Oct. 13, 1925. 1,556,790

R. E. HELFINSTINE

HYDRAULIC SHOCK ABSORBER

Filed March 20, 1924

Fig 2

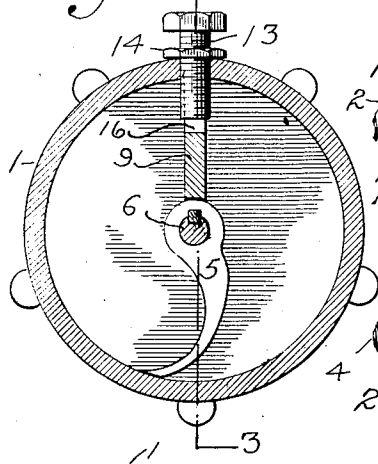


Fig 3

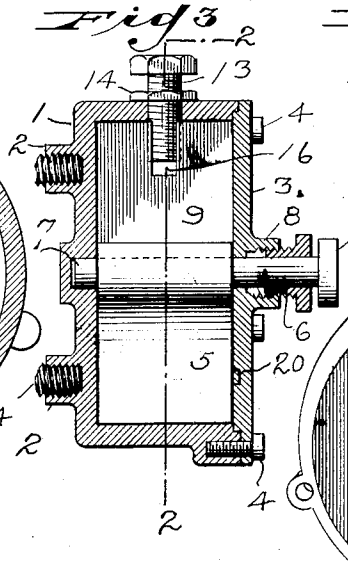


Fig 5

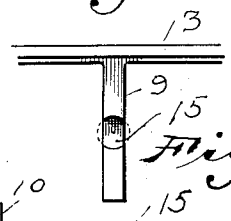
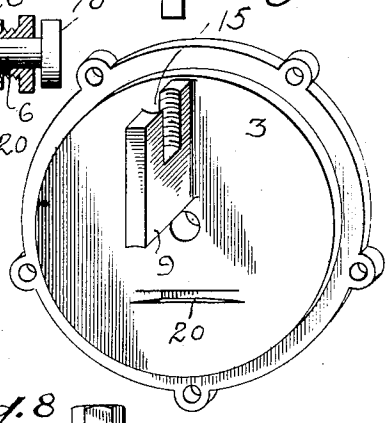


Fig. 4.



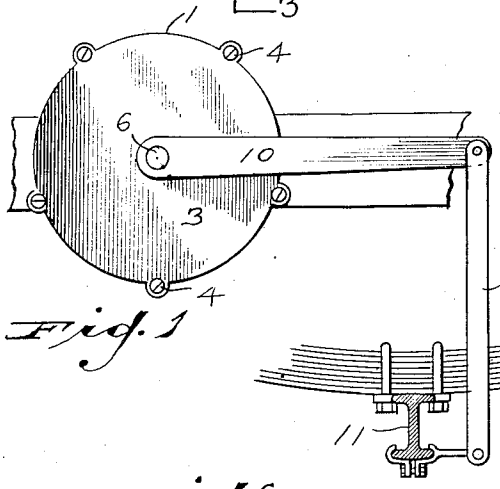


Fig. 1

Fig. 8

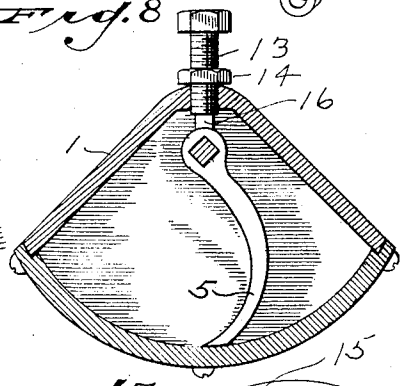


Fig 6

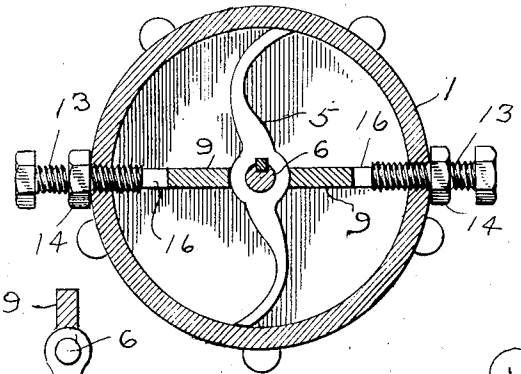
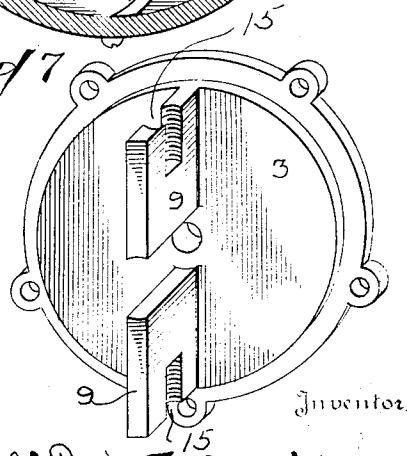


Fig 7



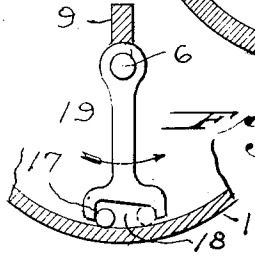


Fig. 9

Inventor.

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UNITED STATES PATENT OFFICE.

RALL E. HELFINSTINE, OF DAYTON, OHIO

HYDRAULIC SHOCK ABSORBER.

Application filed March 20, 1924. Serial No. 700,511.

To all whom it may concern:

Be it known that I, RALL E. HELFINSTINE, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Hydraulic Shock Absorbers, of which the following is a specification.

My invention relates to hydraulic brakes and more particularly to a fluid pressure governor, especially applicable as a shock absorber upon motor vehicles and the like, but also usable in other installations wherein a dash pot regulator or a progressively yielding resistance device is desirable.

The present invention contemplates a hydraulic brake or fluid pressure governor wherein an oscillatory blade or vane is movable to and fro in a fluid body confined within a chamber or housing in accordance with the fluctuations of the vehicle body or other movable member to be regulated, the fluid under pressure being bypassed alternately from one side to the other of the movable pressure member. One of the characteristic features of the present invention is the provision of a flexible or slightly yielding pressure blade or vane of arcuate formation, which when oscillated against fluid pressure in one direction will yield slightly to permit increased leakage from the high pressure to the low pressure side of the movable vane or blade thereby facilitating its movement and decreasing the resistance, but upon movement in reverse direction will by the flexing or yielding of the blade resist any bypass leakage and under the increased pressure will conform more closely to the wall of the chamber, thereby increasing the resistance to its movement in such reverse direction. In addition to the flexible character of the resistance blade or vane, a bypass is provided for the movement of the fluid under pressure from one side to the other of the vane, which bypass may be regulated from the exterior of the housing, such regulating means affording in addition provision for refilling the housing or fluid pressure compartment.

The object of the invention is to simplify the structure as well as the means and mode of operation of hydraulic brakes or fluid pressure governors whereby they will not only be cheapened in construction, but will be more efficient in use, positive in operation, uniform in action, easily controlled and unlikely to get out of repair.

A further object of the invention is to provide such a device having variable resistance to the movement of the pressure member and wherein the resistance to movement in one direction will be materially greater than the resistance to movement in the opposite direction, without the necessity of valves.

A further object of the invention is to provide in such a hydraulic brake or fluid pressure governor mechanism, an improved form of variable bypass, accessible from the exterior of the device by which the resistance in opposite directions may be proportionately adjusted.

A further object of the invention is to provide a construction which will be economical and cheap to manufacture, having but few parts, and so designed as to be easily machined.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention consists of the features of construction, the parts and combinations thereof, and the mode of operation or their equivalents as hereinafter described and set forth in the claims.

In the accompanying drawings, wherein are shown the preferred, but obviously not necessarily the only forms of embodiment of the invention, Fig. 1 is a side elevation of the device forming the subject matter hereof applied to a motor vehicle for shock absorbing purposes. Fig. 2 is a sectional view on line 2—2 of Fig. 3. Fig. 3 is a sectional view on line 3—3 of Fig. 2. Fig. 4 is a detail perspective view of the cover or movable side of the housing with which the partition is formed integrally. Fig. 5 is a detail top plan view of the integral closure and partition shown in Fig. 4. Fig. 6 is a view similar to Fig. 2 but illustrating a double vane construction employing two

partition walls. Fig. 7 is a perspective view of a closure plate and partition walls pertaining to the construction shown in Fig. 6. Fig. 8 illustrates a further modification wherein the housing or fluid chamber is of segmental form. Fig. 9 is a detail view of a modification of the directional control means.

Like parts are indicated by similar characters of reference throughout the several views.

While the present invention has been illustrated and described as applied to motor vehicles for shock absorber purposes, it is to be understood that it is not limited to such purpose, but may be given wide range of application for dash pots, brakes or fluid governor functions. It is recognized that hydraulic brakes or fluid pressure governors having oscillatory vanes or dashers are already quite well known. These devices, however, in most instances, depend for any variation of resistance to movement in one direction in relation to that in the opposite direction upon the presence of valves. In the present instance, the necessity for valves is obviated by providing for the flexing of the vanes or dasher, which though ever so slight is sufficient to vary the resistance to its movement in reverse direction. When applied to motor vehicles for shock absorbing purposes, it is desirable that the device afford a considerable degree of resistance to the initial or compression movement of the spring and shall afford greater resistance to the reaction or rebound. For ordinary conditions of use, with the average machine of the present type, this range of resistance is approximately a resistance pressure of twenty-five pounds upon the initial or down movement of the vehicle body, to sixty-five pounds resistance against the rebound. It will be understood that these pressure estimates are given for illustrative purposes only and are not intended nor to be construed as limiting the invention to any definite range of pressure or action.

Referring to the drawings, 1 is a circular housing having bosses 2, thereon by which it may be attached to a motor vehicle body, or other supporting structure. The housing 1 is provided with a removable closure plate 3, detachably secured by studs, screws or bolts 4. Concentrically mounted within the housing 1 is an arcuate oscillatory vane or dasher 5, carried upon a shaft 6 having bearings in the opposite heads of the housing. This shaft 6 is received in a socket bearing 7, in the inner face of the fixed head of the housing, and extends through an adjustable bearing and packing gland 8, upon the removable closure head. Formed integral with the closure head 3 is a radially disposed partition 9, which projects within the housing 1, contacting the inner peripheral wall of such housing at one end, and the hub of the oscillatory vane 5 at its opposite end. This partition wall 9 together with the oscillatory vane or dasher 5 divides the interior of the housing into two compartments variable in relation with each other, as the vane or dasher 5 is oscillated to and fro. An actuating lever 10 is connected with the shaft 6. In Fig. 1 this lever 10 is shown connected with vehicle axle 11 by a link 12. By this means the fluctuations of the vehicle frame and relative vibration of the axle and vehicle body are transmitted to the oscillatory vane or dasher 5. Inasmuch as the resistance of the vane or dasher to the initial or compression movement of the spring is preferably less than the resistance to its movement upon the rebound or reaction of the spring, the operative connections are so arranged that the vane or dasher 5 will be initially moved in the direction of its convex face, in which direction it moves more easily. Upon the rebound or reaction of the compressed spring, the dasher or blade 5 will be returned in the direction of its concave face, against increased pressure. This variation of resistance according to the direction of movement is primarily due to a slight flexibility of the blade or dasher 5. This capability for flexing movement of the blade need be but very slight or almost imperceptible. The arcuate form of the blade permits the edge of such blade to yield away from the peripheral wall of the housing when subjected to preponderance of pressure upon the convex side. That is to say, upon the initial movement of the vane or blade in the direction of its convexity, it will tend to yield under excessive pressure thereby separating slightly from the interior peripheral wall of the housing. This slight separation which may be merely a few thousandths of an inch will permit the bypass or escape of some of the fluid under pressure from the high pressure to the low pressure side of the vane or blade. To the contrary, when the blade is moved in the reverse direction, with its concave face forward, the increased pressure to which it is subjected tends to flex the blade toward the peripheral wall of the housing, thereby causing the end of the blade to bear more heavily and closely upon the wall of the housing to prevent the escape or bypass of the fluid from the high pressure to the low pressure side.

It is not desirable that the device shall afford a rigid or non-yielding resistance in either direction. Therefore, an auxiliary by-pass is provided between the alternating high and low pressure compartment of the housing. To regulate the resistance and the

rapidity with which the blade or dasher will respond to operative pressure in either direction, this bypass is made adjustable or variable. As a further matter of convenience, and efficiency, the adjustable bypass feature is designed to be used as a filling orifice, through which the fluid contents of the housing may be removed and replenished. To this end a hole is drilled through the peripheral wall of the housing at a point coincident with the partition wall 9. The hole so drilled is of somewhat greater diameter than the thickness of the partition wall 9, so that it intersects both faces of the partition wall forming therein what is in effect a slot, registering with the hole in the housing wall. This hole and registering slot in the partition wall are screw threaded to receive a threaded stud 13, adjustable therein, and which may be locked in any position of adjustment by a lock nut 14. By retracting the threaded stud 13 from the innermost limits of adjustment, wherein it contacts the bottom of the slot 15 in the partition 9, the bypass orifice 16 is afforded. This orifice is adjustable or variable by the adjustment of the threaded stud 13. By this means the rapidity with which the fluid under pressure may be displaced from one compartment to the other by the movement of the blade or vane 5, may be accurately regulated from the exterior of the housing. Furthermore, by removal of the screw threaded stud 13, the threaded orifice in the wall of the housing may be utilized as a filling opening for the introduction of the fluid. While fluids of various character may be employed, oil is to be preferred. The results obtained, rapidity with which the brake or governor will operate in either direction and relative resistance to the action and reaction of the blade or dasher, depend somewhat upon the consistency or viscosity of the oil. Thus by using lighter oils the action may be somewhat accelerated or this may in turn be compensated for or regulated by the adjustment of the screw threaded stud 13 to vary the capacity of the by-pass orifice 16.

In practice it is found that a very slight inherent tension or resiliency of the vane or blade 5 will cause a frictional resistance to movement in the direction of its concavity much greater than such frictional resistance to its movement in the opposite direction, even when the housing may be empty. Obviously, when the housing is filled and the blade subjected to fluid pressure which tends to straighten the blade, and thereby press the free edge into closer contact with the peripheral walls of the housing under high pressure when moved in the direction of its concavity, such resistance will be materially increased. Likewise when moved in the opposite direction, as such fluid pressure tends to flex the blade to greater degree away from the peripheral wall of the housing, its resistance will be decreased, and moreover, more or less fluid under pressure will be allowed to escape between the blade and the peripheral wall. Thus the variation to resistance in opposite directions is effected automatically without the necessity for valves or specially machined parts. Inasmuch as the blade or dasher 5 operates at all times in an oil bath, friction and incident wear is reduced to minimum.

In Fig. 9 there is shown a modification wherein, in lieu of extending the dasher blade by flexing it, the blade is formed in two relatively adjustable portions, one of which is in the form of a roller 17, confined in a marginal recess 18, in the dasher or blade 19. The inner face of the recess 18, is somewhat divergent, approaching more closely to the wall of the housing 1, at one extremity than at the other. This divergent face of the recess has a limiting influence upon the roller 17, holding the roller closely adjacent to the housing wall when at one extremity of the recess, but allowing the roller freedom of movement relative to the wall when at the other limit of the recess. As the dasher moves in one direction, that is, reversely of the arrow in Fig. 9, the roller is pushed by fluid pressure into the narrow extremity of the recess 18, and caused to conform closely to the wall of the housing. As the dasher moves in the direction of the arrow, the roller 17 will be carried to the opposite extremity of the recess 18, where it can yield inwardly under fluid pressure, allowing the fluid to pass more or less freely from one side of the dasher to the other. This construction has the advantage of an intermediate neutral point during the transmission of the roller 17 from one extremity to the other of the recess 18, during which the device will not be independent of the resistance afforded by the dasher.

The same interval of neutral operation or freedom of action and reaction of the spring may be effected with the construction previously described by providing in the closure lid, or in the bottom of the housing, as most convenient or desired, a by-pass channel 20 of limited extent, which is also preferably of variable depth. This channel 20 for convenience of machining operation is preferably located in the closure lid, as shown in Fig. 4. Its capacity is greatest at its central point from which the cross area of the by-pass channel, tapers toward its extremity. Such variation of the by-pass capacity may be effected either by varying the depth or by varying the width, of such channel. The one method is shown in Fig. 4, while the other is shown by dotted lines in Fig. 1. It is to be

understood that the extent of such by-pass channel is quite limited, and that any abnormal movement of the spring will carry the dasher blade beyond the limit of the by-pass channel whereupon the yielding resistance becomes effective. However, within the limits of the by-pass channel, which normally extends but slightly beyond the dasher blade at either side, the spring action will meet with but little resistance, but this resistance will be gradually increased as the dasher blade approaches the limit of the by-pass channel, where it meets with the full resistance of the fluid under pressure, the maximum resistance of which is determined by the adjustment of the bypass stud 13.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its forms, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific details shown, but that the means and construction herein disclosed comprises the preferred forms of several modes of putting the invention into effect and the invention is, therefore, claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. In a fluid pressure governor, a fluid chamber, an oscillatory dasher dividing the chamber into high and low pressure compartments, having an intercommunicating port, said dasher being of arcuate form and flexible, the wall of the chamber being concentric with the center of oscillation of the dasher and into approximate relation with which the free end of the dasher extends, the oscillation of the arcuate dasher in the direction of its convexity against the resultant pressure of the fluid contents of the chamber serving to flex the dasher away from the chamber wall to permit limited bypass of the fluid under pressure, the oscillation of the dasher in the opposite direction and in the direction of its concavity serving to distend the dasher into wiping relation with the wall of the chamber to prevent bypass leakage, the passage of the fluid under pressure from one compartment to the other being thru the intercommunicating port.

2. In a fluid pressure governor of the character described, a chamber containing a quantity of fluid, an oscillatory dasher vane separating said chamber into compartments, the compartments being interconnected by a port, means for oscillating the vane against the pressure of the fluid contents of the chamber, said dasher vane being radially extensible and contractible under influence of fluid pressure created by its to and fro movement whereby when moved in one direction it will be contracted to permit bypass leakage of fluid from one compartment to the other, and when moved in the opposite direction will be extended against the wall of the chamber to prevent bypass leakage of the fluid, the pressure being relieved through the interconnecting port.

3. In a fluid pressure device, an oscillatory arcuate vane, a chamber containing fluid and separated into compartments by the oscillatory vane, the compartments having communication thru an opening for the passage of the fluid under pressure, a wall of said chamber extending in approximate relation with the path of travel of the free extremity of the arcuate vane, said vane being sufficiently flexible to yield under the fluid pressure developed in the respective compartments, whereby when moved in the direction of its convexity it will yieldingly be separated from the compartment wall to permit bypass of the fluid from one compartment to the other, and when moved in the opposite direction will be pressed against the wall to prevent bypass leakage.

4. In a fluid pressure governor, a fluid containing chamber, an oscillatory dasher blade therein, the sweep of the free end of which is contiguous to the wall of the chamber, said blade being radially extensible and contractible under influence of resistance to its movement in alternate directions, whereby the fluid pressure resistance to its movement in one direction will permit bypass leakage from one side to the other intermediate the blade and wall, and the fluid pressure resistance to its movement in the opposite direction will extend the blade against the wall of the chamber to prevent such leakage, and a by-pass for the fluid under pressure from one side to the other of said dasher blade independent of the flexing of said blade.

5. In a fluid pressure governor, a fluid containing chamber, having an arcuate wall, an oscillatory dasher vane, the free end of which sweeps in contiguous relation with the arcuate wall of the chamber and means for effecting a sealing contact with the wall during the movement of the dasher vane in one direction to prevent bypass leakage of the fluid, such sealing contact with the wall being relaxed upon movement of the dasher vane in the opposite direction to permit bypass leakage of the fluid from one side of the vane to the other.

6. In a fluid pressure governor, a fluid

containing chamber having therein an oscillatory dasher vane extending into contiguous relation with the wall of the chamber, said dasher vane when moved in one direction permitting bypass leakage of the fluid intermediate the vane and wall of the chamber, from one side to the other of the vane and when moved in the opposite direction, preventing such bypass leakage of the fluid intermediate the vane and compartment wall.

7. In a fluid pressure governor, a fluid containing chamber, a prime mover operative therein against the pressure of the fluid contents of the chamber, fixed partition in said chamber, an adjustable stud extended through the wall of the chamber and intersecting the opposite faces of the partition, substantially as and for the purpose specified.

8. In a fluid pressure governor, a fluid containing chamber, a prime mover operative therein against the resistance of the fluid contents of the chamber, a partition wall dividing the chamber into separate compartments, a slot in said wall affording an intercommunicating bypass between the compartments, an adjustable stud extending through the exterior wall of the chamber and thence into the slot in said partition, by the adjustment of which from the exterior of the chamber the capacity of the bypass may be varied.

9. In a fluid pressure governor, a fluid containing chamber, a prime mover operative therein against the resistance of the fluid contents of the chamber, a partition wall dividing the chamber into separate compartments, the wall of the chamber and partition wall having a hole drilled therein coincident with the plane of the partition and of greater diameter than the thickness of said partition whereby the hole intersects the opposite faces of the partition, and an adjustable regulating member extending within said hole and by its adjustment varying the capacity of a bypass opening intermediate the regulating member and the bottom of the hole in the partition through which the fluid may be bypassed from one side to the other of the partition.

10. In a fluid pressure governor, a fluid containing chamber, an oscillatory dasher operative therein against the resistance of the fluid contents of the chamber, a closure lid for the chamber, and a partition wall formed integral with the closure lid and coacting with the dasher vane to divide the chamber into separate compartments, and means for bypassing the fluid from one compartment to the other.

11. In a fluid pressure governor, a fluid containing chamber, a prime mover operative therein against the resistance of the fluid contents of the chamber, a removable closure lid for the chamber, and a partition wall for the chamber formed integral with the removable closure lid thereby facilitating the machining of the interior of the chamber.

12. In a shock absorber of the character described, an oscillator capable of flexing movement in addition to its swinging movement, a housing therefor, having a portion of its wall concentric with the axis of oscillation of said oscillator, and fluid pressure means for extending the flexible oscillator into braking contact with the concentric portion of the housing wall when moved in one direction, the engagement of the oscillator with the wall being relaxed under influence of said fluid pressure upon reverse movement of the oscillator.

13. In a shock absorber of the character described, an oscillator, a housing therein having a portion of the wall substantially concentric with the axis of oscillation of the oscillator and with which the oscillator has braking engagement when moved in one direction, and a body of fluid within the housing and subjected to pressure by the movement of the oscillator to influence the oscillator into and out of braking engagement with the wall of the housing in accordance with the direction of movement of the oscillator.

14. In a shock absorber, a brake member capable of to and fro movement, a contact surface contiguous to the path of to and fro movement of the brake member and fluid pressure means for effecting wiping engagement of the brake member with said contact surface during the movement of the brake member in one direction, and to relieve the pressure of the brake member thereon during the retrograde movement of the brake member.

15. In a shock absorber, a housing, a dasher oscillated against a fluid under pressure in said housing, one end of the dasher being pivoted, the other end contiguous to the wall of the housing being free, the pressure of the fluid upon the dasher causing it to contact the wall of the housing effecting a braking action.

16. In a shock absorber, a chamber containing non-compressible fluid, a partition to be oscillated against the fluid, the pressure serving to project the free end of the partition into braking relation with the wall of the chamber.

17. In a shock absorber, a housing containing non-compressible fluid, an oscillating flexible blade moving against the resistance of the fluid and placing the fluid under pressure, the free end of the blade being controlled by the pressure of the fluid, flexing it firmly against the wall of the chamber to afford braking action and further resistance to the movement.

18. A shock absorber comprising a fluid containing casing, a movable resilient partition in said casing and dividing the casing into two compartments, with an intercommunicating port between them, the partition being arranged and constructed to decrease the resistance to movement in one direction by affording an auxiliary communication between the two compartments, and to increase the resistance to movement in the opposite direction by entirely closing the auxiliary communication.

In testimony whereof, I have hereunto set my hand this 18th day of February A. D. 1924.

RALL E. HELFINSTINE.