Sept. 30, 1969 L. NAGIN 3,469,359

FRICTION LOCKED GRATING AND OTHER OPEN GRID STRUCTURES

Filed July 13, 1965 2 Sheets-Sheet 1

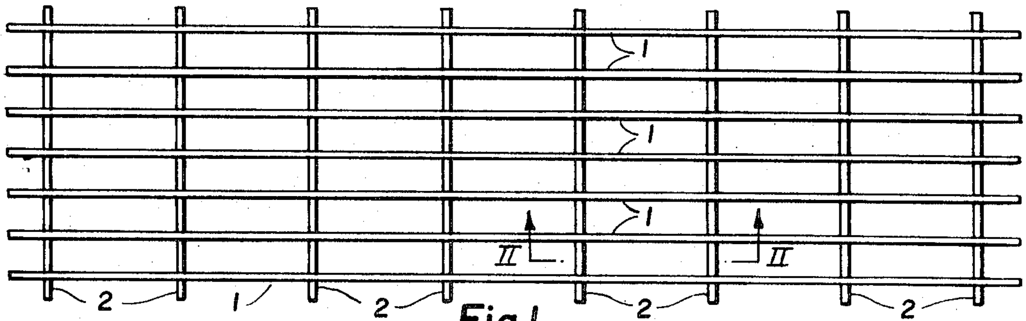

Fig.1.

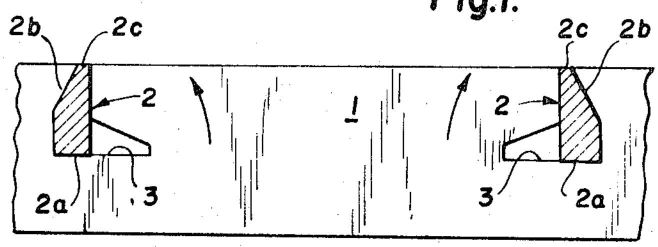

Fig.2.

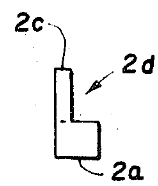

Fig.6.

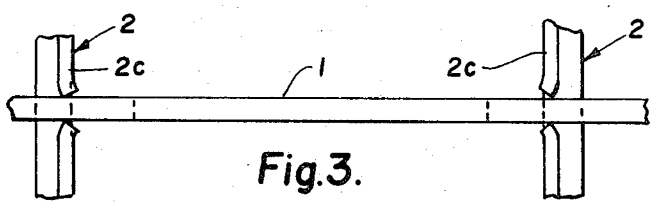

Fig.3.

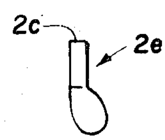

Fig.7.

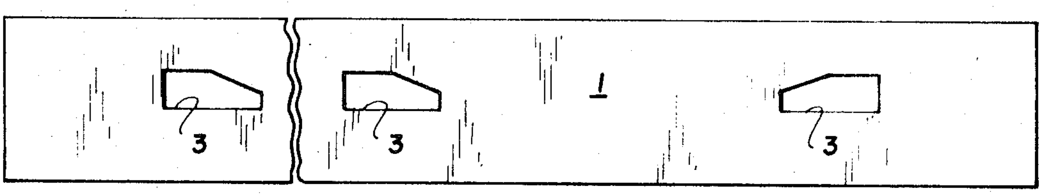

Fig.4.

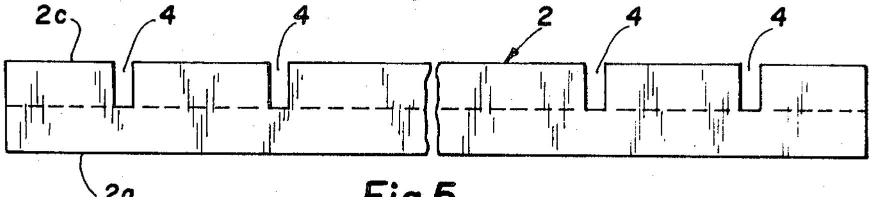

Fig.5.

INVENTOR.
LEON NAGIN
BY
Christy, Parmelee & Strickland
his ATTORNEYS

Sept. 30, 1969 L. NAGIN 3,469,359

FRICTION LOCKED GRATING AND OTHER OPEN GRID STRUCTURES

Filed July 13, 1965 2 Sheets-Sheet 2

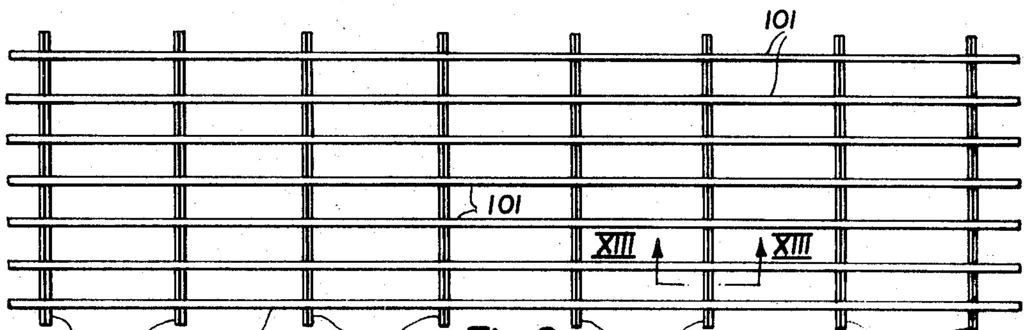

Fig.8.

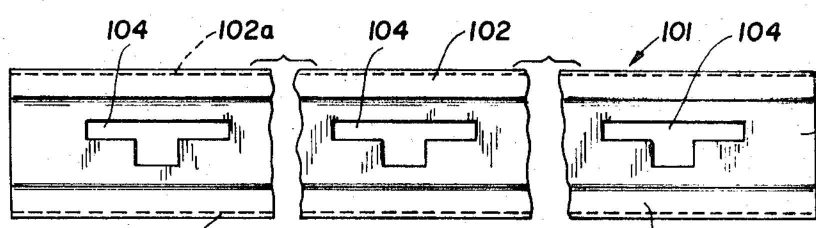

Fig.9.

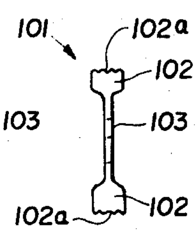

Fig.10.

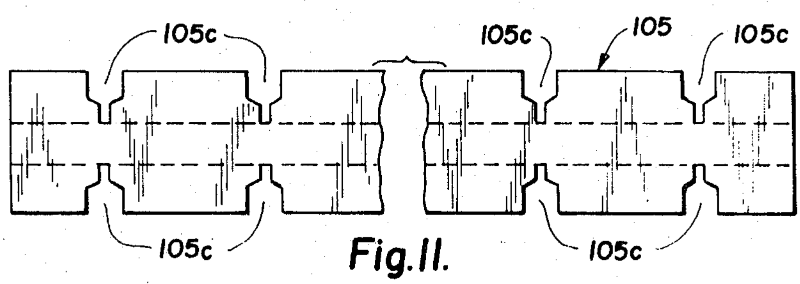

Fig.11.

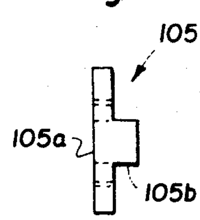

Fig.12.

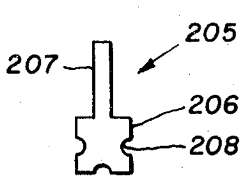

Fig. 15.

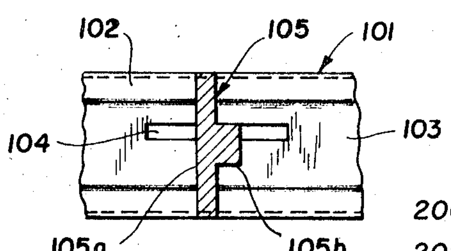

Fig.13.

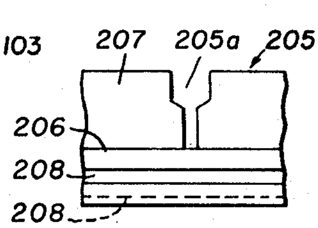

Fig. 16.

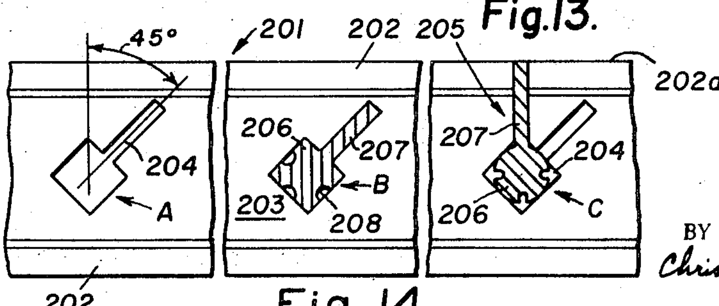

Fig. 14.

INVENTOR.
LEON NAGIN

BY
Christy, Parmelee & Strickland

his ATTORNEYS

3,469,359

FRICTION LOCKED GRATING AND OTHER OPEN GRID STRUCTURES

Leon Nagin, Churchill Borough, Pa., assignor to Reliance Steel Products Company, McKeesport, Pa., a corporation of Pennsylvania

Filed July 13, 1965, Ser. No. 471,588
Int. Cl. E04c *2/42;* E04f *11/16*
U.S. Cl. 52—177 5 Claims

ABSTRACT OF THE DISCLOSURE

The invention is concerned with an open grid or grating whose bearing bars are slotted to slidably receive angularly disposed cross bars embodying an enlarged portion, which cross bars are subsequently rotated to final position and during rotation the said enlarged portions are deformed, locking the cross and bearing bars in assembled relation.

The present invention relates in general to open grid load bearing structures and to lattice type structures as used both for decorative architectural and other purposes wherein rigidity and self-supporting strength are desirable. Such structures may be of ferrous and non-ferrous metals. Non-ferrous metal structures of the type herein described are generally lighter in weight than those of equal strength made of ferrous metals.

Many attempts have previously been made to produce a friction locked grating which will remain in tight assembly under traffic conditions. Much difficulty hase been encountered in attaining this result since the cross bars, under alternate application of load and release therefrom tend to cut into their supporting surfaces on the bearing bars and in moving relative thereto impair the initial friction lock.

Previous attempts to overcome this condition as by welding the bearing and cross bars together have not always been successful, particularly in light-weight grating. The welding of aluminum requires special equipment and is thus more expensive to fabricate and assemble, than are welded ferrous metal grating.

One object of the present invention is to provide novel forms of friction locked open grid load bearing structures and lattice type structures for other purposes which are light in weight and which remain in tight assembly under all conditions of their intended use.

Another object of the invention is to provide an aluminum open grid grating of the type described, wherein each cross bar is locked in frictional engagement to the bearing bars at a plurality of points along the length of each cross bar.

A further object of the invention is to provide a friction locked reversible load bearing grating, embodying the principles of the invention.

These and other objects of the invention will be made apparent from the following specification and the drawing forming a part thereof wherein:

FIG. 1 shows a plan view of a section of grating embodying one form of the invention;

FIG. 2 shows a cross-section taken on lines 2—2 of FIG. 1, illustrating the friction locked relation between the cross bar and the bearing bar in final assembly;

FIG. 3 shows an enlarged plan view of a portion of the grating of FIG. 1 illustrating a second friction lock between the bearing and cross bars adjacent the top of the bearing bar;

FIG. 4 shows a side elevation of a portion of a bearing bar illustrating the slotted openings therein to receive the cross bars;

FIG. 5 shows a side elevation of a portion of a cross bar, illustrating the manner of notching the cross bar for rotation thereof into final assembled position;

FIGS. 6 and 7 show end elevations of alternate forms of a cross bar;

FIG. 8 shows in plan view a section of reversible grating embodying an alternate form of my invention;

FIG. 9 shows in side elevation a portion of one form of bearing bar as employed in a reversible grating of the invention and having the web thereof slotted to initially receive the cross-bars;

FIG. 10 shows an end elevation of the bearing bar of FIG. 9;

FIG. 11 shows in side elevation a portion of one form of cross bar to be employed in a reversible grating embodying the invention;

FIG. 12 shows an end elevation of the cross bar of FIG. 11;

FIG. 13 shows a partial side elevation of the bearing bars of FIG. 9, illustrating the manner in which the cross bar is rotated to final position;

FIG. 14 shows a partial side elevation of a bearing bar as in FIG. 9 with an alternate form of slots in the web thereof to receive the cross bar of FIG. 15 and illustrates consecutively a bearing bar slot, the cross bar as initially received in the bearing bar slot and the cross bar rotated to final position;

FIG. 15 shows an end elevation of the cross bar of FIG. 14; and

FIG. 16 shows a partial elevation of the cross bar of FIG. 15 with slots in the cross bar to receive the bearing bar head portion when the cross bar is rotated to upright position.

Referring now in detail to FIGS. 1 to 5 of the drawings, the grating comprises a plurality of longitudinally disposed and transversely spaced bearing bars **1** or load carrying members, connected by cross bars **2**. As shown in FIGS. 2 and 3, the bearing bars **1** are preferably of rectangular cross section. Spaced longitudinally of bars **1** and intermediate the vertical marginal edges thereof, as shown in FIG. 3, are a plurality of openings **3** corresponding in shape to the shape of the cross bars **2**. The openings **3** of the bearing bars are slightly larger than the cross bars to be received therein. Preferably the cross bars **2** are freely received in openings **3** with a minimum clearance. These openings **3** extend in spaced relation longitudinally of the bearing bar **1**, preferably alternately disposed, so that the cross bars are initially disposed horizontally for insertion through openings **3** of successive bearing bars and thereafter are rotated 90° as hereinafter discussed.

The cross bars **2** are preferably of a modified rectangular shape having a base portion **2*a*** of greatest width and one side wall **2*b*** sloping inwardly from above the base portion, as shown in FIG. 2. The top and bottom longitudinal edges and one side wall of cross bar **2** are preferably at right angles to each other. The height of the cross bar **2**, when in erected position after rotation, brings its edge **2*c*** preferably into the plane of the top edges of bearing bars **1**. As best shown in FIG. 5, the cross bar **2** has rectangular slots **4** therein, of the same or slightly less width than that of the thickness of the bearing bars. Such slots **4** extend inwardly from the top edge **2*c*** thereof to said rectangular base portion and are spaced longitudinally of the cross bar for a purpose to be herein discussed.

As best shown in FIGS. 2 and 3, the grating is assembled by threading the cross bars **2** horizontally through the aligned bearing bar slots **3**. Each cross bar is thus alternately disposed relative to the next succeeding cross bar inwardly of the bearing bar, whereby each cross bar, in rotating to erect position, is rotated in an opposite direction relative to each preceding and succeeding cross bar. By reason of the slots **4** of the cross bars being of equal or less width than the thickness of the unslotted bearing bar portions, the unslotted cross bar portions between adjacent girder bars are deflected slightly during rotation and frictionally engage the adjacent girder bar portions.

During this same substantially 90° rotation of the cross bars relative to the bearing bars, the substantially square thicker base portion of the cross bar rotates within the slightly enlarged correspondingly shaped bearing bar slotted portions. Since such slotted bearing bar portions are only slightly larger than the cross bar base portion, the latter is deformed during this rotation and provides a strong frictional interlocking of the contacting surfaces. To facilitate deformation of one of the contacting surfaces, the cross bars may, but not necessarily, be formed of a softer metal than that forming the bearing bars.

Due to the foregoing rotation of the cross bars **2** relative to the bearing bars **1**, the slotted portions **4** of the cross bars are in deflected frictional locking engagement with the adjacent unslotted portions of the bearing bars **1**. As a result, portions of each cross bar **2** are locked into frictional engagement with the adjacent slotted and nonslotted areas of the bearing bars **1**. Additionally the broad base **2***a* of the cross bars is in bearing engagement with the slotted portion of the bearer bars resisting penetration of the loaded cross bars into the underlying bearing bar portions.

It will be understood that alternate forms of suitable bearing and cross bars may be employed. It is desirable to have the cross bar base portion of greater cross-sectional area than that of the bearing bar, as hereinbefore stated. Cross sections of two alternate forms of cross bar are shown in FIGS. 6 and 7 of the drawing. It will be understood that in all cases the bearing bar slots will conform, in shape, to the cross bar to be freely received therein.

Referring now to FIGS. 8 to 13 of the drawing, wherein is shown a modification of the invention, the grating hereinafter disclosed is referred to as a reversible grating. That is, either planar face of the grating may be the load receiving surface and the grating may be inverted when desired.

As shown in FIG. 9, the bearing bars **101** are symmetrical about their longitudinal centerline or neutral axis. Such bars **101** may be of any desired contour and may be an extruded or rolled member.

Bearer bars **101**, as shown, preferably comprise an aluminum extrusion having thickened top and bottom portions **102** connected by an intermediate web portion **103**, of lesser thickness. Such bars, of course, may if desired be of uniform thickness throughout the vertical height thereof. The outer faces **102***a* of the bars **101** may have suitable corrugations therein, as indicated, to provide a non-skid surface. Spaced longitudinally of bearing bars **101** are suitable apertures or slots **104** to receive cross bars **105**. Such slots **104** are slightly larger than the cross bars to be received therein so as to facilitate threading the cross bars **105** therethrough. The cross bars, as shown in FIG. 12, have a thickened intermediate portion and, as indicated by the longitudinal neutral axis x of the bar, this enlarged portion of slot **104** is preferably equally spaced about said neutral axis.

Cross bars **105**, as shown in FIGS. 11 and 12, are of a modified T-shape, having an elongated top portion **105***a* and a substantially rectangular mid-portion **105***b* of greater thickness than said top portion **105***a*. The portion **105***a*, at opposite ends of mid-portion **105***b*, is provided with inwardly extending suitably shaped slots **105***c* therein conforming to the shape of the bearing bar portions to be received therein, as hereinafter discussed. The respective widths of slot portions **105***c* in the cross bars are preferably that of the corresponding portions of the bearing bar **101** to be engaged thereby.

Referring now to FIGS. 9 and 13, after the bearing bars **101** and cross bars **105** have been slotted, as above described, the cross bars **105** initially disposed in a horizontal position are freely threaded through the corresponding bearing bar slots **104** of FIG. 9. Thereafter each of the cross bars **105** are rotated through an angle of substantially 90° into the position as best shown in FIG. 13. By reason of the cross bar **105** initially conforming to the shape of the slots **104** in the bearing bar and being only slightly smaller than the adjacent bearing bar slot portions, the cross bar portions **105***b* must deform during rotation from horizontal to vertical position. To facilitate such deformation, the rolled or extruded aluminum cross bars **105** may, but not necessarily, be made of a softer alloy than that from which the bearing bars are made. During such deformation of cross bar portions **105***b*, a strong friction locking effect is established at this portion of the intersection of the bearing and cross bars.

The slotted upper and lower portions **105***c* of the cross bars **105**, being substantially of the same dimensions as that of the bearing bar portions to be engaged thereby, may also deflect or distort during the aforesaid rotation. This deflection or distortion would provide a strong frictional locking engagement at the respective areas of contact as the cross bars move into vertical position. As a result thereof each of the cross bars, at each area of engagement with the several bearing bars, effects a strong frictional locking engagement for substantially the full vertical height of the cross bar. If desired, the cross bars, being symmetrical about the mid-portion **105***c* thereof, may be alternately rotated clockwise or counter-clockwise upwardly from horizontal to vertical position, about such mid-portion **105***b* as previously described in connection with FIG. 2 of the drawing.

A further modification of the invention is shown in FIGS. 14, 15 and 16 of the drawings. Here the longitudinally extending bearing bars **201** comprise enlarged head portions **202** at opposite longitudinal edges of a web portion **203**. Each head portion **202** may have a grooved face **202***a* similar to that shown at **102***a* of FIG. 10. Such shaped members are sometimes referred to as I-bars.

The cross bars **205**, as shown in FIG. 15, are comprised of a substantially square or rectangular base portion **206** and an upstanding thinner portion **207**. Portions **207**, above the base portion **206**, as shown in FIG. 16, has suitable slots **205***a* therein to receive the web **203** and one head portion **202** of the bearing bar **201**. The base portion **206** of the cross bar at one or more sides thereof may be provided with indentations, such as **208** extending the length thereof. These latter indentations facilitate deformation of portion **206** during movement from initial to final position as illustrated in FIG. 14.

As shown in FIG. 14, the web **203** of the bearing bar **201** is slotted at **204** to freely receive the cross bars **205**. Slots **204**, instead of being horizontally disposed as at **104** in FIG. 9, are disposed substantially at 45° to the horizontal centerline of each bearing bar **201**. Slots **204** are preferably of such size as to permit freely threading the cross bar therethrough, but with a minimum of clearance. For purposes of illustration, FIG. 14, at A shows the slotted opening **204** only, at B is shown slot **204** with a bearing bar **205** mounted therein, and at C is shown slot **204** with the bearing bar **205** rotated to vertical position. As will be noted upon comparison of B and C, the indentations **208** facilitate deformation of the cross bar base portion **206** in moving from position B to final assembled position C.

Having disclosed and described several species of the invention, it will be apparent that the longitudinal or bearing bars may be of a plurality of different shapes, as may also the connecting cross bars. Additionally, the herein described methods of assembly may be employed to provide other forms of assemblies in addition to gratings, such as lattice type structures.

The friction lock between the enlarged portions of the cross bars and the webs of the longitudinal bars is obtainable from a variety of shapes, provided only that one or the other or both are partially distorted during movement relative to each other. Thus the cross bars may be friction locked only at their intersection with the longitudinal bars, or as shown in FIG. 13, a cross bar may have two frictional locking engagements with each longitudinal bar.

When non-ferrous metals are employed in the longitudinal and cross bars, I have found that many suitable alloys may be employed, depending upon the end use of the completed structures. In the case of aluminum, many of the alloys may be employed in both longitudinal and cross bars. If desired, and the conditions of use permit, a softer alloy may be employed in one of the intersecting bars to facilitate assembly.

I claim:

1. In a grating, the combination of,

(a) a plurality of longitudinally disposed transversely spaced rectangularly shaped bearing bars, each having a depth greater than the thickness thereof and each bar provided with a plurality of longitudinally extending spaced slotted openings therethrough for reception of cross bars extending between a plurality of said bearing bars,

(b) each said beairng bar slotted openings being of sufficient dimensions to freely receive the cross bar disposed therethrough and conforming to the contour of said cross bar being initially disposed therein,

(c) a plurality of transversely disposed cross bars spaced longitudinally of said bearing bars within said slotted openings thereof and each comprising a longitudinal disposed angularly shaped intermediate portion of maximum thickness with portions of lesser thickness extending laterally from opposite margins thereof, and

(d) slotted openings in said laterally extending cross bar portions at each side of said cross bar intermediate portion for embracing the upper and lower marginal portions of the bearing bars during rotation of the cross bar mid-portions into frictional locking engagement with said bearing bar slotted openings.

2. The grating as defined in claim **1**, wherein said cross bar angularly shaped intermediate portions, when initially mounted in said bearing bar slots, extends above and below the neutral axis of said bearing bars.

3. The grating as defined in claim **1**, wherein said bearing bar has its longitudinal marginal portions of greater thickness than the slotted connecting web portion receiving said cross bars.

4. The grating as defined in claim **3** wherein the exposed faces of said bearing bar longitudinal marginal portions are serrated to provide a non-skid surface.

5. In an open grid structure of the character described, the combination of

(a) a plurality of longitudinally disposed and transversely spaced bearing bars each having a depth greater than the thickness thereof and each having a plurality of longitudinally spaced slotted openings therethrough for reception of cross bars extending transversely thereof,

(b) each cross bar opening being of sufficient dimensions to slidably receive a cross bar being threaded therethrough at an angle to the vertical axis of the bearing bar and including a rectangular shaped portion, slidably receiving a correspondingly shaped portion of said cross bar,

(c) a plurality of transversely disposed cross bars each extendable through a plurality of the transversely aligned slots in said longitudinally disposed bars into fully threaded position relative thereto,

(d) each said cross bar having an enlarged portion thereon in spaced relation to at least one longitudinal edge of the bar and which corresponds in shape to said bearing bar rectangularly shaped opening and having a plurality of slotted openings therein extending from said longitudinal edge to said enlarged portion and in registry with adjacent areas of the bearing bar when the threaded cross-bar is in said fully threaded position so that each said cross bar may be rotated about its longitudinal axis from said full threaded position to a final position angularly displaced therefrom, and

(e) said cross bar enlarged portion being so dimensioned relative to the corresponding opening in said bearing bar that it will be permanently distorted by the bounds of said opening in the course of such rotation.

References Cited

UNITED STATES PATENTS

1,132,021	3/1915	Mark et al.	52—667
1,426,736	8/1922	Hess	52—667
2,287,558	6/1942	Nagin	52—667

FOREIGN PATENTS

810,856	1/1937	France.
1,007,873	2/1952	France.

FRANK L. ABBOTT, Primary Examiner

PRICE C. FAW, JR., Assistant Examiner

U.S. Cl. X.R.

52—667; 669