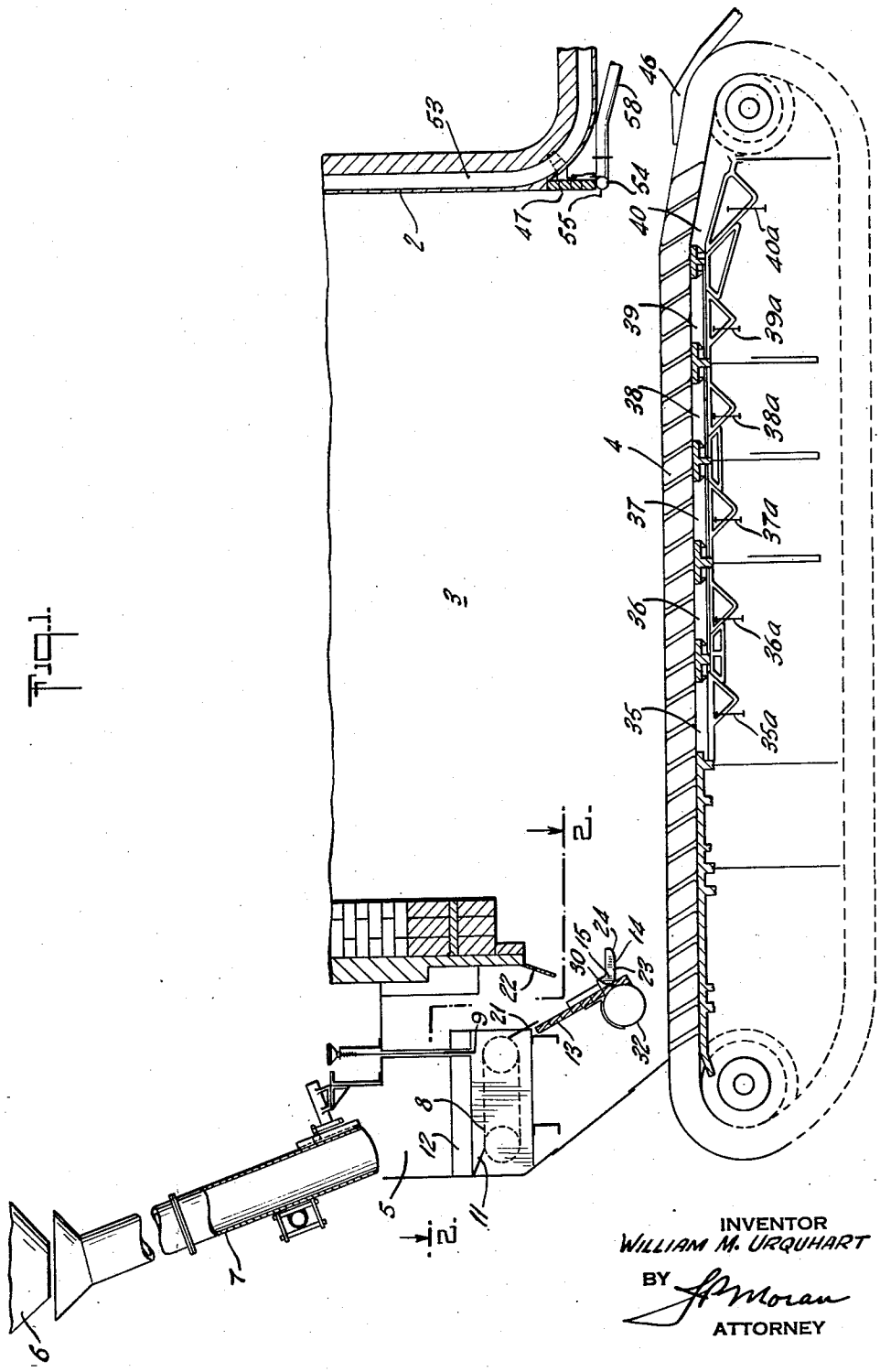
June 11, 1957 W. MacD. URQUHART 2,795,200

APPARATUS FOR BURNING SOLID FUEL

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APPARATUS FOR BURNING SOLID FUEL

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Fig. 2.

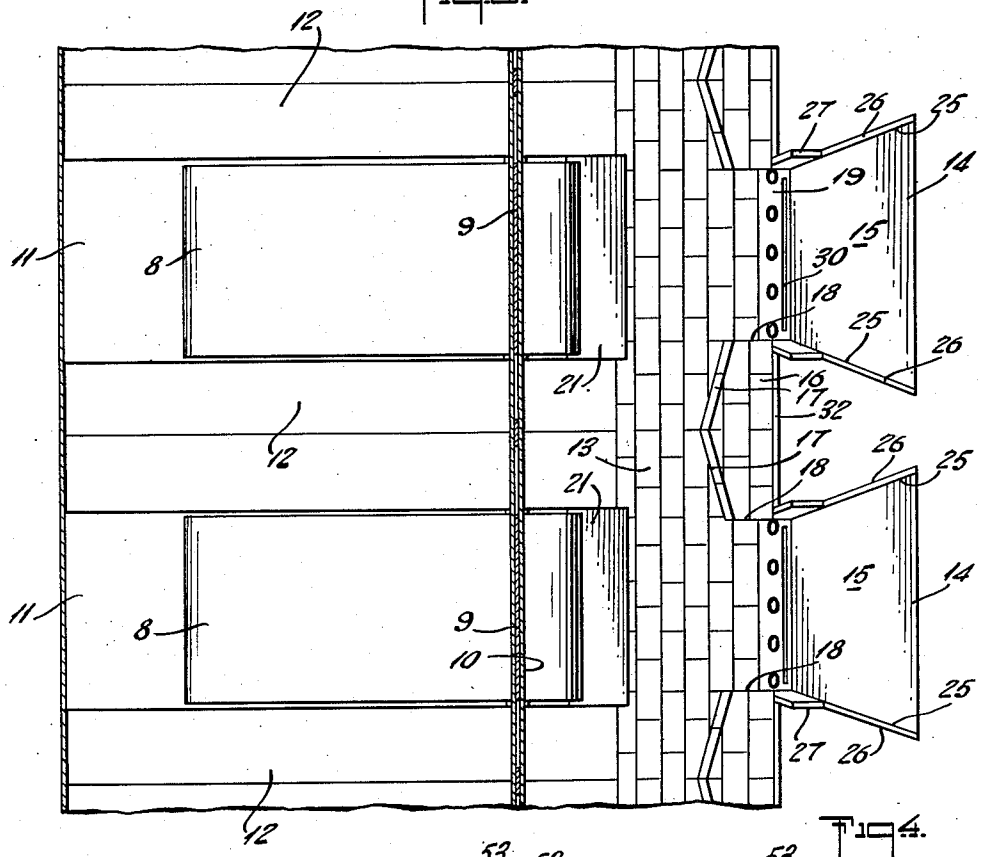


Fig. 3.

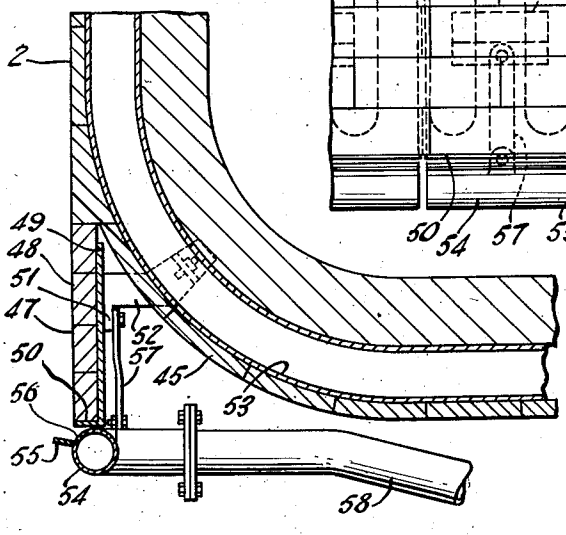
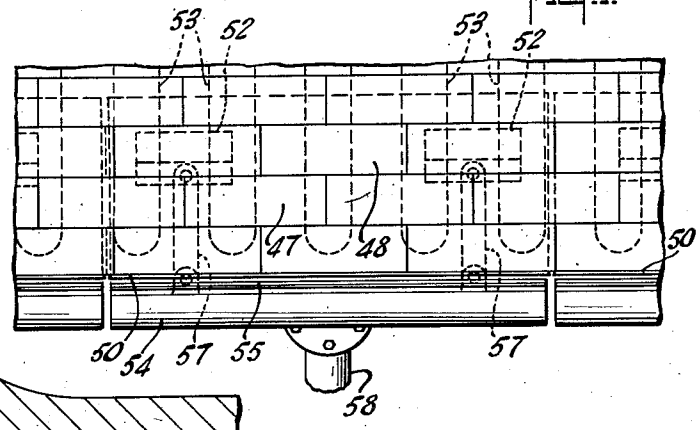


Fig. 4.



INVENTOR
WILLIAM M. URQUHART
BY
ATTORNEY

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APPARATUS FOR BURNING SOLID FUEL

William MacDonald Urquhart, Glasgow, Scotland, assignor to The Babcock & Wilcox Company, New York, N. Y., a corporation of New Jersey

Application February 25, 1953, Serial No. 338,797

Claims priority, application Great Britain February 27, 1952

4 Claims. (Cl. 110—68)

The present invention relates to combustion apparatus, and more particularly to spreader stoker fired furnaces wherein a travelling grate moves from front to rear of the lower portion of the furnace.

In speader stoker fired furnaces of the type described, some of the fuel particles introduced into the furnace have flight trajectories whereby the fuel is thrown to the rear portion of the furnace where they are discharged in an unburned condition with the fuel ashes. This condition can occur with either mechanical or pneumatic types of spreader stokers, and results in an undesirably high carbon loss.

In accordance with this invention means are provided in the rear portion of the furnace to intercept a large portion of the solid fuel particles thrown to the rear of the furnace, and to return the particles to the furnace where they are burned. As hereinafter described, an upright shield is provided adjacent the rear wall of the furnace with the lower end thereof spaced above the upper surface of the burning fuel bed and the included fuel ash. The shield intercepts the particles thrown toward the rear wall of the furnace in flight trajectory above the fuel bed. Additionally, an inwardly projecting ledge is supported on the lower portion of the shield so that the fuel particles that do not rebound from the shield to fall on the furnace grate collect on the ledge from which they are blown forwardly into the furnace by fluid jets.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of my invention.

Of the drawings:

Fig. 1 is an elevation in longitudinal section through the lower portion of a spreader stoker fired furnace constructed and arranged according to the present invention;

Fig. 2 is a plan of part of the furnace coal supply mechanism, including two adjacent spreader units taken on the line 2—2 of Fig. 1;

Fig. 3 is a part of Fig. 1 to a larger scale, including means adjacent the lower end of the furnace rear wall arranged for redirecting coal forwardly within the furnace, and

Fig. 4 is a forward elevation of the coal redirecting means shown in Fig. 3.

Referring to the drawings, the furnace has a front wall 1 and a rear wall 2 at the ends of a combustion space 3 above a travelling grate 4 of the chain grate type arranged so that its upper run moves rearwardly.

In front of and extending laterally of the front wall 1 is arranged a hopper 5, into which coal is led from an overhead bunker 6 through a traversing chute 7. At the bottom of the hopper and arranged side by side in a row extending laterally of the furnace are a number of feeders 8 operating on the endless conveying surface principle.

The feeders are arranged during operation to remove coal rearwardly from the hopper. Suitably all the feeders are driven at the same speed by common driving means. The amounts of coal fed by the feeders can be adjusted individually by raising or lowering guillotine doors 9 positioned above the rear ends of the feeders and slidable within the rear wall 10, which is a double wall of the hopper.

Coal is prevented from falling in front of the feeders by plates 11 and from falling between the feeders by ridged structures 12.

The coal from the rear ends of the feeders is arranged to fall onto a common chute 13 sloping downwardly and rearwardly. At the bottom of the chute behind each feeder is a plate 14 of a respective spreader unit 15, which is arranged to receive the coal falling from the rear end of the feeder. The chute is provided with structures 16 of refractory between adjacent spreader units, which are formed with sloping surfaces 17 normal to the main surface of the chute and adapted to direct coal falling thereon towards the nearmost spreader unit. The side surfaces 18 of the structures 16 act to confine the falling coal to paths leading them to the spreader units.

Adjacent each spreader unit plate 14 the lowermost part of the chute is formed by a metal block 19. The surface of the chute above these blocks, between the refractory structures 16 and above the level thereof, is formed by the surfaces of refractory bricks 20.

A fixed scraper plate 21 is provided adjacent the rear of each feeder to insure the falling from the feeder conveying surface of coal that might otherwise adhere thereto. A screen 22 projecting downwardly and forwardly from the furnace front wall 1 near the bottom thereof is provided for intercepting radiation from the furnace that might damage mechanical parts of the feeders.

In the embodiment of the invention shown in the drawings, center lines of adjacent spreader units are 1′ 9½″ apart. Each spreader unit plate 14 is bolted to the block 19 and has a shelf 23 extending horizontally and rearwardly from the bottom of the chute a distance of 5″; the rear part 24 of the plate is a deflector providing a guide surface which curves upwardly, the curvature being cylindrical around a laterally extending axis distant 6″ from the upper surface of the plate; the plate terminates where the slope thereof has an angle of 33° or thereabouts to the horizontal. The side edges 25 of the plate diverge rearwardly, being 10¾″ apart at the front edge of the shelf and 16″ apart at the rear edge of the deflector. The side edges of the plate are furnished with upstanding guide walls 26 having their upper edges horizontal and at a height of 2½″ above the level of the shelf 23 and provided with forward and upward extensions 27 defining the path of the coal falling over the part of the chute provided by the block 19. The spreader unit is located so that the shelf 23 is 12⅝″ above the grate.

The spreader stoker unit also comprises a horizontally directed elongated orifice 30 formed in the block 19. The orifice is 10″ wide and 1$^{9}/_{64}$″ deep with its lower edge ½″ above the plane of the shelf 23. The orifice registers with a slot in a duct 32 extending adjacent the lower ends of the chute transversely of the furnace and arranged to supply air to all the spreader units.

The space below much of the upper run of the grate is divided into compartments 35—40 to which undergrate air is supplied under the control of respective dampers 35*a*—40*a*. The compartments extend as zones transversely of the grate and control of the respective quantities of air thereto permits the rates of combustion attained at different zones to be varied to suit the character of the coal to be burned.

At the rear end of the furnace the contents of the grate are led beneath an arch 45 at the bottom of the furnace

rear wall 2, before being removed from the grate by the usual ash bars 46 at the rear end of the grate. The front surface of the rear wall 2 is extended vertically downwardly in front of the arch 45 by the front surface of a shield 47 comprising refractory blocks 48 supported by a row side by side across the width of the furnace of backing plates 49, which have at their lower edges horizontal forwardly extending projections 50 beneath the lowest row of blocks 48. Each backing plate is bolted to downward projections 51 of a pair of respective supporting blocks 52. The rear wall 2 and the arch 45 contain cooling tubes 53, and the supporting blocks 52 are clamped between respective adjacent pairs thereof in the arch 45.

Extending horizontally and laterally of the furnace and immediately beneath the projections 50 are sections of pipe 54 which have their center lines at a distance of 1' 1" above the main level of the upper surface of the grate. To each pipe section is welded a ledge 55, 1" wide projecting forwardly of the plane of the front surface of the shield 47 and in a slightly upward direction, and above the ledge 55 the pipe section 54 is slotted to form an orifice 56, 1/16" deep, adapted when the pipe section is supplied with air under pressure to project an air jet sweeping over the upper surface of the ledge in a forward and slightly upward direction.

The supporting blocks which support a backing plate 47 support also the corresponding pipe section through respective supporting bars 57.

The pipe sections are supplied with air under pressure through pipe connections 58 from a common supply line (not shown).

The furnace is adapted for the production of hot gases for steam generation. Appropriately the gases are led across heat absorbing surfaces (not shown) comprising steam generating tubes and steam superheating tubes and subsequently through an economizer.

In operation coal prepared for spreader stoker firing, e. g. crushed and capable of passing through a ½" ring, is fed from the bunker 6 through the traversing chute to the hopper 5, and the feeders 8 are operated to discharge coal continuously from the hopper to the spreader units 15. Air is supplied to the duct 32 at a pressure of 12" to 18" water gauge, and after issuing from the orifices 30 continuously projects coal rearwardly from the spreader units. Most of the coal particles or lumps so supplied to the furnace burn in the fuel bed on the grate 4, which is supplied with undergrate air from the compartments 35—40. The ash arising from the combustion of the coal on the grate is discharged at the rear of the grate.

When the coal particles or lumps are acted upon by the currents of air from the orifices 30, they undergo rearward accelerations. During such accelerations the shelf 23 prevents the coal as a whole from falling. The shelves are horizontal, and the acceleration of a particle or lump while it is over a shelf is larger than if the shelf surfaces were directed rearwardly and upwardly. The deflector 24 at the end of the shelf 23 deflects the relatively fast moving lump or particle so that it leaves the spreader unit in a path having an upward inclination to the horizontal, the angle of which will generally be relatively large. By reason of the large angles to the horizontal and the high speeds at which the coal lumps or particles leave the spreader units, the coal particles or lumps destined to burn out on the grate tend to have trajectories which carry them large distances rearwardly before they reach the fuel bed on the grate. It is found that in this way coal lumps or particles can be distributed over an area which is relatively great from front to rear, so that the furnace can have a deep combustion space. The currents of air from the orifices 30 fan out to a certain extent laterally, while moreover adjacent coal particles or lumps on each spreader unit plate 14 tend to be blown apart. Coal lumps and particles are, therefore, distributed also to each side of each spreader unit at the rear thereof.

The air from the orifices 30 and those coal particles or lumps destined to fall on the fuel bed on the grate travel at least initially in the same general direction with the air sweeping past such lumps or particles. The lumps or particles are, therefore, scrubbed by the air so that ample oxygen for rapid ignition and combustion of such particles or lumps is available.

The larger lumps of coal, inasmuch as they have a smaller ratio of surface area to weight tend to be less greatly accelerated by the air from the orifices 30 and less sustained by the mass of gases rising generally upwardly from the fuel bed on the grate, and consequently they tend to fall in greater proportion towards the front end of the fuel bed on the grate. Larger lumps require a longer time for their combustion than smaller lumps or particles, and this longer time they receive because the upper run of the grate moves rearwardly. The lumps or particles falling near the rear of the fuel bed on the grate tend to be much as are more greatly accelerated by the air currents from the orifices and more greatly sustained by the gas mass rising generally upwardly from the fuel bed, i. e. they are generally the smaller lumps or particles; consequently although a less time is available to them for combustion in the fuel bed before they are discharged from the grate, they will be generally burnt out on the grate before they reach the ash bars 46, since they require only a shorter time to burn.

The shield 47 presents to the combustion space a surface from which coal rebounds onto the grate in a forward direction, or which leads to the ledges 55, many coal lumps or particles falling from the rear wall 2 and from the shield itself. The pipe sections 54 are supplied with air under the same pressure and suitably from the same source as that for the duct 32. From the ledges 55 air discharged forwardly through the orifices 56 projects the coal lumps or particles. The coal lumps or particles which impinge onto the shield at the end of their trajectories from the spreader units might not, if the shield were absent and they fell on the grate, have time to burn out before being carried by the grate to the ash bars 46, but by virtue of their redelivery in a forward direction so that they fall onto the fuel bed on the grate in front of the plane of the rear wall 2 sufficient time is given to such lumps or particles to make possible the completion of their combustion in the furnace. Moreover, the shield 47 reduces the possibility of particles or lumps in the rain of coal projected rearwardly from the spreader units from pursuing trajectories which would carry them onto or beyond the ash bars 46; at the same time the shield 47 constrains air flowing upwardly through the grate below the rear arch 45 to flow in a forward direction above the grate and through the relatively narrow opening between the pipe sections 54 and the fuel bed on the grate, and this movement of air and gases is adapted to shorten the trajectories of lumps or particles which might otherwise fall too near the end of the grate.

I have found that in the apparatus described most grades of coal adapted for spreader stoker firing may be satisfactorily spread onto grates for carrying fuel beds having lengths of from 14 to 20 feet.

The amount of air delivered to the furnace through the orifices 56 is only a small fraction of the total air supplied. The amount of air supplied by the orifices 30 is greater, but to provide it requires a minimum of auxiliary power, for although the air is admitted through the orifices 30 with a velocity sufficient to achieve a satisfactory distribution of fuel by the spreader units 15 over the grate, the aggregate area of the orifices 30 is limited. It is found that the air quantity is substantially less than the normal requirements for overfire air, so that no inefficiency arises by the presence of an excessive proportion of excess air in the gases leaving the furnace. Overfire air that may be required in addition to that from

the orifices 30 is provided through suitable secondary air nozzles. The high velocity of the air from the orifices 30 is a factor causing an advantageous degree of turbulence in the gas mass rising from the fuel bed, and thus promoting complete combustion. The pressure of air required in the duct 32 is not, however, greater than that readily obtainable from a single stage fan.

The advantages of e. g. unrestricted ignition of the coal, flexibility in following load fluctuations, little tendency to form large clinkers, facility of burning highly swelling coals, and other advantages associated with spreader stoker firing are achieved in the furnace described.

Certain methods and apparatus associated with the pneumatic projection of fuel rearwardly into the furnace are disclosed and claimed in a copending application filed February 25, 1953, Serial No. 338,812 in which I have joined John M. Miller and Donald M. McLaren as co-inventors.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of the invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. Combustion apparatus including a furnace having a spreader stoker adapted to distribute solid fuel transversely of said furnace, a moving grate in the lower portion of said furnace, the upper surface of said grate moving from front to rear of the furnace, an arch overlying the rearward portion of said moving grate, ledge means positioned adjacent said rear arch and above said grate intercepting fuel particles discharged by said spreader stoker with a flight trajectory above the grate, and nozzle means constituting continuous transversely elongated slots positioned and arranged to project fuel particles collected on said ledge means toward the front of said furnace.

2. Combustion apparatus including a furnace having a spreader stoker adapted to distribute crushed solid fuel from front to rear of said furnace, a moving grate disposed in the lower portion of said furnace, the upper surface of said grate moving from front to rear of the furnace, means for passing combustion air upwardly through said grate, an arch overlying the rearward portion of said moving grate, and means adjacent the rearward portion of said grate to intercept particles of solid fuel and to project said particles forwardly in said furnace comprising, an upright shield having its lower end spaced above said grate, a ledge supported on the lower portion of said shield and extending inwardly of said furnace, and fluid jet means positioned and arranged to project fuel particles collected on said ledge toward the front of said furnace.

3. Combustion apparatus according to claim 2, wherein the distribution of crushed solid fuel is accomplished by jets of combustion air.

4. Combustion apparatus according to claim 2, wherein said fluid jet means comprises a plurality of combustion air streams disposed to discharge in a generally horizontal direction across said ledge.

References Cited in the file of this patent

UNITED STATES PATENTS

1,393,826	Potter	Oct. 18, 1921
1,532,103	Kraemer	Mar. 31, 1925
1,714,678	Kreisinger	May 28, 1929
2,302,173	Beers	Nov. 17, 1942
2,386,336	Mosshart	Oct. 9, 1945
2,483,728	Glaeser	Oct. 4, 1949

FOREIGN PATENTS

365,354	Great Britain	Jan. 21, 1932
647,417	Germany	July 3, 1937