June 22, 1965 J. H. HEIDORN 3,190,419

ELECTRO MAGNETIC CLUTCH WITH RING LIKE ARMATURES

Original Filed July 15, 1959 4 Sheets-Sheet 1

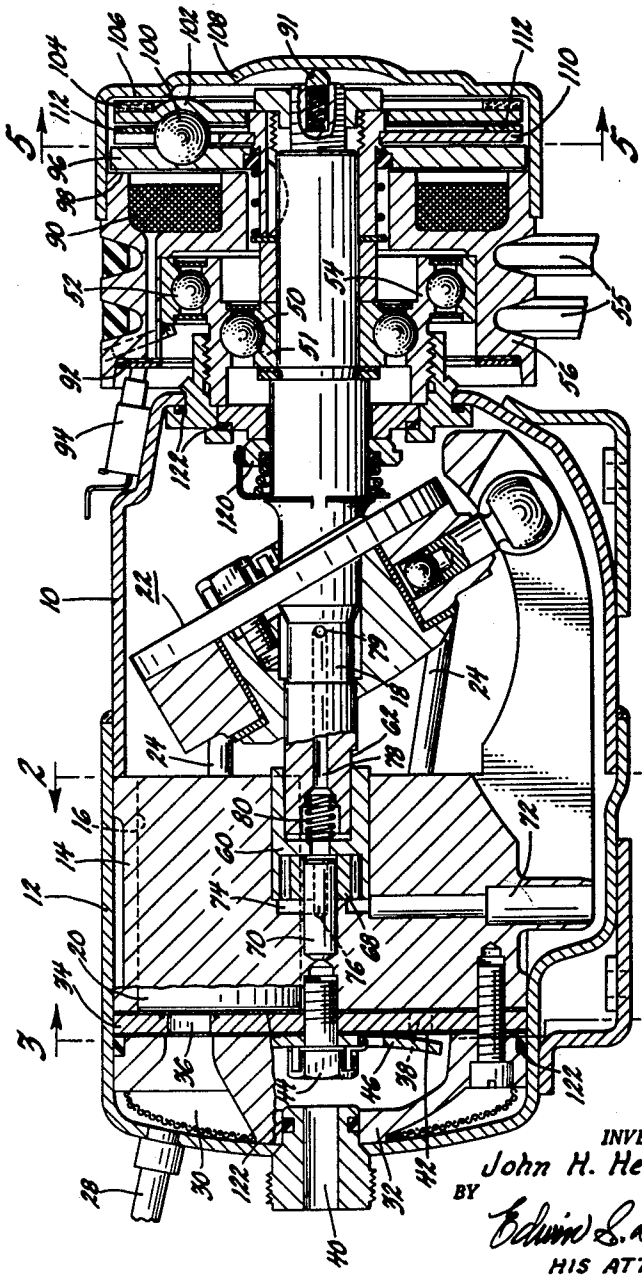


Fig. 1

INVENTOR.
John H. Heidorn
BY
Edwin L. Dybvig
HIS ATTORNEY

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ELECTRO MAGNETIC CLUTCH WITH RING LIKE ARMATURES

Original Filed July 15, 1959 4 Sheets-Sheet 2

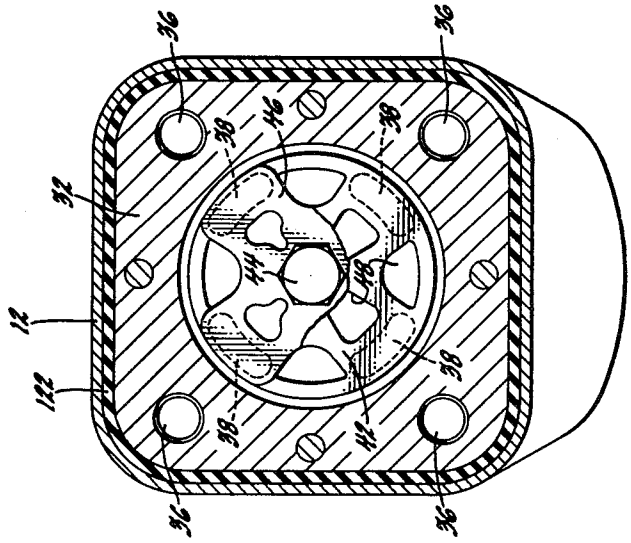


Fig. 3

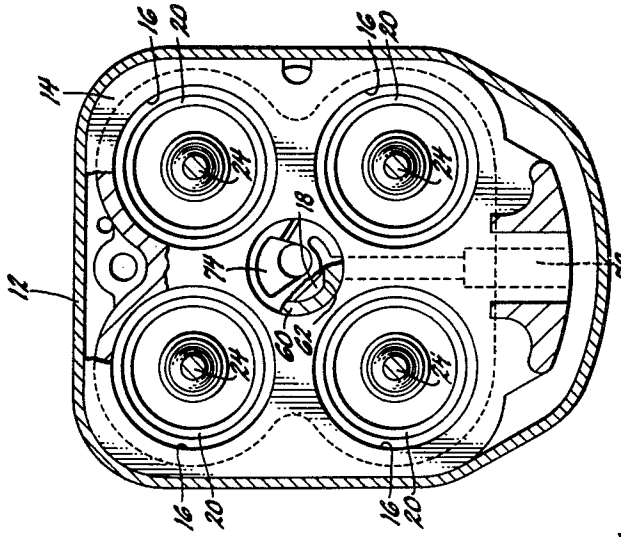


Fig. 2

INVENTOR.
John H. Heidorn
BY
Edwin E. Dybvig
HIS ATTORNEY

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ELECTRO MAGNETIC CLUTCH WITH RING LIKE ARMATURES

Original Filed July 15, 1959 4 Sheets-Sheet 3

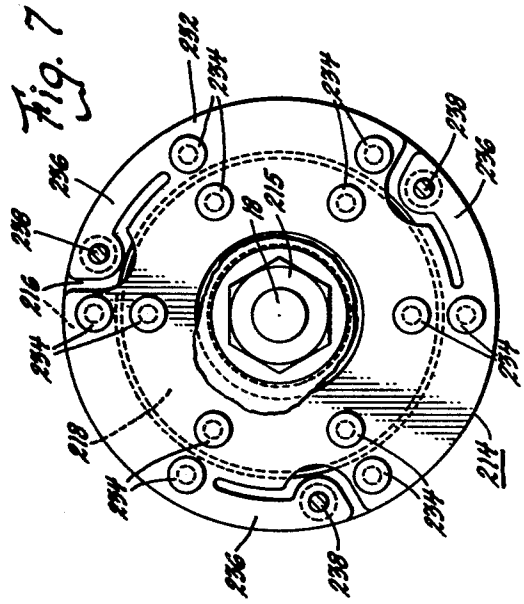


Fig. 7

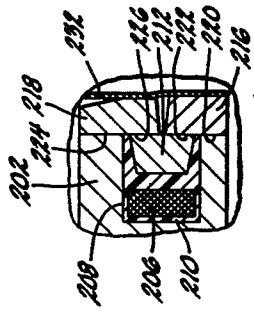


Fig. 9

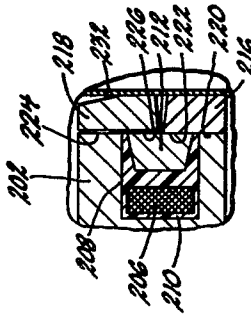


Fig. 8

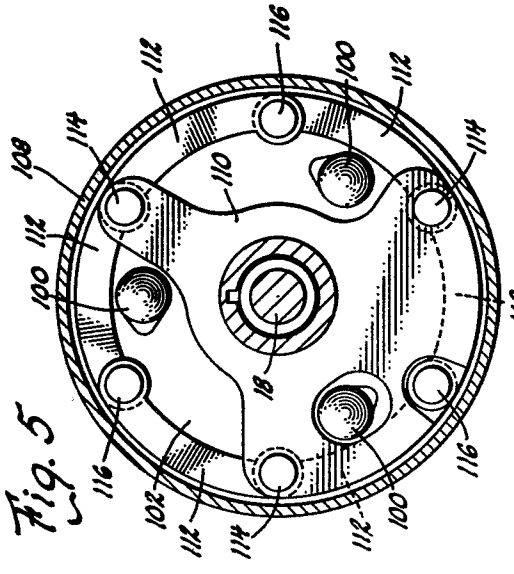


Fig. 5

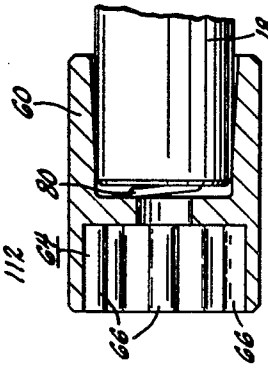


Fig. 4

INVENTOR.
John H. Heidorn
BY
Edwin S. Dybvig
HIS ATTORNEY

June 22, 1965 J. H. HEIDORN 3,190,419

ELECTRO MAGNETIC CLUTCH WITH RING LIKE ARMATURES

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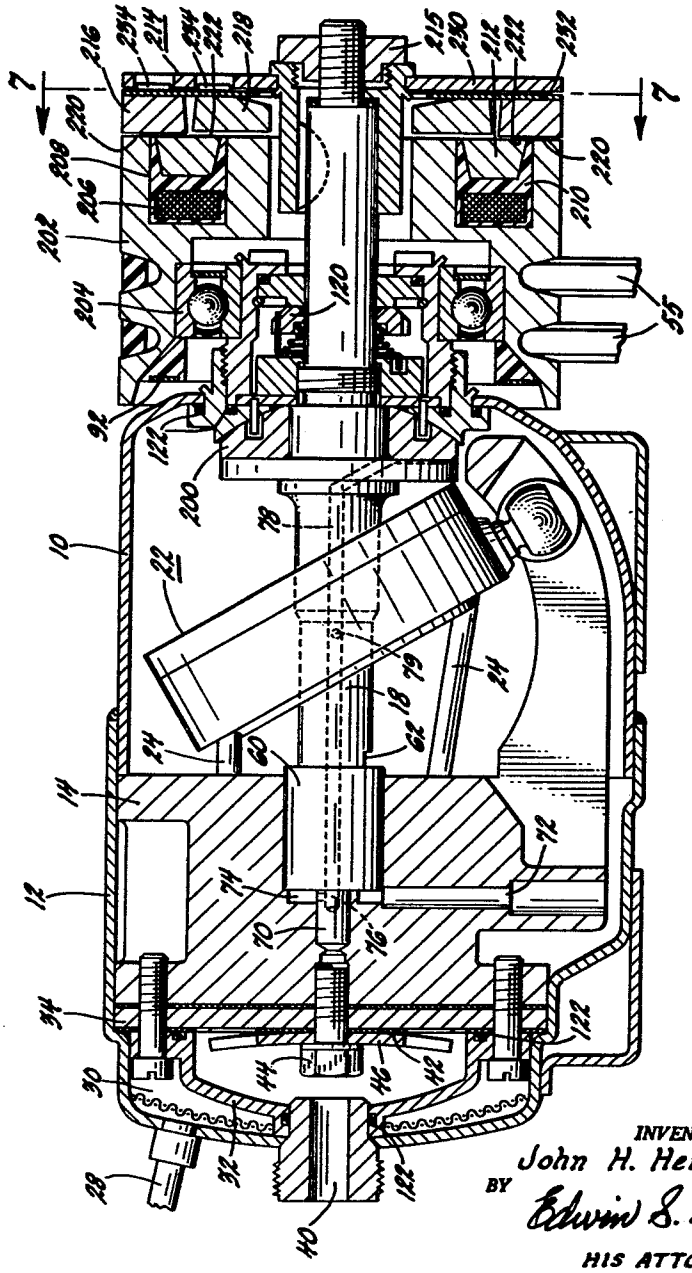


Fig. 6

INVENTOR.
John H. Heidorn
BY
Edwin S. Dybvig
HIS ATTORNEY

United States Patent Office 3,190,419 Patented June 22, 1965

3,190,419

ELECTRO MAGNETIC CLUTCH WITH RING LIKE ARMATURES

John H. Heidorn, Dayton, Ohio, assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Original application July 15, 1959, Ser. No. 827,346, now Patent No. 3,092,307, dated June 4, 1963. Divided and this application July 25, 1961, Ser. No. 126,683

2 Claims. (Cl. 192—84)

This invention relates to refrigerating apparatus and more particularly to a refrigerant compressor for use in automobile air conditioning systems and the like.

This is a division of application Serial No. 827,346, filed July 15, 1959, now Patent No. 3,092,307.

A large number of problems present themselves in designing refrigerant compressors of the type which are adapted to be driven by a car engine either continuously or intermittently through a clutch. These problems result from the fact that the compressor is required to operate throughout a very wide speed range wherein the speed of the compressor bears no relationship to the refrigeration requirements. The problems are multiplied by the fact that the amount of space available for the compressor is very limited and all of the parts must be of lightweight construction and arranged in a small casing.

It is an object of this invention to provide a compressor which is adapted to be driven from a car engine through an improved clutch arrangement.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a vertical sectional view showing a preferred form of the invention.

FIGURE 2 is a sectional view taken substantially on line 2—2 of FIGURE 1 with parts broken away.

FIGURE 3 is a sectional view taken substantially on line 3—3 of FIGURE 1 looking in the direction of the arrows.

FIGURE 4 is a fragmentary sectional view showing the relationship of the oil pump housing to the drive shaft of the compressor.

FIGURE 5 is a sectional view taken on line 5—5 of FIGURE 1 and looking in the direction of the arrows.

FIGURE 6 is a sectional view showing a modified type of compressor.

FIGURE 7 is a sectional view taken substantially on line 7—7 of FIGURE 6 and looking in the direction of the arrows.

FIGURE 8 is a fragmentary sectional view showing the clutch in the early stages of engagement.

FIGURE 9 is a view similar to FIGURE 8 but showing the clutch fully engaged.

Referring now to FIGURE 1 of the drawings wherein a preferred embodiment of the invention has been shown, reference numerals 10 and 12 designate complementary cup-shaped casing elements which serve to enclose a multiple cylinder compressor. These casing elements are made of sheet metal and have their open ends arranged in telescoping relationship, as best shown in FIGURE 1.

The compressor consists of a cylinder block 14 which is supported within the casing element 12 and which is provided with four cylinder bores 16 which are symmetrically arranged about the main drive shaft 18. By virtue of using four cylinder bores arranged as shown, it is possible to utilize an outer casing which is substantially rectangular in cross section rather than using a cylindrical casing of the type most commonly used in automobile air conditioning compressors. This makes it possible to reduce the width and height of the compressor casing without reducing the capacity of the compressor.

Reciprocating piston elements 20 are disposed to operate within the bores 16 in accordance with conventional practice. These piston elements are driven by the wobble plate assembly 22 through the usual connecting rods 24. The gas to be compressed enters through the usual suction line 28 which communicates with the low pressure suction chamber 30 formed in the cylinder head 32. The usual valve plate 34 is disposed between the cylinder head 32 and the cylinder block 14 and is provided with the usual series of inlet and outlet ports 36 and 38 respectively. The compressed gas leaves the compressor through the outlet passage 40.

As best shown in FIGURES 1 and 3 of the drawings, the outlet valve reed 42 is circular in shape and has its central portion clamped firmly to the valve plate 34 by means of a cap screw 44. The extent of opening of the reed valve 42 is limited by a rigid backup plate member 46. The valve plate 42 is provided with cutaway portions 48 which render it more flexible and in effect divide the reed into four lobes which are tied together at their outer periphery. The backup plate 46, as shown in FIGURE 3, is provided with lobes which overlie the outlet ports 38. By constructing the reed valve in the form of a single platelike element, the severity of the opening and closing movement of the valve plate is reduced since the compressed gas flowing out of the one outlet port at a given time tends to retard the closing movement of the next preceding valve port and also tends to initiate the opening movement of the next succeeding valve port.

The main drive shaft 18 is supported for rotation within the casing section 10 by means of a first ball bearing assembly 50 in which the inner ball race 51 is secured to the shaft 18 and the outer ball race 54 is carried by the end wall of the casing 10. This first ball bearing assembly serves to take up the end thrust resulting from the wobble plate pushing against the piston elements. A second ball bearing assembly 52 is provided as shown and serves to take up the belt load. This second ball bearing assembly is arranged directly in line with the belts 55 which drive the compressor pulley 56 secured to the outer ball race of the ball bearing assembly 52. It will be noted that the bearing sleeve member 54 which forms the outer ball race for the bearing assembly 50 also forms the inner ball race of the ball bearing assembly 52 and is, in effect, an extension of the stationary housing element 10. By virtue of this bearing arrangement, the ball bearings and the associated ball races stand up much longer in service than the prior art arrangements as the bearing assembly 52 takes the main belt load and the balls are always moving about in the races whenever the car engine operates.

The inner end of the drive shaft 18 is journaled in the cylinder block 14 in such a manner that slight misalign-

ment between the casing sections 10 and 12 will not cause excessive strain or wear on the drive shaft 18. As best shown in FIGURES 1 and 4 of the drawings, the the inner end of the drive shaft extends into a tapered opening (shown somewhat exaggerated in FIGURE 4) in a member 60 which is adapted to rotate with the shaft 18. As shown in FIGURE 2 of the drawings, the shaft 18 is provided with a flat portion 62 which cooperates with a flat portion on the member 60 so that the member 60 rotates with the shaft 18 but due to the taper on the inner surface of the member 60, the shaft 18 need not line up exactly with the opening in the member 60.

The one end of the member 60 is provided with an oil pumping chamber 64. The inner walls of the oil pumping chamber 64 are provided with conventional gear teeth projections 66 which cooperate with conventional oil pumping gear 68 rotatably supported on a fixed pin 70. Thus, the gear element 68 in cooperation with the rotating member 60 serves to form a gear type oil pump which supplies oil under pressure to the various bearings requiring lubrication.

Referring now to FIGURE 1 of the drawings, the bottom portion of the compressor casing serves as an oil sump and oil from this sump is pumped upwardly through the oil passage 72 to the inlet side of the oil pump just described. The oil discharges from the pump into a chamber 74 which communicates with oil passage means 76 and 78 provided in the pin 70 and in the main shaft 18. The oil is then fed through the radial passage 79 to the wobble plate bearings.

A coil spring 80 serves to bias the member 60 to the left as viewed in FIGURE 1. However, if the speed of the compressor should become great enough so that the quantity of oil handled by the pump exceeds the amount of oil which can flow through the oil feed passage 78, the excessive oil pressure in the pumping chamber will cause the elements 60 and the oil pump gear 68 to move to the right, as viewed in FIGURE 1, so as to automatically unload the oil pump.

When no refrigeration is required, the compressor may be declutched from the car engine and the drive pulley 56 by means of the magnetic clutch shown in FIGURES 1 and 5. This clutch includes a solenoid 90 embedded in the pulley 56, as shown. Current is supplied to the solenoid 90 by means of a collector ring 92 cooperating with a brush element 94 carried by the fixed casing element 10. The soleniod coil 90 is adapted when energized to pull the armature element 96 into frictional engagement with the surface 98 provided on the pulley 56. The one side of the solenoid 90 is grounded to the pulley 56 and in order to insure proper electrical connection between the pulley assembly and the rest of the compressor, a spring pressed ground contact 91 is provided, as shown, for at all times making electrical connection between the housing 108 of the pulley assembly and the shaft 18.

When the armature 96 first contacts the surface 98 in response to energization of the solenoid 90, the armature 96 will tend to rotate with the pulley 56 with the result that a series of conventional spreader balls 100 will serve to force the clutch plate 102 to the right, as viewed in FIGURE 1, so that the friction material 104 carried by the clutch plate 102 will engage the clutch surface 106 formed on the clutch enclosing casing element 108. The element 108 is secured to the pulley 56 so as to rotate therewith. A plate element 110 which is keyed to the drive shaft 18 is arranged between the armature 96 and the clutch plate 102. This plate element is secured to the clutch plate 102 through a plurality of arcuate spring members 112, as best shown in FIGURE 5. One end of each of the spring arms 112 is secured to the plate 110 by means of a rivet 114 and the other end of each of the spring arms is secured to the plate 102 by means of rivets 116.

A conventional oil seal assembly 120 is provided for preventing the escape of lubricant and refrigerant at the

point where the drive shaft 18 passes through the end wall of the casing 10. Suitable O-ring seals 122 are provided, as shown, for preventing the leakage of gas between various parts of the compressor elements.

In FIGURE 6 of the drawings, a modified form of the invention is shown. Like reference numbers have been used in FIGURES 1 and 6 to designate identical parts or parts which are similar in function. In the modification shown in FIGURE 6, a plain end thrust bearing 200 is provided for the drive shaft 18. The main drive pulley 202 is rotatably supported on the compressor housing by means of a ball bearing assembly 204 which is directly in line with the drive belts 55 so as to take up the belt load. The clutch for operating the compressor differs from the clutch construction described hereinabove in that in place of using a clutch of the type wherein the clutch surfaces are mechanically held in engagement and the solenoid is merely used to initiate the operation of the clutch, the arrangement shown in FIGURE 6 utilizes a clutch of the type in which the solenoid coil 206 holds the clutch in engagement. In the arrangement shown, the solenoid coil 206 which corresponds to the solenoid 90 of FIGURE 1 is arranged in a circular groove 208 formed in the outer face of the pulley 202. Suitable nonmagnetic material 210 serves to hold the solenoid 206 in place and also serves to support an armature ring 212 which is arranged as shown. Keyed to the shaft 18 is an armature supporting plate assembly 214 which is held in place on the shaft 18 by means of a nut 215. The plate assembly 214 carries a first ring like armature element 216 and a second ringlike armature element 218. The armature supporting plate assembly comprises a rigid plate 230 carried by the shaft 18 and a flexible armature supporting plate 232 to which the armature rings 216 and 218 are secured by means of rivets 234. Armlike projections 236 formed on the plate 232 and having their extremities secured to the rigid plate 230 by means of rivets 238 enable the armature rings 216 and 218 to move into and out of engagement with the complementary clutch surfaces. The armature ring element 216 is slightly thicker than the element 218 with the result that when the solenoid 206 is first energized, the armature element 216 will move into contact with the surfaces 220 and 222 (see FIGURE 8) and at a subsequent time, the armature element 218 will move into frictional engagement with the surfaces 224 and 226, as shown in FIGURE 9. The advantage of the above described arrangement is that the pull exerted against the armature 218 serves to increase the pressure between the element 216 and the surfaces 220 and 222.

The compressor and clutch are of the general type disclosed in United States application Serial Number 496,131, filed March 23, 1955, now Patent Number 2,907,426, issued October 6, 1959, to which reference may be made for a more detailed explanation of the principle of operation thereof.

While the embodiments of the present invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In combination, a casing, a drive shaft extending through one wall of said casing, a pulley rotatably supported on the end wall of said casing, one portion of said pulley surrounding the outer end of said drive shaft, an electromagnet disposed in the outer face of said pulley, a pair of ring-like armatures, means for drivingly connecting said pair of ring-like armatures to said shaft, resilient means for supporting said pair of ring-like armatures on said connecting means for relative axial movement with respect to one another, a first of said ring-like armatures being located away from the outer face of said pulley a greater distance than the second of said ring-like armatures, said pair of ring-like armatures upon energization of said electromagnet moving selectively into engagement with the outer face of said pulley with said sec-

ond ring-like armature engaging said pulley ahead of the engagement by said first ring-like armature.

2. In combination, a casing, a drive shaft extending through one wall of said casing, a pulley rotatably supported on the end wall of said casing, one portion of said pulley surrounding the outer end of said drive shaft, an electromagnet disposed in the outer face of said pulley, a pair of concentrically arranged ring-like armatures, a plate element rigidly secured to said shaft, a flexible member secured to said rigid plate including first and second portions for supporting each of said ring-like armatures for relative movement into engagement with the outer face of said pulley upon energization of said electromagnet, a first of said ring-like armatures being biased away from said outer face of said pulley a greater distance than the other of said ring-like armatures whereby upon energization of said electromagnet said second ring-like armature engages said pulley ahead of the engagement by said first ring-like armature.

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DAVID J. WILLIAMOWSKY, *Primary Examiner.*

LAURENCE V. EFNER, *Examiner.*