PATENT SPECIFICATION

Inventor: DEMETRIUS COMINO

763,045

Date of filing Complete Specification: April 30, 1953

Application Date: May 9, 1952.

No. 11844/52.

Complete Specification Published: Dec. 5, 1956.

Index at acceptance:—**Class 20(2), F3A.**

COMPLETE SPECIFICATION

Improvements relating to Constructional Elements, particularly such consisting of Slotted Metal Bars of Angle Section

We, DEXION LIMITED, of Craven House, 34, Fouberts Place, Regent Street, London, W.1, a Company incorporated under the laws of Great Britain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns improvements relating to constructional elements of the kind consisting of bars of angular section, preferably an L-section, having lines of holes in their flanges for the insertion of bolts. The invention is particularly, but not exclusively, concerned with improvements upon or modifications of constructional elements such as are described in the Specification of Patent No. 620,696 or of a nature suitable for use in conjunction therewith.

According to the present invention, a constructional element of the kind set forth has at least three longitudinally extending lines (that is lines extending longitudinally of the element) of holes, the holes in one flange at least being arranged so that the said flange can be connected to the corresponding flange of a second such element, crossing the first at right angles, by four bolts located at the corners of a square, at least one such line of holes comprising longitudinally extending recurring groups consisting of two or three holes, one hole at least in each group being elongated longitudinally and the length of each group being not less than the side of the square. Preferably a group of holes comprises a round hole equidistant between two short elongated holes. Groups of holes may be provided in any line of holes in an element. As hereinafter described, they may be used in one or two lines, preferably the outer of two lines, of holes in one flange of an element, the holes in the other flange being longitudinally extending holes of length substantially equal to the length of the groups. In other cases, lines of holes in both flanges may comprise groups of holes. Longitudinally extending holes or groups of holes in two parallel lines in a flange may be arranged in staggered overlapping relationship or may be arranged transversely side by side.

Several embodiments of the invention by way of example will now be described with reference to the accompanying drawings, in which:—

Fig. 1 is a developed plan view of one element.

Fig. 2 a view of one example of a connection made between two such elements,

Fig. 3 a developed plan view of a second element,

Fig. 4 a view of another connection,

Fig. 5 a developed plan view of a third element, and

Fig. 6 a view of a further connection.

In the constructional element of rectangular L-section illustrated in development in Fig. 1, the wider flange 1 is approximately twice as wide as the narrower flange 2. Suitably the flanges may have an approximate or nominal width of 3" and 1½" respectively, but in practice the dimensions may slightly exceed these figures by an amount depending upon the thickness of the metal. For a steel element of the aforesaid dimensions, metal of about No. 12 gauge would be appropriate. The wider flange 1 has two parallel longitudinal lines of longitudinally extending or longitudinally elongated holes 3, 4 arranged in evenly staggered overlapping relationship. The lines of holes 3, 4 are disposed at substantially one quarter of the flange width from the respective edges thereof. As illustrated, however, the distance of the holes 4 from the inner edge is advantageously made somewhat more than the quarter width to allow for the thickness of other elements in certain kinds of connections. The distance of the

holes 3 from the outer edge may, on the other hand, be made slightly less than one quarter of the flange width. The transverse interval i between the lines of holes 3, 4 is made equal to half the nominal flange width, i.e. $1\frac{1}{2}$" in the above instance. The pitch of the holes 3, 4 in their respective lines is twice that interval, namely $2i$ or 3" in the said instance. The overall length of each hole must be at least the said interval i plus the width of the hole, so as to allow two such flanges disposed at right angles to be connected together by a square pattern of four bolts. In practice and as illustrated, however, the holes 3, 4 will be made rather longer than this, so as to allow ample clearance and to facilitate connections between elements at angles other than a right angle. Thus, in the instance considered and using 5/16" bolts, the holes 3, 4 may suitably be 11/32" wide and have an overall length l of 2 1/16", the distance d between the ends of adjacent holes being thus 15/16".

The narrower flange 2 has one line of longitudinally extending or longitudinally elongated groups 5 of holes disposed at substantially the middle of the flange, the actual distances from the outer and inner edges being advantageously the same as the distances of the lines of holes 3 and 4 from respective flange edges. Each group of holes has the same overall length l as the holes 3, 4 and the groups are transversely aligned with the holes 4 or, preferably, the holes 3. Each group 5 consists of a round hole 6 equidistant between two short elongated holes 7. The width of the holes 7 is equal to that of the holes 3, 4 and their length is preferably made equal to the overlap between the holes 3 and 4, that is 9/16" in the instance specified above, or a little longer than the said overlap. The round holes 6 may be designed to afford a slight clearance around the bolts used and may have a diameter equal to or slightly greater than the width of the holes 3, 4, 7, e.g. a diameter of 3/8".

As described and claimed in the Specification of our co-pending Application No. 12,004/53 (Serial No. 763056), the wider flange 1 may also be provided with a further series of holes equidistant between the lines of holes 3, 4 i.e. at a distance of $i/2$ from each such line. These holes are round holes or holes having slight elongation either longitudinally or transversely of the flange. Preferably and as illustrated, alternate round holes 8 and transversely elongated holes 8' are provided at a pitch i and opposite to the mid-lengths of the holes 3 and 4 respectively. The holes 8 may be of the same size as the holes 6 and the holes 8' may suitably be elongated, inwardly of the flange to a length of 7/16". Preferably and as illustrated, transversely elongated holes 8" similar to the holes 8' are also provided at the mid-points between the groups 5 in the flange 2. A particular arrangement of such holes 8" forms the subject of our pending Application No. 12,516/54 (Serial No. 763111).

The element illustrated in Fig. 1 is stronger than a similar element having one long hole in place of each of the groups 5 in the narrower flange 2 because the narrow strip of metal outside each group is braced at intermediate points and is therefore less liable to buckle under local stress or impact, thus rendering the whole element less liable to fail. In spite of the discontinuity of the group 5, the element is still extremely adaptable in its modes of use and in the variety of connections that can be made. Indeed, for some purposes, simpler connections or effective connections by fewer bolts are made possible. By the round holes 6, 8, positively located connections can be made between like or unlike flanges at the pitch of the respective holes. The elongated holes 3, 4, 7, 8' and 8" afford facility in making connections between elements at other intervals and at all angles. The elongated holes preserve a necessary latitude for connections between elements at right angles or between parallel elements, for example for cases in which thickness of metal or slight inaccuracies in location of holes might prevent the lining up of round holes. This applies particularly to the transversely elongated holes 8' and 8" which are especially useful for splicing elements together in such difficult cases.

Fig. 2 illustrates one example of a connection, between two elements at right angles, by means of the flanges 1. As will be seen, five bolts 20 can be used in the connection, if required. The central bolt through the round holes 8 affords a positively located connection.

The element illustrated in development in Fig. 3 has a wider flange 1 identical with the wider flange 1 of the element just described. As described in the Specification of our co-pending Application No. 12,005/53 Serial No. 763057) however, the narrower flange 9 has a nominal width equal to three quarters the width of the flange 1. The narrower flange 9 has one line of longitudinally elongated groups 10 of holes and one line of longitudinally elongated holes 11, the transverse distance between the lines being $i/2$, namely half that between the lines of holes 3, 4. The lines of groups 10 and holes 11 are substantially equally spaced from the adjacent edges of the flange 9. Each group 10 consists of a round hole between two elongated holes and may advantageously be identical with the group 5 in the element shown in Fig. 1, while the holes 11 are similar to the holes 3, 4. Trans-

versely elongated holes 8″ are advantageously also provided. The groups 10 and holes 11 might be arranged in staggered overlapping relationship, but they are advantageously both arranged in transverse alignment with the holes 4 or, preferably and as shown, with the holes 3.

The element illustrated in Fig. 3 has advantages over the element illustrated in Fig. 1 in respect of the variety and rigidity of connections which can be made between a flange 9 of one element and a flange, with a pattern of holes like that of the flange 1 or that of the flange 9, of a similar or dissimilar element or with a pattern of holes like that of the flange 2 (Fig. 1). Rigid connections between elements at right angles involving two flanges 9 or a flange 9 and a flange 1 can be established by two, three or four bolts in a variety of relative positions. In these connections, the bolts are located at two or more corners of squares of side $^1/_2$, in contrast to similar connections between flanges 1 in which the bolts are located at corners of squares of side i. In both cases, however, the square or part-square, generally triangular, patterns of bolts permit of very strong multi-bolt connections, where required. The round holes 6 and 8 again permit of positively located connections. Connections at angles other than a right angle are facilitated by the additional line of holes 11. The use of groups 10 of holes in the outer line is advantageous as regards strength for the reason explained with reference to the groups 5.

Fig. 4 illustrates one example of a rigid connection, between elements at right-angles, involving a flange 9 and a flange 1. Four bolts 20 can be used, if required.

The element illustrated in development in Fig. 5 has a wider flange 12 with two lines of holes. This flange is advantageously identical, as regards its width and the nature and disposition of its holes, with the narrower flange 9 of the element illustrated in Fig. 3. The narrower flange 13 has one line of elongated groups of holes and is advantageously identical with the narrower flange 2 of the element illustrated in Fig. 1. Its nominal width is thus two thirds of the width of the flange 12 or the flange 9 (Fig. 3) or half that of the flange 1 (Figs. 1 and 3). As illustrated in Fig. 5, the groups 5 and 10 and holes 11 are all transversely aligned, but a staggered arrangement of the groups 10 and holes 11, with the groups 5 transversely aligned with the groups 10, might be adopted.

The flange 12 of the element illustrated in Fig. 5 affords the same facilities for making connections as the flange 9 of the element illustrated in Fig. 3. Fig. 6 illustrates one example of a connection between flanges 12.

As will be evident, either or each of the flanges 1 connected together in the connection of Fig. 2 could be a flange 1 of an element such as is shown in Fig. 1 or of an element such as is shown in Fig. 3. The flange 1 bolted to the flange 9 in Fig. 4 could similarly be a flange 1 of either of the said elements. The said flange 9 in Fig. 4 could similarly be the flange 12 of an element such as is shown in Fig. 5. Finally, either or each of the flanges 12 connected together in Fig. 6 could be a flange 9 of an element such as is shown in Fig. 3. In Figs. 2, 4 and 6, the flanges of elements which may alternatively be so embodied in the respective connections are indicated in brackets.

As has been shown, the three varieties of element illustrated in Figs. 1, 3 and 5 can be used very effectively in conjunction with each other and may therefore be applied as a set of elements of which that illustrated in Fig. 1 may be regarded as the standard element and those in Figs. 3 and 5 as elements to be used, in particular, where greater or less size and/or strength is needed. The larger and smaller elements may be of heavier and lighter gauges, for example about No. 10 and No. 14 gauge respectively. All of the elements described can also be used in conjunction with elements such as are described in the Specification of our co-pending Application No. 25,316/55 (Serial No. 763140) and with elements such as are described in Specification No. 620,696.

Punch marks 14 are preferably provided to facilitate cutting the elements at the preferred points.

Various modifications can be made in the above-described elements. Thus in a flange similar to 9 or 12, containing two lines of holes, both lines may comprise groups such as 10. A group in any flange may alternatively consist of a short elongated hole, similar to the hole 7, equidistant between two round holes, similar to the holes 6, the distance between the centres of the round holes being equal to the interval i. Or a group may consist of two or three short elongated holes or of one round hole and one elongated hole. Instead of strictly round holes, holes very slightly elongated longitudinally of the element may be used in any group. The elongated holes 3, 4 and/or 11, particularly the outer holes 3, may be replaced by elongated groups of holes such as the groups 5 or 10 or one of the alternatives just described. Round holes may be provided instead of the holes 8′, 8″ or at other intermediate points.

For some purposes, an element may be useful which has two flanges each similar to the flange 12 (Fig. 5) and each furnished with patterns of holes similar to those in

the said flange 12 or with combinations of other holes or groups of holes such as have been described.

Combinations of patterns of holes such as have been described above can be applied also to elements of channel section, the web of the section being treated as one flange.

Constructional elements in accordance with the invention can be usefully employed, alone or in conjunction with further bracing elements, for producing lattice girders or other braced structures of, for example, Warren or double-Warren form, roof trusses or the like. In structures where maximum strength is important, elements can be arranged so that the stronger flange is located where its strength is most advantageous, for example on the tension side of a beam. In complex members built-up from such elements, for example an I-beam, the stronger flanges can be utilised for the chords, the other flanges being bolted together to form a web of greater or less depth depending upon the holes used for the connections.

What we claim is:—

1. A constructional element consisting of a metal bar of angular section having at least three longitudinally extending lines of holes, the holes in one flange at least being arranged so that the said flange can be connected to the corresponding flange of a second such element, crossing the first at right angles, by four bolts located at the corners of a square, at least one such line of holes comprising longitudinally extending recurring groups consisting of two or three holes, one hole at least in each group being elongated longitudinally and the length of each group being not less than the side of the square.

2. A constructional element as claimed in claim 1, wherein the bar is of L-section.

3. A constructional element as claimed in claim 1 or 2, wherein one flange at least has two parallel lines of longitudinally extending holes or groups of holes arranged in staggered overlapping relationship.

4. A constructional element as claimed in any one of claims 1 - 3, wherein a group of holes comprises a round hole equidistant between two short elongated holes.

5. A constructional element as claimed in any one of claims 1 - 4 and having two lines of holes in one flange, wherein the outer line of holes comprises longitudinally extending groups of holes.

6. A constructional L-section element as claimed in any one of claims 2 - 5 and having one flange approximately half as wide as the other flange, the wider flange having two parallel lines of longitudinally extending holes or groups of holes arranged in staggered overlapping relationship and the narrower flange having one line of longitudinally extending holes or groups of holes, the latter holes or groups of holes being of the same length as the former and transversely aligned with those of one of the two lines, preferably the outer line, in the wider flange, at least one of the said three lines comprising groups of holes.

7. A constructional L-section element as claimed in any one of claims 2 - 5 and having one flange approximately three-quarters as wide as the other flange, the wider flange having two parallel lines of longitudinally extending holes or groups of holes arranged in staggered overlapping relationship and the narrower flange having two parallel lines of longitudinally extending holes or groups of holes, the transverse interval between the lines in the narrower flange being one half of the transverse interval between the lines in the wider flange and the holes or groups of holes in the narrower flange being transversely aligned with those in one of the two lines, preferably the outer line, in the wider flange, at least one of the said four lines comprising groups of holes.

8. A constructional L-section element as claimed in any one of claims 2 - 5 and having two parallel lines of longitudinally extending holes or groups of holes in each flange, the transverse interval between the two lines in one flange being one half of the transverse interval between the lines in the other flange, at least one of the said four lines comprising groups of holes.

9. A constructional L-section element as claimed in any one of claims 2 - 5 and having one flange approximately two-thirds as wide as the other flange, the wider flange having two parallel lines of longitudinally extending holes or groups of holes and the narrower flange one line of longitudinally extending holes or groups of holes, the holes or groups of holes in the two flanges being transversely aligned, at least one of the said three lines comprising groups of holes.

10. A constructional element as claimed in any one of claims 3 - 7, wherein a longitudinally extending series of substantially round holes and/or holes slightly elongated transversely of the flange is provided parallel to and equidistant from the two parallel lines of elongated holes or groups of holes, namely the lines in the wider flange in the elements claimed in claims 6 and 7.

11. A constructional element as claimed in claim 10, wherein a substantially round or transversely elongated hole is provided opposite the mid-length of each longitudinally extending hole or group of holes in the said two parallel lines.

12. A constructional element as claimed in any one of the preceding claims, wherein round bolt holes or holes slightly elongated transversely of the flange are provided between longitudinally extending holes or

the said flange 12 or with combinations of other holes or groups of holes such as have been described.

Combinations of patterns of holes such as have been described above can be applied also to elements of channel section, the web of the section being treated as one flange.

Constructional elements in accordance with the invention can be usefully employed, alone or in conjunction with further bracing elements, for producing lattice girders or other braced structures of, for example, Warren or double-Warren form, roof trusses or the like. In structures where maximum strength is important, elements can be arranged so that the stronger flange is located where its strength is most advantageous, for example on the tension side of a beam. In complex members built-up from such elements, for example an I-beam, the stronger flanges can be utilised for the chords, the other flanges being bolted together to form a web of greater or less depth depending upon the holes used for the connections.

What we claim is:—

1. A constructional element consisting of a metal bar of angular section having at least three longitudinally extending lines of holes, the holes in one flange at least being arranged so that the said flange can be connected to the corresponding flange of a second such element, crossing the first at right angles, by four bolts located at the corners of a square, at least one such line of holes comprising longitudinally extending recurring groups consisting of two or three holes, one hole at least in each group being elongated longitudinally and the length of each group being not less than the side of the square.

2. A constructional element as claimed in claim 1, wherein the bar is of L-section.

3. A constructional element as claimed in claim 1 or 2, wherein one flange at least has two parallel lines of longitudinally extending holes or groups of holes arranged in staggered overlapping relationship.

4. A constructional element as claimed in any one of claims 1 - 3, wherein a group of holes comprises a round hole equidistant between two short elongated holes.

5. A constructional element as claimed in any one of claims 1 - 4 and having two lines of holes in one flange, wherein the outer line of holes comprises longitudinally extending groups of holes.

6. A constructional L-section element as claimed in any one of claims 2 - 5 and having one flange approximately half as wide as the other flange, the wider flange having two parallel lines of longitudinally extending holes or groups of holes arranged in staggered overlapping relationship and the narrower flange having one line of longitudinally extending holes or groups of holes, the latter holes or groups of holes being of the same length as the former and transversely aligned with those of one of the two lines, preferably the outer line, in the wider flange, at least one of the said three lines comprising groups of holes.

7. A constructional L-section element as claimed in any one of claims 2 - 5 and having one flange approximately three-quarters as wide as the other flange, the wider flange having two parallel lines of longitudinally extending holes or groups of holes arranged in staggered overlapping relationship and the narrower flange having two parallel lines of longitudinally extending holes or groups of holes, the transverse interval between the lines in the narrower flange being one half of the transverse interval between the lines in the wider flange and the holes or groups of holes in the narrower flange being transversely aligned with those in one of the two lines, preferably the outer line, in the wider flange, at least one of the said four lines comprising groups of holes.

8. A constructional L-section element as claimed in any one of claims 2 - 5 and having two parallel lines of longitudinally extending holes or groups of holes in each flange, the transverse interval between the two lines in one flange being one half of the transverse interval between the lines in the other flange, at least one of the said four lines comprising groups of holes.

9. A constructional L-section element as claimed in any one of claims 2 - 5 and having one flange approximately two-thirds as wide as the other flange, the wider flange having two parallel lines of longitudinally extending holes or groups of holes and the narrower flange one line of longitudinally extending holes or groups of holes, the hole or groups of holes in the two flanges being transversely aligned, at least one of the said three lines comprising groups of holes.

10. A constructional element as claimed in any one of claims 3 - 7, wherein a longitudinally extending series of substantially round holes and/or holes slightly elongated transversely of the flange is provided parallel to and equidistant from the two parallel lines of elongated holes or groups of holes, namely the lines in the wider flange in the elements claimed in claims 6 and 7.

11. A constructional element as claimed in claim 10, wherein a substantially round or transversely elongated hole is provided opposite the mid-length of each longitudinally extending hole or group of holes in the said two parallel lines.

12. A constructional element as claimed in any one of the preceding claims, wherein round bolt holes or holes slightly elongated transversely of the flange are provided between longitudinally extending holes or

PATENT OFFICE S

* C L M S *

groups of holes in a line thereof.

13. A constructional element substantially as described with reference to Fig. 1. Fig. 3 or Fig. 5 of the accompanying drawings.

JENSON & SON.
77, Chancery Lane,
London, W.C.2.
Chartered Patent Agents.

PROVISIONAL SPECIFICATION

Improvements relating to Constructional Elements, particularly such consisting of Slotted Metal Bars of Angle Section

We, DEXION LIMITED, of Craven House, 34 Foubert's Place, Regent Street, London, W.1., a Company incorporated under the laws of Great Britain, do hereby declare this invention to be described in the following statement:—

This invention concerns improvements relating to construction elements, especially such consisting of slotted metal bars of angle section. The invention is particularly, but not exclusively, concerned with improvements in or modifications of constructional elements of the kind described in the Specification of Patent No. 620,696 or of a kind suitable for use in conjunction therewith.

The constructional element set forth in that Specification consists of a metal bar of angular section, preferably an L-section, with two parallel lines of equally spaced longitudinally elongated holes in one flange and one line or two parallel lines of such holes in another flange, the longitudinal interval between the holes in each line and also the length of the holes being equal to the transverse interval between the parallel lines of holes.

According to the present invention, in a constructional element consisting of a metal bar of angular section, preferably an L-section, with elongated holes, preferably two parallel lines of longitudinally elongated holes, permitting connection means such as bolts to be located in two parallel lines in at least one of the flanges, a longitudinal series of round holes intended to afford little or no bolt clearance is provided in one at least of the flanges.

Also in accordance with the invention, in a constructional element consisting of a metal bar of angular section, preferably an L-section, with elongated holes, preferably two parallel lines of longitudinally elongated holes, permitting connection means such as bolts to be located in two parallel lines in at least one of the flanges, holes are arranged, in at least one flange, in groups consisting of an elongated hole and a round hole or two elongated holes with a round hole between them or two round holes with one elongated hole between them, the major axis of the elongated hole or each such hole and the centre of the round hole or each such hole being in one line. Alternatively a group comprising two elongated holes may be employed for some purposes.

Thus, in a constructional element whose wider flange is generally similar to that of the element illustrated in Figs. 1 and 2 of the aforesaid Specification, a narrower flange may be provided with one or two lines of holes in groups whose overall length is the same as the length of the elongated holes in the wider flange.

Suitably the narrower flange may be made of about three quarters of the width of the wider flange and may be provided with two lines of holes, the distance between the lines themselves being equal to half the distance between the lines in the wider flange and the distances between the lines and respective adjacent edges of the flange being substantially equal to the similar distances in the wider flange. The groups of the inner line in the narrower flange may each comprise two round holes with an elongated hole between them, the groups as a whole being transversely aligned with the elongated holes of the outer line in the wider flange. The groups of the outer line in the narrower flange may each comprise a round hole between two elongated holes, the groups as a whole being transversely aligned with those of the other line in the narrower flange. However, the pattern of holes in the inner and outer lines may be inter-changed. If desired, additional round holes may be provided at the mid points of the intervals between groups in respective lines. The round holes are designed to afford little clearance around the fitted securing bolts to be used. The elongated holes may suitably be equal in length to the overlap between the elongated holes in the wider flange or may be rather longer.

In another construction of element having a wider flange of width equal to that of the narrower flange of the above-described element, the pattern of holes in the said wider flange may be identical with that described for the said narrower flange. The narrower flange, which is half as wide as the wider

flange of the previously described element, is provided with a single line of groups of holes identical with and transversely aligned with the inner or outer line of holes in the other flange.

With such groups of holes, the round holes are of particular value for making positively located connections. The elongated holes increase the facility with which connections can be made at angles other than right angles and also provide necessary clearances to permit latitude in connections between elements at right angles or in parallelism, for example in cases in which the thickness of the metal or slight inaccuracies in the location of the holes might prevent the lining up of round holes. The location of the round holes and the outer ends of the elongated holes so that they conform to a square pattern permits of very strong multi-bolt connections where required. The size of the square of this pattern is half that of the elements of the aforesaid Specification, but the provision of additional holes in the latter, as hereinafter described, allows elements with holes of the two patterns to be used very effectively in conjunction with each other.

Alternatively, in a constructional element which is generally similar to that illustrated in the aforesaid figures, each elongated hole of the single line of holes in the narrower flange may be replaced by a group of holes occupying the same position and having the same over-all length. The group preferably comprises two elongated holes with a round hole between them, as described above.

Such elements are stronger than the known element because the narrow strip of metal outside the long elongated hole in the narrower flange of the known element is now braced at an intermediate point or points and is therefore less liable to buckle under local stress, thus rendering the whole element less liable to fail. Nevertheless the elements remain extremely adaptable in their modes of use and, indeed, have particular advantages of their own in this respect.

By using fitted bolts in the round holes, as already indicated, accurately located connections between elements at an angle to each other can be made by bolts which are positively engaged in each element, that is are engaged in bearing in all directions and not simply by friction. As in the known element, bolts can still be arranged to be in bearing at the ends of elongated holes in either flange.

According to a further feature of the invention, in a constructional element consisting of a metal bar of angular section, preferably an L-section, with elongated holes, preferably two parallel lines of longitudinally elongated holes, permitting connection means to be located in two parallel lines in at least one of the flanges, a longitudinal series of round holes intended to afford little or no clearance is provided along an intermediate line, preferably between the two said lines of elongated holes. Thus, in an element which is generally of the kind illustrated in Figs. 1 and 2 of the aforesaid Specification and in the modified forms of element just described, such round holes may advantageously be provided midway between the two lines of elongated holes in the wider flange and transversely opposite the middle points of the elongated holes nearer the outer edge of this flange.

The provisions of these round holes in no way interferes with the adaptability of the element and does not materially affect its strength. On the other hand, it permits once again of accurately located connections by bolts which are engaged positively or in bearing.

The provision of these holes is particularly useful in conjunction with elements having round holes in the narrower flange as already described. The round holes in the two flanges can then be used in conjunction with round holes in respectively similar or dissimilar flanges or with the elongated holes therein as well as with the holes in other forms of elements described.

If it is desired to reduce the interval at which connections by round holes can be made, additional such holes may be provided. As already mentioned, round holes may be provided at the middle of the interval between groups of holes in narrow flanges. Also additional round holes may be provided in the wider flange midway between the round holes provided therein as already stated.

With or without these additional holes, the invention will enable certain kinds of structures to be made simpler and with fewer bolts at the connections. Triangulated braced structures using the useful rectangular combinations of lengths 3, 4, 5 and 5, 12, 13 can be more readily produced. Furthermore, combinations of round holes at, say, the intervals 3, 4 can readily be found for the application of a member with holes at the interval 5 for initially squaring up a structure.

In special cases, if additional strength is required in bolt connections, round holes may be enlarged slightly with a drill or reamer to take larger fitted bolts.

For some purposes, an element may be useful which has two flanges each furnished with patterns of elongated holes similar to those in the wider flange of the unequally flanged element first described above, the said equal flanges being of the same width as the said wider flange. However, various combinations of the lines of holes described

above may be adopted.

These last-described elements may be used in a variety of ways. Flanges with two lines of elongated holes and an intermediate line of round holes can be bolted together very rigidly crosswise or in alignment, by means of four or five bolts. At intermediate angles, such flanges can be bolted together in a wide variety of ways with a minimum of two bolts. By using the round holes, a connection with one bolt in positive or bearing engagement can be achieved at any angle.

In structures where maximum strength is important, elements can be arranged so that the stronger flange is located where its strength is most useful, for example on the tension side of a beam. This feature will also be particularly useful in complex members built up from such elements. In an I or [beam for example, the stronger flanges can be utilised for the chords, the other flanges being bolted together to form a web of greater or less depth depending upon the holes employed for the connections.

Patterns of holes such as have been described may also be applied to elements of channel section.

Constructional elements such as have been described above can be usefully employed, alone or in conjunction with further bracing elements, for producing lattice girders or other braced structures of, for example, Warren or double Warren form or roof trusses or the like.

JENSON & SON,
77, Chancery Lane,
London, W.C.2.
Chartered Patent Agents.

Sheerness : Printed for Her Majesty's Stationery Office, by Smiths, Printers and Duplicators.—1956
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.