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[54] **TERMINAL FOR PNEUMATIC TUBE DISPATCH SYSTEM**

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[58] **Field of Search** 243/1, 19, 20, 23, 24, 243/25, 28, 38; 302/1, 2

[56] **References Cited**

UNITED STATES PATENTS

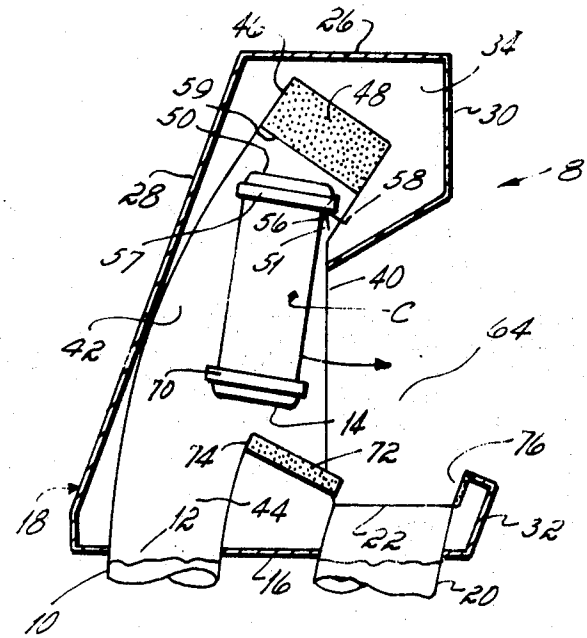
1,383,194	6/1921	Engebretsen	243/24
3,756,536	9/1973	Weissmuller et al.	243/19

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[57] **ABSTRACT**

A terminal for a pneumatic tube system in which the system transmit and receive tubes have spaced ends terminating at the terminal in generally vertically disposed orientation, including a terminal tube section extending upwardly from the receive tube, an elastically compressible braking element mounted at the upper end of the terminal tube section for arresting the forward motion of the received carrier and thereafter forceably directing the carrier rearwardly in a reverse direction, a detent spaced from the compressible braking element to engage the forward end of a received carrier at the periphery thereof to cause it to pivot thereabout as it is reversely directed by compressed brake element, a carrier opening in the side of the terminal tube section through which a pivoting carrier reversely directed by the compressed brake element is adapted to exit, and a carrier guide means extending outwardly and downwardly from the lower extremity of the tube section side opening to the transmit tube for slideably engaging the rear end of a pivoting carrier as it passes through the opening to guide the carrier to a position outside the tube section.

7 Claims, 16 Drawing Figures



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SHEET 1 OF 2

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 14

Fig. 15

TERMINAL FOR PNEUMATIC TUBE DISPATCH SYSTEM

This invention relates to pneumatic tube dispatch systems and more particularly to a terminal for use with such systems which facilitate carrier receipt and transmission.

Pneumatic tube systems propel carriers between distant stations through a tube by means of a pressure differential which exists across the carrier in the direction of carrier transport. Such systems are provided with terminals at the system stations to facilitate transmission and/or receipt of carriers. Such terminals, if they are to receive carriers, advantageously include some form of braking means for gradually arresting the forward motion of a carrier transmitted to the terminal from a distant station. This avoids carrier damage and excessive noise and vibration which would otherwise occur were such braking means eliminated and the forward motion of a rapidly moving carrier to be abruptly stopped at the terminal. It is also desirable to provide at terminals adapted to receive carriers some means for positioning the carrier such that it can be conveniently manually removed by the operator once it has come to rest. Finally, and for purposes of economy, pneumatic terminals, particularly where such are designed to both receive and transmit a carrier, advantageously are compact and utilize a minimum number of moving parts.

Accordingly, it has been an object of this invention to provide a terminal capable of receiving carriers which minimizes damaging impact upon receipt of a carrier and presents it in a disposition facilitating convient manual withdrawal once it has come to rest, and yet is compact and utilizes a minimum number of moving elements. This objective has been accomplished in accordance with a preferred embodiment of the invention by providing, in combination, a tube extension for a system receive tube in which the extension has a lower end communicating with the upper end of the system receive tube through which received carriers pass upwardly following exit from the system receive tube, an elastically deformable brake means mounted at the upper end of the receive tube extension for arresting the forward motion of the carrier and thereafter forceably rearwardly directing the carrier in a reverse direction, a pivot member mounted proximate the upper end of the receive tube extension to engage the forward end of a received carrier at the periphery thereof and cause such to pivot thereabout as it is reversely directed by he brake means, and a carrier exit opening in the side of the receive tube extension through which a pivoting carrier reversely directed by the brake means is adapted to exit for presentment to the operator. In accordance with the foregoing arrangment, the kinetic energy of motion of the carrier is converted into potential energy of the elastically deformable braking element to arrest the forward motion of the carrier without damaging impact, and the arrested carrier forcibly redirected in a reverse direction such that it pivots around the pivot element in the course of which it passes through the exit opening provided in the side of the receive tube extension for presentment to he operator.

In a preferred form of the invention, the foregoing terminal is provided with a carrier guide extending outwardly and downwardly from the side exit opening of the receive tube extension for slideably engaging the rear end of the pivoting carrier as it passes through the exit opening, and an abutment associated with the guide for arresting the sliding motion of the carrier, such that the carrier remains on the guide supported outside of the tube extension for convenient removal by the operator.

In accordance with a further aspect of the invention, the carrier insertion opening of a system transmit tube is located between the carrier guide and the abutment such that the insertion opening is blocked by a received carrier supported on the guide to prevent insertion therein of a carrier, whereby a terminal adapted to both receive and transmit carrier is provided which is compact and which prevents transmission of a carrier when a received carrier supported on the guide means has not been removed.

These and other advantages and objectives of this invention will become more readily apparent from the following description thereof taken in connection with the drawings in which:

FIGS. **1, 2, 3** and **4** are cross sectional views partially in elevation of a preferred embodiment of the combined transmit and received terminal of this invention, showing a carrier in different positions it sequentially occupies during a receive cycle when the carrier has its forward motion arrested by the brake, pivots, and eventually comes to rest supported on the carrier guide;

FIG. **5** is a side elevational view of the preferred embodiment of FIGS. **1-4** showing a carrier in the process of insertion for transmission;

FIG. **6** is a cross-sectional view taken along line **6—6** of FIG. **1**;

FIG. **7** is a cross-sectional view taken along line **7—7** of FIG. **1**;

FIG. **7A** is an enlarged cross-sectional view illustrating details of the detent and leaf spring mounting assembly;

FIGS. **8, 9, 10** and **11** are side elevational views of different modifications of the preferred embodiment depicted in FIGS. **1-7**, in which the terminal tube section extending from the system receive tube is inclined at different angles to be horizontal;

FIGS. **12, 13, 14** and **15** are schematic elevational views of a received carrier engaged by the pivot member and the bumper for terminal tube sections disposed at varying angles to the horizontal, showing the forces applied to the carrier by the pivot member, bumper, and the weight of the carrier and its contents.

With reference to FIGS. **1, 6** and **7,** one preferred form of this invention is seen to include a system receive tube **10,** having an upper, or exit, end **12** through which a carrier C passes or exits, un upwardly direction when propelled by a net pressure force acting in an upwardly direction **15** against the rear end or bottom **14** of the carrier. The system received tube **10,** at least at the point where it enters the bottom **16** of a terminal housing **18,** is inclined in a generally vertical direction. Also included is a system transmit tube **20** which has its upper, or insertion, end **22** open to facilitate insertion of a carrier for transmission to a distant station when a net pressure force is applied to the inserted carrier in the direction of arrow **24.** The transmit tube **20,** which also passes through bottom **16** of the terminal housing **18,** would typically be connected to the input or suction end of a conventional air blower, while the receive tube **10** would be connected to the output or pressure side of the conventional air blower.

The housing **18** can be fabricated of sheet metal or other appropriate material, and having any configuration suitable for enclosing the various structural elements of the terminal **8.** In a preferred form, the housing **18** includes, in addition to the horizontally disposed bottom **16,** a horizontally disposed top panel **26,** an inclined rear panel **28,** a vertical upper front panel **30,** an inclined lower front panel **32,** and spaced vertical side panels **34, 34,** only one of which is shown in FIG. **1.** The configuration of the side panels **34, 34,** only one of which is shown in FIG. **1.** The configuration of the side panels **34, 34** is established by the bottom, top, rear, and upper and lower front panels **16, 26, 28, 30** and **32,** to which the side panels **34, 34** are joined, except that a section established by edges **38** and **40** (FIGS. **1** and **6**) has been removed to facilitate access to the interior of the housing **18.**

Located within the terminal housing **18** is a terminal tube section **42** having a first or lower end **44** communicating with the upper or exit end **12** of the receive tube **10** and a second or upper end **46.** A received carrier C is propelled into the terminal tube section **42** via the lower open end **44** which communicates with the upper end **12** of the receive tube **10.** Located at the upper end **46** of the terminal tube section **42** is a brake means **48** which in the preferred embodiment takes the form of an elastically deformable solid cyclindrical compressible bumper mounted inside the upper end region **46** of the terminal tube section. The bumper **48,** for example, may be fabricated of a closed-cell neoprene foam rubber, having a durometer less than 5 and an axial dimension of approximately 3 inches, in pneumatic tube systems employing carriers 4½'' in diameter with an empty weight of 18 ounces and a velocity of 25 feet per second.

The bumper **48** functions to arrest the forward motion of a received carrier C moving in the direction of arrow **15** by undergoing elastic deformation, or compression, when the forward end **50** of the carrier C abuts the bumper. The extent of compression depends on the momentum of the carrier, i.e., mass of carrier and contents and carrier velocity, and the effective spring constant of the bumper. When the forward motion of the carrier has been completely arrested and the carrier has come to a complete stop the bumper **48,** which is now compressed having converted the kinetic energy of the carrier into potential energy of the compressed bumper, applies a rearward force on the carrier in the direction of arrow **52,** as shown in FIG. **2.** This rearward force on the carrier in the direction of arrow **52** applied to the carrier by the bumper **48** tends to propel the carrier in a reverse direction in the terminal tube section **42.** The carrier-arrest function of the bumper **48,** by virtue of the elastic deformation thereof upon carrier abutment, is accomplished without undesirable carrier damage, noise and vibration.

The terminal **8** also includes a pivot member or detent **56.** The detent **56** is mounted to the upper end **46** of the terminal tube section **42** by a leaf spring **58** such that the detent **56** normally projects into the terminal tube section sufficiently to mechanically interfere with a received carrier, as best shown in FIG. 7A. Because of the leaf spring mounting of detent **56,** the normally inwardly projecting detent does move radially outwardly when the enlarged head **57** at the forward end **50** of the carrier C abuts the inclined surface **51** of the detent as the forward end of the carrier passes the detent in the course of moving toward the bumper **48.** The detent **56** is spaced from the carrier-engaging lower surface **59** of the bumper **48** a distance sufficient to permit the detent to return under spring action to a position projecting into the terminal tube section **42** behind, or below, the enlarged head **57** when the bumper is compressed, as shown in FIG. **2.** With the detent **56** in the position shown in FIG. **2,** an arrested carrier will pivot counterclockwise about the detent under the action of the combined weight of the carrier and contents and/or the compressed bumper **48,** as will be described more fully hereafter.

A carrier opening **64** is provided in the side of the terminal tube section **42** to facilitate exit from the terminal tube section of a received carrier as it pivots about the detent **56.** The opening **64** extends in a longitudinal direction from a point proximate the detent **56** downwardly at least a distance equal to the radius R of an arc **66** through which the lower end **14** of a received carrier moves in the course of pivoting about the detent **56.** With the length of the opening **64** so dimensioned in the longitudinal direction, the lower end **14** of a carrier C pivoting about detent **56** will pass clear of the lower edge of the opening in the course of exiting the terminal tube section **42,** as shown in FIG. **3.** The width of the opening **64** must exceed the diameter of the enlarged heads **57** and **70** of the carrier to permit free passage of the carrier through the opening **64.**

Carrier guide means **72** in the form of a planar inclined panel extends outwardly and downwardly from the lower edge of the opening **64.** The guide panel **72** is mounted in the desired position in any suitable manner such as by securing it to the housing **18.** The guide panel **72** underlies and slideably engages the rear end **14** of a pivoting carrier as it passes through the side opening **64** of the terminal tube section **42** to guide the carrier to a position substantially outside the terminal tube section with the rear end **14** of the carrier remote from the opening. Additionally, the guide panel **72** operates to support for convenient removal a received carrier after it has pivoted through the opening **64** and come to rest with its head **57** engaged by the upper edge **74** of the guide panel. Preferably, and as shown in FIGS. **1** and **7,** the guide panel extends substantially the entire distance between adjacent wall portions of the terminal tube section **42** and the transmission tube **20** to provide maximum support for a carrier which has come to rest thereon.

An abutment **76** inclined upwardly and outwardly at a point proximate the outer edge of the insertion end **22** of the transmit tube **20** is provided. The abutment **76** functions to assist in arresting the sliding motion of the received carrier on the guide panel **72** as well as to hold the carrier in place on the guide panel until it is manually removed by an operator. The panel **72** desirably should be disposed to have a substantial horizontal component to facilitate convenient removal therefrom by the operator. Preferably, both the guide panel **72** and the abutment **76** are provided with a resilient surface layer to minimize noise, vibrations, and damage to the carrier upon engagement therewith in the course of coming to rest on the panel **72** and against the abutment **76.**

In view of the placement of the guide panel **72** and abutment **76** on opposite side of the insertion end **22** of the transmit tube **20,** a received carrier awaiting manual removal (FIG. **4**) overlies the insertion end of

the transmit tube. This enhances the compactness of the terminal **8** as well as prevent transmission of a carrier via the tube **20** without first removing the received carrier from the guide panel **72.**

In operation, and with reference to FIGS. **1–4,** a carrier transmitted from a remote point to the terminal **8** travels in the direction of arrow **15** through the receive tube **10,** as a consequence of a net pressure force acting upwardly on the lower end **14** of the carrier C. The moving carrier C enters the terminal tube section **42** via the lower end **44** which communicates with the receive tube **10.** The moving carrier continues travelling upwardly in the terminal tube section **42** until its forward end **50** abuts the lower surface **59** of the bumper **48** whereupon the bumper elastically deforms, or compresses, until all forward carrier motion in an upwardly direction has been arrested. At this point wherein the carrier has terminated its forward motion, the kinetic energy of the previously moving carrier has been converted into potential energy now stored in the elastically deformed, or compressed bumper. In addition, the detent **56** which had momentarily retracted when the enlarged head **57** of the carrier moved therepast to engage the bumper **48,** has now returned to a projecting condition behind and below the enlarged head **57** of the carrier as shown in FIG. **2.**

With the carrier and detent in the position shown in FIG. **2** and the bumper **48** elastically compressively deformed, the bumper applies a force in the direction of arrow **52** against the forward end **50** of the carrier. This bumper force, which is applied uniformly across the face of the forward end **50** of the carrier, can be considered as a single force B acting in the direction of arrow **52** along the carrier axis at a perpendicular distance D from the detent **56** about which the carrier pivots. The bumper force B applies a counterclockwise moment to the carrier having a magnitude proportioned to the product of B and D, which tends to pivot the carrier about the detent **56** in a counterclockwise direction.

Also tending to pivot the carrier counterclockwise about the detent **56** is the combined weight W of the carrier and the contents. Assuming the contents of the carrier are uniformly distributed spacially in the carrier, the combined weight W of the carrier and contents can be assumed to act vertically downwardly in the direction of arrow **80** through the center of gravity CG of the carrier which is located along the carrier axis midway between the opposite ends **14** and **50** thereof. The combined weight W of the carrier and contents applies a counterclockwise moment to the carrier about the detent **56** having a magnitude correlated to the product of W and X, where X is the perpendicular distance between the detent **56** and the direction of arrow **80** through which the weight W acts.

The combined effect of moments WX and BD, both acting in the same counterclockwise direction, is to pivot the carrier counterclockwise about the detent **56.** As the carrier pivots from the position shown in FIG. **2** to the position shown in FIG. **3,** and thence to the position shown in FIG. **4,** the lower end **14** thereof moves outwardly through the exit opening **64** (FIG. **3**). Eventually the enlarged head **57** of the carrier, which at the start of the pivotal carrier motion about detent **56** was engaged with the detent, becomes disengaged therefrom, allowing the lower end **14** of the carrier to slideably engage the guide panel **72.** Following further pivoting and sliding engagement of the carrier and guide panel **72,** the carrier eventually comes to rest with the end **14** thereof against the abutment **76,** the body portion of the carrier between heads **57** and **70** thereof supported by guide panel **72,** and the enlarged head **57** engaged with the guide panel edge **74.** In this position, the insertion end **22** of the transmit tube **20** is blocked and the received carrier conveniently disposed for manual removal by an operator (FIG. **4**).

FIGS. **8, 9, 10** and **11** depict possible modifications **108, 208, 308** and **408** of the terminal **8** shown in FIGS. **1–7,** in which the angulation of the respective terminal tube sections **142, 242, 342** and **442** thereof vary with respect to each other and with respect to the angulation of terminal tube section **42** of the terminal **8** shown in FIGS. **1–7.** Except for the angulation of the terminal tube sections **142, 242, 342** and **442** terminals **108, 208, 308** and **408,** respectively, of FIGS. **8, 9, 10** and **11,** respectively, the terminals shown in these figures are in all other respects structurally identical to the terminal **8** depicted in FIGS. **1–7.** Accordingly, elements in the terminals **108, 208, 308,** and **408** of FIGS. **8–11** which are identical to corresponding elements of terminal **8** of FIGS. **1–7** bear reference numerals which are identical to those in FIGS. **1–7.**

In the preferred embodiment of the invention depicted in FIGS. **1–7,** the axis A of the terminal tube section **42** at the upper end **46** thereof is inclined with respect to the horizontal at an angle of approximately 60° as indicated by angle **89.** In contrast, in the modified embodiments of FIGS. **8, 9, 10** and **11,** the axis A of the terminal tube sections **142, 242, 342** and **442** at the upper ends thereof is angled with respect to the horizontal at approximately 0°, 30°, 90° and 120° as indicated by angles **189, 289, 389,** and **489,** respectively. In each of the embodiments of FIGS. **8–11** a received carrier compresses the bumper **48,** pivots counterclockwise about the detent **56,** and eventually comes to rest supported on the guide panel **72** with its lower end **14** against the abutment **76.** Necessary counterclockwise pivotal action of the carrier about the detent **56** in the embodiment of FIGS. **8–11** will occur providing that the counterclockwise moment BD exerted by the compressed bumper **48** against the carrier end **50** tending to pivot it counterclockwise about detent **56** exceeds any clockwise moment WX, should one exist, produced by the combined weight W of the carrier and its contents acting through the perpendicular distance between the detent **56** and a vertical line through which the weight W of the carrier and content acts which, as indicated, passes through the center of gravity CG of the carrier and contents. Should the contents of the carrier not be uniformly spatially distributed in the carrier and, for example, fall to the bottom of the carrier, the center of gravity of the carrier and contents, through which the combined weight W of the carrier and content acts, is closer to the lower end **14** of the carrier than the forward end **50.**

With reference to FIG. **12** depicting the compressed bumper **48,** detent **56** engaged therewith, and carrier C in approximately the disposition found in the embodiment of FIGS. **1–7,** it is clear that the moment BD exerted on the carrier by the compressed bumper **48** and the moment WX exerted on the carrier as a consequence of its own weight and that of the uniformly distributed contents therein, both act to pivot the carrier in a counterclockwise direction about the detent **56.** In accordance with this embodiment wherein the moment

WX is counterclockwise, the carrier will pivot in the desired manner as previously described even if the force B exerted on the carrier by the compressed bumper should go to zero.

FIG. **13** depicts a carrier, bumper and detent in the orientation they would occupy in the embodiment of FIG. **10** wherein the terminal tube section **342** is oriented at approximately 90° with respect to the horizontal. In this embodiment the bumper force B and the combined weight W of the carrier and contents act in the same direction and along the same line, namely, vertically downwardly, through the center of gravity CG of the carrier, with the perpendicular distances D and X between the detent **56** and the lines of forces B and W being identical, i.e. distance D equals distance X. Like the embodiment depicted in FIG. **12**, the embodiment of FIG. **13** will also cause the received carrier to pivot counterclockwise about the detent **56**, as desired, even though the bumper force may go to zero.

FIG. **14** depicts an embodiment in which the combined weight W of the carrier and its contents acting vertically downwardly through the center of gravity CG of the carrier, passes through the detent **56** with the result that distance X equals zero. With distance X equally zero the moment WX also equals zero with the result that the weight of the carrier does not assist pivoting of the carrier in the desired counterclockwise direction about the detent **56**. Assuming the bumper force B is greater than zero, the moment BD will exceed zero, causing the carrier to pivot counterclockwise about detent **56**, as desired.

FIG. **15** depicts a modification in which the combined weight W of the carrier and its contents acting vertically downwardly through the center of gravity CG of the carrier is displaced rightwardly of the detent **56**, with the result that the moment WX applied to the carrier as a consequence of the combined weight W of carrier and contents operates to apply a clockwise moment to the carrier about detent **56**. In accordance with this moidication, the carrier will only pivot in the desired counterclockwise direction about the detent **56** if the moment BD produced by the compressed bumper **48** which is in the counterclockwise direction exceeds the moment WX which is in the clockwise direction. In this modification, the force B applied by the bumper to the forward end of the carrier **50** is essential to effect the desired counterclockwise pivoting of the received carrier about detent **56**.

We claim:

1. A pneumatic system for receiving carriers, comprising:

a system receiving tube having an exit end through which received carriers moving in a forward direction exit,

a terminal tube section having a first end communicating with said exit end of said system receiving tube through which received carriers moving in a forward direction pass following exit from said system receiving tube, said terminal tube section having a second end and an elongated intermediate tube region located between said terminal tube section ends,

brake means, including an elastically-deformable braking element mounted at said second end of said terminal tube section, for arresting the forward motion of a received carrier moving in said intermediate tube region and thereafter forceably directing said carrier rearwardly in a reverse direction, said braking element becoming elastically deformed incidental to carrier arrest and thereafter becoming undeformed incidental to carrier reversal,

a pivot member mounted proximate said second end of said terminal tube section at a point to engage the forward end of a received carrier at the periphery thereof and cause it to pivot thereabout as it is reversely directed by said brake means, the rear end of said pivoting carrier moving through an arc having a specified radius as said carrier pivots about said pivot member, and

a carrier opening in the side of said intermediate tube region through which a pivoting carrier reversely directed by said brake means is adapted to exit from said intermediate tube region, said opening extending from said pivot member in a direction toward said first end of said terminal tube section a distance approximating said radius of said arc through which the rear end of a received carrier moves when the forward end thereof pivots about said pivot member.

2. The system of claim **1** further including a carrier guide means extending outwardly and downwardly from said carrier opening for slidably engaging the rear end of a pivoting carrier as it passes through said carrier opening to guide the carrier to a position substantially outside said intermediate tube region with the rear end thereof remote from said carrier opening and the carrier overlying said guide means and supported thereby.

3. The system of claim **2** further including an abutment mounted remote from said carrier opening and engageable with said rear end of said carrier to arrest said sliding motion of said carrier while engaged by said underlying guide means thereby supporting said carrier stationarily outside said terminal tube section.

4. The system of claim **1** wherein the said elastically deformable element is a compressible bumper secured to said second end of said terminal tube section to abut the forward end of a received carrier and become compressed in the process of arresting forward carrier motion.

5. The system of claim **3** further including a system transmit tube having a carrier insertion end located between said abutment and carrier opening, said transmit tube insertion end adapted to be blocked by a received carrier supported on said guide means to prevent insertion therein of a carrier to be transmitted, said insertion end being adapted to receive inserted carriers for transmission when unblocked by a carrier supported on said guide means.

6. The system of claim **4** wherein said pivot member is a deflectable detent normally extending into said intermediate tube region for engagement with a received carrier, having an enlarged head at the forward end thereof, at a point slightly rearwardly of said enlarged head when the forward end of said received carrier abuts said bumper.

7. The system of claim **1** wherein said system receive tube is disposed to discharge carriers from the exit end thereof with a substantial vertically upwardly directed component of forward motion, and wherein said intermediate tube region is disposed to have a substantial vertical component proximate said second end thereof, and wherein said carrier guide means is disposed to have a substantial horizontal component to facilitate convenient manual removal therefrom.

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