

May 10, 1932.

G. E. IRELAND

1,858,047

SHEET METAL DIE

Filed June 10, 1930

3 Sheets-Sheet 1

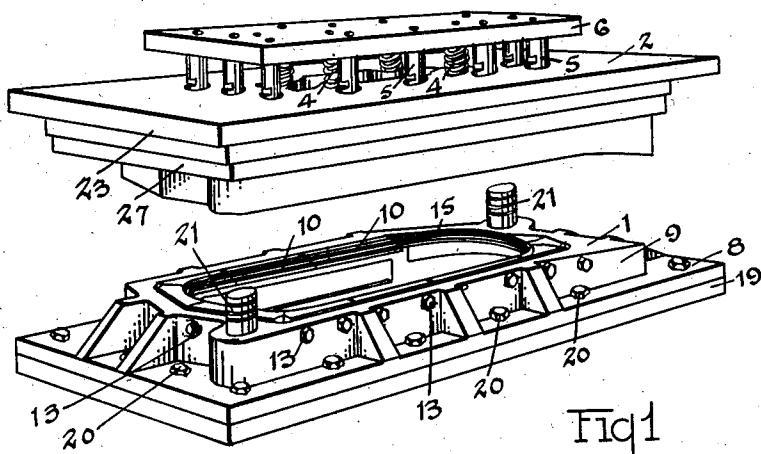


Fig 1

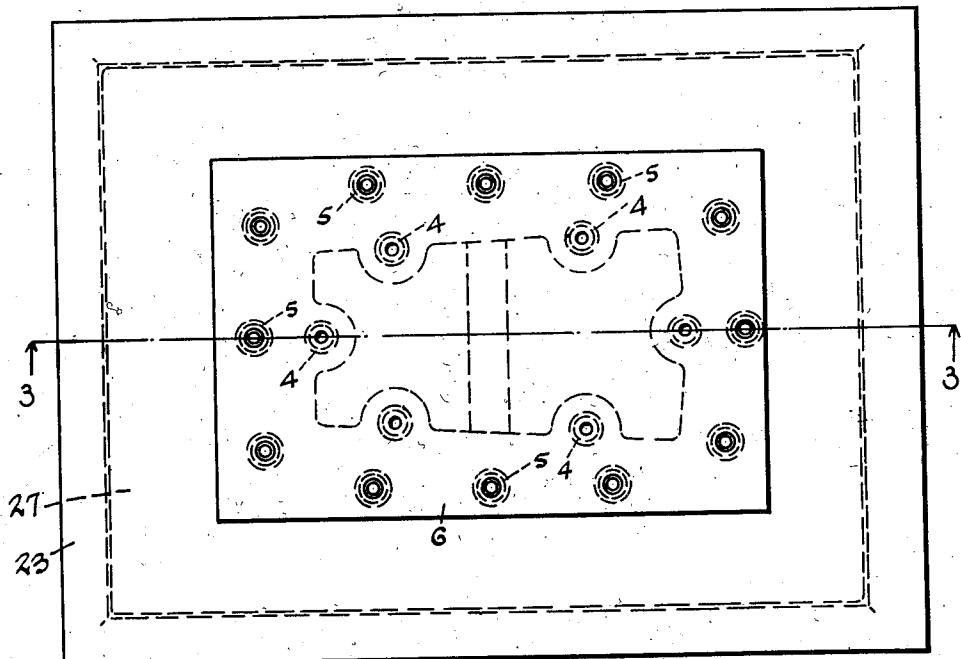


Fig 2

Inventor

George E. Ireland

By *Frank F. Crampton*  
Attorney

May 10, 1932.

**G. E. IRELAND**

1,858,047

SHEET METAL DIE

Filed June 10, 1930.

3 Sheets-Sheet 2

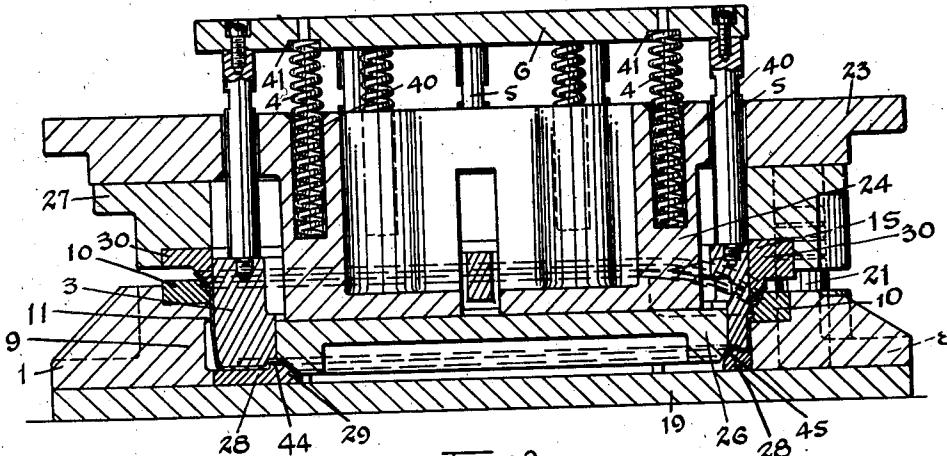


Fig 3

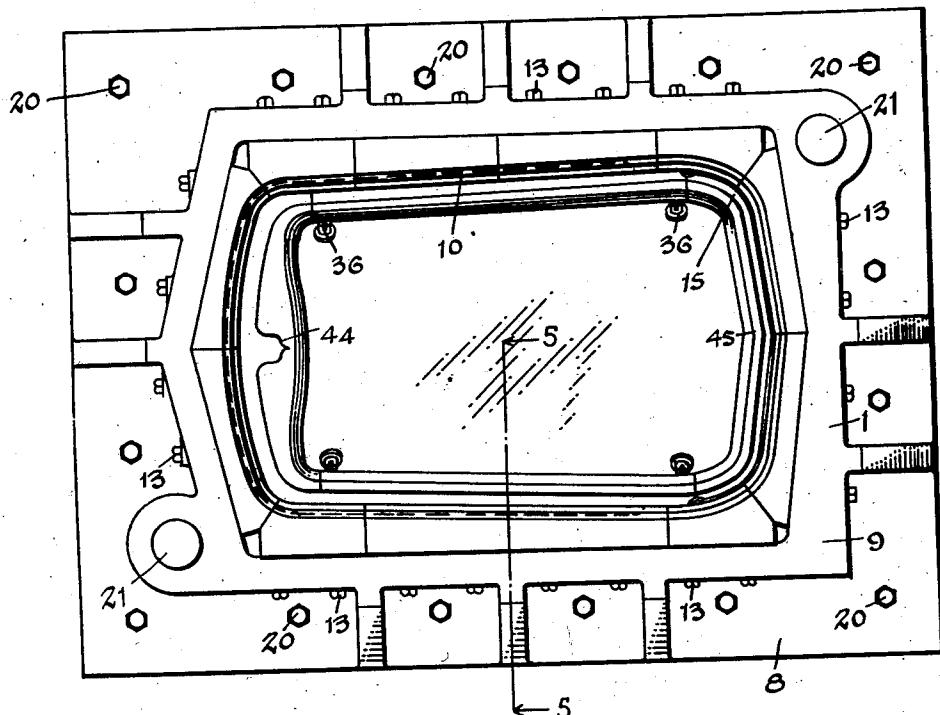


Fig 4

Inventor

George E. Ireland  
James F. Crampton  
Attorney

May 10, 1932.

G. E. IRELAND

1,858,047

SHEET METAL DIE

Filed June 10, 1930

3 Sheets-Sheet 3

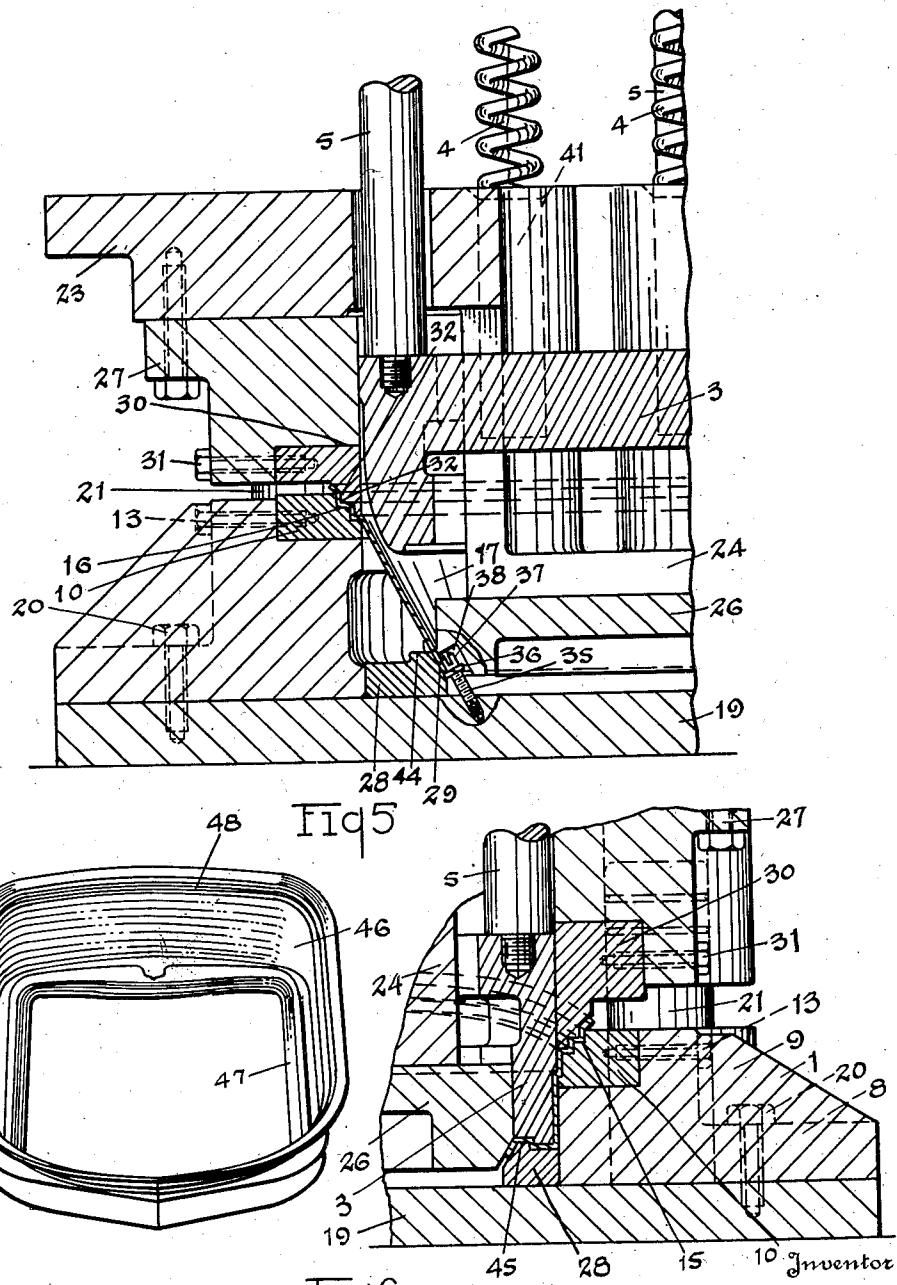


Fig 7

Fig 6

George E. Ireland  
Samuel G. Chapman,  
Attorney

Patented May 10, 1932

1,858,047

# UNITED STATES PATENT OFFICE

GEORGE E. IRELAND, OF TOLEDO, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE CITY AUTO STAMPING COMPANY, OF TOLEDO, OHIO, A CORPORATION

## SHEET METAL DIE

Application filed June 10, 1930. Serial No. 460,259.

My invention has for its object to provide an exceedingly efficient die for shaping sheet metal parts wherein the metal is stretched to conform to the required configuration, as distinct from bending the parts of the sheet metal die, by the coaction of male and female dies. The invention particularly relates to dies wherein the stretching of portions of the sheet metal is done progressively by movement of the die in a direction inclined to the surface of the sheet metal to produce a gradual distention of the metal in the formation of the article.

The invention particularly relates to a die having a means for securely clamping edge portions of the sheet metal to prevent slipping of the edge portion of the sheet metal as the surface of the die member slides along the surface of the sheet metal. The invention also provides a die having parts so interconnected that the die shape may be altered as may be desired within, however, the limitations of the general contour of the articles that may be formed from the die. The invention consists in other features and advantages which will appear from the following description and upon examination of the drawings forming a part hereof.

The invention may be contained in die structures that vary in their details and, to illustrate a practical application of the invention, I have selected a die for forming an oblong sheet metal part having substantially an L-shaped cross section as illustrative of the various structures that contain the invention, and shall describe the die hereinafter. The die selected for purposes of illustration, and as an example of the various embodiments of my invention, is shown in the accompanying drawings.

Fig. 1 is a perspective view of the die and of the sheet metal holder. Fig. 2 is a top view of the die illustrated in Fig. 1. Fig. 3 is a view of a section taken on the plane of the line 3—3 indicated in Fig. 2. The dimensions of the view shown in Fig. 3 is considerably less than the dimensions of the view shown in Fig. 2. Fig. 4 is a top view of the sheet metal holder. Fig. 5 is a view of a section taken on the plane of the line 5—5 illus-

trated in Fig. 4. Fig. 5 also illustrates a section of the die shown in Figs. 1 and 2 taken on the same plane as that of the die holder shown in Fig. 4. Fig. 6 is a view of a section similar to that shown at the right end of the view shown in Fig. 3. The dimensions of the section shown in Fig. 6 being much larger than the dimensions of Fig. 3. Fig. 7 is a perspective view of the article formed by the die which, in this case, is a radiator shell of the type commonly used for covering edge portions of radiators of automobiles for decorative purposes.

The die selected for purpose of illustrating an embodiment of the invention, consists of two parts, namely, the movable die member and the die holder. The die holder consists essentially of two parts which cooperate to clamp edge portions of the die. One of the parts of the die holder is substantially dish-shaped to receive the sheet metal which is preferably formed of one or more strips cut so as to form a band having portions which roughly conform to the finished article. The band may be so shaped that its surface in all of its parts will be inclined to the planes of its edges and, consequently, so that it will nest in the sheet metal holder. The edge portions are securely clamped to retain the edge portions in position as the die member operates to progressively stretch portions of the sheet metal.

In the particular form of construction shown, the sheet metal holder 1 is supported on a suitable bed of a press. The coacting die holder and clamp, for clamping the edge portions of the sheet metal to be formed, is assembled with the movable die member which may be connected to a movable part of the press for raising and lowering the movable die member and the coacting sheet metal holder part to and from the die holder 1, facilitating the insertion of the sheet metal into the holder 1, and the removal of the shaped shell from the holder. Thus, the coacting clamping member 2 may be raised and lowered by part of a press and the movable die member 3, carried by the part 2, may be elastically supported relative to the part 2 by means of the springs 4 and guided in its

movement relative to the part 2 by means of the pins 5 which are connected to a plate 6. Thus when the part 2 has been located in position by the die press, the ram of the press 5 may operate to depress the die member 3 and shape the metal.

Preferably, the die holder 1 comprises a plate 8 having a flange part 9 for receiving a plurality of segments 10 located on a ledge 11 formed on the flange part 9. The segments 10 are secured in position by means of suitable bolts 13 and may be replaced by other segments of different shapes and dimensions but with limitations, depending upon the general shape and contour of the article to be formed, particularly as to the dimensions of the shells that may be formed from the die. The segments or sections 10 are, preferably, stepped, as at 15, to form a plurality of relatively spaced gripping corners, as at 16, for gripping the upper edge portion of the sheet metal 17 to prevent the sheet metal from slipping downward as the die member 3 is depressed and moved over the surface of the sheet metal 17. The flange plate 8 may be secured to a bed plate 19 by means of the bolts 20. Also, the flange part 9 may be provided with guiding pins 21 to insure registration of the coacting clamping member 2 and the die part 3 with the sheet metal holder 1.

The coacting movable sheet metal holder 2 comprises a movable head or bridging member 23 having, preferably, a hollow dependent part 24 to which is connected a clamping plate 26. A clamping ring 27 is secured to the movable head 23 in diagonally offset substantially parallel spaced relation with the clamping plate 26 forming therebetween an inverted channel enclosing the forming member 3 and which is bridged by the supporting head 23. The bed plate 19 is provided with a clamping ring 28 having inner edge portions 29 that coact with the edge portions of the clamping plate 26 for securing the lower edge portion of the sheet metal blank, while the clamping ring 27 is provided with a plurality of segments 30 that are secured to the clamping ring 27 by means of the bolts 31 cooperating with the segments 10 of the stationary die member to grip the upper edge of the sheet metal blank. The parts 30 correspond in shape and in dimensions to the segments 10 that are secured to the sheet metal holder part 1. The segments 30 are also provided with stepped portions 32 that correspond to the stepped portions 15 and so as to form the sharp gripping corners in the sheet metal 17 to securely hold the upper edge portion of the sheet metal 17, while the sheet metal is being operated upon by the movable part 3 on the die.

The gripping surfaces of the edge portions 29 of the clamping ring 28 and of the edge portions of the clamping plate 26 are located with respect to the stepped portions 15 and

32, so that the sheet metal 17 will lie in contact with the corners of the stepped portions and the said surfaces just in advance of the engagement of the coacting clamping member 2. Thus the sheet metal 17 may be readily placed in position so as to rest against the surface of the clamping ring 28 and the corners of the stepped portion of the segments 10, and will not be moved therefrom when the clamping member 2 is moved downward by the operation of the press. Continued movement of the press will shape the edge portion of the sheet metal 17 by the stepped portions 15 and 32 to produce a strong gripping area while at the same time the lower edge portion will be clamped by the opposed clamping areas of the ring 28 and the clamping plate 26.

In order to locate the lower edge of the sheet metal part 17, it may be secured by the heads of the screws 35 which may be located in the bed plate 19. The screws 35 may be provided with flanges 36 located between the shanks of the screws and the heads 37. The position of the flanges 36 may be adjusted by varying the position of the screws 35 in the bed plate 19. The heads are, preferably, cylindrical in form and are so located that they will extend parallel to the clamping surface of the ring 28. The clamping plate 26 is provided with recesses 38 in which the heads of the screws will be located when the movable clamping member 2 is lowered by the press to engage the sheet metal 17. The sheet metal 17 may be placed in position by locating its lower edge against the flanges 36 of the screws 35 and between the heads and the ring 28 which will hold the sheet metal 17 in position until the movable clamping member 2 is depressed to engage and clamp the edge portions of the plate 17.

The movable member 3 of the die is supported within the clamping member 2 and is movable relative to the clamping member in a direction substantially perpendicular to the general direction or plane of the blank gripping surfaces. It is guided for its movements, not only by the pins 5, but also by the clamping means 27. The clamping member 2 with the movable member 3 are lowered when the sheet metal strip 17 is placed in position in the die holder 1. When the movable member 3 is placed against the sheet metal 17, it is supported in position by the sheet metal strip 17 as the clamping member 2 is lowered to clamp the sheet metal strip along its edge portions that will be located on the inside and on the outside of the movable member 3 of the die. The press then forces the movable member 3 downward and causing the lower surface of the movable member 3 to slide over the work with a wiping or camming action and depress and stretch the portion of the sheet metal strip 17 between the clamped edge portions of the strip. The springs 4, which are located in

sockets 40, formed in the movable member 2, and sockets 41 located in the plate 6, operate to raise the movable member 3 relative to the clamping member 2 when the ram of the 5 press is lifted to release the die member 3 from the sheet metal strip 17 in advance of the releasement of the edge portions of the sheet metal strip 17.

The movable die member 3 is provided with 10 a surface conforming to the configuration that it is desired to produce in the shell and its surface slides over the surface of the sheet metal to progressively stretch the sheet metal with a wiping or camming action as the movable die member is depressed. If it is desired to bend portions of the sheet metal 17, the clamping ring 28 may be shaped accordingly, that is, it may be provided with the raised portions 44 and 45, such as is indicated 15 by Fig. 3.

In referring to the direction of movement of the forming member which is substantially perpendicular to the general "plane" of the gripping surfaces such term is employed to 20 broadly designate the general disposition of the surfaces, whether curved, inclined or distorted and is not necessarily limited to a flat plane.

When the clamping member 2, together 25 with the movable die member 3, has been raised away from the die holder 1, the shell formed by the operation of the die, such as the shell 46, may be removed from the die holder. The edge portions 47 and 48 may 30 be trimmed from the shell, leaving the finished article formed by the die. If desired, the shell may be further shaped such as to produce further alterations in its configuration.

40 I claim:

1. In a die, a stationary clamping member, a movable die member and a movable clamping member, the clamping members having endless spaced clamping surfaces engaging 45 the inner and outer margins of a flaring endless sheet metal blank for supporting the sheet metal blank in a position that its surface will be inclined to the direction of movement of the movable die member, and means 50 for guiding the movable die member intermediate the clamping surfaces of the clamping member and in a direction substantially perpendicular to the plane thereof.

2. In a die, a stationary clamping member, 55 a movable die member and a movable clamping member, the clamping members having diagonally offset spaced clamping surfaces for supporting the sheet metal operated upon in a position that its surface will be inclined 60 to the direction of movement of the movable die member, means for guiding the movable die member intermediate the clamping surfaces of the clamping members, the clamping surfaces of the clamping members being disposed for clamping the metal on the inside

and outside of the die member and interconnected with each other in overlying relation therewith.

3. In a die, a stationary clamping member, 70 a movable die member and a movable clamping member, the clamping members having diagonally offset spaced clamping surfaces for supporting the sheet metal operated upon in a position that the piece to be operated upon will be inclined to the direction of 75 movement of the movable die member, means for guiding the movable die member intermediate the spaced clamping surfaces which engage the metal on the inside and outside of the die member, the outer of the clamping 80 surfaces being shaped for gripping the outer edge portion of the sheet metal more firmly than the inner edge is gripped.

4. In a die, a stationary clamping member, 85 a movable curvilinear die member and a movable clamping member having therein a curvilinear grooved recess in which the movable member is located, the clamping member having clamping surfaces on opposite sides of the die member for supporting the sheet 90 metal operated upon in a position that it will be inclined to the direction of movement of the movable die member, means for actuating the movable die member independently of the clamping member, the movable die member 95 having projecting parts whose surfaces operate to stretch the metal between the portions of the metal clamped by the clamping member.

5. In a die, a stationary clamping member, 100 an endless movable die member and a movable clamping member the clamping members having endless clamping surfaces disposed interiorly and exteriorly of the die member for supporting the sheet metal operated upon 105 in a position that it will be inclined to the direction of movement of the movable die member the outer clamping surfaces being adapted for gripping the outer edge portion 110 of the sheet metal more firmly than the inner edge thereof, the movable die member being operated intermediate the clamping surfaces to stretch the metal between the portions 115 of the metal clamped by the clamping surfaces.

6. In a sheet metal forming apparatus, two pairs of concentric endless relatively spaced blank holders, one of said pairs of blank holders being offset out of the plane of the other blank holder so that the blank to be shaped may be held in an inclined position and an endless forming member interposed between the blank holders and in concentric relation therewith, said forming member being movable relative to the blank holders in a direction substantially perpendicular to the general planes thereof into forming engagement with material held thereby.

7. In a sheet metal forming apparatus, two 130

substantially parallel spaced curvilinear blank holding portions disposed in diagonally offset relation, a movable body portion upon which the blank holder portions are jointly carried for unison motion into and out of engaging position, and having therein an inverted channel shaped recess intermediate the blank holding portions, a stationary die member having mating portions engaged thereby to hold a sheet metal blank, a contoured forming member carried by the body portion within the inverted channel shaped recess intermediate the blank holding portions for unison movement therewith, said forming member being capable of further movement independently of the blank holders in a like direction.

8. In a sheet metal forming apparatus, two pairs of endless interconnected curvilinear blank holders adapted for simultaneously engaging the opposite margins of a strip of material in diagonally offset relation and an endless curvilinear pressure applying forming member engaging the held material intermediate the blank holders and movable relative thereto in a direction substantially perpendicular to the general plane of said holders, whereby the material so held is shaped with a wiping action of the die thereon.

9. In a sheet metal forming apparatus, a pair of interconnected curvilinear blank holders of different dimensions relatively offset in inclined relation, a pair of complementary blank holders for clamping the work therebetween and a non-expanding curvilinear forming member enclosed between the blank holders, a bridging member transversely connecting the blank holders of one pair with each other over the forming member, the forming member being operable relative to the blank holders into forming engagement with the work with a wiping action thereon.

10. In a sheet metal forming apparatus, a pair of endless blank holders engaging the blank to be formed and offset obliquely from each other and a complementary pair of blank holders cooperating therewith to hold the work in inclined position, and an endless forming member interposed between the blank holders and movable with wiping action into engagement with a blank extending between the blank holders and while moving in the general direction of the lowermost blank holders.

11. In a sheet metal forming apparatus, two pairs of endless curvilinear concentric blank holders disposed in diagonally offset relation, for holding a blank in inclined position and an endless curvilinear forming member disposed in concentric relation with the blank holders and therebetween, said forming member being movable in a direction substantially axially relative to the concentric

blank holders into forming engagement with the blank.

12. In a sheet metal forming apparatus, a concave die member having flaring sides, blank holding means including spaced bearing portions transversely interconnected throughout their lineal extent and engaging the die at the top and bottom of the flaring sides, cooperating to hold the work therebetween and a non-expanding forming member enclosed intermediate the bearing portions of the blank holding means exerting simultaneous lateral pressure in different directions within the flaring walls of the die.

13. In a sheet metal forming apparatus, a concave die member having flaring side and end walls, relatively spaced blank holders substantially coincident with the larger and smaller margins of the flaring walls, a bridging member transversely interconnecting the blank holders and a non-expanding forming member enclosed beneath the bridging member and movable into and out of the die in a direction substantially perpendicular to the general plane of the margins of its flaring walls, and exerting lateral pressure in different directions upon a curvilinear flaring blank held by the blank holders within the flaring walls of said die member.

14. In a sheet metal forming apparatus, a stationary member having relatively spaced substantially concentric curvilinear material gripping surfaces disposed in diagonally offset relation to each other, the member being recessed intermediate the gripping surfaces beyond the contour line of the finished product, a coacting movable supporting head, relatively spaced curvilinear blank holding members mounted upon the movable head in substantially concentric diagonally offset spaced relation agreeing with the relative disposition of the material gripping surfaces of the stationary member, and separated by an inverted channel and a curvilinear forming member disposed in parallel relation with the blank holding members and within the inverted channel therebetween, said forming member being movable with the head and capable of further movement independently thereof into forming engagement with material extending between such gripping surfaces with a wiping action on the material which is thereby projected into space intermediate the gripping surfaces.

15. In a sheet metal forming apparatus, a die member having relatively spaced concentric curvilinear material gripping portions disposed in inclined relation to each other, a movable head, separate curvilinear material gripping members coacting with said gripping portions, and carried in substantially concentric spaced relation upon the head, and separated by an inverted channel shaped recess and a relatively movable non-expanding curvilinear forming member

located within the inverted channel shaped recess in substantially parallel relation intermediate the material gripping members and movable relative thereto into forming engagement with a sheet metal blank with a wiping action thereon intermediate the spaced material gripping portions which is supported thereby.

16. In a forming apparatus for a radiator shell, a die member having continuous flaring side and end walls, a movable head having gripping engagement with the top and bottom margins of the flaring side and end walls for holding therein a flaring sheet metal blank said head having therein an inverted channel shaped recess between the engaging portions of said head and a movable continuous curvilinear forming member engaging the blank in a direction substantially perpendicular to the general plane of the gripped margins of the blank, and exerting outwardly directed forming pressure simultaneously upon the opposite side and intermediate end walls of the blank held within the die.

17. In a sheet metal forming apparatus for simultaneously shaping the opposite sides and interconnecting end portion of an open frame like member, a supporting member having flaring side and end portions within which a blank of curvilinear flaring formation may be nested, bearing surfaces at the top and bottom margins of the flaring side and end portions of the support, a movable head, relatively spaced complementary bearing surfaces upon the movable head mating with those of the support to marginally grip the opposite edges of the curvilinear flaring blank, and a relatively movable contoured forming member supported upon the head intermediate said bearing surfaces for movement in unison therewith and capable of further movement independently thereof within the flaring walls of the support and wipingly engaging the gripped flaring blank in a direction substantially perpendicular to the general plane of the edges of the flaring blank and thereby stretching the blank transversely over the contoured form.

18. In a sheet metal forming apparatus, a die member having endless flaring side and end walls, blank gripping surfaces formed at the top and bottom margins of the side walls, coating blank holding means having gripping surfaces mating with those of the die for gripping the opposite margins of an endless flaring blank roughly conforming to the shape of the die, and a non-expanding forming member movable in a direction substantially perpendicular to the general plane of the margin of the flaring blank into operative engagement therewith, said forming member being shaped to afford camming pressure intermediate the gripped margins of the blank for stretching the blank simul-

taneously in different directions by its movement in a single direction.

19. In a sheet metal forming apparatus for producing an open frame like sheet metal body having transversely contoured side walls and interconnecting end portions, a die member having endless flaring side and end portions merging one into the other, gripping surfaces disposed in spaced relation upon the flaring walls of the die, the die walls being recessed intermediate said gripping surfaces to afford clearance space extending beyond the ultimate line of the finished product, a blank holder, endless gripping surfaces thereon mating with those of the die member, and an endless contoured forming member intermediate the gripping surfaces and movable relative to the die member to operatively engage a flaring curvilinear blank nested therein in a direction angularly disposed to the general plane of the die member for simultaneously forming the opposite sides and the interconnecting ends of the flaring curvilinear blank by projecting the same into the clearance space intermediate the gripped margins.

20. In a sheet metal forming apparatus, a die having flaring side and end walls, gripping surfaces disposed upon the flaring side walls in spaced relation with each other, co-acting blank holder means having relatively spaced gripping surfaces mating with said first mentioned gripping surfaces, and a relatively movable non-expanding forming member yieldingly supported upon the blank holder intermediate the gripping surfaces thereof for engaging a flaring curvilinear blank nested within the die intermediate the gripping surfaces and movable relative thereto with a camming action in a direction angularly disposed to the general plane of the flaring curvilinear blank.

21. A machine for forming sheet metal comprising in combination a pair of sheet metal clamping members disposed in fixed relation with respect to each other and in different planes, a clamping mechanism including a pair of clamping members co-operating with said first clamping members, a bridge for interconnecting said second clamping members, said bridge and second clamping members forming a channel one side of which is of greater depth than the other, and a forming mechanism including a forming die interposed in said channel, one of said mechanism being movably mounted so that said mechanisms have a relative movement during the operation of said machine.

22. In an apparatus for forming sheet metal from a blank, two pairs of endless work holders for engaging the blank to be formed, each pair of said work holders including a fixed member and a movable member, one of said pairs being offset out of the plane of the other pair, a bridging member

interconnecting said movable members, a movably mounted endless forming member, said forming member being disposed intermediate, said movable work holders and operating independently of said movable work holders during the forming of the sheet metal.

23. In an apparatus for forming sheet metal from a blank, two pairs of blank holders one of said pairs being offset out of the plane of the other pair, each pair of said blank holders including a fixed clamping member and a movable clamping member, a bridge connecting the movable clamping members, said bridge and said movable clamping members forming a channel, one side of which extends beyond the other side, a forming member, movably mounted in said channel, said forming member moving independently of said movable clamping members during the forming operation.

24. In an apparatus for forming sheet metal from a blank, a pair of fixed clamping members, a pair of movable clamping members co-operating with the fixed clamping members for holding the blank, the coacting members of the respective pairs of clamping members being offset out of the plane of the other such members a bridge interconnecting one pair of clamping members, said bridge and said interconnected clamping members forming a channel, a movable forming member interposed in said channel, said forming member and said interconnected clamping members having a relative movement during the forming operation.

In witness whereof I have hereunto signed  
my name to this specification.

GEORGE E. IRELAND.