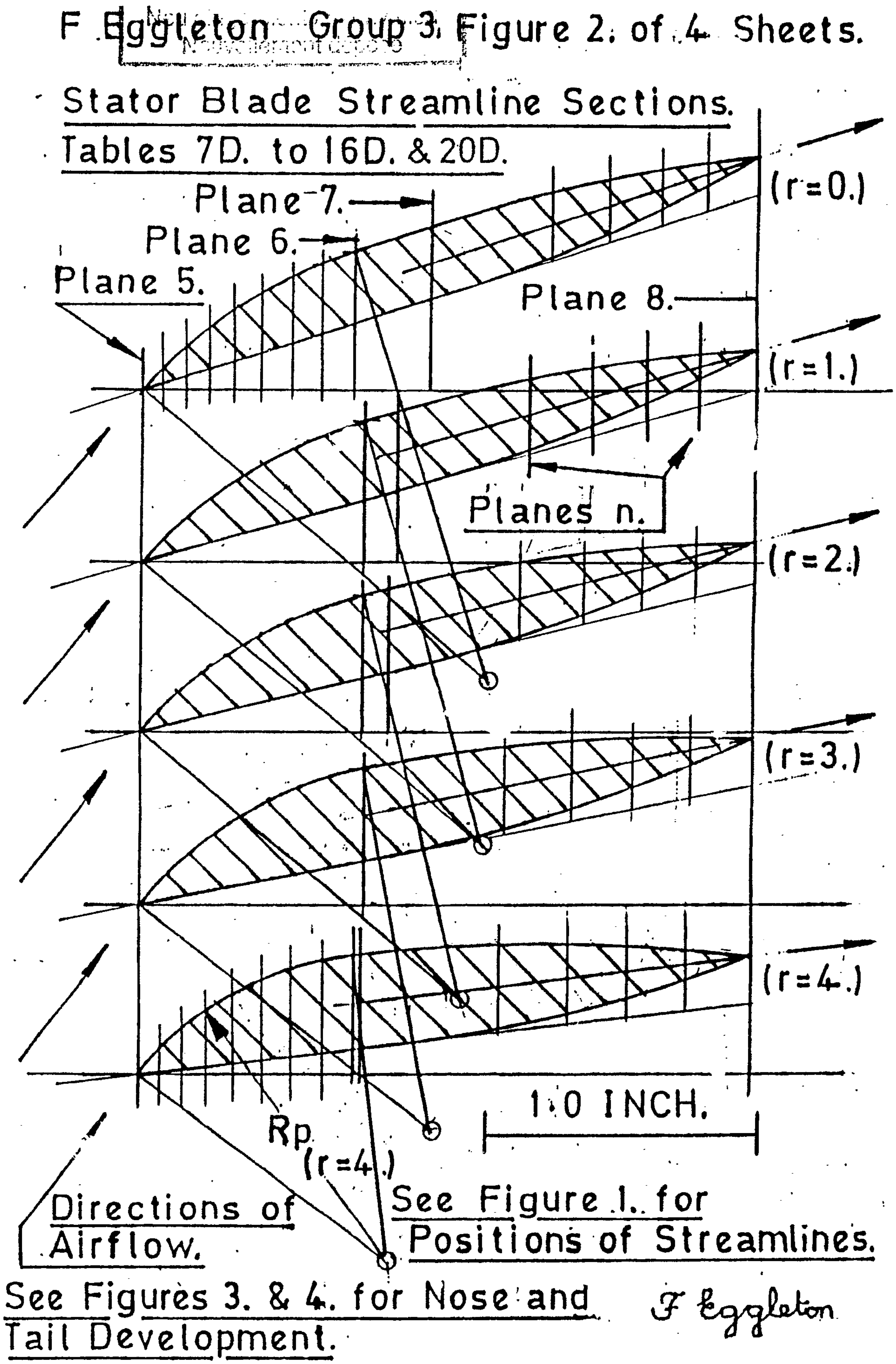
F. Eggleton Group 3. Figure 1. of 4. Sheets

Stator Blade Profile.
57 Blades in Ring.
Tables 7D. to 16D. & 20D.



See Figure 2. for Blade Sections and Figures 3. & 4. for Nose and Tail Development.

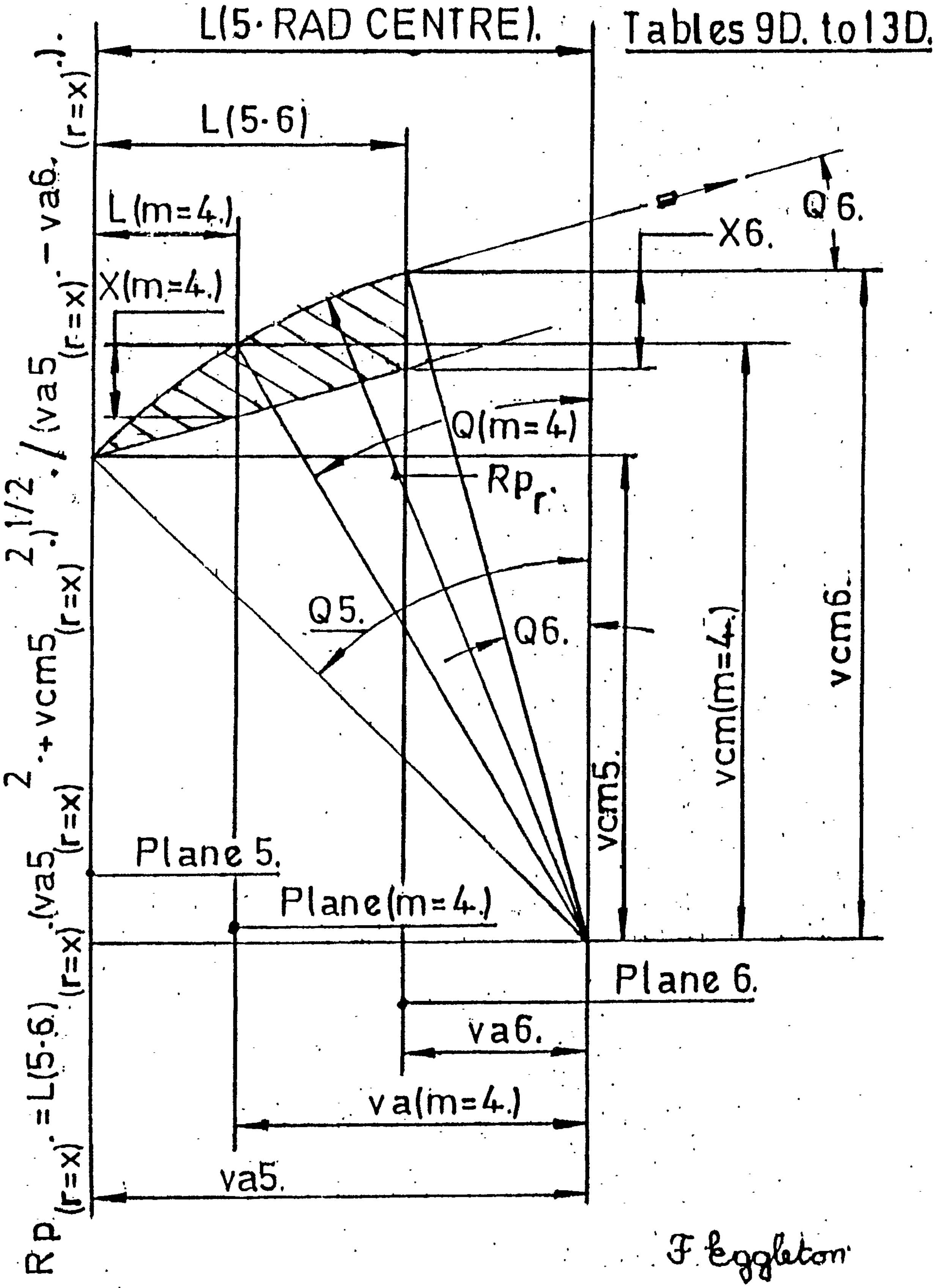
F Eggleton


F Eggleton Group 3 Figure 2. of 4 Sheets.
Stator Blade Streamline Sections.
Tables 7D. to 16D. & 20D.
Plane 7.
Plane 6.
Plane 5.
Plane 8.
(r=0.)
(r=1.)
Planes n.
(r=2.)
(r=3.)
(r=4.)
1·0 INCH.
Rp
(r=4.)
Directions of Airflow.
See Figure 1. for Positions of Streamlines.
See Figures 3. & 4. for Nose and Tail Development.
F Eggleton

F. Eggleton. Group 3. Figure 3. of 4 Sheets.

DEVELOPMENT ON STREAMLINE OF STATOR NOSE SECTION. (TYPICAL)

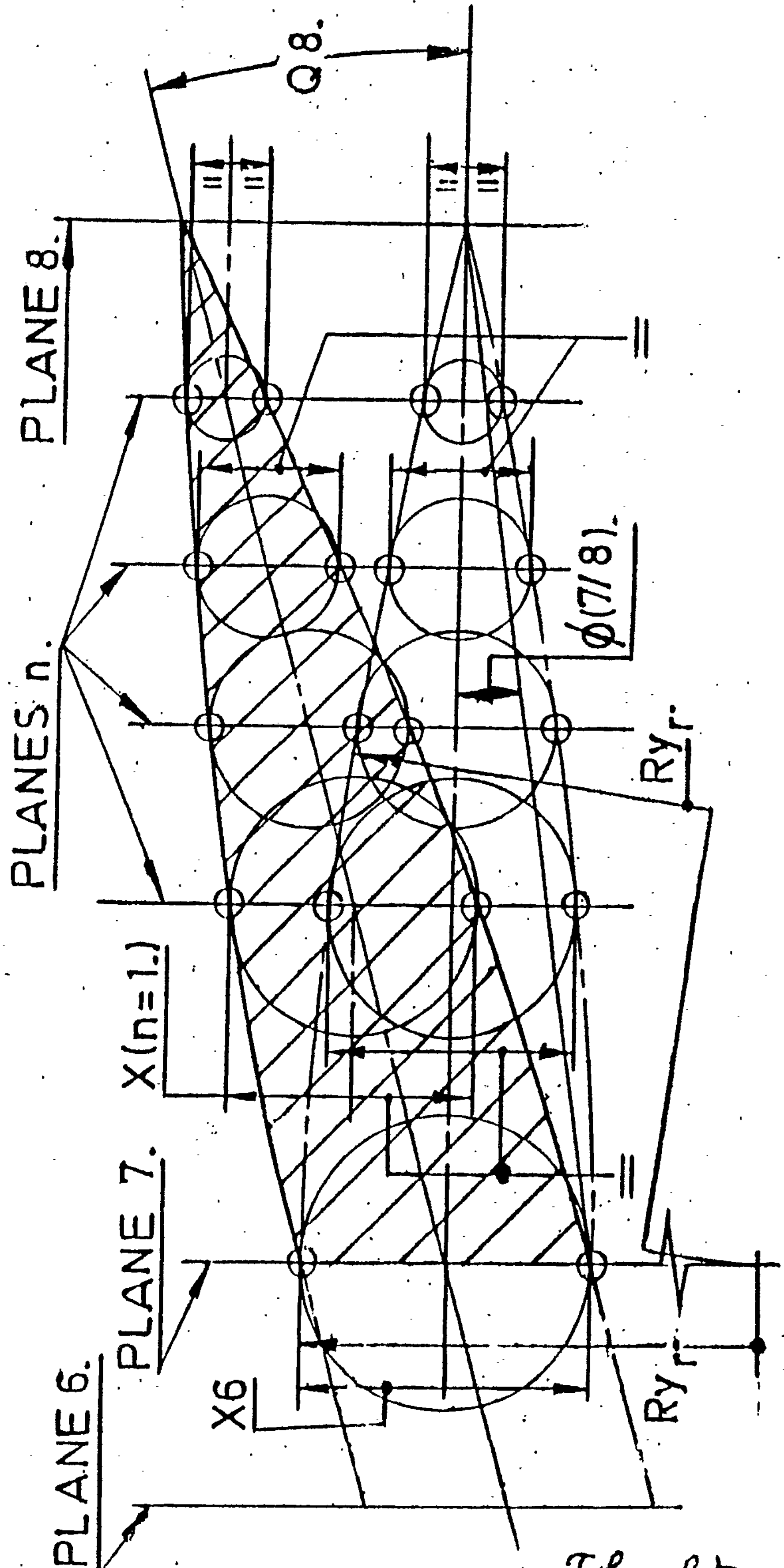
Tables 9D. to 13D.



F. Eggleton

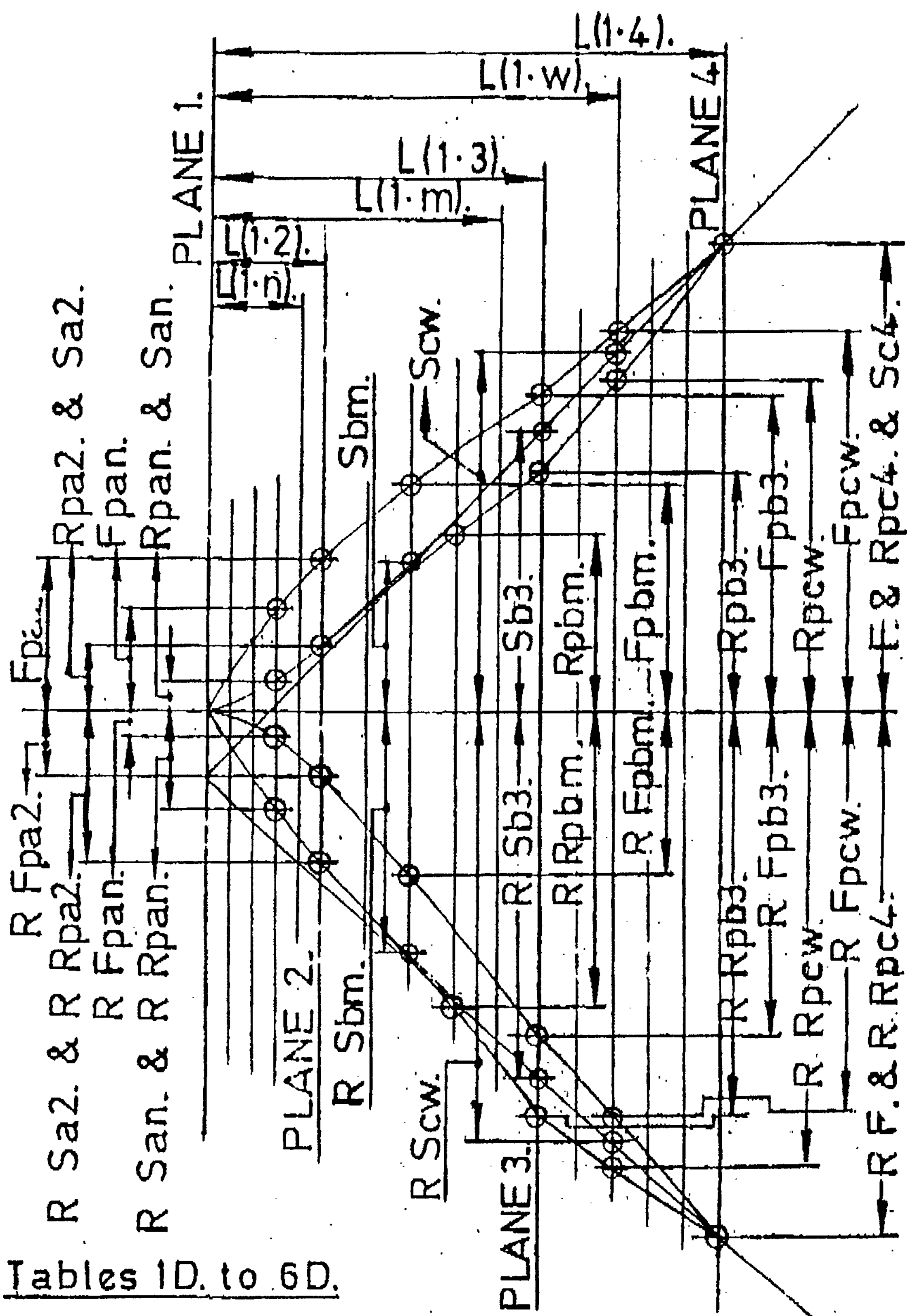
F. Eggleton Group 3. Figure 4. of 4 Sheets.

CONSTRUCTION OF REAR SECTION OF STATOR BLADES.
THIS FURTHER ACTION IS REQUIRED FOR ALL VALUES
OF Q6. ABOVE ZERO. NOT TO SCALE.
Tables 13D. to 16D.



F. Eggleton

Figure 1. of 1. Sheet.



Tables 1D. to 6D.

Dimensions used to produce blade profile & air flow path on streamline surface.

Not to scale

F Eggleton